

Selected Topics: Disaster Medicine

THE EFFECT OF TROPICAL CYCLONES (TYPHOONS) ON EMERGENCY DEPARTMENT VISITS

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Abstract—Background: Case reports have indicated that a tropical cyclone may increase Emergency Department (ED) visits significantly. **Study Objectives:** To examine emergency health care demands across a series of tropical cyclones, and to build a predictive model to analyze a cyclone's potential effect. **Methods:** This was an observational non-concurrent prospective study performed in Taiwan. Twenty hospitals were included. The number of daily ED visits in each hospital was our primary end point, and data were retrieved from the database provided by the National Health Insurance Research Database. Our study examined the period from 2000 to 2008. A total of 22 tropical cyclones (typhoons) that had passed over eastern Taiwan and covered the area under study were included. Multiple linear regression time-series models were employed to estimate the effects of “days since typhoon landfall” and various characteristics of the typhoons on the end point of daily ED visits to each hospital. **Results:** The final multiple linear regression time-series model showed that the number of daily ED visits increased in areas where a strong typhoon had landed directly, with the increase being evident during the first 2 days since landfall. Our model also indicated that the three most important variables to predict a change in the pattern of daily ED visits were intensity of typhoon, simultaneous heavy rain, and direct landfall. **Conclusions:** During tropical cyclones, emergency services were under increased demand in selected time periods and areas. Health care authorities should collect information to build local models to optimize their resources allocation in preparation. Crown Copyright © 2013 Published by Elsevier Inc.

Keywords—emergency service; hospital; cyclonic storms

INTRODUCTION

Background

As the earth becomes warmer, its global climate is changing. These changes affect human health in numerous ways, for instance, by altering the seasonality of certain infectious diseases and increasing the frequency of extreme weather events (e.g., tropical cyclones and floods). The Executive Board of the World Health Organization approved a work plan in 2009 to support member states in protecting human health from climate change. Two of the key areas were “Enhance scientific evidence” and “Strengthen health systems” (1). In line with these recommendations, this study would like to assist health systems to address the health threats posed by severe climate changes.

Tropical cyclones are extreme weather events and have inflicted great damage on people living in tropical and subtropical zones. Evidence indicates that severe cyclones have increased markedly in recent decades and this trend is likely to continue (2). Previous studies in the United States (US) have shown that the number of Emergency Department (ED) visits increases after a tropical cyclone landfall. Researchers have postulated that

people are injured relatively frequently during both the day of a landfall and the recovery period (3–7). Shortages of electricity and water could also impede the use of life-support equipment, including home respirators and dialysis machines, requiring Emergency Medical Services to provide immediate alternatives. Further demands arise from interruptions to primary care by local clinics and family doctors (8). Therefore, both manpower and resources should be prepared early on in the EDs (9).

Importance

Previous evidence of the effect of tropical cyclones on ED visits is limited, and most studies have focused on a single tropical cyclone and limited number of hospitals (9). A recent study revealed that the duration of the increased ED visits was 5 days, which had been shortened compared with the studies reported in the late 1990s (3–7,9). From the studies published from 1984 to 1994, the durations of the increased ED visits were all more than 1 week (3–7). However, the current available evidence does not indicate whether the effect of tropical cyclones on emergency health care services is similar for all types of tropical cyclones. Because a tropical cyclone is one of the few disasters that can be forecast, monitored, and measured, an investigation on the effect of various types of tropical cyclones on emergent health care services is warranted.

Objectives

Taiwan is located in the western Pacific Ocean and experiences an average of three or four tropical cyclones per year. People living on the islands of Taiwan suffer great losses of human life and property due to tropical cyclones (also known as typhoons) each year. The current study adopted a clinical epidemiologic approach to examine the effect of typhoons on the workload of EDs. We also investigated variables and attempted to identify the characteristics of a tropical cyclone that could act as clear predictors of the increased demand on EDs. To the best of our knowledge, this was the first empirical study on emergent health care load across a large series of typhoons.

MATERIALS AND METHODS

Study Design

The design of the current study was observational, non-concurrent, and prospective; the study protocol was approved by the Institutional Review Board of the National Yang-Ming University Hospital. Our analysis included data from all hospitals with EDs in three counties in

eastern Taiwan, namely Ilan, Hualiang, and Taitung. These three counties were confined geographically by Xueshan (mountain) in the north and the Chungyang mountains in the south (a total area of 10,286 square kilometers and about 1,038,000 residents). The counties had relatively self-sustaining local health care systems. In Taiwan, more than 70% of the recorded typhoons come from the east side of the island. The region of study included the three counties located at the eastern part of the island, which the typhoons usually damaged first and most commonly. Specifically, our research included 30 hospitals with EDs; one of these was a medical center, seven were regional hospitals, and 22 were area hospitals. We excluded 10 area hospitals that did not provide a regular ED service or that had small volumes of ED visits under normal circumstances (< 10 ED visits per day). A final count of 20 hospitals was included in the data analysis.

Almost all tropical cyclones (typhoons) in Taiwan occur in the summer and fall months. Hence, our study period covered June to November each year, from 2000 to 2008.

Data Collection

We retrieved the daily ED visit data from the National Health Insurance Research Database (NHIRD). The NHIRD was maintained by the National Health Research Institutes of Taiwan (ROC). It is population based and contains registration files and original claim data for reimbursement of the National Health Insurance program, a mandatory-enrollment, single-payment system created in 1995, now covering over 99% of Taiwan's population (10,11).

We analyzed the demographic and clinical characteristics of all ED patients, including sex, age, major disease or injury treated at ED, and triage level. Patients were grouped into age categories as follows: < 15 years, \geq 65 years, and 15 to 64 years. The major problem treated in the ED was categorized as either trauma (International Classification of Diseases, 9th Revision [ICD-9] codes: 800-959) or non-trauma. Four types of common traumatic injuries were counted: 1) fractures or dislocations of extremities; 2) lacerations; 3) superficial injuries, including contusions and abrasion wounds; and 4) traumatic brain injuries. Two non-traumatic diseases that have previously been associated with typhoons were also counted, namely dermatological diseases and psychological illnesses (3,4,6,7). In line with the policy of the Department of Health of Taiwan, we used the following four levels to classify triage scores: 1 = life-threatening/resuscitation; 2 = urgent; 3 = less urgent; and 4 = non-urgent. However, because some hospitals did not employ triage in the ED, in our analysis of triage levels we included only hospitals in which more than 90%

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