

## Impact of Flood Disaster on the Mental Health of Residents in the Eastern Region of Jeddah Governorate, 2010: A Study in Medical geography

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**Abstract:** The impact of natural disasters over the last decade has resulted in many lives lost and livelihoods destroyed. Recent disasters, such as the earthquakes, the drought in the Horn of Africa, and landslides in Yemen have tested the capacities of Member States as well as national and international humanitarian agencies to provide quick and effective assistance. Flood disaster constitutes the most costly natural as well as technology-induced disaster, in terms of both human suffering and financial loss. Natural disaster risk assessment is a complex task, involving a wide variety of processes which require large amounts of spatial and temporal thematic data and information coming from disparate sources. In conjunction with the natural disaster risk assessment, medical geography aims at explaining the distribution of health status and disease. It identifies efficient ways to intervene and distribute trained personal and technology and has a crucial role in assessing and managing the consequences of disasters. Aim of the study: Exploring the impact of the floods on the mental health of the residents in the Eastern region of Jeddah Governorate, Locate neighbourhoods affected by the flood disaster in the city of Jeddah; Identify the natural factors causing the disaster; Human impact and negative role in the disaster; Measuring the psychological impact on the population in the affected place; Estimate the prevalence of PTSD among residents in the eastern region of Jeddah, as well as the residents who were shifted to the lodging houses; Describe the potential and exacerbating factors associated with occurrence of PTSD among residents exposed to the flood disaster and finally develop plans and recommendations that would reduce the recurrence of the disaster in the future. Methods and subjects: The study depends on the objective approach, using many methods in analyzing the information such as the descriptive, analytical and interpretative in addition to field studies. Through a cross sectional community based on a design sample of 450 individuals, who were selected randomly from an estimated 336000 residents who were living along the stream courses of the flood. Cluster sampling using ArcGis 9.1 was made to assign 40 random clusters distributed proportionally according to the expected severity of exposure and from each cluster 10 households were selected by systematic random sampling plus 50 individuals who were selected randomly from those who were evacuated to lodging houses. PTSS-10 questionnaire was used to discover PTSD among people exposed to disasters. The results obtained from this study are explained and illustrated in tables and figures, in addition the study covering the following topics: Re-experiencing symptoms (Flashbacks—reliving the trauma over and over, including physical symptoms like a racing heart or sweating, bad dreams and frightening thoughts); Avoidance symptoms (e.g. Staying away from places, events, or objects that remind of the experience, feeling emotionally numb, feeling strong guilt, depression, worry, losing interest in activities that were enjoyable in the past and having trouble remembering the dangerous event) and Hyper-arousal symptoms (Being easily startled, feeling tense or “on edge”, having difficulty sleeping, and/or having angry outbursts). Conclusion and Recommendations: While it is extremely difficult, if not impossible, to predict the occurrence of most natural hazards; it is possible to take action before emergency events happen to plan for their occurrence when possible and to mitigate their potential effects putting into consideration the expected scenario of the event. Our study revealed two important issues that would help in the preparedness plan for flood disaster in Jeddah Governorate, first, the anatomy of the expected flood that could be modified through establishment of properly designed underground drainage tunnels leading to the red sea on the western border of the city. Secondly, in addition to the direct effect of the disaster represented by loss of properties and morbidities that could be ameliorated by compensations and concurrent health services, an overlooked post disaster impact shown as Post Traumatic Stress Disorders should be put in consideration in planning for the comprehensive health services provided to the victims of the flood. Thirdly, the authorities must prevent the establishment of any buildings, roads or infra-structure along the courses of dry valleys. [Katibah Maghrabi **Impact of Flood Disaster on the Mental Health of Residents in the Eastern Region of Jeddah Governorate, 2010: A Study in Medical geography**. Life Science Journal 2012; 9(1):95-110] (ISSN: 1097-8135). <http://www.lifesciencesite.com>

**Keyword:** Flood Disaster, Mental Health, Jeddah, Governorate, geography.

### 1. Introduction

The impact of natural disasters over the last

decade has resulted in many lives lost and livelihoods destroyed. Recent disasters occurred in

the East Mediterranean Region such as the earthquakes in Pakistan (2005) and Islamic Republic of Iran (2003), the drought in the Horn of Africa (2006), and landslides in Yemen (2005), have tested the capacities of Member States as well as national and international humanitarian agencies to provide quick and effective assistance<sup>(1)</sup>. Subsequently, many of the affected countries and communities in the Eastern Mediterranean Region are now calling for better disaster preparedness and mitigation programs to avert the adverse effects of major disasters.<sup>(2)</sup> The ability to determine disaster risk for a region and its resident populations could strengthen its disaster management capacity by providing the information necessary to decision makers to advocate for resources to improve emergency preparedness and mitigation; supporting emergency response; help to identify, plan and prioritize areas for mitigation activities to minimize the effects of natural hazards<sup>(3)</sup>. Natural disaster risk assessment is a complex task, involving a wide variety of processes which require large amounts of spatial and temporal thematic data and information coming from disparate sources. In this context, geography and Geographic Information Systems (GIS) can provide an ideal platform for the integration of the different data, their analysis and, ultimately, the development of disaster risk models for a region and its resident populations<sup>(4-6)</sup>. One potential application of the hazard distribution maps is the calculation of the population exposed to each of the hazard specific level of intensity. This can be achieved through the combination of the hazard distribution layers with a population distribution grid covering the area of interest<sup>(7,8)</sup>.

In conjunction with the natural disaster risk assessment, medical geography aims at explaining the distribution of health status and disease. It identifies efficient ways to intervene and distribute trained personal and technology<sup>(9)</sup>. It has a crucial role in assessing and managing the consequences of disasters.

Flood disaster constitutes the most costly natural as well as technology-induced disaster, in terms of both human suffering and financial loss. More important, it continues to profoundly impact the livelihood and the mental and physical health of those who experienced evacuation<sup>(10)</sup>.

**Hunter**, noted in a comparative overview of global natural disasters that migration decisions related to disaster vary by hazard type, settings, household characteristics, and perception of risk, and that this variance is particularly visible among vulnerable populations<sup>(11)</sup>. The place identity is concerned with the sense of self based on the places in which one passes one's life." After a major life interruption event, such processes are "threatened by

displacement, and the problems of nostalgia, disorientation, and alienation may ensue." This is especially true following environmental disasters<sup>(12)</sup>.

The consequences of disasters on public health are often thought of in terms of mortalities, physical injury, and epidemics. However, according to the comprehensive view of health adopted by the World Health Organization (**WHO**)- "a complete state of physical and mental well-being"—suggests that mental health requires post disaster attention throughout the "disaster community"<sup>(13)</sup>. The Recent reports suggest that after natural disasters mental health problems and mental health needs pose a resource problem for primary care providers, as it is expected that about 4–5 percent of the survivors of a large-scale natural disaster can develop Posttraumatic Stress Disorder (PTSD)<sup>(14)</sup>.

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The Recent reports suggest that after natural disasters mental health problems and mental health need pose a resource problem for primary care providers, as it is expected that about 4–5 percent of the survivors of a large-scale natural disaster can develop Posttraumatic Stress Disorder (**PTSD**),<sup>(16)</sup>.

Post-Traumatic Stress Disorder, PTSD, is an anxiety disorder that can develop after exposure to a terrifying event or ordeal in which grave physical harm occurred or was threatened. Traumatic events that may trigger PTSD include violent personal assaults, natural or human-caused disasters, accidents, or military combat<sup>(17)</sup>.

There are various types and causes of disasters; natural and human. The natural disasters come on top of the most devastating ones. Literally, natural disasters occur when extreme and magnitude of stochastic natural processes cause severe damage to society. Some natural disasters could be predicted before its propagation e.g. volcanoes and tornadoes, while others are still unpredictable through our available technologies e.g. earthquakes. On the other hand, floods are coming in between,<sup>(18)</sup>.

Flooding is caused by prolonged and intensive rainfall, which inundates the surrounding area. Flash floods occur within six hours of a rain event, or after a dam or levee failure. It can catch people unprepared, without warning<sup>(19)</sup>.<sup>(4)</sup>

Several factors contribute to flooding; two key elements are rainfall intensity and duration. Intensity is the rate of rainfall, and duration is how long the

rain lasts. Topography, soil conditions, and ground cover also play important roles. Most flash floods are caused by slow-moving thunderstorms or heavy rains from hurricanes and tropical storms. Floods, on the other hand, can be slow- or fast-rising, but generally develop over a period of hours or days,<sup>(20)</sup> <sup>(3)</sup>

As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb water. Urbanization increases runoff two to six times over what would occur on natural terrain. During periods of urban flooding, streets can become swift moving rivers, while basements and viaducts can become death traps as they fill with water<sup>(21)</sup> <sup>(3)</sup>

Apart from the physical harms occurring during the flood, psychological disorders are expected to increase after its vanishing. The commonest is the Post-Traumatic Stress Disorder (PTSD),<sup>(22)</sup> <sup>(3)</sup> People with PTSD have persistent frightening thoughts and memories of their ordeal and feel emotionally numb, especially with people they were once close to. They may experience sleep problems, feel detached or numb, or be easily startled.

### Background:

By the end of 2009, Jeddah which is considered as the main sea port for the Kingdom of Saudi Arabia on the Red Sea coast was afflicted by heavy rains that lasted few hours and caused massive floods, which left behind several casualties in addition to massive destruction in buildings, main highways and private properties in the eastern part of Jeddah governorate. Although the physical casualties were circumscribed accurately to put forwards adequate compensations for the residents in the affected area, however, the impact of the disaster on the mental and psychological conditions has not been elaborated.

The city of Jeddah on Wednesday, the 8<sup>th</sup> of Dhu al-Hijjah 1430, was exposed to a wave of heavy rains, which caused the creation of torrents, leading to the collapse of houses and cutting off the main roads, the destruction of a large number of cars and the loss of many of victims. Furthermore, the emergence of many diseases such as dengue fever, cholera, malaria, respiratory problems and skin diseases was another serious problem. The number of damaged property was 11,799 in addition to 10,913 vehicles, (Civil Defence), in the Eastern and South-eastern districts of Jeddah, including the neighbourhoods (Al-Shorouk, Al-Mareekh, Al-Waha, Al-Nakheel, Raghma, Hadaek Al-Salam, Al-Rabbwa, Kilo 14, Al-Amir Fawaz, Al-Jamiaa, Sulaymaniyah, Harazat, Al-Suwaydaa, Qoizp) figure (1). This is due to the following:

- Location in the arid region, which is characterized by sudden and variable rainfall.
- Presence of a large number of dry valleys, which restrict the speed of run-off such as

(Wadi Al-Mareekh, Breiman, Bani Malik, Qoizp, Galil, Wadi Fatima) figure (2).

- Delay in carrying out the establishment of projects to avoid water flooding.

The study is a selected topic to ameliorate the impact of the disaster on those who lost their homes. The Kingdom's authorities shouldered the responsibility of providing instantaneous housings for those who lost theirs. To solve this problem, the affected people were moved to lodging houses, which are widely spread in Jeddah Governorate, and the costs were covered by the government.

Although the physical casualties were circumscribed accurately to put forwards adequate compensations for the residents in the affected area, however, the impact of the disaster on the mental and psychological conditions of the people who experienced the disaster has not been elaborated.

### Aim of the study:

1. Exploring the impact of the floods on the mental health of the residents in the Eastern region of Jeddah Governorate.
2. Locate neighbourhoods affected by the flood disaster in the city of Jeddah.
3. Identify the natural factors causing the disaster.
4. Human impact and negative role in the disaster.
5. Measuring the psychological impact on the population in the affected place.
6. Estimate the prevalence of PTSD among residents in the eastern region of Jeddah Governorate, as well as the residents who were shifted to the lodging houses.
7. Describe the potential and exacerbating factors associated with occurrence of PTSD among residents exposed to the flood disaster.
8. Develop plans and recommendations that would reduce the recurrence of the disaster in the future.

### Questions of the study:

- 1 - What are the neighbourhoods affected by the flood disaster in the city of Jeddah?
- 2 - What are the factors causing the natural disaster?
- 3 - What is the role of human factors in the disaster?
- 4 - Does measuring the psychological effects on the population in the affected area agree with the applicable measure of psychological effects of non-affected population?

### Methodology:

The study depends on the objective approach in dealing with disaster. It uses many methods in analyzing the information such as the descriptive, analytical and interpretative in addition to field studies.



Source: The work of the researcher depending on the secretariat of the Jeddah 1425

Through a cross sectional community based on a design sample of 450 individuals, who were selected randomly from an estimated 336000 residents who were living along the stream courses of the flood. Cluster sampling using ArcGis 9.1 was made to assign 40 random clusters distributed proportionally according to the expected severity of exposure and from each cluster 10 households were selected by systematic random sampling plus 50 individuals who were selected randomly from those who were evacuated to lodging houses. PTSS-10 questionnaire was used to discover PTSD among people exposed to disasters. Other demographic characteristics were taken into consideration such as age and gender, in order to explore exacerbating factors associated with the stress.

- 150 in Harazat
- 250 in Qoisah
- 100 from lodging apartments

Unexpected incidents caused by the forces of nature, or because of human action, followed by consequent loss of lives and destruction of property. It has severe impact on national economy and social life.

Are harmful events that occur in the environment due to natural factors, which results the loss of lives and resources . They are divided into high-risk, medium and weak ones <sup>(23)</sup>;



**3. Torrents:**

Natural disaster that occurs as a result of heavy and intensive precipitation in sudden and large amounts for a short period of time, as tropical cyclones, which are loaded with heavy rain. They cause the rising of river water, which flood buildings, roads and agricultural fields<sup>(24)</sup>.

**4. Posttraumatic stress disorder (PTSD):**

It is a severe anxiety disorder that can develop after exposure to any event that results in psychological trauma.<sup>[1][2][3]</sup> This event may involve the threat of death to oneself or to someone else, or to one's own or someone else's physical, sexual, or psychological integrity,<sup>[1]</sup> overwhelming the individual's ability to cope. As an effect of psychological trauma, PTSD is less frequent and more enduring than the more commonly seen acute stress disorder.

**Population of study:**

The whole population living in the south eastern region of Jeddah Governorate in the area covered by the following coordinates.

39°24'53.707"E 21°32'44.928"N

39°25'25.452"E 21°25'32.385"N

39°13'14.81"E 21°24'46.8"N

39°12'43.566"E 21°31'55.58"N

This area consists of five districts either totally or partially. The total population living in this area is estimated to be about 336000, distributed as following: Quiza (42000), Montazahat (58000), Harazat (26000), Kilo 14 (60000) and Jamea (150000).

**Sampling:****Sample size:**

The sample size was calculated using EPI program ver. 6.04 based on the following assumptions:

- The expected frequency of the (PTSD) is 5% (0.05);
- The worst acceptable frequency is  $\pm 2\%$  (0.02);
- The confidence level is set at 95%.
- The power is set at 80%.

The total sample accounted for 457, which was rounded to 500.

**Selection of the sample:**

The main sample was taken from Harazat, Quiza and the adjacent three districts. These areas were extremely affected by the floods.

The majority of those who were shifted to the lodging houses are driven from these two districts, accordingly, the sample of the study will be withdrawn from the residents of Quiza and Harazat in addition to those in the lodging houses it is as

follow:

- 250 from Quiza
- 150 from Harazat
- 100 from the lodging houses.

**Sampling technique:**

Two techniques will be adopted to allocate the participants of the study:

- *Cluster sampling*: will be used to select individuals from the studied area, twenty clusters will be selected from Quiza and 10 clusters from Harazat. From each cluster, ten adults are equally divided between males and females, who will be selected randomly and interviewed.
- *Systematic random sample*: will be used to select individuals from families shifted to the lodging houses after the flood.

**Inclusion criteria:**

- Adults (18+ years) who were living in Quiza and Harazat and were present at home at the time of the flood.

**Exclusion criteria:**

- Young individuals.
- Adult individuals who are proven to have previous mental disorders or have been under treatments, which affect the mental ability of the patients.

**Tools of the study:**

The reviewed literature revealed that the PTSS-10 had been used for discovering (PTSD) among people exposed to disasters. The PTSS-10 (Appendix) was originally developed by the Division of Disaster Psychiatry, University of Oslo and the Norwegian Armed Forces Joint Medical Service in Oslo as a clinical screening instrument to identify persons at risk of developing post-traumatic stress reactions, (25).

The questionnaire was translated into Arabic language and back translated to ensure its lexical equivalence. The final Arabic version was reviewed by psychologist to ascertain its face content validity in the Saudi community.

**Data collection:**

Data will be collected from the participants through trained interviewers from 4<sup>th</sup> year students in the Faculty of Arts, King Abdul Aziz University. The researcher will train the students on the skills of interviewing and the completion of the questionnaire.

**Ethical consideration:**

Informed consents from potential participants are considered as a prerequisite for inclusion in the study after informing them of the study's aim and procedures. They will be informed about their rights

to refuse participation or withdraw at any time of the study without giving reasons and with no further consequences. They will be also reassured that all the information collected will be used only for the purpose of this research and would not be used for any other purpose without notifying them. Lastly, ensuring personal confidentiality the questionnaires will be left anonymous, and only code numbers will be used to track each individual participant.

#### Statistical analysis:

Data entry and statistical analysis will be done using SPSS 14.0 statistical software package. Quality control will be done at the stages of coding and data entry. Data will be presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations for quantitative variables. Statistical significance will be considered at p-value <0.05.

#### Information Sources:

##### Previous studies:

There are many studies, which deal with similar subjects:

- **Bussman study (1989)** on the psychological stress during the Red River flood. The study clarified the benefit of predictability in the occurrence of natural disaster in order to save resources by using models.
- **Hobfoll study (1989)** about natural disaster as imminent phenomena, which lead to the loss of resources. The study concentrated on the negative mood and the psychological symptoms affecting the population.
- **Al-Nabulsi study (1991)** on the psychological trauma of war and disaster. The study points out that wars affect several aspects of live, physical, psychological, social.
- **David et al., study (1992)** on the psychological effects among the victims of the shelter after Hurricane Andrew, which struck South Florida. The victims suffered from psychological symptoms as they lost their homes and were living in shelters for four and a half weeks.
- **Al-Saud study (2004)** on the environmental problems in the city of Jeddah confirms that Jeddah is located in the natural basin on the east at the mouths of series of valleys that descend from mountains towards into the sea. Poor sanitation also contributes to the spread of flood water in the streets.
- **Robertson and others study (2005)** on the impact of Hurricane Katrina on the mental health of adolescent offenders. The researchers explained that exposure to multiple traumas are common

among juvenile delinquents. Where used in the study of stress theory to study the effect of shocks. The Hurricane Katrina had negative effects on mental health for adolescent offenders in the state of Mississippi.

- **Al-Zahrani study (1428 / 2006)** in which the risks of floods in Mina have been presented. He suggested many protection ways for pilgrims. Also the natural pathways of water flood were pointed out.
- **Moamen and Solomon study (2007)** aimed to describe the psychological effects of disasters in a sample of victims of the vessel (Al-Salam 98).
- **Moamen and Hashad (2008)** studied the psychological effects of Dahab bombings (2006) in Egypt.

It is clear from the previous review that the previous studies on the impact of disasters are in several countries. However, to the knowledge of the researcher there is no study on the impact of spatial and psychological effects combined in the city of Jeddah.

#### 2. Documentary sources:

They contain the scientific material that have been published about the region from documentary sources such as governmental publications and statistics.

#### 3. Maps and satellite images:

They are an important source of information and have been used largely in this study.

#### 4. Field study:

It is the main source of many data which the study relied upon such as:

- Identifying the exact area of study by using GPS
- Applying the questionnaire for the population affected and non-affected by the disaster.

#### Geographic study of the disaster area:

The city of Jeddah located on the eastern coastal plain of the Red Sea, which represents a natural extension of the coastal plain known as Tahama between latitudes 21° 25', 21° 45' N, and longitudes 39° 5', 39° 20' E. It is bounded by a set the hills from the east, followed by high mountains which are apart from Hijaz mountain range<sup>(25)</sup>.

#### Relief:

Towns and villages are always located near valleys where fresh water and fertile soil are available. In the case of dry valleys in deserts the conditions are changeable as sudden and intensive rainfall collects in their courses and flowingly damage everything. There are hundreds of dry valleys, which descend

from the western highlands of Hijaz into the Red Sea. For example: Wadi Obhour and Wadi Fatima in the area of Jeddah. Water does not run in the courses of these valleys except after heavy rain, so they remain dry for many years. That is why many inexperienced citizens and planners forget the nature of these valleys and its exposure to torrents, so they construct

buildings and roads in them. When torrents occur they destroy and sweep off all these constructions, in addition to the lives of many humans<sup>(26)</sup>.

The main dry valleys (Wadis) which cross the city of Jeddah are from north to south: Obhour, Dgash, Bani Malik, Asher, Goz, Golal and Fatima<sup>(27)</sup>.



Figure (2): Map of the Kingdom of Saudi Arabia showing the location of the studied area. Source: prepared by the researcher

### Valley Paths:

There are three courses of dry valleys which cross the urban area of the city of Jeddah. All of them descend from the eastern mountains of Jeddah and terminate in the Red Sea.

#### The first track:

It extends next to Qweza, east of the highway, which borders the west side of King Abdul-Aziz University and Al-Sulaymaniyah bridge. It passes through the residential area of Qweza crossing under the highway.

The flooding of 2009 destroyed this residential area and the whole district. The flood water continued damaging the walls of King Abdul-Aziz University and also the Sulaymaniyah bridge. The torrent stopped at the Mekka road through the old stadium of Prince Abdallah Feisal.

#### The second Track:

It came from the south through Waziriya district. That is where the disaster has begun. The torrent passed through residential neighborhoods. In this district two tracks of torrents converged causing more damage. The rate of water absorption was not enough

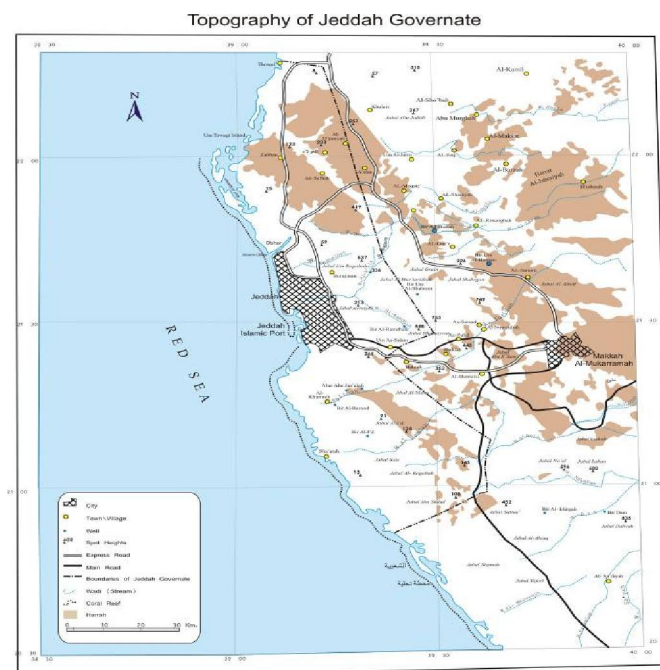
compared to the high water level.

#### The Third and Fourth Track:

They began east of the highway in the middle of Jeddah. The third track starts in a residential area and the water of the torrent arrived at the dam level there, which turned the surface there into a muddy area. The third track runs towards north-west through Rehab district. There it converged with the forth track and they continue their courses towards the west along the Prince Mohammed bin Abdul-Aziz Street (previously called Tahlia). In this location the water stopped, after damaging the residential area, before reaching the sea. The collecting water formed swamps, which attract mosquitoes, flies, and support the emergence of germs and bacteria, which pollute the environment. (Saudi Society for the Environment)

#### Climate:

Jeddah is located within the tropical arid region, where temperature is high throughout the whole year. This region is characterized by scarcity of rainfall and extreme disparity in the amount and timing of rainfall, which concentrates only in one or few hours<sup>(28)</sup>.



Source: Centre for Information Technology in Jeddah Municipality

The climate of Jeddah is influenced by geographical location and high humidity during summer. Temperature reaches more the 40 Celsius in the summer. Rain is rare and scarce.

Lower temperatures in Jeddah are reported in December and January (11.4 Celsius), highest temperatures are reported in June and July (39 Celsius) as in the following table:

Table (1) Mean monthly temperature maximum and minimum (C°) in Jeddah (1985-2008)

Month	Maximum temperature C°	Minimum temperature C°	Range
January	28.8	18.2	10.6
February	29.4	17.9	11.5
March	31.7	19.3	12.4
April	34.8	22	12.8
May	37.3	24	13.3
June	38	24.7	13.3
July	39.4	26.4	13
August	38.7	27.4	11.3
September	37.7	26.4	11.3
October	24	36.6	12.6
November	33.4	22.3	11.1
December	30.6	19.9	10.7

Source: Student work based on data from the Ministry of Defence and Aviation, the General Presidency of Meteorology and Environment Protection.

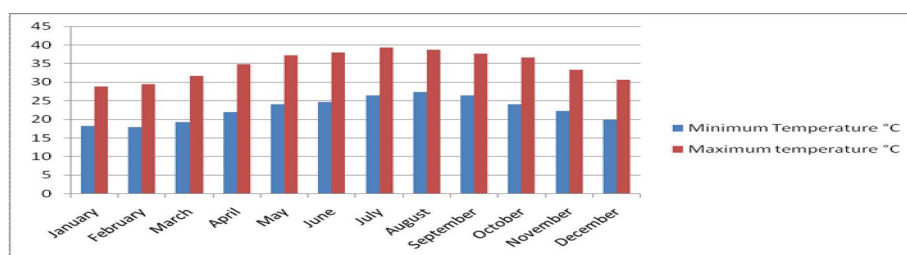


Figure (4): Mean monthly temperature maximum and minimum (C°) in Jeddah (1985-2008)

Source: Student work based on table (1) data



**Table (2):** rainfall in Jeddah (mm) average of the period 1985-2008

Month	Average rainfall
January	10.746
February	2.804
March	3.117
April	3.021
May	0.183
June	0.0
July	0.0
August	0.542
September	0.012
October	1.213
November	24.921
December	10.562

Source: Student work based on data from the Ministry of Defence and Aviation, the General Presidency of Meteorology and Environment Protection.

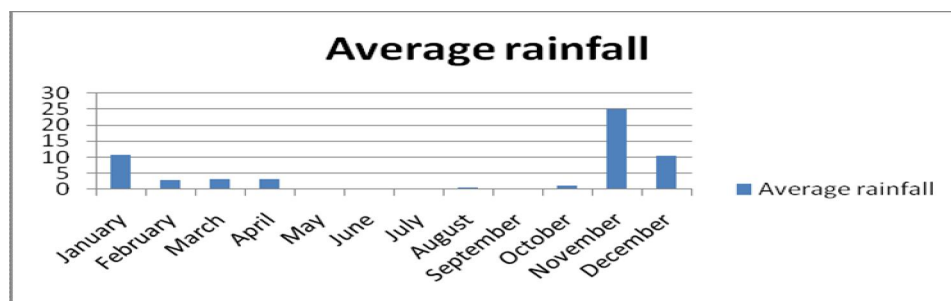


Figure (5) rainfall in Jeddah (mm) average of the period 1985-2008

Source: Student work based on data table 2

### Wind:

The prevailing wind in the city of Jeddah is north-westerly, its speed is usually light to moderate most days of the year. Sometimes as southerly wind blow through spring and fall, temperature rises. The high speed of this wind causes dust storms accompanied by thunderstorms and heavy rain, which result torrents.

### The history of floods in the City of Jeddah:

Jeddah is always exposed to violent torrents because of its location in the arid region and at the foot-slops of Hijaz Mountains. The main floods, which happened in Jeddah, are:

- The floods of 1968, which came from the valleys east of Jeddah and destroyed many constructions as well as the walls of the old airport. However, the built-up area was not as big as the current one.
- The flood of November 1972: the quantity of rain reached 83 mm fell in a short period of time and left its destructive action on the streets of the old districts and formed swamps, which pollute the environment <sup>(29)</sup>.
- Floods of 1979, which were resulted by continuous rain. The water rose in the streets above 1 meter, life ceased for three days.

- Floods of November 1985, which happened after heavy rain over Jeddah and the surrounding area.

### Analysis of the climatic situation in Jeddah 25/11/2009:

Jeddah was exposed to a depression from south-east Jordan that pushed a cold front, causing heavy rain on Wednesday morning. The rain concentrated for a very short period of time (only several hours). The quantity of rain reached about 90 mm in some areas, which formed the dangerous flood.

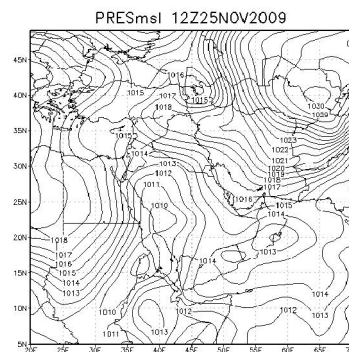
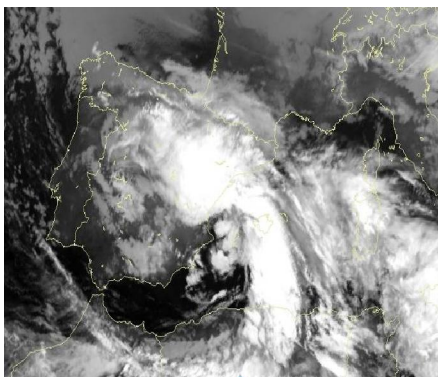


Figure (6): shows the weather forecast for the city of Jeddah on 25/11/2009

Source: <http://forum.arabmms.com/t200265.html>.



Pressure on the Red Sea was very low and it is an extension of a low pressure found on the Caspian Sea. The value of the low pressure was 1010 ms bar, this shows the great depth of the low pressure. (1 bar = 1000 ms bar)

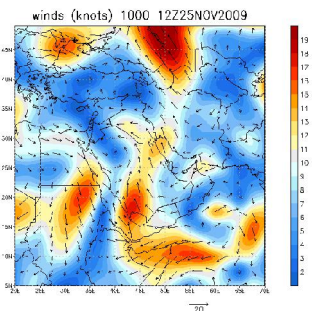


Figure (7): shows the surface winds coming from the east of Jordan.

<http://forum.arab-mms.com/t200265.html>

Referring to the maps, which show the surface wind circulation, there was a cold air mass on south-east Jordan, which came from the west and the north-west. This mass met with a warm humid one, which came from the south-west. These two masses collided near Jeddah and the south-western part of the Arabian Peninsula.

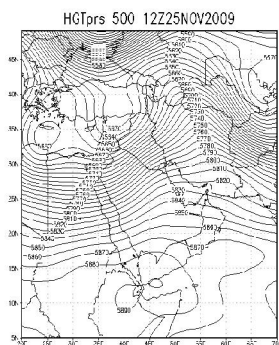


Figure (8): shows the low air coming from the east of Jordan

<http://forum.arab-mms.com/t200265.html>

The collisions of the different masses composed a cold front over south-east Jordan and withdraw clouds and rains from the south. Maturity stages have been observed over Jordan on Tuesday 24.11.2009.

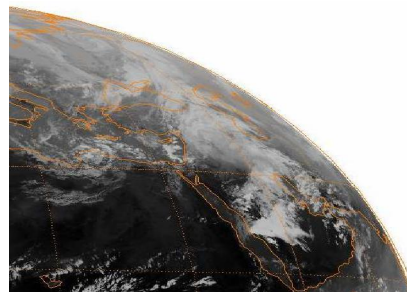


Figure (9): shows the maturity of the low air over Jordan and Syria.

<http://forum.arab-mms.com/t200265.html>

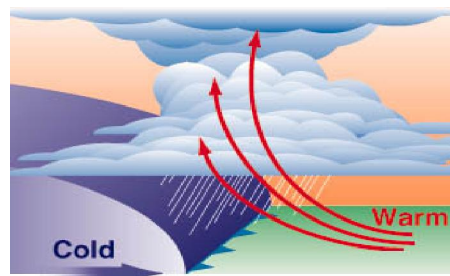


Figure (10): shows the maturity of the low air over Jordan and Syria.

<http://forum.arab-mms.com/t200265.html>

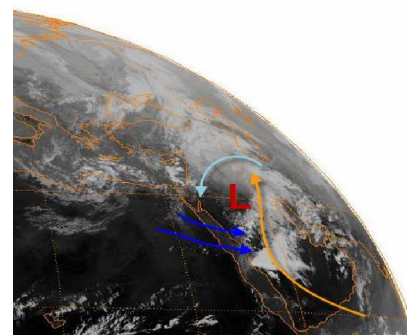


Figure (11): shows the low air and a cold front and warm on the region.

<http://forum.arab-mms.com/t200265.html>

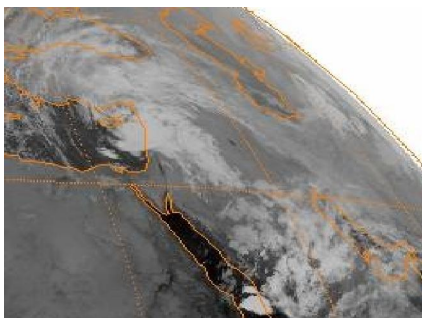


Figure (12): three-dimensional image shows what happened in Jeddah:

Source: <http://forum.arab-mms.com/t200265.htm>

Figure (13): A comparison of maturation of depression on the western Mediterranean and Jordan.

Source: <http://forum.arab-mms.com/t200265.html>

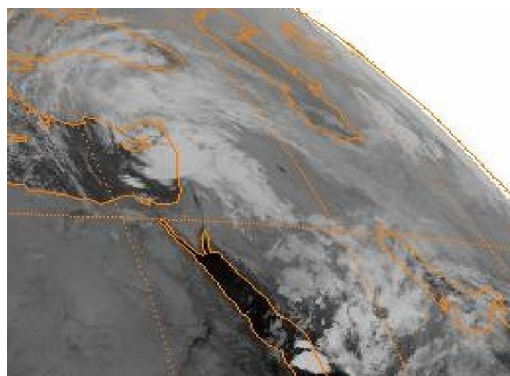


Figure (14): shows the status similar to mature over the Jordan.

<http://forum.arab-mms.com/t200265.html>

## 2. Material and subjects:

The previously mentioned rainfalls are the main cause of the destructive flood in the eastern part of Jeddah. As a natural geographic disaster it has an impact on health and, therefore, can be considered as an example under the field of medical geography. The methods used in the current study will be described in this view.

All population living the south eastern region of Jeddah Governorate in the area covered by the following coordinates who were potentially exposed to the flood disaster were considered as the population of study from which a sample was withdrawn.

39°24'53.707"E 21°32'44.928"N

39°25'25.452"E 21°25'32.385"N

39°13'14.81"E 21°24'46.8"N

39°12'43.566"E 21°31'55.58"N

The inclusion criteria specified adult individuals (18+ years) who were living in Quiza and Harazat

and were present at home at the time of the flood, and we excluded young individuals, and adult individuals who were proven to have previous mental disorders or they were under treatment which are known to affect the mental conditions of the patients.

The sample size was calculated using EPI program version 6.04 based on the following assumptions: the expected frequency of PTSD is 5% (0.05); the worst acceptable frequency is +2% (0.02); the confidence level is set at 95%, and the power is set at 80%. Accordingly, the calculated sample size accounted for 457.

The reviewed literature revealed that the PTSS-10 had been used for discovering Post-Traumatic Stress Disorder (PTSD) among people exposed to disasters. The PTSS-10 (Appendix) was originally developed by the Division of Disaster Psychiatry, University of Oslo and the Norwegian Armed Forces Joint Medical Service in Oslo] as a clinical screening instrument to identify persons at risk of developing post-traumatic stress reactions<sup>(15)</sup>. The people who are exposed to such disasters suffer from many psychological symptoms. These symptoms can be grouped into three categories<sup>(29)</sup>.<sup>(5)</sup>

### 1. Re-experiencing symptoms:

Flashbacks—reliving the trauma over and over, including physical symptoms like a racing heart or sweating, bad dreams and frightening thoughts. Re-experiencing symptoms may cause problems in a person's everyday routine. They can start from the person's own thoughts and feelings. Words, objects, or situations that are reminders of the event can also trigger re-experiencing.

### 2. Avoidance symptoms:-

These are for example: Staying away from places, events, or objects that remind of the experience, feeling emotionally numb, feeling strong guilt, depression, worry, losing interest in activities that were enjoyable in the past and having trouble remembering the dangerous event.

Things that remind a person of the traumatic event can trigger avoidance symptoms. These symptoms may cause a person to change his or her personal routine. For example, after a bad car accident, a person who usually drives may avoid driving or riding in a car.

### 3. Hyper-arousal symptoms:-

Being easily startled, feeling tense or "on edge", having difficulty sleeping, and/or having angry outbursts.

Hyper-arousal symptoms are usually constant, instead of being triggered by things that remind one

of the traumatic event. They can make the person feel stressed and angry. These symptoms may make it hard to do daily tasks, such as sleeping, eating, or concentrating.

It's natural to have some of these symptoms after a dangerous event. Sometimes people have very serious symptoms that go away after a few weeks. This is called acute stress disorder, or ASD. When the symptoms last more than few weeks and become an ongoing problem, they might be PTSD. Some people with PTSD don't show any symptoms for weeks or months.

### 3. Results:

Out of all interviewed individuals (n=450), males constituted slightly more than one half of them 258(57.3%) and the majority were Saudis 367(81.6%). The mean age accounted for  $31.8 \pm 12.8$  years (ranged between 15-85 years), and the married were 248(55.1%). Only 24.9% have university qualifications and 54.4% have jobs. According to the study design, the great majority of the respondents were basically living in houses present along the main stream of the flood, mainly in Qweza 250(55.6%) and Harazat 171(38.%) and only 29(6.4%) were living relatively away from the main stream. The mean number of persons who were

present in a house during the flood accounted for 6 individuals (ranged between 1-21 individuals).

More than one third of the interviewees 162(36%) indicated that they shifted from their homes either to lodging apartments 87(19.3%) or rented new houses away from the disaster scene.

Regarding incidents encountered during the flood, the great majority of the interviewees 416(92.4%) were sight witnesses for the disaster scene, and almost equal percentage 407(90.4%) denoted that they lost some or all of their properties during the flood. One third 146(32.4%) indicated that they had been injured, and 71(28.4%) expressed that one or more members of their families had been injured or being admitted to hospitals, in addition to 194(43.1%) who indicated that one or more of their companions had been injured. Moreover, 71(15.8%) addressed that they lost one or more of their family members, and 191(42.4%) said that they lost one or more of their companions and friends.

The aftermath assessed by the PTSS-10 questionnaire revealed the overall stress disorder mean score among the interviewees accounted for  $3.50 \pm 1.39$  out of 7. The following table describes the mean score for each item included in the questionnaire.

Table (3): Mean scores for items reflecting Post Traumatic Stress Syndrome.

Items	Mean score	SD
Sleep problems	3.80	1.99
Nightmares	3.36	1.93
Depression, feeling dejected/downtrodden	3.59	1.92
Jumpiness, easily frightened by sudden sounds or sudden movements	4.34	1.96
The need to withdraw from others	2.90	1.84
Irritability, easily agitated/annoyed and angry	3.34	1.89
frequent mood swings	3.39	1.90
Bad conscience, blaming self, have guilt feelings	3.13	2.03
fear of places and situations, which remind the disaster scene	4.43	1.93
Muscular tension	2.76	1.83

The table shows that the highest stress score was recorded for the feeling of fear of places and situations which remind the interviewees with the disaster scene ( $4.43 \pm 1.93$ ) followed by feeling jumpiness, easily frightened by sudden sounds or movements ( $4.34 \pm 1.96$ ), and the least score was realized for the muscular tension ( $2.79 \pm 1.83$ ) followed by the perceived need to withdraw from others ( $2.90 \pm 1.84$ ).

Geographically, as displayed in the map illustrated in Figure 1, the mean stress score was found to be significantly higher among those who indicated that they were residents of Queza ( $3.84 \pm 1.36$ ) followed by Harazat ( $3.44 \pm 1.01$ ) which are present along the geographical stream of the flood, if compared to districts adjacent to the stream namely Kilo 14 ( $3.03 \pm 1.36$ )  $p < 0.05$ .



Table (4): Mean stress scores among interviewees according to their demographic characteristics.

Demographic characteristics	Post Disaster Stress score		P value
	Mean	SD	
<b>Gender</b>			
Males	3.62	1.40	0.045
Females	3.35	1.38	
<b>Nationality</b>			
Saudi	3.46	1.42	0.186
Non Saudi	3.69	1.27	
<b>Marital status</b>			
Married	3.49	1.43	0.811
Unmarried	3.52	1.35	
<b>Occupational status</b>			
Has a job	3.67	1.35	0.007
Jobless	3.31	1.42	

The table demonstrates that the mean stress score was significantly higher among males ( $3.62 \pm 1.40$ ) than females ( $3.35 \pm 1.38$ ), and was significantly higher among those who have jobs ( $3.67 \pm 1.35$ ) if compared to the jobless interviewees

( $3.31 \pm 1.42$ )  $p < 0.05$ . On the other hand, it was found that neither nationality nor marital status has significant impact on occurrence of post disaster stress.

Table (5): Mean stress scores among interviewees according to direct exposure and encountering different forms of casualties.

Exposure and casualties	Post Disaster Stress score		P value
	Mean	SD	
<b>Sight witness</b>			
Yes	3.55	1.41	0.001
No	2.93	0.95	
<b>Had been injured</b>			
Yes	3.95	1.34	<0.001
No	3.29	1.37	
<b>Lost family member</b>			
Yes	4.41	1.31	<0.001
No	3.34	1.34	
<b>Injury of family member</b>			
Yes	4.17	1.17	<0.001
No	3.24	1.39	
<b>lost friend or companion</b>			
Yes	3.97	1.16	<0.001
No	3.16	1.45	
<b>Injury of friend or companion</b>			
Yes	3.86	1.17	<0.001
No	3.24	1.49	
<b>Lost properties</b>			
Yes	3.53	1.39	0.213
No	3.25	1.37	

As expected, the table illustrates that the mean stress score was found to be significantly higher among those who were sight witnesses to the disaster scene, those experienced physical injury, loss or injury of one or more of family members, loss or injury of one or more of the friends or companions  $p < 0.05$ . On the other hand, it was noticed that the score of stress was higher among those who lost their properties than those who didn't, however this difference is in not statistically significant.

#### Conclusion and Recommendations:

While it is extremely difficult, if not impossible,

to predict the occurrence of most natural hazards; it is possible to take action before emergency events happen to plan for their occurrence when possible and to mitigate their potential effects putting into consideration the expected scenario of the event. Our study revealed two important issues that would help in the preparedness plan for flood disaster in Jeddah Governorate, first, the anatomy of the expected flood that could be modified through establishment of properly designed underground drainage tunnels leading to the red sea on the western border of the city. Secondly, in addition to the direct effect of the disaster represented by loss of properties and

morbidities that could be ameliorated by compensations and concurrent health services, an overlooked post disaster impact shown as Post Traumatic Stress Disorders should be put in consideration in planning for the comprehensive health services provided to the victims of the flood.

Thirdly, the authorities must prevent the establishment of any buildings, roads or infra-structure along the courses of dry valleys in order to avoid these



Figure (15): The mean stress score in the affected areas

Source: Prepared by the researcher

#### 4. Discussion:

Disasters can strike uncontrollably whenever or wherever, leaving horrendous marks of physical and psychological damage on people upon their passing<sup>(32)</sup>. Jeddah 2009 flood started by heavy rains accumulated on the high mountainous area, present along the eastern border of the Governorate, and it ran along narrow valleys crossing towards the western area. Along its streams it caused remarkable destruction in buildings, infrastructures, properties of individuals in addition to direct morbidities and mortalities. Loss of a dear is considered as one of the triggering situations for depressive disorders<sup>(33)</sup>, this notion support our findings which showed that PTSD was significantly more frequent among those who lost one of their relatives and/or those who lost one of their friend than those who didn't. Moreover, physical injury had been documented to be associated with constellation of symptoms including pain, post traumatic stress disorder (PTSD), and depression<sup>(34-36)</sup>, which explain our findings where it was realized that those who were injured were significantly more likely to acquire PTDS. Fair compensation for the lost assets of victims would make them able to re-establish themselves productively; that would diminish the likelihood for occurrence of massive psychiatric disorders<sup>(37)</sup>. This claim explain our findings where it was found that

there was no significant difference in the occurrence of PTSD between those who lost and those who didn't lose their properties. In general and as expected, the nearer to stream of the flood the more exposure to its destructive effect, therefore, it was remarked that the frequency of PTSD was significantly higher among those who indicated that they were living very near to the flood stream and those who were sight witnesses for the scene and those who were shifted to lodging houses if compared to those who were relatively away from the flood stream.

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#### References :

1. The World Bank Natural Disaster Hotspots(2005). A Global Risk Analysis. Disaster Risk Management;5.
2. El Morjani ZA, Ebener S, Boos J, Abdel GE, Musani A(2007). Modelling the spatial distribution of five natural hazards in the context of the WHO/EMRO Atlas of Disaster Risk as a step towards the reduction of the health impact related to disasters. Int J Health Geogr;6:8.
3. Pelling M(2004). Visions of Risk: A Review of International Indicators of Disaster Risk and its Management. A report for the ISDR Inter-Agency Task force on Disaster Reduction - Working Group 3: Risk. Vulnerability and Disaster Impact Assessment.
4. Esmali A, Ahmadi H(2003). Using GIS & RS in mass movements hazard zonation - a case study in Germichay Watershed, Ardebil, Iran. Proceeding of the Map Asia conference: 2003; Kuala Lumpur, Malaysia.
5. Tangestani MH(2003). Landslide susceptibility mapping using the fuzzy gamma operation in a GIS, Kakan catchment area, Iran. Proceeding of the Map India conference: 28-31 January 2003; New Delhi, India.
6. Al-Rawas G, Koch M, El-Baz F(2001). Using GIS for Flash Flood Hazard Mapping in Oman. Earth Observation Magazine;10:18-20.
7. Geographic Information Science and Technology(2011). Landscan database. <http://www.ornl.gov/sci/landscan/>.
8. Gridded population of the World(2011). <http://sedac.ciesin.columbia.edu/gpw/>.
9. Meade MS, Erickson RJ(2000). Medical Geography. New York : The Guilford.

10. Jones L, McDaniel A (2006). From the second line The Katrina Writing Project. New Orleans, LA.
11. Hunter LM (2005). Migration and environmental hazards. *Population & Environment*; 26(4):-273.
12. Fullilove MT (1996). Psychiatric implications of displacement: Contributions from the psychology of place. *The American Journal of Psychiatry*; 153:1516-23.
13. Kraemer B, Wittmann L, Jenewein J, Schnyder U (2009). 2004 Tsunami: long-term psychological consequences for Swiss tourists in the area at the time of the disaster. *Aust N Z J Psychiatry* May;43(5):420-5.
14. Hu SH, Xu Y (2008). [Post-disaster psychological crisis intervention]. *Zhonghua Yu Fang Yi Xue Za Zhi* Nov;42(11):782-5.
15. Kraemer B, Wittmann L, Jenewein J, Schnyder U (2009). 2004 Tsunami: long-term psychological consequences for Swiss tourists in the area at the time of the disaster. *Aust N Z J Psychiatry* May; 43(5):420-5.
16. Hu SH, Xu Y. (2008). [Post-disaster psychological crisis intervention]. *Zhonghua Yu Fang Yi Xue Za Zhi* Nov; 42(11):782-5.
17. The Kraemer B, Wittmann L, Jenewein J, Schnyder U. (2009).
18. Carroll B, Morbey H, Balogh R, Araoz G (2009). Flooded homes, broken bonds, the meaning of home, psychological processes and their impact on psychological health in a disaster. *Health Place* Jun; 15(2):540-7.
19. Lalande G, Maltais D, Robichaud S (2000). [Disaster victims of the 1996 Saguenay floods: problems experienced and psychological consequences.]. *Sante Ment Que*;25(1):95-115.
20. Carroll B, Morbey H, Balogh R, Araoz G, 2009.
21. Ibid Ibid Alahidb, Ibrahim bin Sulaiman (1420/2000) natural hazards in Saudi Arabia and how to confront, Edition 2, (in Arabic).
22. Ibid. American Psychiatric Association(1994). *Diagnostic and Statistical Manual of Mental Disorders*. Fourth edition. Washington DC, American Psychiatric Association.
23. Hamdan, Fatima Abdul Aziz (1990) *The city of Jiddah construction site environment of the population*, Edition 1, Jeddah, Dar community for publication and distribution. (in Arabic).
24. Ibid Ibid Alahidb, Ibrahim bin Sulaiman (1420/2000). Title, Journal, volume:pages?
25. Hamdan, Fatima Abdul Aziz (1990). Title, Journal, volume:pages?
26. Alahidb, Ibrahim bin Sulaiman, (1420/2000). Title, Journal, volume:pages?
27. Bae J, Kim KY, Panuncio RL, Choi N, Im SB(2009). Inauguration of the first Psychological Support Center for disaster victims in Korea. *Nurs Health Sci* Dec; 11(4):351-6.
28. Kokras N, Kouzoupis AV, Paparrigopoulos T, Ferentinos P, Karamanakis P, Kontoyannis DA, *et al.* (2011). Predicting insomnia in medical wards: the effect of anxiety, depression and admission diagnosis. *Gen Hosp Psychiatry* Jan;33(1):78-81.
29. Turner AP, Jakupcak M (2010). Behavioral activation for treatment of PTSD and depression in an Iraqi combat veteran with multiple physical injuries. *Behav Cogn Psychother* May;38(3):355-61.
30. Wang J, Yang FD, Sun CY (2008). [The analysis of depression, anxiety and sleep disorder in earthquake-related injuries]. *Zhonghua Nei Ke Za Zhi* Sep; 47(9):721-2.
31. Wang CH, Tsay SL, Bond AE (2005). Post-traumatic stress disorder, depression, anxiety and quality of life in patients with traffic-related injuries. *J Adv Nurs* Oct; 52(1):22-30.
32. Cernea M(1999). "Why Economic Analysis is Essential to Resettlement: A Sociologist's View". *The Economics of Involuntary Resettlement*: (Washington, DC: World Bank).
33. Alahidb, Ibrahim bin Sulaiman, (1419/1999), *Natural Disasters and how to confront*. Journal, volume:pages????
34. Thabati, A. bin Saad (1427/2007), *Facing the Floods*, 1<sup>st</sup> Edit., Mecca, (in Arabic)
35. -----, (2007), *Disasters*, Mecca, (in Arabic).
36. Zamkka, A. A. (1420/2000), *Social and Economic Factors for the Variation in Residential Neighbourhoods*, M.A. Thesis, King Abdul-Aziz University, Jeddah.
37. Zamzami, Izdehar Ahmed (1999). *Social and Economics Factors and their Relation to Public Health and Disease Issues in Saudi Society*, M.A., King Abdul-Aziz University, (in Arabic).
38. Al-Zahrani, Afrah b. A. (2008). *Flood Hazards and the Safety of Pilgrims in Mina*, M.A., King Abdul-Aziz University, (in Arabic).
39. Mahsoub, M. S., Arbab, M.I. (2002). *Natural Hazards, its Confrontation, geographical study*, Cairo, Dar Al-Arab, (in Arabic).

#### Internet Websites:

- <http://www.daliamoemen.net/researchs/arabic-abstracts/-5>
- <http://www.daliamoemen.net/researchs/arabic-abstracts/-----98>

- <http://www.okaz.com.sa/new/Issues/20100319/index.htm>
- <http://www.al-madina.com/>
- [www.saudigis.org/FCKFiles/File/...2009/.../20\\_AmalSheikh\\_KSA.doc](http://www.saudigis.org/FCKFiles/File/...2009/.../20_AmalSheikh_KSA.doc)
- <http://www3.interscience.wiley.com/journal/121537879/abstract?CRETRY=1&SRETRY=0>

- <http://www3.interscience.wiley.com/journal/121537883/abstract>

12/30/2012