STUDY OF HEAT WAVE: A GIS BASED APPROACH OF KARACHI, SINDH

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ABSTRACT: *Extreme heat is a hypersensitive disorder that frequently occurs in the summertime and is marked by a greater consciousness and a higher core of excess heat level of 40°C. This is also the leading cause of mortality generally. In June 2015, Pakistan was ravaged by a terrible heat wave, while Karachi was especially hard hit. Over 1450 cases of heatstroke were documented, with 874 cases of fatalities and 576 cases of morbidity, as per official data collected from different sources. The research's goal is to use GIS tools to find important heat-affected regions in Karachi, which the ArcGIS has performed. Various maps were generated utilizing GIS techniques such as performing and developing the data, Mapping, and Density Map Analysis, Different maps were formed through using mapping technique to illustrate the areas of heatstroke cases as per union councils, towns, and districts, and frailty has been shown in various colors using density maps. Quantitative data on heatstroke was already collected from Pakistan Meteorological Department (PMD), and strategies are also created on the analyzed outcomes, which are essential to review the Karachi Master Plan 2020 that requests to increase the green spaces in* ***Karachi.***

Keywords: ArcGIS, Density Analysis Map(DMA), Shape-files, Karachi Master Plan (KMP).

1. INTRODUCTION

Heatstroke is a widespread summer disorder that is characterized by a different mental status and a higher concentration of thermal level of 40 degrees Celsius. It happens when individuals utilize themselves in a warm environment during periods of high temperatures [1]. Internationally, Stroke is the subsequent driving reason for death. Representing 5.53 million expiries in 2016, it was the main source of passing in China, as per the 2017 disease trouble report by Lancet [2]. High heat temperature may promote stroke, however, there is little study of the impact of heat on first-historically-speaking strokes. Lower air-filled force is a quick cause of anxiety and an increase in heart rate, and it has the power to damage a person's health [3].

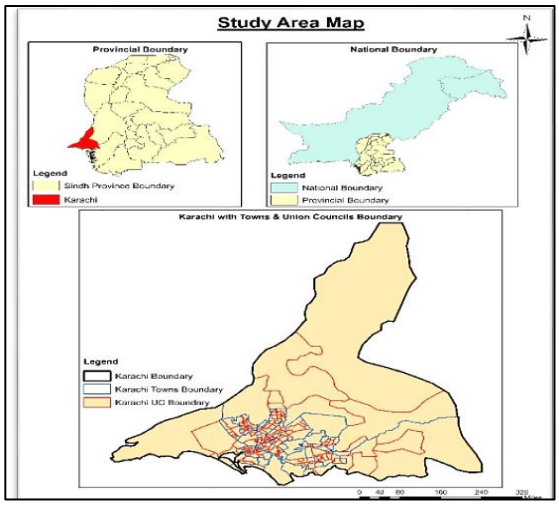
Heatstroke is a condition in which the greater part of the body overheats as a result of frequent exposure to high temperatures or physical exertion. Heatstroke happens when the normal body temperature surpasses 104 degrees F (40 degrees Centigrade) or higher [4]. It originates whenever the metabolism and biological heat gathered in the body surpasses the immune function to reduce it down. When the heat overcomes the body, it proceeds to assemble and the body's normal temperature increases and ending in hyperthermia. [5]. Likewise, a necessity to comprehend the process of heatstroke, dampness misfortune in soil and the process of warmth hit independently. It is alleged, 60% of the Indian sub-landmass encounters changed times of warmth upsurge cum heatwave conditions between March to July, yearly [6]. Heatstroke can be a result of natural elements or metabolic elements. Natural components incorporate an introduction to a hot climate, presentation to a high dampness climate in which evaporative cooling is undermined. When this arises, both biological and respiratory variables impact their cumulative effects, which begin with a series of pathophysiologic alterations that include dehydration and electrolyte imbalances [7]. Due to intense heat pressure, heat stroke induces harm to outer tissues, acute kidney injury, rhabdomyolysis, abdominal ischemia, body blood loss, hepatic gastrointestinal bleeding, severe lethargies, severe hyperthermia, or even fatality may result in this harm [8]. A patient experiencing extreme heat is suspects of thirst, discomfort, shakiness, cerebral pain, and deficiency, as well as an internal temperature of 37-40 degrees Celsius. There are two types of heat stroke: old-fashioned and exertional. When the environmental temperature is high, an older style of heatstroke affects the more established age gathering. Exertional extreme heat arises when people participate in high-intensity activities such as long-distance races and the body's energy production is disordered. Over a few hours, the disease develops rapidly [9]. The study also indicated that a protracted rise in temperature will lead to a significant rise in the severity of heat-related health effects in the coming. In any case, because of the inconstancy of restricting microclimates created by problems of the physical and manufactured environment, financial twists of events, and approaches, community affects blended profoundly across the district and sub-areas [10]. Evaporative cooling, iceberg boxes, cold water soaking, and chilled venous fluid are some of the methods that can be used to reduce heat temperature. The effective process is to soak your entire body with cold water [11]. Physiological increment in the temperature sets purpose of the body, it conveys high mortality of almost 80% if successful treatment isn't given punctually, because of ecological warmth involvement in absence of thermoregulation and typically convoluted with the broken focal sensory system, metabolic irregularity, and unconsciousness [12]. While practicing out in the heat, the skin blood circulation and moisture rate must always be considered for heat dissipation to the surrounding environment. In any event, increased physical pressure may cause parchedness as the activity progresses. [13]. In a professional, military operation, athletic, and leisure situation, heat stress is a key factor. In these settings, numerous cases of the thermal disease were reported. [14]. Pakistan was devastated by a brutal heatwave in June 2015, and Karachi became greatly affected for the first time over fifty years. Throughout June 2015, the climate changed due to a heatwave that included air discouragement over the Arabian Sea, which limited the stance of oceanic wind to the urban dweller metropolitan area via clear airs, as well as degraded the situation by producing hotter wind, and continued to stay in the area intended for a long period [15].

2. MATERIAL AND METHODS

2.1 Area of Research

Karachi is the capital and largest city of Sindh, Pakistan's southernmost province. It is the state's largest city and main harbor, including a big economic and modern center among a population of 14.9 million people (census report, 2017), and an estimated $164 billion in GDP in 2019. It is situated on the Arabian Sea's shore and to the north of the Indus River Channel. The majority of the year, the weather is vibrant. Merely 2 months, May and June, are the hottest, with temperatures reaching 105 degrees Fahrenheit (41 degrees Celsius). The calmest months are January and February when the lowest recorded temperature is around 56 degrees Fahrenheit (13 degrees Celsius). During these months, a threatening northerly wind shifts, and the temperature may drop.

Figure 1. Map of Karachi (Town & UC).



2.2 Data Collection and Methodology

The research is based on primary data and secondary data acquired from organizations which are Pakistan Meteorological Department and Hospitals and analyzed through different ArcGIS techniques which are preparation and development of maps and density analysis map, maps are prepared for locating the locations of the heatstroke affecters of the Karachi by the help of mapping of the areas and the Mortality & morbidity is shown in density maps in 7 ranges.

3. RESULTS

3.1 Maximum & Minimum Temperature

The climate information was obtained from the Pakistan Meteorological Department (PMD), as well as an accurate temperature chart of the research region was created.

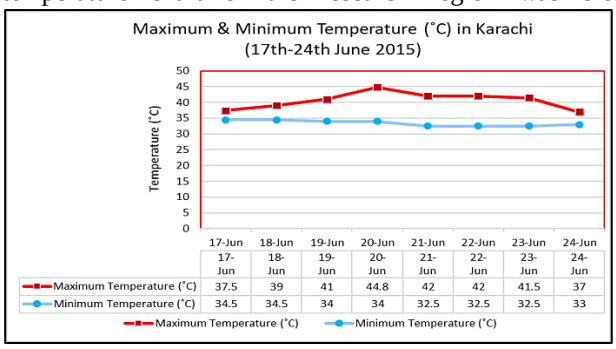


Figure 2. Extreme & least temperature (˚C).

3.2 Heat Stroke Cases of Karachi Hospitals

A total number of heatstroke cases with a male and female ratio was identified by the data collected from hospitals.

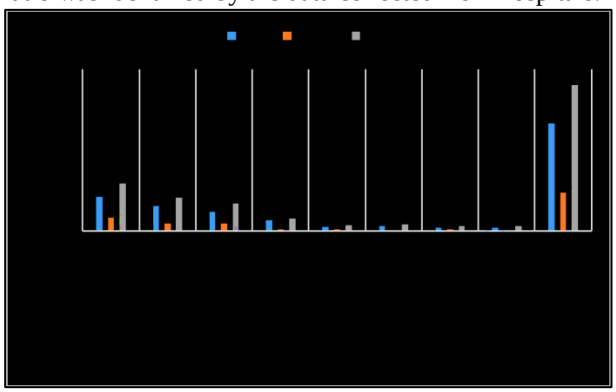


Figure 3. Male & Female ratio of heatstroke cases

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3.3 Karachi Towns Heat Stroke Cases

Data of 19 towns of Karachi is acquired with its mortality rate and morbidity rate from the Pakistan Meteorological Department as shown in figure 4.

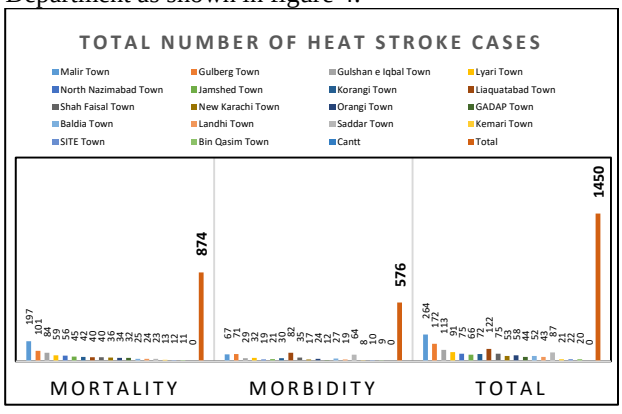

Figure 4. Mortality & Morbidity Heatstroke cases.

3.4 Aeronautical Reconnaissance Coverage Geographical Information System (ArcGIS)

From ArcGIS software, the qualitative data is made & analyzed which includes preparation of data and development of maps, study area mapping and the density analysis maps are generated which shows in colors in 7 ranges.

3.5 Mapping

The mapping in ArcGIS is done using data obtained from various sources of Karachi UC's and towns.

Figure 5 depicts two maps, the left of which includes labels and the right of which does not, to obtain an accurate picture of the data points. Heatstroke patients are mapped to indicate the distribution of instances; lines indicate the research area's boundaries, and red dots represent heat stroke fatality cases, while blue ones signify heat stroke illness occurrences.

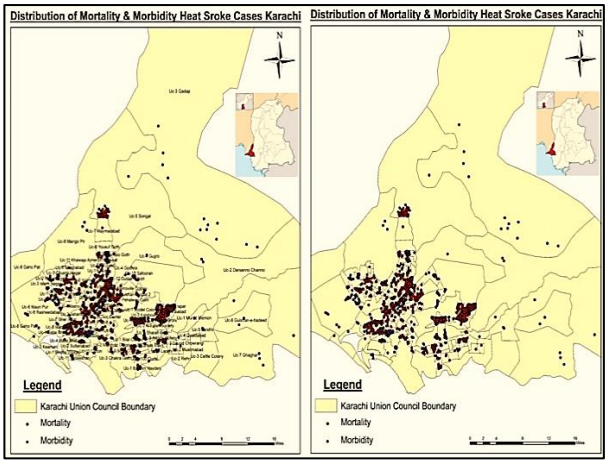

Figure 5. Scattering of Death and Illness of HS cases.

3.6 Density Analysis of Map

Density maps of morbidity & mortality are developed of Karachi towns and UC's that illustrate the density of heatstroke cases in numerical form in different colors. The dark and light colors show the number of HS cases in 7 ranges which shows the vulnerability of the Karachi areas concerning HS cases.

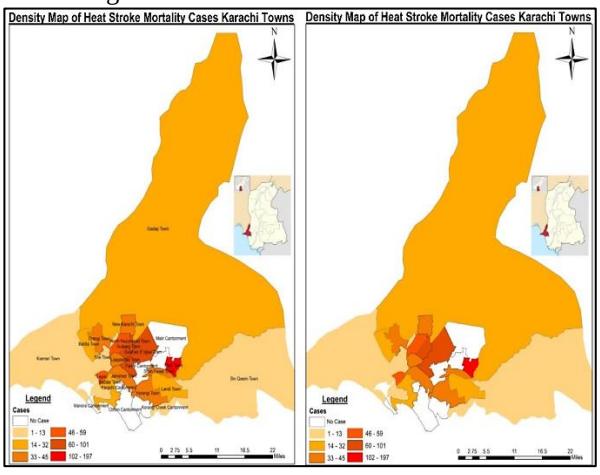

Figure 6. Mortality Town Map HS Cases.

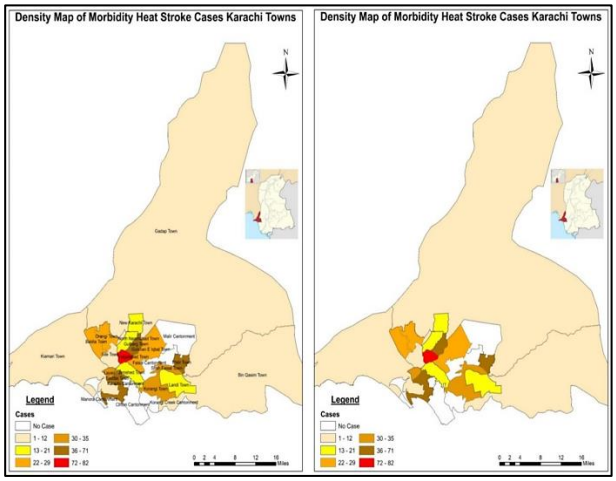

Figure 7. Morbidity Town Map of HS Cases.

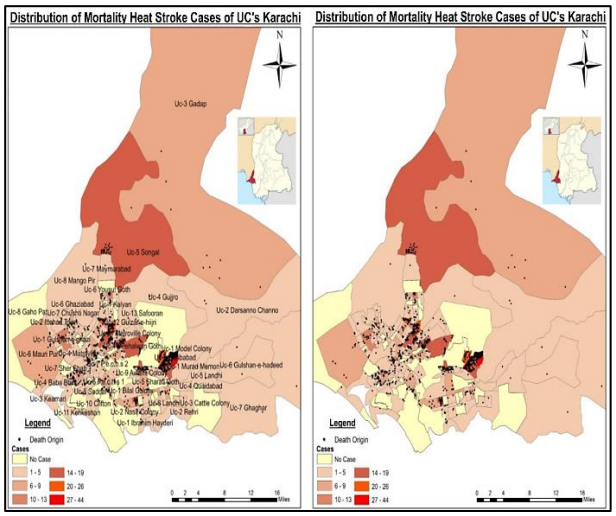

Figure 8. Mortality distribution of HS Cases (UC Map).

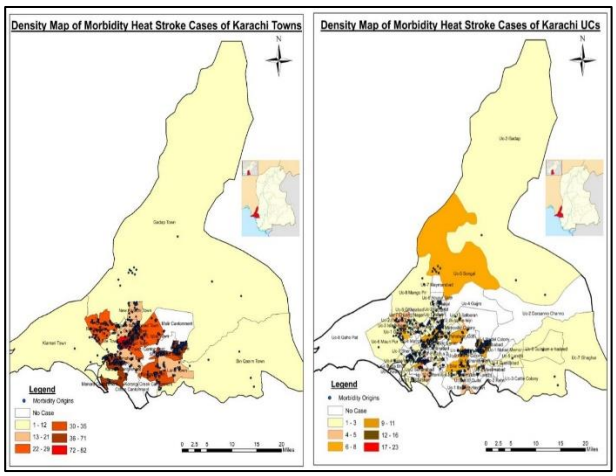

Figure 9. Morbidity distribution of Heat Stroke Cases (UC & Town Map).

5 DISCUSSION

Heatstroke is a major issue these days, and according to the Lancet, the world's second leading cause of mortality. It should be addressed quickly until it becomes too difficult to tackle. Over 1450 cases of heatstroke were reported, with 874 cases of death and 576 cases of illness. Specialists who play a vital part in the decision-making process to reduce the impact of upcoming heat waves should be involved in suggesting policies and strategies for heatstroke. Although most of the locations were harmed by traffic and a lack of green spaces, developing green areas and creating awareness about heatstroke will assist to minimize the effects of heatstroke situations in the future.

6 CONCLUSION

The entire study is focused on Karachi for heatstroke and is the major cause of death, and the temperature is rising slowly but surely as a result of environmental deterioration. As a result, it is critical to address this issue by incorporating experts in the decision-making process so that they may recommend several reasonable solutions for dealing with heatstroke. The density maps of different Karachi Towns and Union Councils were created for the analysis of the areas of heatstroke cases throughout this research. According to the findings, heatstroke is caused by the lack of green places in the city. Open spaces should be adequately provided, and sprawl growth and congested built-up regions should be corrected. Field Specialists must be included in the decision-making process by the government. Efficient transport facilities should be created to prevent individuals from using personal vehicles, which are the primary cause of traffic congestion, and the master plan 2020 for the supply of green areas should be evaluated.

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