

# Determining the Types of Diseases and Emergency Issues in Pilgrims During Hajj: A Literature Review

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**Abstract—Introduction:** Every year 2-3 million pilgrims with different background and most of them are elderly from 184 countries in the world congregate in the holy place ‘Haram’ at Makkah in Saudi Arabia to perform Hajj. During the pilgrimage, they come across a great deal of rough and tough environment, physical hassle and mental stress. Due to the hardship of travel, fluctuation of weather, continuous walking during religious rites at specific time and sites, many pilgrims injury, feel tired, sick, and exhausted. These may also create complications and overburden the physiological functions including heart, chest, abdominal, and kidney of those who suffer from chronic diseases. Besides the problem of diseases, crowds could cause some other significant problems including missing and lost pilgrims, injuries, and even death. **Objective:** To determine the common health problems e.g. diseases and emergency incidents encountered by pilgrims during Hajj was the main objective of this study. **Methods:** An extensive literature review to determine the common health problems and emergency incidents during Hajj was conducted through a systematic literature review. Numerous scholarly databases were used to search for articles published related to health problems and emergency incidents during Hajj from 2008 to 2016. Eligible articles included case reports, experimental and non-experimental studies. Only thirty articles out of two hundred and sixty articles had met the specific inclusion criteria. **Results:** The analysis revealed that respiratory diseases include pneumonia, influenza, and asthma (73.33%) were the main health problems encountered by the pilgrims during Hajj followed by heat stroke or heat attack, sunlight effects (16.67%), cardiovascular disease, heart disease (10%). The analysis also revealed that emergency incidents include traffic accidents, and trauma was 3.33%. Notwithstanding the information given above, according to the analysis, the common health problems during Hajj are mainly divided into two categories: non-communicable diseases (62.5%) and communicable diseases (37.5%). IBM’s statistical package for the social sciences (SPSS) version 22 was used to analysis the result. **Conclusion:** Both communicable and non-communicable health issues are the most common health problems encountered by pilgrims during Hajj. But, due to lack of existing studies associated with this research area, a definite conclusion could not be made. However, our findings demonstrated the necessity of new research to find solutions to pilgrims’ health problems during Hajj.

**Keywords—Hajj; pilgrims; health; communicable diseases; non-communicable diseases; emergency**

## I. INTRODUCTION

The largest yearly religious mass gathering worldwide is the Hajj, one of the obligatory five pillars of Islam. Every year during Hajj event an amount of 2-3 million pilgrims and a total of 10 million pilgrims for Hajj and Umrah from 184 countries congregate in Makkah, Saudi Arabia [1, 2, 3, 4]. The number of Hajj pilgrims has increased rapidly from 58, 584 in 1920 to 20, 00,000 (approx) in 2015 where 13, 84, 931 attended from outside Saudi Arabia. During the last 95 years, the increase rate of foreign pilgrims is 3.5, and the reason is a nonstop expansion of the Grand Mosque at Ka’aba in Makkah [5]. The following Fig. 1 shows the number of pilgrims attending the Hajj during the year 2006-2015. Data were retrieved from the official portal of the royal embassy of Saudi Arabia, Saudi Ministry of Hajj, and central department of statistics and information [5, 6, 7].

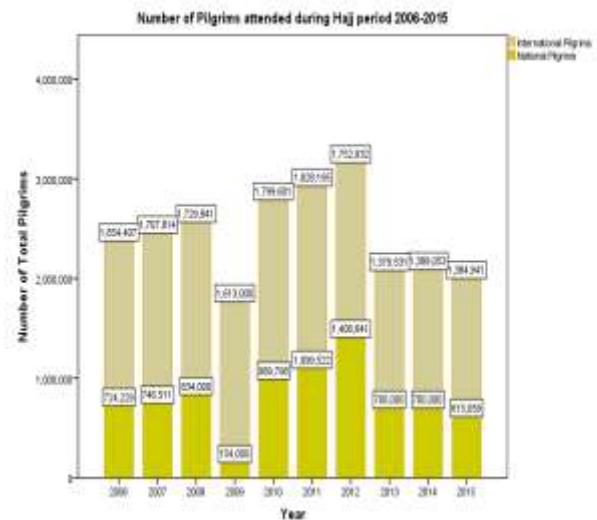


Fig. 1. Statistics of number of pilgrims performed Hajj during the year 2006-2016

Hajj is a dynamic system to appreciate fully the physical dimensions of it which imply movement and travel. Walking Hajj distance: from Kaaba to Mina: 8 km, from Mina to Arafat: 13 km, Arafat to Muzdalifah: 13 km, Muzdalifah to

Mina: 2 km, Mina to Jamarat Akabah: 3.8 km. Makkah to Madina 450 km. On arrival, the pilgrims must don the Ihram and circumambulate the Ka'ba seven times and then perform the Saa'y seven times between the hills Safa and Marwah, a total distance 3.5 km. Crowd densities can increase to seven individuals per m<sup>2</sup> during Hajj. Overcrowding is one of the major problems since the area is limited and the numbers are increasing annually. The area of pilgrimage rites is a sandy valley embraced by rugged sun-baked mountains. In Makkah, especially during the hot months of May to September the temperature ranges between 38°C and 50°C with a relative humidity of 25% to 50% [8]. This kind of hot environment with high radiant heat favors the development of heat illnesses e.g. heat exhaustion, heat stroke, unintentional physical injuries, and respiratory illnesses, dehydration called as non-communicable diseases or problems [9].

The imminence between pilgrims due to the packed and crowded accommodation, congregation, and prayers creates an ideal atmosphere for spread and transmission of infectious diseases. Influenza, influenza-like illness, meningococcal disease, viral hemorrhagic fevers, yellow fever, cholera, polio, plague, tuberculosis and gastrointestinal infections, foodborne diseases e.g. diarrhea, food poisoning, etc. are examples of communicable diseases [10, 11, 12, 13]. Due to the physical exertion and overcrowding situation, some pre-existing chronic diseases such as asthma, heart disease, chronic chest conditions, diabetes, renal and liver disease may become harmful for pilgrims especially elderly which eventually favors the spread of communicable namely non-chronic diseases or infectious disease [14].

According to the findings, respiratory diseases includes pneumonia, influenza, and asthma 73.33% were the main health problems encountered by the pilgrims during Hajj followed by heat stroke/ attack, sunlight effects 16.67%, diabetic/ diabetes mellitus 13.33%. Cardiovascular disease, heart disease 10%, hypertension 6.67%, dehydration 6.67%, musculoskeletal 6.67%, urinary tract problems 3.33%, meningococcal disease 3.33%, diarrhea and jaundice 3.33%, finally, traffic accidents and trauma 3.33%. According to the studies, the pilgrims encountered 62.5% non-communicable diseases and problems along with 37.5% communicable diseases during Hajj. To determine the common health problems e.g. diseases and emergency incidents encountered by pilgrims during Hajj was the primary objective of this study. Hence, the result from this study could be beneficial in initiating, planning and design the appropriate healthcare system to prevent diseases and emergency situations encountered by Hajj pilgrims.

## II. SEARCH STRATEGY AND SELECTION CRITERIA

The Lancet, IEEE Explore, MedLine, EBSCO Host, PubMed, Google Scholar, Science Direct, the Elsevier (Scopus), Academic search complete, Springer Link, ACM digital library, Emerald Insight, Taylors and Francis and Wiley database were used to search for articles published related to health problems and emergency incidents during Hajj from 2008 to 2016. The majority of related articles were published in various prominent journals around the world where most of the studies were carried in Saudi Arabia, Iran,

France, United Kingdom, Malaysia, and Pakistan. Finally, we accessed official Saudi governmental statistics, with a particular emphasis on data from the Saudi Ministry of Health and Saudi Ministry of Hajj and Umrah. The combinations of specific keywords were utilized to retrieve the articles including pilgrims, Hajj, Diseases, healthcare, health problem, medical, medicine, overcrowd, emergency incidents, health pattern. Only thirty studies had met the specific inclusion criteria: the subjects were Hajj, pilgrims, health, crowd, emergency; the type of study was experimental or non-experimental study; available full article in English. The research was conducted to find the answers to these questions e.g. What are the major diseases do the pilgrims carry and suffering? What are the reasons behind emergency incidents during Hajj? What are the emergency incidents occur during Hajj? Fig. 2 illustrates the search strategy as depicted. This paper is organized as, Section II: Search strategy and selection criteria; Section III: Data collection and analysis; Section IV: Analyzing the result; Section V: Discussion of the research; and Section VI: Conclusion.

## III. DATA COLLECTION AND ANALYSIS

Items and their distributions of all respondents in the studies chosen were well briefed and summarized according to the author, and year. Meanwhile, the subsequent information gathered were objective, study design, the pattern of health problems and emergency situations, analyzing of the result and discussion of research shown in Table I. Table I tabulated all the information from selected articles.

## IV. ANALYSING THE RESULT

Universally, elderly pilgrims were vulnerable to get the infection due to decreased rate of immune responses which is actively provoked by other factors such as hard work, lack of sleep and disturbances in the dietary schedule, and mental stress. Main reasons for infectious disease transmission due to airborne agents and pilgrims health hazards; especially injuries, trauma, etc. are extended stays at Hajj sites, and physical exhaustion, extreme heat, and crowded accommodation [15]. The most feared trauma hazard during Hajj is stampede causing huge casualties. Chronicle of Hajj disasters as depicted in Table II, where data retrieved from the official portal of the embassy of Saudi Arabia, Saudi Ministry of Hajj, and central department of statistics and information [5, 6, and 7]. Hajjis face multiple health issues like extreme temperatures, intravascular volume and electrolytes disturbances which also increases the risk of communicable and non-communicable diseases, where Hajj pilgrims encounter a great deal of tough physical and mental stress [16].

Some studies related to the current health and diseases situation during Hajj spotted that, one in three pilgrims experiences such respiratory symptoms [17]. Congestion and close contact stimulate the spread of infection especially upper respiratory tract infections URTIs followed by diseases of the skin, GIT, rheumatology [18, 19], and URTIs as reported among the most common cause of illness among Iranian pilgrims [20]. Other hazards include traffic accidents and fire injuries are reported in the literature [21]. Due to the hazards like accidents, overcrowding situation, and human jam many

pilgrims divert from their groups and get lost, where pilgrims gathering.  
are walking shoulder to shoulder in such massive Hajj

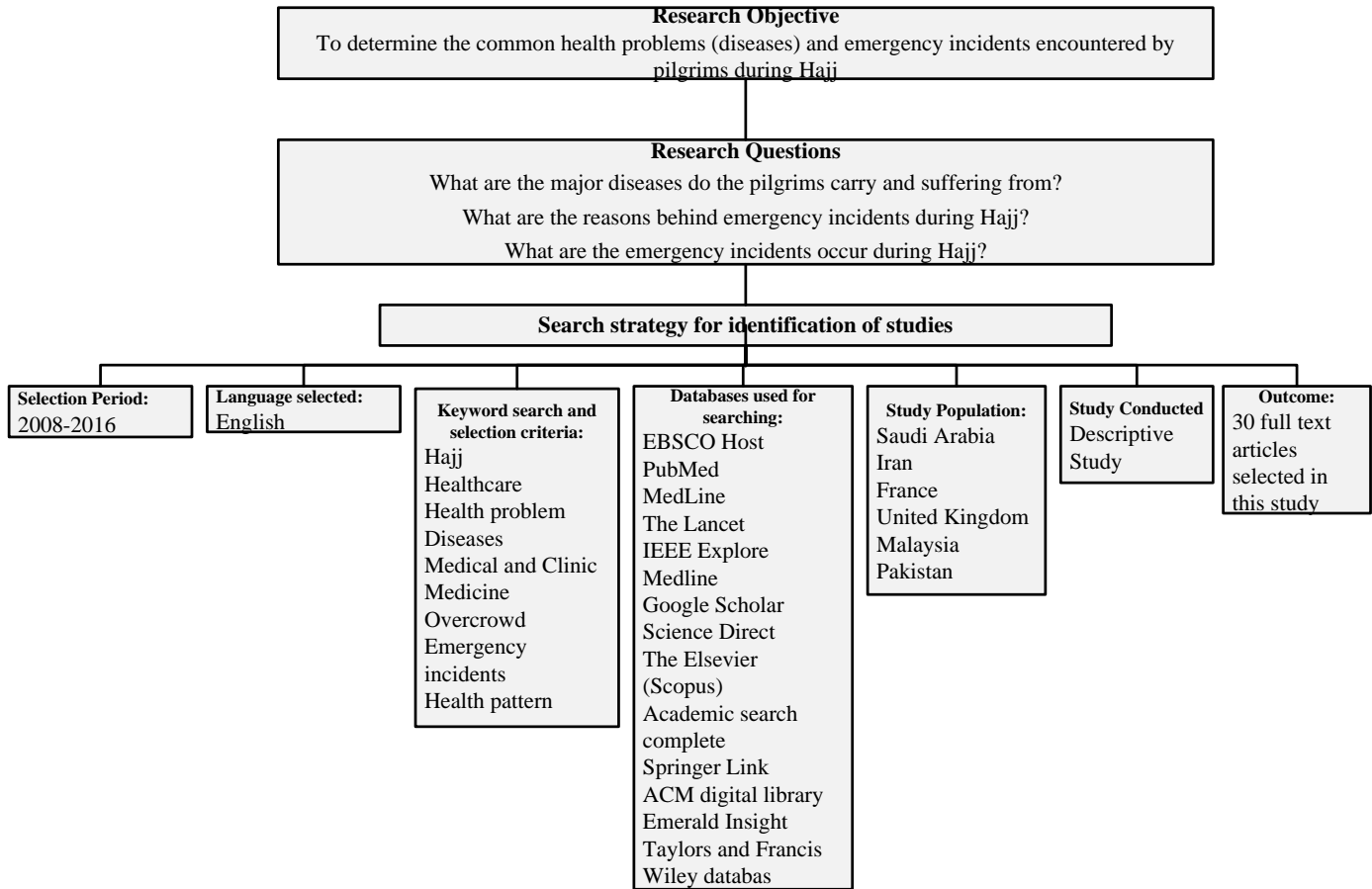


Fig. 2. Flow of the search strategy

TABLE I. EXPERIMENTAL STUDY ON THE BASED ON PILGRIMS' HEALTH PROBLEMS AND EMERGENCY INCIDENTS DURING HAJJ

Research Author, Year [Ref]	Objectives	Method	Result and Discussion
Memish et al. (2016) [22]	Hajj health services emerged as an ad-hoc activity to treat ailing pilgrims which are subject to consultation with global stakeholders for compliance with the International Health Regulations.	Comparative study	Emphasized on non-communicable diseases (NCDs) prevention
Bader et al. (2016) [23]	Clinical pattern of pneumonia during the Hajj period 2004-2013	A retrospective cohort analysis	The mortality rate in the intensive care unit-ICU was 21.45%, while the rate in the ward was 2.4%.
Murtaza et al. (2015)	Pattern of diseases among pilgrims seeking medical	Observational study	Respiratory diseases 52.5%, musculoskeletal

[24]	services		29.6%, skin 5.9%, cardiovascular 2.9%, urinary tract problems 2.3%, diabetic 17.9% and 26.4% hypertensive.
Sindy et al. (2015) [25]	To assess the pattern of patients and illnesses encountered at one health facility at Arafat during Hajj 2013 where acute severe asthma and injuries were the major problems encountered	Cross-sectional study	Bronchial Asthma 34%, Injuries 16%, Diabetes Mellitus 10.4%, Heat effects 6.6%, Hypertension 6.6%, Gastroenteritis 6.63% Dehydration 5.69%
Habsah et al. (2015) [26]	Determining the consequence of influenza vaccination alongside acute respiratory illness amongst Malaysian Hajj pilgrims	Observational cohort study	Respiratory illness was a major problem and caused high hospital admission during Hajj seasons.
Abdulrahman et al. (2015)	Evaluating the diseases pattern among pilgrims during the Hajj	Cross sectional study	Respiratory problems 17.6%, skin diseases 15.7%,

[27]	season 2013		gastrointestinal tract (GIT) diseases 13.2%
Nurul et al. (2014) [28]	Overcrowding, extreme temperatures, and electrolytes imbalance are common among pilgrims. These factors trigger the increased risk for the communicable and non-communicable disease.	Cross-sectional study	The analysis revealed that respiratory diseases 76.2% was the main health problem followed by skin disease 7.4%, meningococcal disease 3.7% and heat stroke 3.7%.
Memish et al. (2014) [29]	Infectious disease surveillance during Hajj 2012 and 2013	Descriptive study	Report showed that infectious diseases posed the major threat among pilgrims
Habida et al. (2014) [30]	Need for equal attention on infectious and non-communicable diseases during Hajj	Comparative study	The majority about 60% of pilgrims participating in the Hajj are elderly with preexisting chronic conditions. Mental stress, overcrowded conditions, extreme heat and sunlight leading to heat cramps, heat exhaustion, heat stroke, and dehydration which ultimately favors spreading infectious diseases.
Osamah et al. (2014) [31]	The attack rate of influenza-like illnesses due to respiratory viruses among the pilgrims from Saudi Arabia, Australia, and Qatar during Hajj 2013	Cross-sectional study	11 % pilgrims had influenza, where rhinovirus was the commonest cause 28%.
Samir et al. (2014) [32]	Specimen of France pilgrims during Hajj 2013 were tested for respiratory viruses and bacteria	Prospective cohort study	Rhinovirus (14.0%), coronavirus E229 (12.4%), and influenza A (H3N2) virus (6.2%)
Samir et al. (2013) [33]	Identifying the pattern of at least 11 respiratory viruses during Hajj 2012 among the pilgrims of France	Prospective cohort study	38.6% pilgrims were affected by different respiratory viruses including rhinovirus, adenovirus, influenza B, and enterovirus
Tawfiq et al. (2013) [34]	Causes of respiratory tract infection during Hajj	Cross-sectional study	The most common respiratory tract viruses are influenza and rhinovirus. Pneumonia is a significant cause of an admission

			accounting for 25-50% of such admission.
Abdullah et al. (2012) [35]	Establishing a pragmatic system to manage the challenge of cardiovascular morbidities and mortality during Hajj.	Cross-sectional study	Most significant causes of death during 2002 Hajj was cardiovascular diseases (with hypertension) 45.8%, followed by respiratory and cardiac system failure 14.3%, traffic accidents and other traumas 6.4%
Alzahrani et al. (2012) [36]	Seeking medical services for pilgrims suffering from various diseases.	Descriptive study	Respiratory diseases 60.8%, musculoskeletal 17.6%, skin disease 15.0% and gastrointestinal 13.1%.
Mandourah et al. (2012) [37]	Determining diseases among hospitals providing medical care to Hajj pilgrims.	Prospective cohort study.	Pneumonia was the primary cause of critical illness 27.2%
Memish et al. (2012) [38]	The occurrence of different respiratory viruses among healthcare worker during Hajj event. Pilgrims' attendance at the Hajj was proportional to the increase of acquiring influenza.	Cross-sectional study	Rhinoviruses and Coronaviruses 229E were detected during the study. Influenza A 0.1-0.2%
Moattari et al. (2012) [39]	Seasonal and pandemic influenza attack rate among returning Iranian pilgrims after the 2009 Hajj.	Cross-sectional study	By virus culture, it was recorded that about 9.1% pilgrims had influenza
Almalki et al. (2012) [40]	Estimating the frequency of the cardiovascular diseases during Hajj 2011	Descriptive study	Ischemic heart disease 34%, elevated blood pressure 20% and stroke 17%
Ziyaeyan et al. (2012) [41]	The occurrence of A (H1N1) among returning Iranian pilgrims.	Cross-sectional study	Influenza A (1.6%)
Saeed et al. (2012) [42]	The prevalence of three symptoms of interest diarrhea, acute respiratory infection and jaundice among Afghanistan Hajjis during Hajj 2010	Cross-sectional Study	Diarrhea and jaundice remained constant, but Acute respiratory infection 1.4% at pre-transit to 4% at transit area and 37% during Hajj.
Ashgar et al. (2011) [43]	Find the common causes of bacterial pneumonia during the 2005 Hajj season.	Cross-sectional study	Clinically suspected pneumonia 53.9% were confirmed positive.

Mimish et al. (2011) [44]	Electrocardiographic (ECG) changes in exposed to high outdoor temperature 45-degree centigrade, humidity approaching 80% with heat stroke and heat exhaustion.	Case-control study	Sinus tachycardia and ischemic changes.
Mirza et al. (2011) [45]	Predictors of asthma exacerbations during the Hajj.	Cohort study.	46.6% suffered from mild asthma attack, and 31% suffered from moderate asthma attack
Zakuan et al. (2010) [46]	The relationship between pre-morbid conditions and influenza-like illness (ILI) among Malaysian pilgrims during Hajj 2007	Cross-sectional study	Underlying asthma was significantly associated with severe ILI, e.g. a sore throat, longer duration of a cough, runny nose (p=0.016) and the Pilgrims who suffered from chronic obstructive pulmonary diseases (COPD), diabetes mellitus and respiratory problem.
Alborzi et al. (2009) [47]	Incidence of the common respiratory viruses among Iranian pilgrims during Hajj 2006	Cross-sectional study	The rates of different types of respiratory virus infections: influenza (9.8%), parainfluenza (7.4%), adenovirus (5.4%) and RSV (1.4%). Where Viral agents (25%) of nasal specimens
Gautret et al. (2009) [48]	The incidence of a febrile cough among French pilgrims during Hajj.	Prospective cohort study	Diabetes mellitus 22.8%, Hypertension 25.3
Gautret et al. (2009) [49]	Investigate prospectively the occurrence of common health hazard in French pilgrims during Hajj 2007	Prospective cohort study	Cough 51%, followed by a headache, heat stress, and fever
Rashid et al. (2008) [50]	Burden of influenza and RSV in asymptomatic British pilgrims during Hajj	Cross-sectional study	Influenza or RSV with 18%
Rashid et al. (2008) [51]	Rates of various influenza virus infections among the UK and Saudi pilgrims during Hajj.	Comparative study	25% the UK and Saudi pilgrims

A total of 30 studies related to communicable diseases or infectious diseases and non-communicable diseases/ problems or chronic diseases were used for analyzing the result. Regarding the study design of the selected articles; most of the studies were based on cross-sectional studies 46.67%, prospective cohort study 16.67%, descriptive study 10%, comparative study 6.67%, retrospective cohort analysis 3.33%, comparative study 3.33%, case-control study 3.33%, and Cohort study 3.33% as depicted in Fig. 3. Different types of instruments were used in the quantitative studies.

TABLE II. CHRONICLE OF DISASTER: 1990-2015

1990: 1426 pilgrims killed by stampede/asphyxiation in tunnel leading to holy sites
1994: 270 killed in a stampede
1997: 343 pilgrims died and 1500 injured in a fire
1998: 119 pilgrims died in a stampede
2001: 35 pilgrims died in a stampede
2003: 14 pilgrims died in a stampede
2004: 251 pilgrims died in a stampede
2006: 76 pilgrims died after a hotel housing pilgrims collapsed; a stampede wounded 289, killing 380
2015: 4173 pilgrims died in a stampede

Experimental studies based on pilgrims' health problems and emergency incidents during Hajj

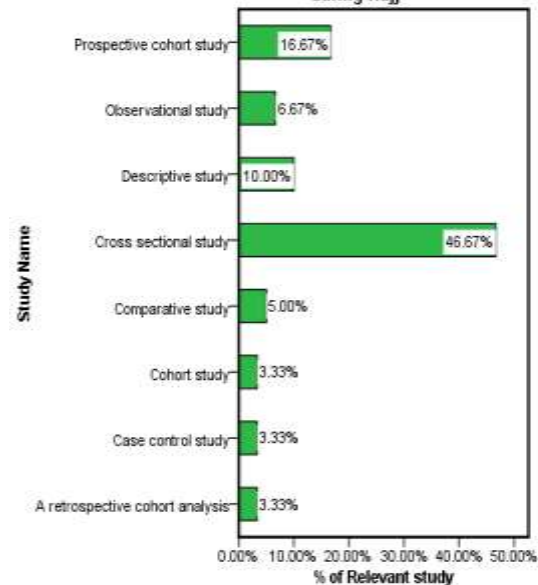


Fig. 3. Percentage of studies based on pilgrims' health problems and emergency incidents during Hajj

Out of 30 selected studies, 22 articles had concluded that respiratory diseases include pneumonia, influenza, and asthma 73.33% were the main health problems encountered by the pilgrims during Hajj as presented in Table III and Fig. 4. The above findings followed by heat stroke/ attack, sunlight effects 16.67%, diabetic/ diabetes mellitus 13.33%, cardiovascular disease, heart disease 10%, hypertension 6.67%, dehydration 6.67%, musculoskeletal 6.67%, urinary tract problems 3.33%, meningococcal disease 3.33%, diarrhea and jaundice 3.33%, finally, traffic accidents and trauma 3.33%.

TABLE III. MAJOR HEALTH PROBLEMS ENCOUNTERED BY PILGRIMS ACCORDING TO THE STUDIES AND CATEGORIZATION OF DISEASES

Diseases name, major health problems	Number of studies	Percentage of health problems	Category based on Communicable Diseases (CD)/problems-Chronic, Non-Communicable Diseases(NCD)-Infectious
Respiratory disease includes asthma, influenza, pneumonia	[23] [24] [26] [27] [28] [31] [32] [33] [34] [35] [36] [37] [38] [39][41][42] [43][45] [46] [47][50] [51]	22 of 30, 73.33%	Both CD-Infectious (Influenza, Pneumonia), NCD-Chronic (Asthma)
Various communicable diseases	[22]	3.33%	NCD-Chronic
Various infectious disease	[29]	3.33%	CD-Infectious
Cardiovascular disease, heart disease	[24] [35] [40]	10%	NCD-Chronic
Urinary tract problems	[24]	3.33%	CD-Infectious
Skin problem	[24] [27] [28] [36]	13.33%	CD-Infectious
Heat stroke/ attack, Sunlight effects	[25] [28] [30] [44] [49]	16.67%	NCD-Chronic
Diabetic/ diabetes mellitus	[24] [25] [26] [48]	13.32%	NCD-Chronic
Hypertension	[25] [48]	6.67%	NCD-Chronic
Gastroenteritis	[25] [27] [36]	10%	NCD-Chronic
Dehydration	[25] [30]	6.67%	NCD-Chronic
Meningococcal disease	[28]	3.33%	CD-Infectious
Musculoskeletal	[24] [36]	6.67%	NCD-Chronic
Diarrhea and jaundice	[42]	3.33%	CD-Infectious
Traffic accidents and Trauma	[35]	3.33%	NCD-Chronic

Health problems or diseases are categorized into two main classes, namely communicable or infectious diseases and non-communicable or chronic diseases. According to the studies, as shown earlier in Table I and Table III, 62.5% are non-communicable diseases and 37.5% are communicable diseases, as shown in Fig. 5, encountered by the pilgrims during Hajj.

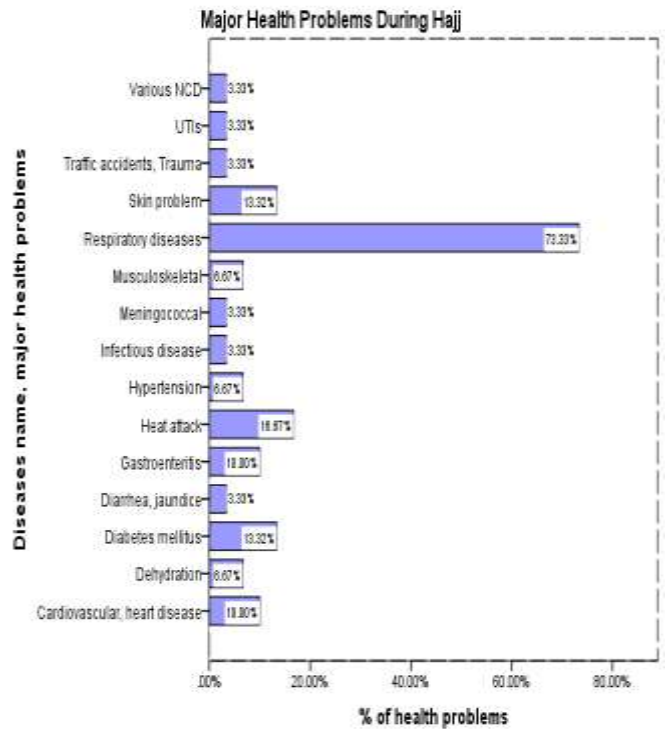


Fig. 4. Percentage of studies according to major health problems

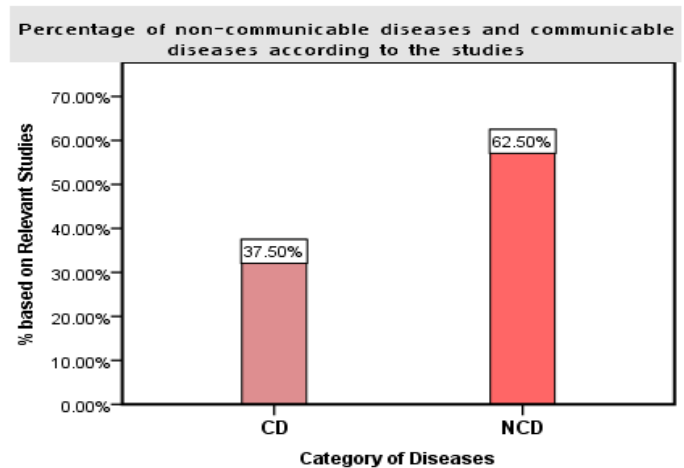


Fig. 5. Percentage of non-communicable diseases and communicable diseases according to the studies

## V. DISCUSSION OF THE RESEARCH

This concise review is intended to present a structured analysis of published articles of health problems and emergency situation over the past ten years with regards to Hajj pilgrim. Health problems and their challenges for pilgrims during the pilgrimage, related outcomes, and suggestions for future investigators are highlighted in this study.

**Respiratory Tract Infections** were considered as the predominant clinical health patterns which encountered by Hajj pilgrims. It continues to be the increasing burden of diseases among Hajj pilgrims, but there is still a lack of studies being conducted to overcome these problems. Researchers had identified respiratory diseases as the most common cause of hospital admission (52.5%) during Hajj, with pneumonia being the leading reason for hospitalization. A prospective study was conducted in two different hospitals during Hajj 2011 [24]. The overall mortality rate in the ward among pilgrims with pneumonia was 2.4% and in the ICU was 21.45% during Hajj period 2004-2013 which is similar to the mortality rates in West [23]. Out of 30 selected studies, 22 of articles had concluded that respiratory diseases includes pneumonia, influenza and asthma 73.33% were the main health problems encountered by the pilgrims during Hajj [23] [24] [26] [27] [28] [31] [32] [33] [34] [35] [36] [37] [38] [39][41][42] [43][45] [46] [47][50] [51].

**Meningococcal Disease:** A crowded environment with high humidity and dense air pollution are the main reasons for a meningococcal disease which is defined as an infection as high as 3.33% among all the diseases encountered by pilgrims during Hajj [28].

**Skin Infections:** Bacterial skin infection is one of the pilgrims' health problems where Makkah is one of the hottest places in the world with the temperature range of 38 to 42°C during Hajj. The studies revealed that 23.6% dermatitis and 11.2% pyoderma patients were reported during Hajj. Among 80 pyoderma cases, 52.5% were primary pyoderma where impetigo was the leading causes for primary pyoderma. Whereas, 47.5% were secondary pyoderma led by *Staphylococcus aureus* responsible as main causative agents and followed by *Streptococcus pyogenes* [24] [27] [28] [36].

**Environmental Heat Injury:** The main factor of heat stress during Hajj as revealed from the literature are extreme summer temperature, direct and long time heat exposure from the sun, heat from vehicles and internal heat which lead to heat exhaustion or heat stroke among pilgrims [25] [28] [30] [44] [49].

**Cardiovascular Diseases:** Over the past few years, the study revealed cardiovascular disease with hypertension is one of the important causes of pilgrims' intensive care unit-ICU admission with high mortality rate [24] [40]. During 2002 Hajj, the percentage of cardiovascular diseases was 45.8 [35].

**Gastrointestinal infections:** Major food-borne outbreaks of gastroenteritis with high mortality rates are common at all religious festivals, including the Hajj [25] [27] [36].

**Blood-borne diseases:** To shave head during Hajj is compulsory which leads to transmission of blood-borne diseases including hepatitis B, C, and HIV. Illegal unlicensed barbers continue to operate the act whether the Saudi Ministry of health-MoH promotes and encourages all pilgrims to receive hepatitis B vaccination before travel to Hajj [22, 29].

**Malaria:** Although WHO classifies Saudi Arabia as a low, geographically restricted malaria transmission area and since 2008 has been listed as being in the elimination stage of the program, but the risk during Hajj is still exist. In 2011 Hajj season 19 cases of *P vivax* malaria was reported where 75% such cases found among the Indian and Ethiopian pilgrims. In 2012, 48 cases of malaria were recorded in Makkah and 78 cases were recorded in Madinah among Pakistan, Nigeria, Guinea, India, Mouritania, Chad, Mali, Afghanistan, Somalia, Ethiopia, Yemen and Ivory Coast pilgrims.

**Trauma risks:** During Hajj trauma is one of the major causes of morbidity and mortality. In a prospective study of 713 trauma patients, who were injured while performing Hajj, presenting to the emergency room, 248 (35%) were admitted to surgical departments and intensive care. The most common surgical presentations were orthopedic and neurosurgical [35]. For a large part of the Hajj, pilgrims travel either by foot, walking through or near dense traffic, or in vehicles themselves.

**Fire-related injury:** In 1997, fire devastated the Mina area when makeshift tents were set ablaze by open stoves since banned at the Hajj. There were 343 deaths and more than 1500 estimated casualties. Since then all makeshift tents have been replaced by permanent fiberglass installations. At Hajj time, Teflon-coated awnings are added, and the aluminum frames remain in place the rest of the year. No pilgrim is permitted to set up his own tent. Additionally, pilgrims are not allowed to cook food at Mina. Smoking is forbidden during the Hajj by Islamic teaching, thus reducing the risk of a naked flame. Continuous public education is being undertaken to further reduce fire risk.

**Environmental heat injury:** Heat exhaustion and heatstroke are a leading cause of morbidity and mortality during the Hajj, particularly in summer. Temperatures in Mecca can rise higher than 45°C. Lack of acclimatization, arduous physical rituals, and exposed spaces with limited or no shade, produces heatstroke in many pilgrims. Adequate fluid intake and seeking shade is essential. Supplicating pilgrims might not notice the dangers of extreme heat exposure until their symptoms are pronounced. Water mist sprayers operate regularly in the desert at Arafat, a time of high risk for heatstroke, when many stand for long hours during the day. Performing rituals at night, using umbrellas, seeking shade, and wearing high-SPF sunblock creams are all advisable and permissible during the Hajj. Children accompanying their parents must be specially protected. The timings of rites are flexible and acceptable at the pilgrim's convenience—it is key that pilgrims are aware of this since, through fear of committing errors, they might not make sensible choices in completing their rituals [25] [28] [30] [44] [49]. Although the Hajj is not due to fall in the summer for

several years, Saudi winters are warmer (35–50°C) than most pilgrims will be used to, and they must seek shade and drink plenty of fluid during their rites.

**Occupational hazards of abattoir workers:** Abattoir workers at the Hajj are exposed to unique traumatic risks. Over a million cattle are slaughtered each Hajj, up to half a million before noon on the 10<sup>th</sup> day of the Hajj. In one study, 298 emergency visits for hand injury were treated in Mecca over four Hajj seasons. More than 80% were injuries from animal slaughter; many avoidable injuries were sustained by lay people and not trained abattoir workers. Pilgrims need to be assured that professional slaughtering arrangements are easily available at the Hajj, and far safer.

## VI. CONCLUSION

Both communicable and non-communicable health issues are the most common health problems encountered by pilgrims during Hajj. But, due to lack of existing studies associated with this research area, a definite conclusion could not be made. However, our findings demonstrated the necessity of new research to find solutions to pilgrims' health problems during Hajj.

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