Flood and Hypertension: A Systematic Review

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Flood and Hypertension: A systematic review

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Abstract

Background:

Several studies have been conducted on the effects of floods on the health of the affected community. We aimed to determine the effects of floods as the most common disaster on hypertension as one of the most common non-communicable diseases (NCDs).

Material and Methods:

The 4 databases, including Medline, Scopus, Google Scholar, and Science Direct were searched with the search strategy protocol up to the end of 2020. Grey literature database and websites of WHO, UNDRR, and PreventionWeb also searched. After removing duplicate articles, abstracts of the relevant titles were reviewed and eligible articles were included for full text review. Finally, the study variables were extracted from selected articles.

Results:

The search strategy resulted in 8 final relevant articles from total number of 48980 articles. All final articles noted meaningful effect of flood on hypertension. There were founded positive correlation between anxiety level, property loss, financial loss, physical activity, use of alcoholic beverages, interruption of medication and medical cares with hypertension. Different studies have reported also long-term effects of flooding on blood pressure.

Conclusions:

The flood has effect on blood pressure in affected population. According to the importance of hypertension and its burden, screening are recommended in the affected community.

Keywords: Hypertension, Disaster, Flood, Blood pressure

Introduction

In recent 50 years, natural disasters occurring three times more often than before with Increasingly bad consequences (1). For example, disasters have resulted in roughly 700.000 deaths, over 1.4 million injured, and near 23 million people homeless (2). Floods are the most frequent natural disaster around the world, with potential growing occurrences in the future due to the consequences of climate change (3). Floods not only have short term effects on human health, but also pose long-term side effects resulting from unhealthy living conditions and population displacement (4).

Disasters create the conditions for disease to occur or worsen by destroying infrastructure and reducing access to essential living resources, including safe water and food, health care facilities, and available resources (5). These changes in life conditions pose a significant risk of diseases to affected population. Non-communicable diseases, especially those with a chronic nature, such as hypertension (HTN), are among a group of diseases that are greatly affected (5). HTN or high blood pressure is an important health issue that markedly increases the risks of heart, brain, kidney diseases. It's estimated 1.28 billion adults aged 30-79 years around the world have HTN which most of them (two-thirds) live in low- and middle-income countries (6). Disasters cause the emergence of new cases or disruption of the treatment of chronic diseases, including high blood pressure and affect the state of disease control (7).

In recent years, several studies have been conducted on the effects of disasters, especially floods, on the health of the affected community. Although several studies have been performed on the effects of floods on the cardiovascular system, but the current study seeks to determine the effects of floods as the most common disaster on hypertension as one of the most common non-communicable diseases (NCDs). It is hoped that the results of this study will pave the way for proper planning for better management of hypertension in disasters.

Material and Methods

We developed a searching strategy, inclusion, and exclusion criteria of studies. We have reported the process of our review and results according to the PRISMA guideline.

Research questions

The review aimed to answer the following questions:

1. How many documents and what are the characteristics of the articles on the Hypertension and Disasters in terms of article type, study approach (qualitative or quantitative), study setting, Population and samples, results, time period, and country or affiliation of first/corresponding authors?
2. What are the consequences of flood on blood pressure?

Definitions

• A “disaster” is “a man-made or natural event that disrupts the affected community functions and results in widespread losses that are greater than community resources” (8).

• "Hypertension" is a chronic disease of the cardiovascular system (CVS) characterized when blood pressure is too high. Hypertension is diagnosed if, when it is measured on two different days, the systolic blood pressure readings on both days is ≥140 mmHg and/or the diastolic blood pressure readings on both days is ≥90 mmHg (6).

Inclusion criteria

• Articles that were published in peer-reviewed journals and had addressed blood pressure or hypertension in the context of flood (as defined above).

• Articles in any format including editorials, case reports, and original research.

• Books or Guidelines had addressed hypertension in the context of flood (as defined above).

Exclusion criteria

• All non-English articles, unless an English abstract was available.

• Papers with abstracts that did not include enough information or were not accessible for extraction of the study variables.

Search strategy (Data sources and literature search)

We searched 4 databases, including Medline, Scopus, Google Scholar, and Science Direct. We searched the databases for retrieving published articles up to the end of 2020. In addition, grey literature [1] was searched through the "New York academy of medicine grey literature reports" (9). Websites of WHO, UNDRR, and PreventionWeb searched for relevant guidelines. We also reviewed the references of retrieved studies to identify additional articles.

We chose key terms and developed a search strategy based on the National Library of Medicine "Medical Subjects Headings (MeSH)". The following search strategy was applied in the PubMed database: “(Flood [Title/Abstract]) AND ("High Blood pressure" OR "Hypertension") [Title/Abstract]). For searching in the other databases, we did it similar to the PubMed search strategy. Searched contents were limited to titles and abstracts of articles.

[1] - Grey literature definition: "That which is produced on all levels of government, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers."

Study screening process

Primarily, the mentioned keywords were entered into the search box of databases, and the search was limited to abstracts and titles. The keywords search results were reviewed by members of the review team (GG, SP, MH, RN, and FG). The studies that met the inclusion criteria, were included in the review. If there was any uncertainty for meeting the inclusion criteria, a decision was made based on the supervisory team consensus (RH, YS, and FG). Articles unrelated to the aim of the study were excluded. The remaining titles were entered into a spreadsheet and sorted to exclude duplicates. In the next step, the abstracts of the selected titles were screened for their precise relevance to the aims of the study. The abstracts that met the inclusion criteria, were included in the review. Abstracts that were not precisely relevant were excluded. The full texts of the remaining papers were downloaded from the databases. If an article was not available free of charge, we paid for access. Data extraction from selected articles, data sorting in tables, and presentation of analysis results and writing of the final report were done by (RH, YS, RN and FG).

Data analysis

The finally included papers were evaluated by a member of the review team (RH, YS, FG) using a data abstraction sheet developed by the research team. This data sheet included the study variables: name of the authors; title; study type; model/framework used for the study; study population; the study approach/aims; mark results/findings; limitations of the study; country of study and the publication year. In the extraction of the study approach and aim, our first priority was the authors’ statement. If the study approach were mentioned in the article, the data were included in our data abstraction sheet. If not, the review team used a consensus approach to decide whether the data should be included.

Ethics and dissemination

We obtained the approval of the Human Research Ethics Committee (HREC) for the present study as follows: HREC number: IR.MAZUMS.REC.1398.5926 date: 8.8.2019.

Results

The search strategy resulted in 8 final relevant articles. Initially 48980 potentially relevant articles were identified. After a duplicate articles removal and with the title and abstract review, 24 articles were selected for full text review. After reviewing the full text, 16 articles were rejected, 8 articles selected for analysis. (Figure 1)

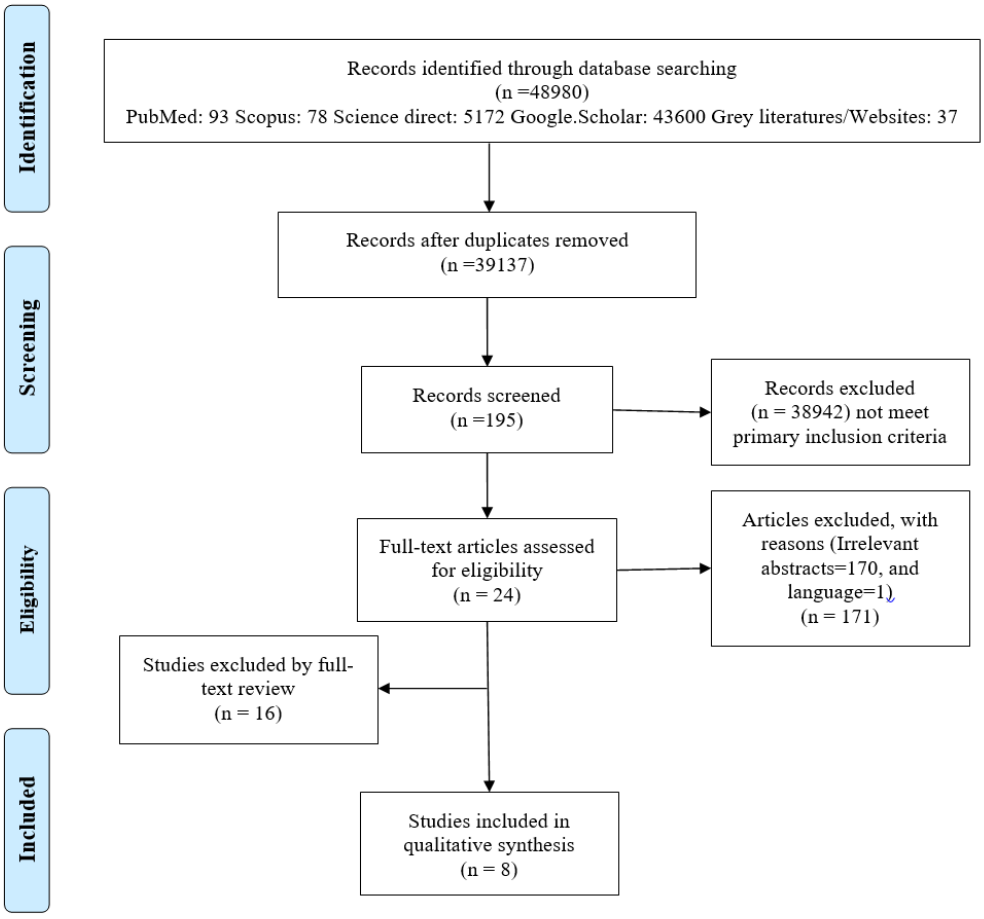

Fig 1- The articles selecting process

The first study was performed in 1980 and the last one in 2016 with the most gap between 1980 to 2001.The most common data study type was cross-sectional/cohort (n=6; 75%). All eight studies were conducted in different countries.

A total of 34 researchers have collaborated to write these 8 articles, with an average of 4 people per article. In considerable articles (4 studies, 50%) the gender of the sample was not specified, in three articles (37.5%) the samples were male and female and one article (12.5%) all samples were women. (Table 1)

Table 1- Summary of the basic features of included studies

Authors	Year	Location	Study design	Study sample	Correlation	Gender (Female/Male)	Age (Mean ± SD)
Logue Et al.(10)	1980	USA	Retrospective Cohort- Quantitative	29	T= 3.01 Df=24 P=0.01	Female	57.24 case 56.38 control
Baxter, Et al.(11)	2001	UK	Report: retrospective	NR	NR	NR	NR
Tomio Et al. (12)	2010	Japan	Cross-sectional-Quantitative	228 HTN	Adjusted OR = 0.2; 95% CI = 0.1-0.8) P=0.02	F 65% M 35%	73
Bich Et al(13)	2011	Vietnam	Cross-sectional-Quantitative l	107 non flooded area 104 flooded area	P<0.05	M=53.15% F=46.85%	NR
Joob Et al.(14)	2012	Thailand	Letter to editor-Before-After study-Quantitative	452	P<0.05	NR	N/A
Phalkey Et al.(15)	2012	India	Cross-Sectional-Quantitative	29	NR	NR	NR
Murakami Et al(7)	2013	Japan	Cross-Sectional-Quantitative	1687 old cases HTN 2624 no history of HTN	P<0.05	M=33.8% F= 66.2%	70.0 (10.41) 54.0 (16.62)
Salazar Et al.(5)	2016	Philippines	Retrospective-Quantitative	0.7<2momths 0.2>2months Per 10000	P<0.05	NR	NR

NR: Not Reported

There were generally Positive correlation between anxiety level and the high blood pressure. The other effective factors were of property loss, financial loss, subsequent financial difficulties, physical work, and use of alcoholic beverages as well as interruption of medication and medical cares. (Table 2)

Table 2- Summary of the findings and limitations of included articles

Authors	Findings	Correlation	limitations
Logue Et al.	A consistent association between property loss, financial loss, subsequent financial difficulties, physical work, use of alcoholic beverages, and perceived distress associated with the recovery period and the development of hypertension over the five-year period following a major American flood.	T= 3.01 Df=24 P=0.01	Small sample size, Retrospective cohort study, reliability of self-reporting of hypertension,
Baxter, Et al.	High blood pressure due to increased levels of anxiety about a repeat flood event	NR	Analysis presented a complex picture in which we find significant limitations in the current state of hazard and risk analysis of coastal floods and recommends that these need to be addressed before the impact of climate change on human health can be satisfactorily estimated.
Tomio Et al.	The prevalence of interruption of medication was lower among the patients with hypertension than for those being treated for other diseases. The interruption of medication among the outpatients with chronic conditions occurred more commonly in the participants who were evacuated. Among the evacuated, the elderly and those receiving long-term care services were at high risk for interruption of medication	Adjusted OR = 0.2; 95% CI = 0.1-0.8) P=0.02	1-The selection bias caused by convenient sampling design - Exclusion of the subjects who did not respond to the key questions 2-recall bias –the relatively longer recall period of the survey. This also could have caused underestimation of the prevalence of interruption. 3-the clinical relevance of interruption of medication defined in this study was not verified, and the information on the types of medications and the duration of interruption was not obtained. 4-data collection based upon self-reporting might not capture some key information. 5- The relatively small sample size might cause the typ-2 error to failing to find statistical significance for some associations.
Bich Et al	No new cases. The percentage of hypertensive people reporting that it got worse after the flood was significantly higher in the severely affected commune than that of the less affected commune in the urban district (20.3% in Thanh Tri and 42.9% in Thinh Liet).	P<0.05	1-self-reported method data collection 2-with the nature of a cross-sectional study, causal relationship cannot be proven
Joob Et al.	Of 452 hypertensive patients under following up, only 124 patients (27.4%) visited to the physicians at appointed date. This means the rate of loss following up is equal to 72.6%, which is significantly higher than that rate during non-flooding period (about 5%).	P<0.05	NR
Phalkey Et al.	Treatment of chronic conditions like hypertension, were rated as poor by 13 (44.8%) of the respondents	NR	NR****
Murakami Et al	SBP* and DBP** among non-medicated subjects remained significantly higher in flooded than in non-flooded areas by 4.1 mm Hg (95% confidence interval (CI) = 1.3 to 6.8; P < 0.01) and 2.0 mm Hg (95% CI = 0.2 to 3.8; P = 0.03), respectively. There was no significant association of flooded/ no flooded dichotomy with SBP/DBP among individuals on medication.	P<0.05	1- BP*** measurement was performed only once per subject and varied with respect to time of the day, making the measurements prone to intraday fluctuation. 2- Elderly females were overrepresented in the study sample compared with the population of all residents in surveyed areas. 3- The tendency to screen more severely affected areas earlier might have biased the results away from the null hypothesis, even though the time elapsed between the tsunami and BP measurement was matched to within 2 weeks in the matched case–control analysis.
Salazar Et al.	After 2 months, hypertension rates dropped	P<0.05	1-the quality of the data is difficult to assess 2-The data is also limited by the fact that the severity of the different conditions has not been entered. 3-the applied population denominators may only roughly estimate the actual number of individuals within the respective catchment areas, since out-migration of affected people was not taken into account.

* SBP: Systolic Blood Pressure
** DBP: Diastolic Blood Pressure
*** BP: Blood Pressure
**** NR: Not Reported

Different studies have reported different long-term effects of flooding on blood pressure. Some found it effective for up to 5 years, and some reported that the incidence of high blood pressure decreased shortly after the flood.

Discussion

According to the records and as far as we know, the present study is the only systematic review research that has been done exclusively on the effects of flood on blood pressure with the wide range of searched databases. All countries around the world spend significant financial resources on diagnosing, treating and rehabbing the effects of high blood pressure as one of the most common NCDs(16). Due to the conditions of the disaster-stricken community, trauma and infectious diseases are usually given priority, and non-communicable diseases such as hypertension are usually ignored in the early stages (17).

Our study emphasized the importance of HTN cases management in survivors of flood as new patients or existing patients whose treatment was interrupted. The interruption of treatment of known cases of hypertension arise from many factors such as inaccessibility to medication and health care services due to closing paths, lack of medicine stockpile for disaster situation by patients, and providing inappropriate medical services (12, 13).

However, according to available statistics, not all cases of post-flood hypertension can be attributed to flood because a significant percentage of people are unaware of having high blood pressure before flood (6). This important point should be considered in the interpretation of epidemiological findings related to prevalence of HTN caused by disasters. Another important point is samples composition that women greater than men in significant number of studies and should be considered in generalizing the results of these studies to the community.

The availability of complete information on patients in the affected area and their electronic health records in the event of a disaster is very helpful in continuing their medical care(18). Access to medical information of individuals when moving from the scene of the disaster is very high because the interruption of medication occurred more commonly in the people who were evacuated especially in elderly (12).

The meaningful correlation between the mental and physical state of flood survivors and HTN indicated the importance of proper planning to address in this issue. Many factors such as change in physical activity, use of alcoholic beverages, disaster induced stress, Change in diet, and

displacement facilitate the development of hypertension over the period following a flood(19). Beside that, due to destroying access routes to medical cares and drugs, the controlled cases of HTN may develop more advanced stages of the disease (20). Additionally, according to adverse effects of flood related stress on individuals' blood pressure, psychological supports should be taken into account(21). Due to the special nature of the psychological effects of floods and the persistence of its effects for a long time after its occurrence, continuous supportive measures are necessary(4).

In using the information of studies on the effects of floods on blood pressure, their limitations including Small sample size, reliability of self-reporting of hypertension, recall bias, types of medications and the duration of interruption, measurement bias, quality of registered data, Preference of women in sampling, and the accuracy of applied population denominators should be considered.

CONCLUSION

This study found that the flood has actual effect on blood pressure in affected population in comparison to the general population. However, according to the patients with unknown hypertension in the affected population before flood, epidemiological information should be interpreted with more caution. Access to medical history and medical health records of affected population in the time of disaster happening is very helpful to better planning and to avoiding disruption in medication. Due to the serious burden of hypertension, screening studies are recommended in the affected community.

Declarations

Ethics approval and consent to participate

We obtained the approval of the Human Research Ethics Committee (HREC) for the present study as follows: HREC number: IR.MAZUMS.REC.1398.5926 date: 8.8.2019.

Consent to publish

Not applicable.

Availability of data and materials

All data provided in the current study are available within the manuscript.

Competing interests

The authors declare that they have no competing interests in this research.

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Authors' Contributions

The members of the review team (GG, SP, MH, RN, and FG) were done primary search and performed selecting process. If there was any uncertainty for meeting the inclusion criteria, a decision was made based on the supervisory team consensus (RH, YS, and FG). Data extraction from selected articles, data sorting in tables, and presentation of analysis results and writing of the final report were done by (RH, YS, RN and FG).

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References:

1. United Nations. Natural disasters occurring three times more often than 50 years ago: new FAO report2021. Available from: https://news.un.org/en/story/2021/03/1087702.

2. United Nations. UNISDR, Sendai Framework for Disaster Risk Reduction 2015-2030. Sendai, Japan. 2015.

3. Kundzewicz ZW, Kanae S, Seneviratne SI, Handmer J, Nicholls N, Peduzzi P, et al. Flood risk and climate change: global and regional perspectives. Hydrological Sciences Journal. 2014;59(1):1-28.

4. Seyedin H, HabibiSaravi R, Djenab VH, Hamedani FG. Psychological sequels of flood on residents of southeast Caspian region. Natural hazards. 2017;88(2):965-75.

5. Salazar MA, Pesigan A, Law R, Winkler V. Post-disaster health impact of natural hazards in the Philippines in 2013. Glob Health Action. 2016;9:31320.

6. Hypertension [Internet]. 2021. Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension.

7. Murakami H, Akashi H, Noda S, Mizoue T, Okazaki O, Ouchi Y, et al. A cross-sectional survey of blood pressure of a coastal city's resident victims of the 2011 Tohoku tsunami. Am J Hypertens. 2013;26(6):799-807.

8. Reduction DR. UNISDR terminology on disaster risk reduction. Bangkok; 2009.

9. Zhong S, Yang L, Toloo S, Wang Z, Tong S, Sun X, et al. The long-term physical and psychological health impacts of flooding: A systematic mapping. Science of The Total Environment. 2018;626:165-94.

10. Logue JN, Hansen H. A case-control study of hypertensive women in a post-disaster community: Wyoming valley, pennsylvania. 1980;- 6(- 2):- 34.

11. Baxter P, Moller I, Spencer T, Tapsell S. Health effects of climate change in the UK: an expert review for comment. London: Department of Health. 2001:177-87.

12. Tomio J, Sato H, Mizumura H. Interruption of medication among outpatients with chronic conditions after a flood. Prehosp Disaster Med. 2010;25(1):42-50.

13. Bich TH, Quang LN, Ha le TT, Hanh TT, Guha-Sapir D. Impacts of flood on health: epidemiologic evidence from Hanoi, Vietnam. Glob Health Action. 2011;4:6356.

14. Joob B, Wiwanitkit V. Big flooding in thailand, the problem on loss following up of patients with hypertension. 2012;- 12(- 3):- 284.

15. Phalkey R, Dash S, Mukhopadhyay A, Runge-Ranzinger S, Marx M. Prepared to react? Assessing the functional capacity of the primary health care system in rural Orissa, India to respond to the devastating flood of September 2008. Global health action. 2012;5(1):10964.

16. Egan BM, Kjeldsen SE, Grassi G, Esler M, Mancia G. The global burden of hypertension exceeds 1.4 billion people: should a systolic blood pressure target below 130 become the universal standard? Journal of hypertension. 2019;37(6):1148-53.

17. Gohardehi F, Seyedin H, Moslehi S. Prevalence Rate of Diabetes and Hypertension in Disaster-Exposed Populations: A Systematic Review and Meta-Analysis. Ethiopian Journal of Health Sciences. 2020;30(3).

18. Ochi S, Murray V, Hodgson S. The great East Japan earthquake disaster: a compilation of published literature on health needs and relief activities, march 2011-september 2012. PLoS currents. 2013;5.

19. Paterson DL, Wright H, Harris PNA. Health risks of flood disasters. 2018;- 67(- 9):- 1454.

20. Vanasse A, Cohen A, Courteau J, Bergeron P, Dault R, Gosselin P, et al. Association between Floods and Acute Cardiovascular Diseases: A Population-Based Cohort Study Using a Geographic Information System Approach. Int J Environ Res Public Health. 2016;13(2):168-.

21. Azuma K, Ikeda K, Kagi N, Yanagi U, Hasegawa K, Osawa H. - Effects of water-damaged homes after flooding: Health status of the residents and the environmental risk factors. 2014;- 24(- 2):- 175.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- FloodandHypertensionPRISMAchecklist.pdf