



# Research Journal of Pharmaceutical, Biological and Chemical Sciences

## Health Impacts After the Century's Worst Flood in Chennai- a Prospective Telemedicine Study.

Raja Amarnath, Sugirtha Jenitha, and Ghanshyam Verma\*.

Department of Critical Care Services, Sree Balaji Medical College and Hospital, 7, works road, Chrompet, Chennai-600044, Tamil Nadu, India.

### ABSTRACT

Flood demolished Chennai and its outskirts strengthened to face the arising demands such as disease outbreaks and its prevention, since the threat left a gob of sewage and filth on the roads, and moreover, the residents from low lying area were squash with garbage. The risk and magnitude is assessed with the outbreaks of disease and its transmission. Data on post flooded victims came for telemedicine consultations were analysed using descriptive and statistical analysis to rule out the disease outbreaks. The study includes 130 victims who have attended telemedicine consultation and reveals that married women belongs to the age group of 21-40 years with co morbid condition had a large impact on flood and affected by vector, water and air borne diseases. However younger adults affected with distress post disaster. There is a need for disaster preparedness and early warning alarms to the public in order to prevent the disease transmission and outbreaks.

**Keywords:** Water borne diseases, air borne diseases, vector borne diseases, food borne diseases, disease transmission

*\*Corresponding author*



## INTRODUCTION

Natural disaster is an inevitable accident, a supernatural event, arising unavoidable casualty. A flood is an excess or overflow of water leading to submergence of land. Either the man-made or natural disaster, the disaster occurrence will be higher. The assessment of risk and its magnitude can be assessed by the outbreaks of epidemics in the community, the current structure, nutritional status, and health status, potentiality to recover safe and clean water, effluent and access to healthcare. People get stuck in water for multiple numbers of days leading to epidemic outbreaks of communicable as well as non-communicable diseases, in relation with the calamity. It is the major flood recorded over the past 100 years and resulting in evacuation and migration of more than 18 lakh people, residing in Chennai. More than 500 people were killed.

## BACKGROUND

Flooding is an unforeseen event leading to essential epidemiological catastrophe resulting in mortality, impairment, interruption in framework<sup>[1,2]</sup>. It consequently ends up with episodes of morbidity for a chronic period<sup>[3]</sup>. The post disaster victims always end with increased morbidity, mortality and highest impact on their economic factors. Most of the developing countries have lack of supplies, reserves, good framework, preparedness to the natural calamities are inversely affected by disasters<sup>[1]</sup>. Post disaster victims have to be taken care from 4 days to 4 weeks post disaster to prevent epidemics such as water borne, food borne, air borne, and vector borne diseases. 40% of water and vector borne diseases occur due to natural calamity especially in flooding<sup>[4]</sup>. It is essential to strictly adhere universal precautions while handling dead bodies, and utmost care should be taken from the deaths occurred by food borne, water borne, air borne, vector borne diseases in order to prevent disease transmission<sup>[5-8]</sup>.

It is recommended to disinfect and incinerate the things properly before and after handling dead bodies<sup>[1, 5-7, 9]</sup>. A proper risk assessment strategies to be followed post disaster to identify the epidemic and endemic disease transmissions and the environment where the people living, their food, clothing, accessibility to clean and safe water, sanitation etc. disease transmission, its control and prevention starts from every individual personal hygienic measures such as hand washing, handling of water, food and sanitation. Proper vaccination and immunization plays a vital role in disease prevention. Disaster outbreaks often ends with more water borne diseases as during flooding, people get scarcity of water supply from both portable and non-portable ends with sharing the water supply for the large population aggravating unhygienic conditions<sup>[10]</sup>.

There is lack of information on data regarding the non communicable disease outbreaks and pregnancy related problems faced during disaster<sup>[11]</sup>. Due to power failures in flood ends in hazardous and unsafe stored and frozen foods resulting in food borne diseases. Stagnation of water in streets resulting in breeding of mosquitoes and excretion of animal wastes in pooled water leading to vector borne diseases and zoonotic diseases. Exposure to molds, dusts resulting in exaggerating allergies and upper respiratory diseases and thereby increasing the cold like symptoms such as watery nose, eyes, sneezing, sore throat etc. moreover, the major concern of the post flooded victims are the physical and emotional stress related with the disease, loss of family members, home, fear of uninsured things or materials, financial burdens.

Restoring the damaged properties and leading a normal life needs challenging to the disaster victims resulting in more strain to the individual both physically and emotionally. The major public health concern post disaster is epidemic and endemic disease transmission, following flooding<sup>[12]</sup>. Health interventions should be made in post impact disaster phase to control epidemics and also before, after and during flooding to decrease the vulnerability of infections, provision of safe water, shelter, disposal of wastes, are considered to be a preventive measures following flooding<sup>[13]</sup>. The severity of flooding is assessed by its characteristics, morbidity and mortality incidence related with flooding, economical and financial impacts such as economical loss from automobiles, vehicles<sup>[14-17]</sup>.

Flood related injuries are more common after post disaster while people trying to restore themselves back to home for leading a normal life such as broken and unstable buildings, broken electricity wires and cables<sup>[18]</sup>. Fecal-oral disease transmission is more common among low income group people in relation with poor access to safe and clean water and sanitation resulting in water borne disease outbreaks in a community<sup>[19, 20]</sup>. Post traumatic stress disorder, depression, insomnia, anger, irritability are more common among post flooded victims especially living in low income groups<sup>[21-23]</sup>.

The other major concern after flooding is overcrowding. Due to loss of shelter for the public, they are forced to live in places wherever they are migrating. It results in facilitating transmission of diseases such as measles [24, 25]. The risk of infectious diseases is usually created a panic situation to the public by overemphasizing the problems in media, social networking sites, forums etc. the risk of transmission increases manifold due to inadequate resources in health care such as manpower, facilities and utilities and also the insufficient coverage of vaccination access to rural people.

### SUBJECTS

The post flooded victims came for the Teleclinic for treatment were selected as subjects. The problems, investigations, referrals to the tertiary care were recorded in MEDIPRESENCE software.

### TOOL

The data was collected using a MEDIPRESENCE, the software which enables patient records in a central database station which can be accessed by all healthcare centers. This helps specialists / doctors take right decision without asking for repeated examination/diagnostic tests. Also Doctors need not depend on patient's memory for any historical symptoms etc as all are captured in electronic records. Data captured from all health centers are stored in the database without any time lag, daily reporting / real time dashboard of various parameters can be displayed. With real time data available, all stake holders will have knowledge of the current situation and resource utilization can be accurately planned. Disease Management is easier as real time data is available and response to epidemic is immediate due to alerts based on dashboard and daily reporting.

### METHODS

Data from the computerized entry in MEDIPRESENCE on flood impact victims are analysed using statistical packages and the assessments were made regarding the disease outbreaks post flooding.

### STATISTICAL ANALYSIS

All statistical analyses were performed using SPSS Version 19. Demographic data including gender, age, marital status, Diagnosis, Co morbidities and specialty were recorded as numbers and percentages. Frequencies for all variables were found out. Chi square analysis was performed to analyze the relationships among the variables. Correlation analysis was performed for finding the relationship among variables. All calculations were performed using a software SPSS V.19, with the level of significance set at  $p < 0.05$ .

### RESULTS

#### Characteristics of the flood affected people

Characteristics	N	%
<b>Age</b>		
0-20	25	19.2
21-40	42	32.3
41-60	49	37.7
>61	14	10.8
<b>Marital Status</b>		
Married	104	80
Unmarried	26	20
<b>Gender</b>		
Male	53	40.8
Female	77	59.2
<b>Diagnosis</b>		
Air borne disease	14	10.8
Dermatology diseases	14	10.8

ENT problems	11	8.5
Eye diseases	4	3.1
Pregnancy	5	3.8
Psychiatric disorders	15	11.5
Respiratory diseases	20	15.4
Vector borne diseases	18	13.8
Water borne	25	19.2
Food borne	4	3.1
<b>Symptoms</b>		
Cold	34	26.2
Itching	14	10.8
Fever	46	35.4
Irritation	16	12.3
Fear	15	11.5
Abdominal pain	5	3.8
<b>Co morbid conditions</b>		
Nil	91	70
DM,HTN	24	18.5
Cardiac problems	14	10.8
Stroke	1	0.7
<b>Co morbidities</b>		
With Co morbidities	91	70
Without Co morbidities	39	30
<b>Speciality</b>		
Dermatology	25	19.2
ENT	11	8.5
Gastroenterology	5	3.8
Gynecology	5	3.8
Medicine	61	46.9
Ophthalmology	4	3.2
Psychiatry	15	11.5
Pulmonology	4	3.1

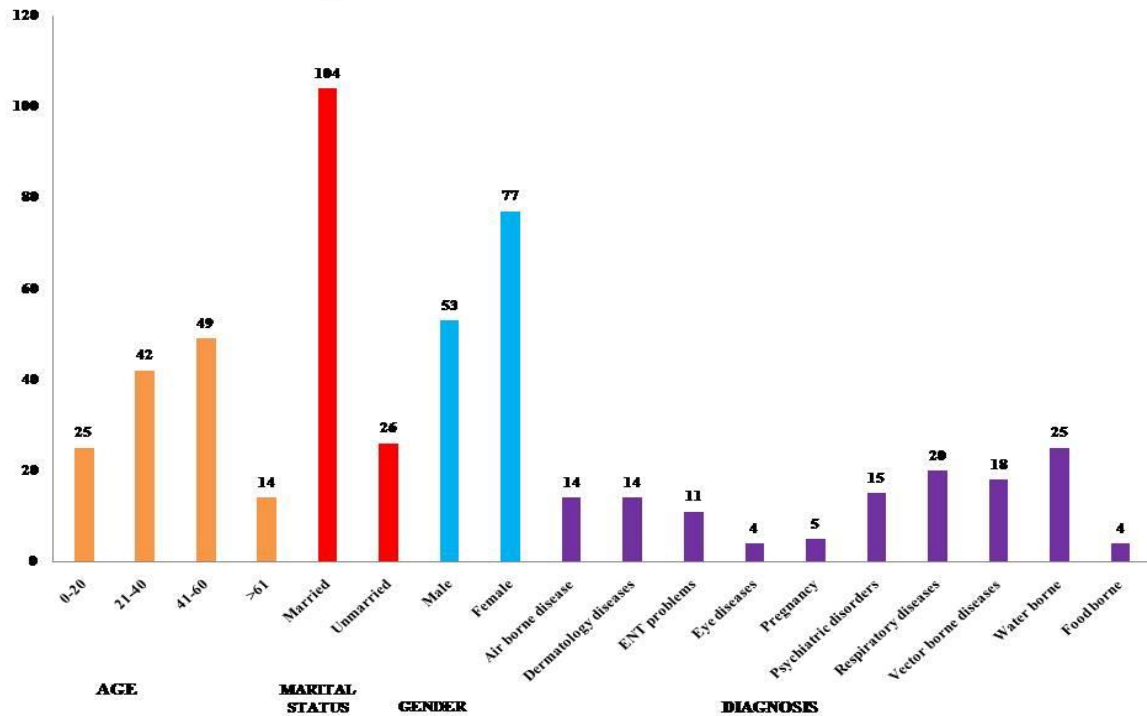
**Table I: Characteristics of the flood affected people**

Table-I shows the characteristics of the flood affected people. Among the post flooded victims, 130 persons attended the telemedicine consultation for their current problems. Among those 130 victims, 25(19.2%) victims belong to the age group of below 20 years, 42(32.3%) victims belong to the age group of 21-40 years, 49(37.7%) victims belong to the age group of 41-60 years, and the remaining 14(10.8%) victims belong to the age group of above 60 years. Among the post flooded victims, 104(80%) of individuals got married and the rest 26 (20%) remain singles. Majority of the victims 77(59.2%) were female and the rest 53(40.8%) were male. Majority of the post flooded victims 46(35.4%) affected with the complaints of fever, 34(26.2%) were affected with cold, 16(12.3%) had the complaint of irritation in skin, 15(11.5%) had the complaints of fear and anxiety, 14(10.8%) had the complaint of itching on skin and the rest 5(3.8%) had the complaints of abdominal pain.

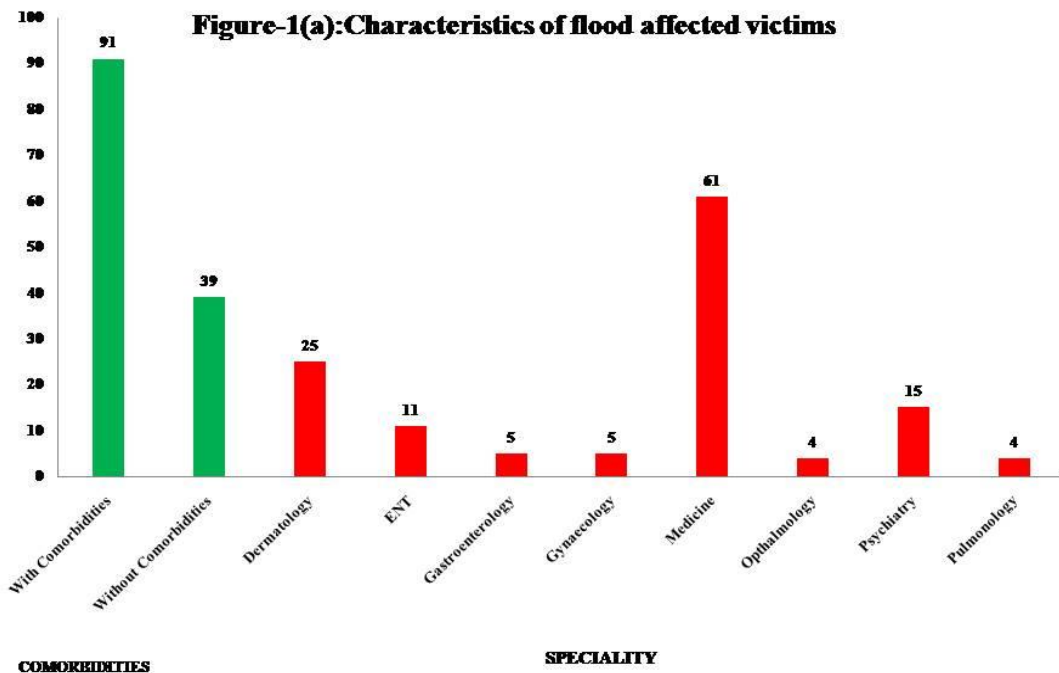
Majority of post flooded victims 91(70%) were not associated with any co morbid conditions earlier, 24(18.5%) had co morbidities such as Diabetes mellitus, hypertension, 14(10.8%) had co morbidities such as cardiac problems, and the rest 1(0.7%) had co morbidities such as stroke. Majority of the post flooded victims 91(70%) were not having any associated co morbidities and the rest 39(30%) were associated with co morbid conditions. Among the post flooded victims, 14(10.8%) were diagnosed of having air borne diseases, 14(10.8%) were diagnosed of having Dermatology diseases, 11(8.5%) were diagnosed of having ENT disorders, 4(3.1%) were diagnosed of having eye diseases, 15(11.5%) were diagnosed of having psychiatric disorders, 20(15.4%) were diagnosed of having respiratory diseases, 18(13.8%) were diagnosed of having vector borne diseases, 25(19.2%) were diagnosed of having water borne diseases, 4(3.1%) were diagnosed of having food borne

diseases and the rest 5(3.8%) of victims were pregnant. Majority of post flooded victims 61(46.9%) were undergone treatment for the medical problems, 25(19.2%) victims took treatment for dermatology issues, 11 (8.5%) victims took treatment for ENT issues, 5(3.8%) victims took treatment for Gastroenterology issues, 5(3.8%) victims took treatment for Antenatal checkups, 4(3.2%) victims took treatment for ophthalmology issues, 15(11.5%) victims took treatment for psychiatric problems, and the rest 4(3.1%) victims took treatment for Pulmonology issues. It is represented in figure-1 & 1 (a).

**Figure-1: Characteristics of flood affected victims**



**Figure-1(a): Characteristics of flood affected victims**



Comparison of variables with/without co morbidities

Characteristics	With Co morbidities		Without Co morbidities		p - value
	n	%	n	%	
<b>Age</b>					
0-20	24	18.5	1	0.8	<b>&lt;0.001</b>
21-40	41	31.5	1	0.8	
41-60	23	17.7	26	20	
>61	3	2.3	11	8.5	
<b>Marital Status</b>					
Married	66	50.8	38	29.2	<b>0.0001</b>
Unmarried	25	19.2	1	0.8	
<b>Gender</b>					
Male	36	27.7	17	13.1	<b>0.052</b>
Female	55	42.3	22	16.9	
<b>Diagnosis</b>					
Air borne disease	13	10	1	0.8	<b>&lt;0.001</b>
Dermatology diseases	10	7.7	4	3.1	
ENT problems	5	3.8	6	4.6	
Eye diseases	3	2.3	1	0.8	
Pregnancy	5	3.8	0	0	
Psychiatric disorders	10	7.7	5	3.8	
Respiratory diseases	6	4.6	14	10.8	
Vector borne diseases	18	13.8	0	0	
Water borne	17	13.9	7	5.4	
Food borne	3	2.3	1	0.8	
<b>Speciality</b>					
Dermatology	20	15.4	5	3.8	<b>0.435</b>
ENT	5	3.8	6	4.6	
Gastroenterology	3	2.3	2	1.5	
Gynaecology	5	3.8	0	0	
Medicine	42	32.3	19	14.6	
Ophthalmology	3	2.3	1	0.8	
Psychiatry	10	7.7	5	3.8	
Pulmonology	3	2.3	1	0.8	

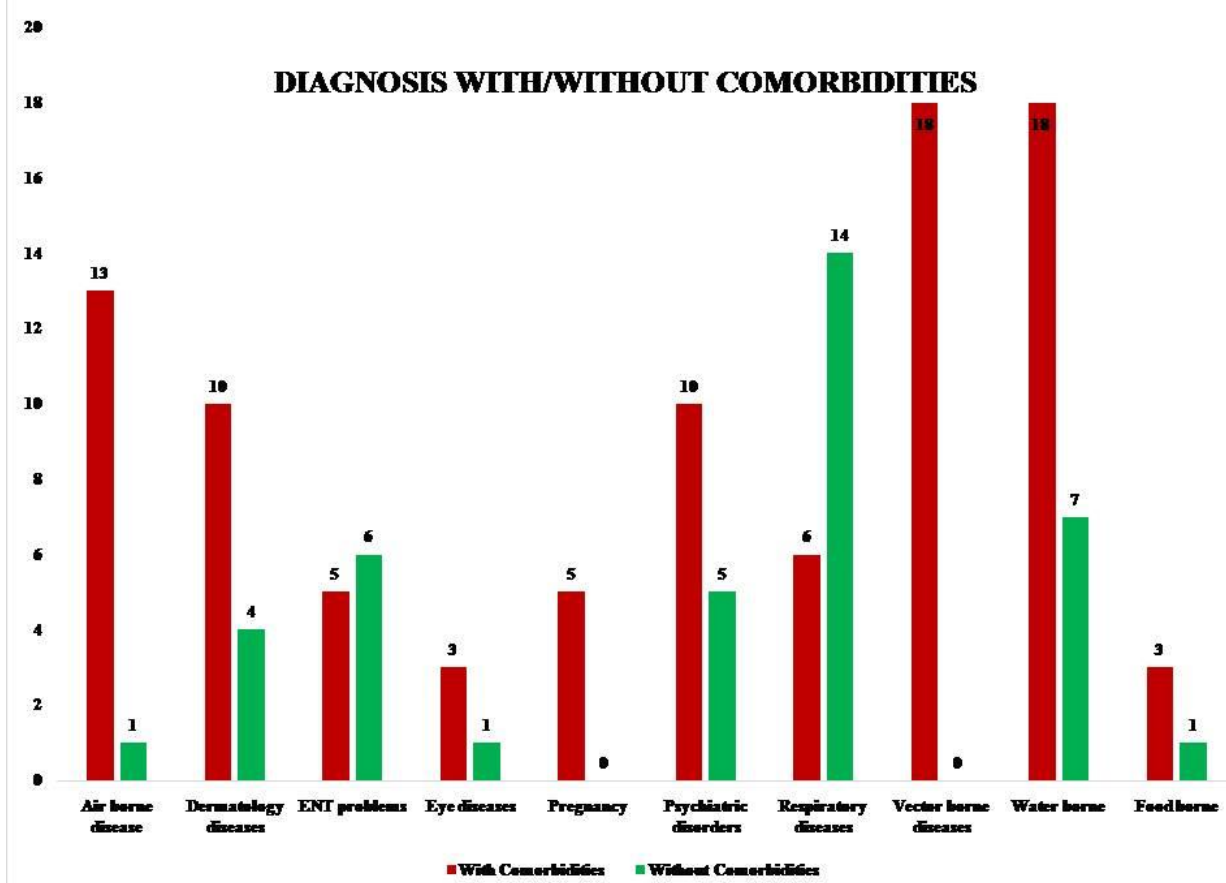
Table II: Comparison of variables with/without co morbidities

Table- II shows the comparison of variables such as age, marital status, gender, diagnosis, specialty with presence/absence of co morbid conditions. Majority of the victims 41(31.5%) with co morbid conditions belong to the age group of 21-40 years and the least number of victims 3(2.3%) were affected with co morbid conditions belongs to the age above 60 years. Surprisingly, the age group of 41-60 years treated in teleconsultation without co morbid conditions. When the age factor is compared with the presence and absence of co morbid condition, it is found to be highly significant at the p value less than 0.001. When the marital status of the victim was compared with co morbidities, it is found that, majority of married victims

66(50.8%) treated with co morbidities than the married victims 38(29.2%) treated without co morbidities. As such majority of the victims who are single 25(19.2%) were treated with co morbidities than the single victims 1(0.8%) were treated without co morbidities. When the variable marital status is compared with presence/absence of co morbid condition, it is found to be highly significant at the p value less than 0.0001.

In comparison with male, female victims had significant co morbid conditions than male 36(27.7%) were treated with co morbid conditions, 22(16.9%) of female victims were treated in telemedicine consultation without co morbidities than male 17(13.1%) were treated without co morbidities. When the variable gender is compared with the presence/absence of co morbidities, it is found to be significant at the p value less than 0.05. When the variable specialty is compared with co morbidities, we found that majority of the medical consultation victims 42(32.3%) had co morbid conditions and 19(14.6%) were treated without co morbidities. The next to medical consultations, dermatology consultations 20(15.4%) victims had co morbid conditions and 5(3.8%) treated without co morbidities. It is represented in figure-2.

**Figure-2: Comparison of diagnosis of flood affected victim with presence/absence of co morbidities**



**Comparison of all variables with diagnosis of post flooded victims**

Characteristics	Air borne		Derm diseases		ENT problems		Eye diseases		Pregnancy		Psychiatric disorders		Respiratory diseases		Vector borne		Water borne		Food borne		p-value
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%			
Age																					
0-20	4	3	4	3.1	2	1.5	0	0	1	0.8	3	2.3	1	0.8	6	5	3	2.3	1	0.8	0.026
21-40	4	3	3	2.3	1	0.8	1	0.8	4	3.1	5	3.8	3	2.3	8	6	12	9.2	1	0.8	
41-60	5	4	6	4.6	7	5.4	2	1.5	0	0	6	4.6	8	6.2	4	3	9	6.9	2	1.5	
>61	1	1	1	0.8	1	0.8	1	0.8	0	0	1	0.8	8	6.2	0	0	1	0.8	0	0	

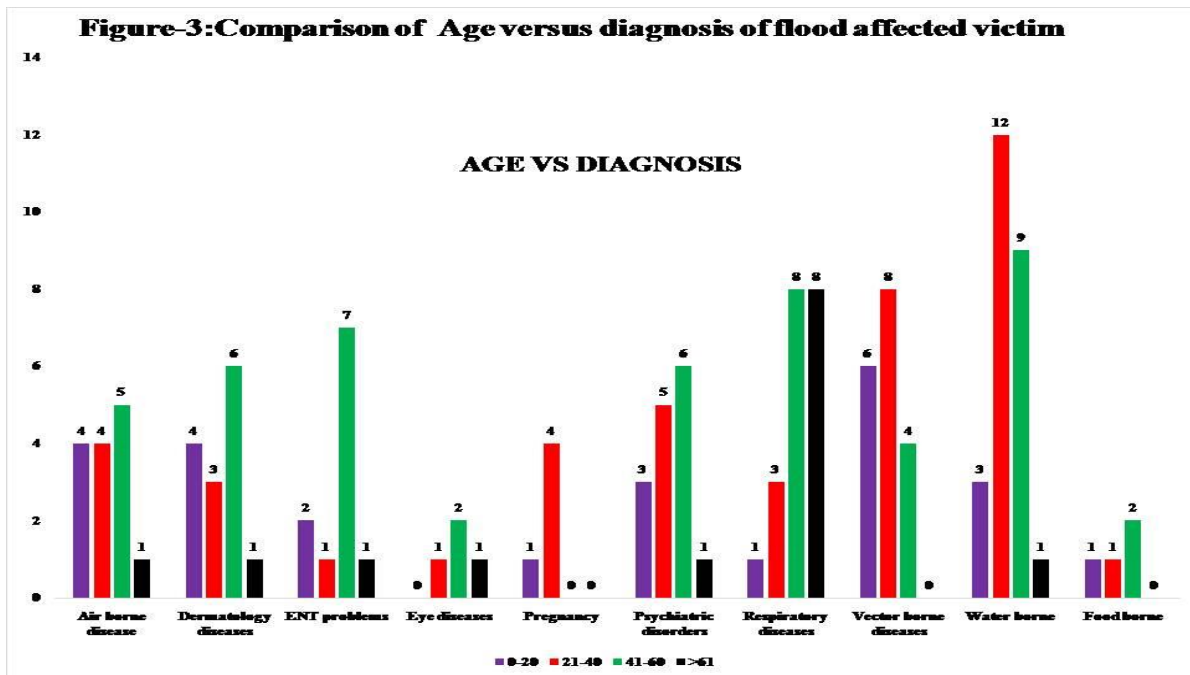
<b>Marital Status</b>																						
Married	10	8	10	7.7	9	6.9	4	3.1	4	3.1	12	9.2	18	13.8	12	9	22	17	3	2.3	<b>0.78</b>	
Unmarried	4	3	4	3.1	2	1.5	0	0	1	0.8	3	2.3	2	1.5	6	5	3	2.3	1	0.8		
<b>Gender</b>																						
Male	8	6	3	2.3	5	3.8	1	0.8	0	0	6	4.6	10	7.7	11	9	7	5.3	2	1.5	<b>0.205</b>	
Female	6	5	11	8.5	6	4.6	3	2.3	5	3.8	9	6.9	10	7.7	7	5	18	14	2	1.5		
<b>Comorbidities</b>																						
With Comorbidities	13	10	10	7.7	5	3.8	3	2.3	5	3.8	10	7.7	6	4.6	18	14	18	14	3	2.3	<b>&lt;0.001</b>	
Without Comorbidities	1	1	4	3.1	6	4.6	1	0.8	0	0	5	3.8	14	10.8	0	0	7	5.4	1	0.8		
<b>Speciality</b>																						
Dermatology	11	9	14	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<b>&lt;0.001</b>
ENT	0	0	0	0	11	8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gastroenterology	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2.3	2	1.5	0	
Gynaecology	0	0	0	0	0	0	0	0	5	3.8	0	0	0	0	0	0	0	0	0	0	0	
Medicine	3	2	0	0	0	0	0	0	0	0	0	0	16	12.3	18	14	22	17	2	1.5	0	
Ophthalmology	0	0	0	0	0	0	4	3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	
Psychiatry	0	0	0	0	0	0	0	0	0	0	15	11.5	0	0	0	0	0	0	0	0	0	
Pulmonology	0	0	0	0	0	0	0	0	0	0	0	0	4	3.1	0	0	0	0	0	0	0	

**Table III: Comparison of all variables with diagnosis of post flooded victims**

Table-III shows that the comparison of all variables with the diagnosis of post flooded victims. Among the post flooded victims, age group of below 20 years 4(3%) were affected with air borne diseases, 4(3.1%) were affected with dermatology diseases, 2(1.5%) were affected with ENT problems, 1(0.8%) were pregnant ladies, 3(2.3%) were affected with psychiatric disorders, 1(0.8%) were affected with respiratory diseases, 6(5%) were affected with vector borne diseases, 3(2.3%) were affected with water borne diseases, 1(0.8%) were affected with food borne diseases. Age group of 21-40 years 4(3%) were affected with air borne diseases, 3(2.3%) were affected with dermatology diseases, 1(0.8%) were affected with ENT problems, 1(0.8%) were affected with eye problems, 4(3.1%) were pregnant ladies, 5(3.8%) were affected with psychiatric disorders, 3(2.3%) were affected with respiratory diseases, 8(6%) were affected with vector borne diseases, 12(9.2%) were affected with water borne diseases, 1(0.8%) were affected with food borne diseases.

Age group of 41-60 years 5(4%) were affected with air borne diseases, 6(4.6%) were affected with dermatology diseases, 7(5.4%) were affected with ENT problems, 2(1.5%) were affected with eye problems, 6(4.6%) were affected with psychiatric disorders, 8(6.2%) were affected with respiratory diseases, 4(3%) were affected with vector borne diseases, 9(6.9%) were affected with water borne diseases, 2(1.5%) were affected with food borne diseases. Age group of above 60 years 1(1%) were affected with air borne diseases, 1(0.8%) were affected with dermatology diseases, 1(0.8%) were affected with ENT problems, 1(0.8%) were affected with eye problems, 1(0.8%) were affected with psychiatric disorders, 8(6.2%) were affected with respiratory diseases, 1(0.8%) were affected with water borne diseases. When the age factor is compared with the diagnosis of post flooded victims, it is found to be significant at the p value less than 0.02. It is represented in figure-3.





Among post flooded victims, who were treated in telemedicine consultation with co morbidities 13(10%) were affected with air borne diseases, 10(7.7%) were affected with dermatology diseases, 5(3.8%) were affected with ENT problems, 3(2.3%) were affected with eye problems, 5(3.8%) were pregnant ladies, 10(7.7%) were affected with psychiatric disorders, 6(4.6%) were affected with respiratory diseases, 18(14%) were affected with vector borne diseases, 18(14%) were affected with water borne diseases, 3(2.3%) were affected with food borne diseases. Among post flooded victims, who were treated in telemedicine consultation without co morbidities 1(1%) were affected with air borne diseases, 4 (3.1%) were affected with dermatology diseases, 6(4.6%) were affected with ENT problems, 1(0.8%) were affected with eye problems, 5(3.8%) were affected with psychiatric disorders, 14(10.8%) were affected with respiratory diseases, 7(5.4%) were affected with water borne diseases, 1(0.8%) were affected with food borne diseases. When the variable presence / absence of co morbidities is compared with the diagnosis of post flooded victims, it is found to be highly significant at the p value less than 0.001. When the marital status and gender is compared with the diagnosis of post flooded victim, it is found that there is no significance at the respective p values.

### DISCUSSION

The post flood impact resulting as a consequence of lack of preparedness, resources, materials, health access etc. scientific literature reveals the bitter truth of collective impact on post flooding due to scarcity of resources and knowledge. There is an increase demand of healthcare for several weeks post disaster was observed in all natural calamities [26, 27]. Medical and healthcare team was overburdened with the field visits, preparing the medical reports, etc. From the literature, it is found that Acute Respiratory Infections were the most common indication of post flooded victim to seek medical help. Next to acute respiratory infections, psychological disorders ranked for the consultations [27, 28]. Moreover, there is insufficient data regarding the non-communicable diseases and the pregnancy outcomes post disaster [29]. Outbreaks of epidemics occur as a impact of natural disaster due to contamination of flood and water via both transportation, storage and sharing of resources, utensils etc. Food borne diseases are considered to be a leading cause of mortality following disaster and the people living in triage camps [30].

Acute Respiratory Infections is the major incidence post flooding due to poor nutrition, overcrowding in shared shelters, lack of ventilation and the climatic condition [31]. Stagnant water post flooding enhances the mosquito breeding and frequency of mosquito bites in overcrowded places such as camps, shared public shelters resulting in vector borne diseases. Collection of stagnant rain water in rubber tubes, broken plastic containers, buckets give way to mosquito breeding and resulting of dengue epidemics [32]. Previous studies reveal that there are no significant differences in impact of flood in men and women. However, people from 35 and 75 years of age, who comes under low and moderate income groups got affected more post flooding [33].

<sup>34]</sup>. Literature suggests that psychiatric problems were more common among the people belong to low income group and they are prone to the adverse effects post disaster <sup>[35]</sup>. Studies from Australia and US suggest that there is no much significant differences in gender related with impact of flooding, still male belong to the age group of 35-54 years and between 10 and 29 years, female belong to the oldest age were prone to get affected by adverse effects of disaster <sup>[36-38]</sup>. Few studies suggest that there is an increase risk of impact on flooding for those who have co morbid conditions earlier <sup>[39-42]</sup>. No studies identify the vulnerability of mortality factors. Still, the old age group people are prone to get cardiac arrest and other cardiac problems related with flooding <sup>[38, 43]</sup>. Literature supports the old age group people had a high risk of getting psychological issues as well as female were prone to get psychological issues than male. Younger adults were prone to get distress <sup>[44, 45]</sup>.

### CONCLUSION

Our study reveals that there is a lack of transport facilities, inaccessible to health care services, inadequate medical help due to scarcity of resources and manpower, 50% of the people were not come forward for seeking medical attention post flooding. There is a need of intense research to plan the strategies for disaster preparedness and to face the impact post flooding. Effort should be taken to create awareness to the public regarding the disease transmission risk and hazards related to disaster.

### FUTURE PROSPECTS

There is a need for public health measures for prior preparedness for natural disasters, early warning systems. There is no study conducted for the long term impacts post flooding related with psychological problems faced by the people. Information of non communicable diseases, the quality of life post flooding, needs further research to have a clear understanding on impact of floods. Prospective and retrospective cohort studies should be initiated to identify the impact on pre, during and post flooding on vulnerable groups.

### COMPETING INTERESTS

The authors declare that they have no competing interests.

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