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Systematic Review

Factors Influencing the Health of Participants in Religious Mass Gathering Ceremonies in Iraq: A Systematic Review

Maryam Hajain[1], Shahram Mohaghegh[2]*

[1] Community Medicine Specialists, Research Center for Addiction and Risky Behaviors, Iran University of Medical Sciences, Tehran, Iran.

[2] Research Center for Health Management in Mass Gathering, Red Crescent Society of the Islamic Republic of Iran, Tehran, Iran.

*** Corresponding Author**: Shahram Mohaghegh, Sports and Exercise Medicine Specialist, Iran-Helal Institute of Applied-Science and Technology, Red Crescent Society of the Islamic Republic of Iran, Tehran, Iran. Tel: +9891230409654; Email: shahrammohaghegh5@gmail.com

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Abstract

Introduction: In the last decade, the number of religious mass gathering ceremonies, which take place in Iraq, has increased considerably. Millions of participants visit the country annually from across the world to reach Karbala on foot or by other vehicles for participation in a religious ritual called Arbaeen, which lasts about 20 days. Unlike the Hajj mass gathering, another important annual religious mass gathering event of Muslims, an evidence-based review of scientific literature about influential factors on the health of participants in these ceremonies in Iraq has not been done.

Methods: Using PRISMA guidelines and searching PubMed, Scopus, ISI_Web of Science, Cochrane Library, ProQuest, and Google Scholar databases, original English language studies focused on participants' health in religious ceremonies of Iraq until October 2021 were selected. The methodological quality of the studies and the risk of bias were checked using the Joanna Briggs Institute (JBI) checklists.
In addition, the data from the Iraqi Ministry of Health and other organizations, including WHO and CDC, about Iraq's health condition and other resources were used to describe the related findings better and make health recommendations for the participants.

Results: Thirty-two studies passed our criteria and were included for analysis. There was not any clinical trial. All of them were observational (cross-sectional) or qualitative (interview) research; the majority had low to moderate quality scores. Considering the limitations, the leading health risks of participants in religious ceremonies in Iraq include road accidents, insufficiency of Iraq's health system, cardiovascular disease, respiratory tract (including Covid-19) infections, unhealthy food and drink, gastrointestinal infections (including hepatitis), and zoonotic infections(leishmaniasis).

Conclusion: Regarding the grandeur of Iraqi-related mass gatherings, preparation must begin before the events. Pre-participation examination, vaccination of high-risk individuals, and training of pilgrims and authorities on the health hazards are critical.

Keywords: Iraq; Public health; Infectious disease; Population Health Management; Travel Medicine; Arbaeen; Ashura.

Introduction

Every year several religious mass gatherings and ceremonies take place in Iraq, with the participation of millions of pilgrims from across the world[1,2]. In the last decade, the number of pilgrims visiting Iraq, particularly Karbala on the anniversary of Imam Hussain's martyrdom (named Ashura day) and for participation in the Arbaeen ceremony (40th day of Imam Hossein martyrdom) has increased considerably from year to year. It was approximated that about 25 million pilgrims had visited Iraq for the Arbaeen ceremony in 2016, nearly 20% coming from countries outside of Iraq, especially from neighboring countries, while this number was just about 3 million in 2003[3,4].

In annual Arbaeen ceremonies, millions of participants of different ages travel on foot from cities across Iraq and adjacent countries to the shrine of Imam Hussein in Karbala. They may walk hundreds of kilometers for several days. So their walking performance is affected by many physiological factors[5.] Besides walking pilgrims, some pilgrims travel by vehicle on the same route. Karbala is located 100 km southwest of Baghdad (Iraq's capital city) and 80 km from the holy city of Najaf. Najaf-Karbala road is the main walking route for pilgrims and is usually used for

pilgrims from cities in southern Iraq and international participants[6]. Rest areas (locally called Mawakeeb) along the roads provide water, food, shelter, accommodation, and health services freely for walking pilgrims[7].

On the other hand, Karbala has just an area of approximately 43.7 km2[3]. So nowadays Arbaeen ceremony can be considered the world's largest yearly mass gathering event. Millions of Muslim pilgrims of approximately 60 nationalities gather in a limited time and environment[8,9]. The ceremony repeats annually, lasts 10 to 20 days, and every year begins ten days sooner compared to the last year as follows the Muharram, the first lunar month in the Islamic calendar; so it is influenced by environmental and seasonal changes of Iraq, the host country[10].

Previous studies on the Hajj mass gathering, another important annual religious mass gathering event of Muslims, revealed gathering size, population density, weather, and amount of health facilities available to pilgrims as fundamental challenges of the host county health system[11]. Nevertheless, until now, a comprehensive and evidence-based review of scientific literature has yet to be done about influential factors on participants' health in religious ceremonies in Iraq. Therefore, this study aimed to review the scientific documents about these essential factors to support pilgrims and health system authorities for better planning of these events in the future.

Methods

In this systematic review, we used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline. The PubMed, Scopus, ISI_Web of Science, Cochrane Library, ProQuest, and Google Scholar databases were searched using various combinations of the related keywords, including "Mass gathering," "Iraq," "Karbala," "Public health," "pilgrim," "Arbaeen," health management" and "Infectious disease." Original English language studies, which focused on participants' health in religious ceremonies in Iraq until October 2021, were selected. In addition, the references of identified publications were evaluated for additional suitable studies. Reviews and editorials were not included, but their reference lists were searched for relevant studies. Authors independently screened titles and abstracts for suitable studies according to the inclusion criteria. Then the authors analyzed the full texts of the included papers independently. If any debate were between reviewers, they would negotiate and make decisions together about it. The quality evaluation of the studies was carried out using the Joanna Briggs Institute (JBI) Critical Appraisal checklists. Two authors rated each study.

In addition, the Iraqi Ministry of Health data and other organizations, including WHO and CDC, about Iraq's health condition and other resources were used to describe the related findings better and make health recommendations for the participants.

Results

Among the databases reviewed to identify appropriate investigations, finally, 32 studies met our criteria and were included in the present review. Methodologically there was not any clinical trial; 28 studies were observational (cross-sectional and case report), and four were qualitative (interview) researches; the majority of them have low to moderate quality scores (Table 1). Table 2 shows the prominent reported cases of different diseases and syndromes in previous Arbaeen gathering events (Tables 2,3). Based on the finding of these studies and related data, the health risks of participants in religious ceremonies in Iraq can be classified into communicable, non-communicable, health management, and education domains as follows:

Communicable diseases

These include respiratory tract and gastrointestinal diseases. The mentioned respiratory tract infections include acute and upper respiratory tract infections, Influenza and Influenza illnesses, common cold, and Covid 19 infections. The gastrointestinal tract infections mentioned include acute gastroenteritis (diarrhea and severe dehydration) and Hepatitis A (Table 2).

Based on the available literature, acute respiratory symptoms and signs were the main complaints of pilgrims referring to health facilities in Arbaeen and Ashura mass gatherings[8,17-20]. Regarding the etiology of acute respiratory complaints, influenza virus subtypes A/H1N1 and A/H3N2 were

detected by PCR in 14% of swab throats of Iranian Karbala Pilgrims in the 2013 -2016 period, which was higher than in Iranian Mecca Pilgrims and general Iranian population at the same time[25].So participation in religious mass gatherings in Iraq can pose pilgrims with

a higher risk of upper respiratory tract infections, especially Influenza infections.

Gastrointestinal complaints have also been common in Arbaeen and Ashura pilgrims[3,17,23]. Some studies of our research investigated the etiology of gastrointestinal infections of pilgrims. Although in lami et al. study, all stool specimens of patients with gastrointestinal symptoms and signs were negative for cholera[18], in Ghasemian et al. study, the presence of acute hepatitis A infection in recent (within three months) Karbala pilgrims was confirmed by serology tests[26]. Also, in Shokri et al. study, Coliform bacteria were obtained from 24.7% of water samples of Mawakeeb on the south border of Iraq and Iran[27].

Table 1: Health-related risks of religious mass gatherings in Iraq based on the retrieved articles.

Author(s) ; publication date	Methodology	Type of Mass gathering& location ; year	Health risks ;related data	Study conclusion	Quality scores of studies 1-Strong 2-Moderate 3-Weak
Al-Ansari F, et al.[6]; 2020	Pilot cross-sectional, Structured interview with 191(143 males, 58 female) pilgrims.	Arbaeen walking route between Najaf and Karbala;2017	URT[rhinorrhea (22.6%) and cough(22.5%)] &GI(diarrhea in 12.6%) symptoms were the most common complaints.	Street food consumption and high-income country origin were independent risk factors for respiratory or gastrointestinal infection symptoms(diarrhea)	2
Al-Lami F, et al.[12]; 2013	cross-sectional study on 18415 attendees at the 3 public hospitals In Karbala.	Ashura mass gathering , Karbala;2010	Compared with the pre-event phase, a 7-fold increase in febrile disorders and a 2-fold increase in chronic diseases complications and injuries were noted, no difference in mortality	Implementing public health surveillance during mass gatherings	2
Karampourian A, et al.[13]; 2018	Qualitative research method, Semi-structured interviews with 13 executive managers and 4 health policymakers about communicable diseases.	Arbaeen mass gathering, Iraq-Iran land terminals (Mehran, Shalamche, and Chazaba) and also in health care posts in Iraq;2017-2018	Health infrastructure defects in Iraq; poor control of the infectious diseases; the low perception of risk in pilgrims; ineffectiveness of health education.	Pilgrim-based training, planning and controlling other challenges were recommended.	2
Chitheer A, et al.[14]; 2020	Retrospective Analysis of emergency department records of six public hospitals and two major Temporary medical units(1564 injury cases, including 73 fatal cases)	Arbaeen Mass Gathering at Babel Governorate, 2014	Most injuries were unintentional and occurred in young people; occurred on the street and daytime; the injured people were mainly male, not transported by ambulances nor receive pre-hospital medical care; Minor injuries and traffic accidents were the most common types of injuries, followed by falls; traffic accidents and violence were the leading causes of death. The injured individuals mostly reached a hospital	Limited access to ambulance transportation for injured people.	2

			Within an hour of injury.		
Hantoosh H, et al.[15]; 2019	cross-sectional study on all health facilities in south of Karbala based on timing Of the mass gathering event: pre-event, the event, and post event. (totally 884,834 incidents)	Arbaeen Mass Gathering, three governorates (Thiqar, Muthana, and Diwania) along the southern way from Basra to Karbala; 2014	The majority of incidents (95%) were reported during the event phase in mobile clinics; Musculoskeletal disorders were the most common complaints; mean daily deaths did not differ significantly during pre-event, event and post event phases with 3 main causes: Cardiovascular diseases (43.5%), injuries (29.8%), and respiratory illnesses (12%).	large disease and economic burden on Iraq governorates that pilgrims Pass through.	2
Karampourian A, et al.[16]; 2019	qualitative research method, semi-structured interviews with six pilgrims, 12 executive managers, and four policymakers about traumatic accidents	Three land borders between Iran And Iraq on the route to Karbala (Arbaeen ceremony); date of study was not mentioned.	Low Risk perception and fatalism; inadequate pilgrim preparation to incidents; Poor Health system response to traumatic events; inadequate medical infrastructure , manpower, equipment and facilities in Iraq and border cities;	Education of pilgrims about risks of the Arbaeen ceremony for changing their behavior, developing a national strategic plan for Arbaeen health Policymakers, and doing scenario-based maneuvers for executives.	2
Lami F, et al.[17]; 2019	Cross-sectional study for evaluation of the 30 temporary clinics.	Arbaeen ceremony; Al-Karkh, Baghdad; 2014	Inadequate health care providers; insufficient drug availability (especially diabetes and hypertension drugs), medical waste disposal supplies and surgical sterilization instruments.	Need for better equipping of clinics and provision of enough health care providers	2
Lami F, et al.[18]; 2019	Cross-sectional study for identification of the main communicable diseases syndromes on 40 mobile clinics(total of 87,865 patients)	Wassit governorates; clinics along the road to Karbala during the Arbaeen mass gathering; 2014	5% of the cases had communicable diseases syndromes; 42% of these had fever and cough, 29% had acute diarrhea, 27% presented with vomiting with/without diarrhea, and 2% had bloody diarrhea. Cultures for Vibrio cholera were negative.	Timely detection and Response to infectious disease outbreaks by Syndromic surveillance	2
Lami F, et al.[19] (18); 2019	Cross-sectional study on 120 temporary health care facilities	Arbaeen ceremony; Najaf to Karbala road; 2014	Profound shortage of trained human resources and medical supplies. Most of the medical problems encountered were musculoskeletal (97%).	Improving health services by adequately equipping and following standardized operation Procedures.	2
Lami F, et al.[20]; 2019	Cross-sectional study on 20 health care facilities(total of 41,689 patients)	Arbaeen ceremony; Najaf to Karbala road; 2016	Patients were mainly from Iraq and then Iran (33.3% female and 66.7% male); 58.5% had acute or infectious conditions and symptoms, 33.1% had chronic conditions, 23.9% had traumas or injuries, 28.2% had joint pain related to walking long distances, and 0.3% had chronic Dermatologic conditions.	As Arbaeen mass gathering puts a high burden on the Iraqi health care system, preparedness, proper management, and control of different conditions are important.	2
Lami F, et al.[21]; 2019	Cross-sectional study on public hospitals for non-	Arbaeen ceremony; Karbala, Najaf, and	hypertension, hyperglycemia, ischemic	Pilgrim education especially about risk factors for non-	2

	infectious disease emergencies (total of 4425 cases)	Babel governorates; 2014	heart disease, asthma, and pulmonary edema were the main non- infectious emergencies; Intense physical activities and poor adherence to diet and medication were risk factors for ischemic heart disorders, hypertension, And hyperglycemic emergencies. Inhalation of noxious gases or fumes and recent respiratory infections were risk factors For asthma emergencies.	infectious disease emergencies is important	
Lami F, et al.[7]; 2019	Cross-sectional study about knowledge, attitude and practice of 500 food handlers at 100 temporary rest areas	Arbaeen ceremony; Baghdad; 2014	Unsatisfactory attitudes and practices about food handling and personal hygiene with potential risk of spreading foodborne and waterborne diseases.	All persons involving with food handling should be trained about food safety and personal hygiene and licensed from the Health authorities.	2
Mousavi J, et al.[22];2016	Cross-sectional study on 26574 Iranian patients admitted to Iranian clinics in Iraq	Arbaeen ceremony; Najaf, Karbala, Baghdad and Kazemain ; 2013	42% of patients were women and 58% were men. The main referral reasons were related to acute respiratory infection symptoms and signs (48%), musculoskeletal problems (19%), control of underlying disease (diabetes, cardiovascular disease, hypertension, gastritis) (16%), and gastroenteritis symptoms (7%).	Appropriate training about use of personal protective equipment, Vaccination, medical examination before deployment, and establishing medical records for pilgrims are important .	2
Mohammadinia L, et al.[23];2021	Cross-sectional study at temporary clinics and health stations (total of 26,875 patients)	Arbaeen walking ceremony; Najaf to Karbala road; 2019	Mainly male patients (63.04%); The most common chief complaint were musculoskeletal conditions (21.99%) followed by foot blisters (20.94%) and skin lesions (19.62%).	Providing more organized services, especially in emergency health care; Significance of the health history of pilgrims.	2
Obaid KB, et al.[8]; 2020	cross-sectional study, conducted at three pediatric clinics(total of 350 pateints)	Arbaeen ceremony; Karbala; 2018	Children patients were mainly from Iraq (77.1%) and then Iran (19.9%); more than one half (54.3%) of them have upper respiratory tract complaints.	Prevention through educational programs for pilgrims is necessary	2
Taher A, et al.[24]; 2017	cross-sectional structured interview about oral hygiene conducted on 3500 adult pilgrims	Arbaeen walking ceremony; Najaf to Karbala road; the date of the study was not mentioned.	Most of the participants were Iraqi (50.8%) and then Iranian (28.8%); About 28% of participants had bleeding gum; About 38.5% never or occasionally Brushed their teeth; Most of participants ignored their Oral hygiene during the mass gathering, and most of them did not aware of the importance of the Oral Hygiene toward the general health; 24.8% of the study participants were smokers and mainly 18 -20 year old males	Use the media for education Of pilgrims in mass gatherings about Significance of oral health. Relationship between educational level of pilgrims and their oral health	3

Yavarian J, et al.[25]; 2018	cross-sectional study, conducted at 42351 throat swabs for presence of influenza viruses and MERS-CoV in Iranian general population and pilgrims returning from Mecca and Karbala with severe acute respiratory infection (by RT-PCR kit)	Karbala and Mecca related Ceremonies; arriving pilgrims at Emam Khomeini Airport in Tehran for pilgrims and local Iranian hospitals for general population ; 2013–2016.	None of the patients had MERS-CoV but influenza viruses were detected in 12.7% with high circulation of influenza A/H1N1 (47.1%); Higher prevalence of influenza virus carriage in Karbala pilgrims compared to Iranian general population	Necessity of influenza vaccination for pilgrims; screening for MERS-CoV in pilgrims with severe respiratory infection	1
Ghasemain R, et al.[26]; 2016	Cross-sectional study, the data of 9 patients with acute hepatitis A admitted in hospital in less than 3 months with a history of recently returning from Karbala or being exposed to Karbala pilgrims were registered	Karbala related ceremonies; 2014-2015	7 patients had history of traveling to Karbala during the last 45 days; 2 patients without traveling history exposed to Karbala pilgrims	Necessity of conducting evaluations regarding Hepatitis A infection and follow up monitoring on all persons travelling to Karbala.	2
Shokri R, et al.[27]; 2020	Cross-sectional study on the 267 Mawakeeb of Shalamcheh (south border of Iraq and Iran). 186 samples about the microbial quality of water, and 66 samples about the microbial quality of food were analyzed	Arbaeen ceremony;2018	24.7% of water samples were contaminated by Coliform bacteria	Proper implementation and continuous control of health regulations at Mavakeeb; Training of the personnel about personal hygiene; necessity of obtaining medical approval for them.	3
Sadeghi S,et al.[28];2105	Cross-sectional study on 177 patients referred to Iraqi hospitals(Najaf and Karbala) from Iranian clinics	Ashura and Arbaeen ceremonies during a 5-month period from 16 January 2012 until 14 June 2012	Most of the referrals were due to cardiovascular diseases (38.6%,) then trauma (26.55%), and finally renal failure in need of dialysis (12.43%). Around 90% of deaths were due to heart diseases	Regarding the high prevalence of cardiovascular diseases and fractures in Iranian pilgrims, self-care training of pilgrims for diminishing such rates is necessary	2
Lami F, et al.[29];2021	Cross-sectional study on 152 field clinics in 11 governorates in Iraq at strategic points along route from all governorates to	the Arbaeen ceremony; 2018(October – November)	The majority of patients were from Iraq (87.6%) and then Iran (10.3%), mostly male (57.5%); 72.8% of patients complained from acute and infectious conditions (mostly influenza like illness),59.70% from chronic	Need of better planning for challenges in health service delivery and health security	2

	Karbala (total of 338,399 patients		conditions, and 2.0% reported traumas and injuries.		
Soltani, et al.[30];2021	Cross- sectional study on 1200 Iranian pilgrims one month after the end of this event by using a researcher-made questionnaire	Arbaeen ceremony;2019	The mean age of pilgrims was 41.2±14.1 years and were mainly (65.7%) male. The cold was the main compliant in medical referrals. About 90 % of the participants did receive medical services and mostly (more than 90%) from Iranian red crescent medical society, and mostly (more than 82%) satisfied from medical services.	Necessity of Comprehensive multi-organizational planning and cooperation before the Arbaeen Pilgrimage and training the pilgrims	2
Al-Ansari F, et al.[31];(2021)	cross-sectional survey of a sample of 1842 Arbaeen participants about respiratory symptoms and related risk factors.	Arbaeen ceremony; 2019	Participants were mainly Iranian (57.4%) then Iraqi (36.6%); 63.3% male,36.7% female; Cough was the commonest symptom (25.6%); Toilet facilities often lacked running water (67.9%) and soap (73.9%).	Necessity of proper handwashing or sanitation, facemask approaches, healthy food preparation and social distancing in rest areas are needed for prevention of respiratory infections especially COVID19 in the event.	2
Fard R,et al.[32];(2014)	Cross sectional study on 14 brands of bottled drinking water for their fluoride level.	Arbaeen ceremony, Najaf – Karbala road; 2013	Although measured fluoride differed significantly from the values shown on the labels, all were below 1 mg/L(threshold for fluorosis)(mean fluoride level was 0.28 mg/L)	None	3
Karampourian A, et al.[33] ; 2019	National cross-sectional study based on obtained data including the number of visits and injuries to health centers as trauma care needs and the number of physicians, paramedic, ambulance, and treatment center as access	Border cities of Iran and Iraq, Najaf, Karbala, Najaf to Karbala route, Arbaeen ceremony 2016.	The trauma care facilities were relatively distributed equally at the border towns in Iran; however, were not equally distributed in Iraq.	The consequences of incidents could be reduced if distributing trauma care facilities equals at mass gatherings.	2
Nazari A,et al.[34]; 2017	a cross-sectional study on 200 patients (mostly elderly) admitted in the hospitals of Ilam(Border city of Iran and Iraq) with an interval of one month (i.e., two weeks before and two weeks after Arbaeen)	Arbaeen ceremony , 2016	Myocardial infarction and acute gastroenteritis with severe dehydration were two major mortality causes. In addition, Diabetes type 2 and influenza diagnosis were two important cause of hospitalization.	Complying with hygiene standards regarding food and water consumption, training the pilgrims about infectious and non- infectious diseases. Pre participation examination for screening of high-risk pilgrims.	3
Abdulredha M, et al.[35];2018	Field observations and in-depth interviews with nine senior managers	Arbaeen ceremony , 2016	Operational and governance weaknesses including waste collection coverage was about 70%, no controlled landfill site, no formal recycling scheme	Improving public awareness and introducing a formal recycling scheme to make the	3

	from Karbala's municipalities about solid waste management system			event municipal solid waste management system effective and financially sustainable	
Nazari A,et al.[36]; 2019	Cross sectional study on 105 patients with infectious diseases admitted to hospitals of Ilam(Border city of Iran and Iraq) on the Day of Arbaeen. .	Arbaeen ceremony , 2017	Most patients were above 60 and under 20 years old (totally 53.4%). Respiratory tract infections and gastroenteritis with severe dehydration were two major causes of mortality.	Children and elderly were more prone to infectious diseases. Compliance with hygiene standards to control and prevent the infectious diseases	3
Saraei M,et al.[37];2021	Case reports of 16 Iranian patients with cutaneous leishmaniosis	Religious ceremonies of Iraq, 2018	Except for a woman who was among the pilgrims to Karbala, the rest of patients were from Bus Company employees who were responsible for transferring of pilgrims from Mehran to border regions of Iran and Iraq. The place of sleep and rest of these people was located in a building on the suburbs of the city of Mehran (border city of Iran and Iraq)	Cutaneous leishmaniosis could be a serious threat for pilgrims. Strict measures must be taken to prevent the disease.	2
Ali M, et al[38];2021	Assess the linear regression model of the incidence of COVID-19(based on PCR test) during the days of Safar for the middle and southern Iraqi governorates in which almost all contributed to the ceremony in comparison with the control northern governorates population.	Arbaeen ceremony,2020	Significant decline in COVID-19 incidence and mortality soon after the commencement of the ceremony for the test population that participated in the visit to Karbala. Control northern Iraqi population revealed an increased rate of COVID-19 incidence and death at the same time.	Further reviewing of the nature of community attitude and its role in the severity and incidence of the epidemics is mandatory for the health system decisions	2
Hossein AH, et al[39];2021	Cross sectional study on one hundred swap samples taken in transport media from different locations across the way of pilgrims. Samples were classified and cultured using different growing media	Arbaeen ceremony; the date of the study was not mentioned.	Staphylococcus Aureus is the most abundant pathogen in all types of samples followed by Staphylococcus epidermidis and E. coli. Most of samples taken from drinking water and furniture are contaminated.	Complying with hygiene standards regarding food and water consumption.	2
Peyravi M, et al[40] ;2020	Qualitative study using semi-structured and in-depth interviews with twelve experts and six pilgrims about health-related challenges	Arbaeen ceremony,2019	Bone and joint pain, muscle spasms, headache, toothache, pharyngitis, rhinorrhea, and common cold, purulent throat, and gastrointestinal symptoms were the main complaints of pilgrims. The main problems of those with chronic conditions included having forgotten to take medications or running out of medications. Food and water safety and sanitary conditions were inappropriate. Iraq's health system was not prepared to fulfill the health needs of the people at such a gathering	International aid from the countries whose citizens attend the event are needed.	2

Table 2: The main reported cases for different diseases and syndromes in previous Arbaeen gathering events.

Disease(syndrome)	Reported cases		
	Authors	**Year(event)**	**Description**
Respiratory tract diseases	Al-Ansari F, et al.[6]	2017	About 23 percent of cases(about 14 percent female and 9 percent male) had URTI symptoms(rhinorrhea or cough)
	Hantoosh H, et al.[15].	2014	The third cause of death(12% of cases)
	Lami F, et al.[18]	2014	42% of cases (20 percent male and 22 percent female) had fever and cough
	Mousavi J, et al.[22]	2013	The main referral reasons of Iranian cases to Iranian clinics in Iraq (48%) were related to acute respiratory infection symptoms and signs.
	Obaid KB, et al.[8]	2018	More than one half (54.3%) of children in pediatric clinic have upper respiratory tract complaints (about 29 percent male and 26 percent female)
	Yavarian J, et al.[25]	2013-2016	Higher prevalence of influenza virus carriage in Iranian Karbala pilgrims compared to Iranian general population.
	Lami F, et al.[29]	2018	72.8% of patients (about 41 percent male and 32percent female) complained from acute and infectious conditions (mostly influenza like illness)
	Soltani, et al.[30]	2019	The cold was the main compliant (about 41 percent) in Iranian medical referrals.
	Al-Ansari F, et al.[31]	2019	Cough was the commonest symptom (63.3% in males, 36.7% in females)
	Nazari A,et al.[36]	2017	Respiratory tract infections were a major (second) cause of mortality in Iranian cases (mortality rate 10 percent). Most patients were above 60 and under 20 years old.
	Ali M, et al.[38]	2020	Significant decline in COVID-19 incidence and mortality in Karbala soon after the commencement of the ceremony in comparison to north parts of Iraq at the same time.
Gastrointestinal Diseases	Al-Ansari F, et al.[6]	2017	Diarrhea in 12.6 percent of cases(about equal involvement of males and females) and vomiting in about of 20percent of cases (6percent male and 14 percent female)
	Lami F, et al.[18]	2014	29%(including 14 percent male and 15 percent female) of cases had acute diarrhea, 27% (13 percent male and 14 percent female) presented with vomiting with/without diarrhea, and 2% (1.1 percent

			male and 0.9 percent female) had bloody diarrhea.
	Mousavi J, et al.[22]	2013	Gastroenteritis symptoms in 7% of Iranian cases.
	Ghasemain R, et al.[26]	2014-2015	Acute hepatitis A in Iranian patients (7 males and 2 female) admitted in hospital
	Nazari A,et al.[34]	2016	Acute gastroenteritis with severe dehydration as the first mortality cause (with mortality of 16.7 percent) in Iranian patients
Traumatic injuries	Chitheer A, et al.[14]	2014	Minor injuries and traffic accidents were the most common types of injuries, followed by falls; traffic accidents and violence were the leading causes of death. 72.6 percent of patients were male and 27.4 percent female. injuries were more likely to occur among individuals aged 21-40 years.
	Sadeghi S,et al.[28]	2012	Trauma is the second referral reason from Iranian clinics. Mean Age of Hospitalized Patients due to trauma was 50.72 years.
	Hantoosh H, et al.[15])	2014	Injuries (29.8%) was the second cause of death.
	Lami F, et al.[20]	2016	23.9% of cases had traumas or injuries. The most prevalent complaints reported were blisters due to walking long distances (68.5%;), wounds (26.2%;), accidental injuries (4.3%;), and fractures (1%;).
Musculoskeletal disorders	Hantoosh H, et al.[15]	2014	Musculoskeletal disorders were the most common complaints
	Lami F, et al.[20]	2016	28.2% of cases had joint pain related to walking long distances
	Mousavi J, et al.[22]	2013	Musculoskeletal problems in 19% of Iranain cases in Iranian clinics in Iraq (62.4 % female and 37.6% male) (second referral reasons).
	Mohammadinia L, et al.[23]	2019	The most common chief complaint were musculoskeletal conditions
	Peyravi M, et al.[40]	2019	Bone and joint pain, muscle spasms, as one of the main complaints of Persian speaking pilgrims
Cardiovascular disease	Hantoosh H, et al.[15]	2014	Cardiovascular diseases (43.5%), was the main cause of death
	Sadeghi S,et al.[28]	2012	Most of the referrals to Iraqi hospitals from Iranian clinics were due to cardiovascular diseases (38.6%,). Around 90% of deaths were due to heart diseases. Mean Age of Hospitalized Patients due to cardiovascular diseases was 63.2 years

	Nazari A,et al.[34]	2016	Myocardial infarction as a major mortality cause.
	Mousavi J, et al.[22]	2013	Hypertension was the most common chronic disease in Iranian patients referred to Iranian clinics in Iraq(57.6% female and 42.4% male), cardiovascular diseases were the third cause(62.9% male and 37.1 % female)
Dermatological diseases	Saraei M,et al.[37]	2018	16 Iranian patients with cutaneous leishmaniosis
	Mohammadinia L, et al.[23]	2019	Foot blisters as second referral reasons followed by skin lesions(sweat, heat, bites, burns, and edema)
Non infectious disease emergencies and referrals	Lami F, et al.[19]	2014	hypertension, hyperglycemia, ischemic heart disease, asthma, and pulmonary edema were the main non- infectious disease emergencies
	Mousavi J, et al.[22]	2013	Diabetes was the second common chronic disease in Iranian patients referred to Iranian clinics in Iraq (32.7% male and 67.3% female),
	Sadeghi S,et al.[28]	2012	Renal failure in need of dialysis (12.43% of emergency referrals from Iranian clinics). Mean Age of Hospitalized Patients due to dialysis was 62.68 years.
Oral health, smoking behaviors	Taher A, et al.[24]	Was not mentioned	Most of participants ignored their oral hygiene during the mass gathering, ; 24.8% of the study participants were smokers
	Peyravi M, et al.[40]	2019	Toothache as one of the main complaints of Persian speaking pilgrims

Non-communicable diseases

Traumatic and musculoskeletal injuries (mainly traffic accidents, violence, falls, muscular spasms, bone and joint pain related to long-distance walking), cardiovascular diseases(Ischemic heart disease, hypertension, and myocardial infarction), dermatological diseases (leishmaniasis, sunburn, sweat, heat, bites, and foot blisters), oral disorders (toothaches) and, other non-infectious disease emergencies (hyperglycemia, asthma, pulmonary edema and renal failure in need of dialysis) were the mentioned titles of non-communicable diseases (Table 2).

In these domains, studies focused on trauma and injuries[17,29,35] and chronic diseases[17,30,32,33,35-38]. One study which evaluated the reported injuries at hospitals and temporary health facilities during the 2014 Arbaeen ceremony showed that traffic accidents and violence were the major causes of death in the ceremony. Also, traffic accidents were the cause of half of the injury-related deaths and a quarter of nonfatal injuries[14].

Musculoskeletal injuries were the major finding in some reviewed studies[17,30,33,34,40]. Foot blisters, wounds, joint pain from walking long distances, leg and back pains, muscle spasms, accidental injuries, and fractures were marked musculoskeletal injuries in these studies.

Cardiovascular diseases were the leading cause of death in the 2014 Arbaeen ceremony study by Hantoosh et al.[15]. Also, cardiovascular diseases were the leading cause of death in Iranian hospitalized patients in Iraq hospitals[28]. In a study by Lami et al. in 2014 Arbaeen

ceremony, the rate of severe hypertension as an emergency complaint (29.04%) was higher than other non-communicable disease emergencies, including Ischemic heart diseases (21.1%), asthma (19.23%), diabetes (16.43%), pulmonary edema (3.86%) and cerebrovascular accident (2.45%) emergencies. In that study, the rate of severe hypertension and diabetes-related emergencies in the Arbaeen event concerning pre-event increased more than other emergency complaints (3 folds versus two folds, respectively)[21].

Health Management and education risks

Poor infrastructure of Iraq's health system[31,40], lack of trained health personnel[31,32,40], drug insufficiency[31,32,40], improper waste disposal and sterilization instruments[17,35], considering health history of pilgrims[17,34]and the need for pilgrims and authorities' education and training[7,8,17,19,25,31,35,37,38.40]were the mentioned titles of health management and education risks in reviewed studies.

Regarding food safety and personal hygiene, food handlers are essential for preventing outbreaks and spreading food-borne infections. Lami and his colleagues showed that food handlers in pilgrim rest areas (Mawakeeb) had bad attitudes and practices toward food handling and personal hygiene. As most individuals working with food in Mavakeeb are not certified food handlers, health authorities must routinely examine these facilities. Their number has dramatically increased over the last few years, so there are concerns about the risk of spreading food-borne infections concerning food and water usage in these rest areas[7].

In addition, the lack of enough pre-hospital medical care and ambulance services in Iraqi-related mass gatherings can be a risk factor for pilgrims[14]. This can be partly attributed to the poor infrastructure of Iraq's health system and its high burden in mass gathering ceremonies[31,33,40] and partly to road congestion during the heavy mass gathering[14]. Also, another study by Lami et al. on temporary clinics established in Mawakeeb (temporary rest areas) reported that drugs for controlling hypertension and diabetes were available in just half of them[17].

Table 3: Some of the Important infectious diseases of Iraq.

Name of Disease(s)	Description	Reference(s)
Chickenpox and mumps	Reported high incidence in 2016 in Karbala Province, highest rate for both diseases was in age range of 5–9 years followed by 10–14 years.	43
Hepatitis C	According to 2020 report of WHO, the Eastern Mediterranean Region including Iraq has the highest prevalence and incidence of hepatitis C virus in the world. (three times higher incidence than the global rate)	44
leishmaniosis (cutaneous and visceral)	A major public health concern in Iraq based on 2020 report of WHO.	44
Measles	Because of insufficient levels of immunization coverage against measles, Iraq continues to suffer from measles outbreaks.(WHO 2020)	43
Polio	Iraq is considered as a risky country for polio infection. .(WHO 2020)	43,47
Crimean- Congo hemorrhagic fever (CCHF)	In 2018, outbreak of Crimean- Congo hemorrhagic fever (CCHF) was reported in Iraq(WHO 2020).	43,47
Covid-19	In late March of 2021, the official number of COVID 19 cases in Iraq is about 22 per 1,000 people, a high rate in the Middle East countries	48
Cholera	Cholera had been endemic in Iraq since 1966 and this country had been facing an outbreak of cholera in 2015.	49

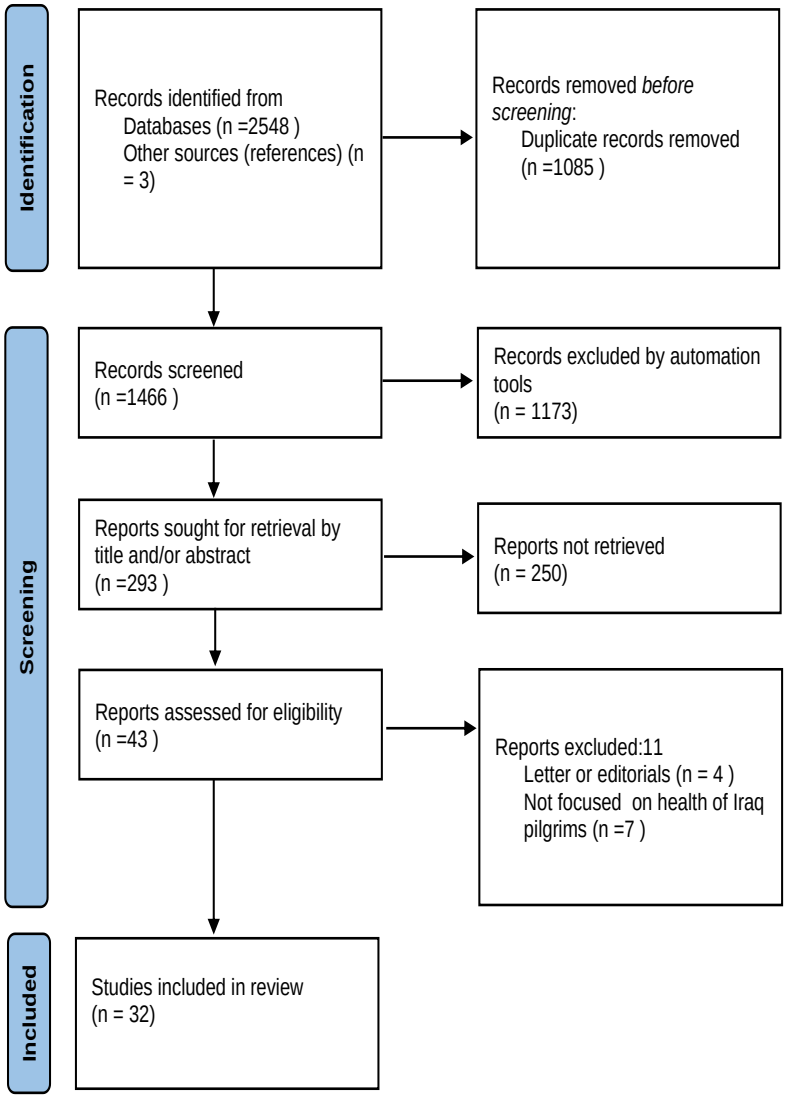

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Figure 1: study's flow chart

Discussion

As mentioned before, all of the studies were observational (cross-sectional or case report) or qualitative (interview), with the majority having low to moderate quality scores. Cross-sectional studies cannot determine the true etiologic relationship[41]. Also, the results of the qualitative interviews could be more generalizable and have systematic errors (bias)[42]. Thus, the finding of these studies must be viewed with caution.

Infectious diseases domain

According to recent statistics from the Iraqi Ministry of Health, infectious diseases have been the cause of 17% of all deaths in Iraq[43]. In 2019, Iraq's age-standardized mortality rate of communicable diseases was 44.6 per 100,000 populations, higher than its neighboring countries[44]. Diarrheal diseases, acute respiratory infections (ARI), measles, mumps, typhoid, leishmaniosis, and Hepatitis E were the main infectious diseases mentioned in the 2004 report of the Iraqi Ministry of Health[45].

Some of the Important infectious diseases of Iraq and their descriptions are summarized in Table 3. See Table 2 for more description of infectious diseases according to our retrieved studies.

There are concerns about spreading the infection to/from neighboring countries and the involvement of millions of pilgrims participating annually in the Arbaeen ritual[49]. Based on the WHO report, the high burden of drug-resistant tuberculosis and malaria in Pakistan, Afghanistan, Sudan, and Yemen[47] near Iraq and the origin of many pilgrims raises concerns about spreading these infections to other pilgrims during Arbaeen and Ashura ceremonies. Water deficiency, aging water infrastructure, and conflicts potentially aggravate cholera infection dissemination in Iraq. In April 2017, the world's largest cholera outbreak, with more than 1 million suspected cases, occurred in Yemen, a nearby country in south Iraq[49].

Therefore, it is necessary to consider public health measures, personal caution, and proper vaccination to prevent these infections. Good water, food sanitation, and safe drinking water and ice are critical[49-51].

Non-communicable diseases domain

Some Important causes and descriptions of non-communicable diseases influencing the health of Iraq pilgrims are presented in Table 4. See also Table 2 for more information according to retrieved studies.

In 2019, Iraq age–standardized mortality rate due to injuries was 88.3 per 100,000 populations, which was higher than its neighboring countries except for Syria[44]. The primary reason for injuries was traffic accidents due to increased vehicles and inadequate security and safety precautions procedures, including drivers' misbehaviors[52,53].

Musculoskeletal muscle spasms during prolonged walking may be related to water and electrolyte imbalance in some cases and muscle fatigue in others. However, there is uncertainty about the causes and remedies for it. The principal risk factors are significant sweat losses and ingesting large volumes of plain water. Many prospective studies revealed that adding salt to the water could reduce the incidence of muscle spasms. In addition, a 2015 Cochrane review reported that ingestion of 200 – 500 mg quinine daily could reduce cramp frequency and intensity. It was shown that passive stretching and ingestion of pickle juice (which has a high salt content and a sharp taste due to acetic acid content) could effectively reduce cramps' duration[57,58].

In a 2021 systematic review on Hajj pilgrims in the cardiovascular domain, the weighted pooled prevalence rates of hypertension and diabetes in all included studies were higher than those of other underlying health conditions[59]. This higher rate of hypertension and diabetes may also be expected in Iraqi-related mass gatherings because of the similarities of pilgrims participating in these ceremonies. Some of our reviewed studies confirm this data (Table 2). The physiological demands of long-distance walking and hiking are related to the length and status of the route, walking duration, dietary intake, backpack weight, and environmental conditions[60]. Regarding the long-distance walking route for reaching Karbala and the improper conditioning of some participants, it is necessary to pay more attention to the cardiac examination of pilgrims before the journey. This is especially important for pilgrims with one or more following risk factors: sedentary lifestyle (absence of at least 30 minutes of physical activity, three days a week for three months or more), family history of heart disease before age 55 in men and age 65 in women, males more than 45 or females more than 55 years old, smoking or history of it in the past six months, hypertension or hypercholesterolemia or using drugs for

controlling it, being overweight or suffering from obesity, diabetes or impaired glucose tolerance[61].

In one study, asthma was reported as a non-communicable emergency in Arbaeen mass gatherings after hypertension and ischemic heart disease associated with exposure to noxious gases or fumes and recent respiratory infections[21]. In addition, Environmental tobacco smoke (ETS) due to secondhand smoke is a significant source of indoor air pollution associated with many cardiovascular and respiratory diseases and even death in children and adults. Interestingly, available ventilator systems cannot remove gaseous and particulate components of ETS from indoor spaces, and indoor smoking prohibition is the most effective method. Also, it is essential to know that opening a window for smokers or transferring to another room cannot provide enough ventilation[62-64].

. Health management, education, and terrorism domain

In 2019, Iraq ranked eighth regarding the highest number of people killed by terrorist attacks and fourth in terms of the most attacks. Also, in 2014, DAESH (a terrorist group), which was in power in some parts of Iraq, threatened the Arbaeen pilgrims for terrorist attacks and destroying the religious shrines in Iraq and Syria. Interestingly, in the face of these dangers, Arbaeen pilgrims have been increasing in these years, attributed to the pilgrimage's spiritual aspects and psychological consequences of these mass gathering events[65].

Conclusion

Due to the large numbers of participants and possible defects in the health system infrastructure of Iraq, enough preparedness for these annual meetings, including pre-event preparation and post-event activities by pre-participation examination of pilgrims, especially for long-distance walking, providing safe water sources, appropriate public toilettes, hand hygiene, and mask usage facilities, adequate cooling devices for sensitive foods, healthy food delivery, and waste disposal, and control of harmful rodents and insects seem necessary. Training of pilgrims and authorities is essential too. Health recommendations for Iraqi mass gatherings and Arbaeen walking events can be seen in Table 5. Potential public health risks in Iraqi mass gathering events are summarized in Table 6.

Table 4: Some Important causes and descriptions of non-communicable diseases influencing the health of Iraq pilgrims.

Cause	Description	Reference(s)
Traffic accidents and trauma	Traffic accidents were the main causes of fatal injuries in Iraq in 2010. In 2013, mortality rate over Iraq due to traffic accidents is moderately higher than the worldwide rate. See also table 2	14,52,53
Musculoskeletal conditions	Pilgrims may walk for several days with backpack for reaching Karbala. So the huge burden on the musculoskeletal system is anticipated. Common distance walking injuries are due to overuse that occurred in the lower extremity, particularly in the foot, ankle, and knee .	54
Cardiovascular disease, hypertension and Diabetes related emergencies.	Relatively high prevalence of cardiovascular and diabetes related emergencies might be related to long distance walking and backpacking for reaching Karbala (that can put high burden on cardiovascular system of patients) and change of diet and medication use.	18,21
Environmental factors (heatstroke sunburn and air pollution)	Karbala has a desert climate characterized by extreme temperatures and drought. Summers are extremely warm with temperatures easily rising above 50 degrees Celsius. Environmental pollution may be due to vehicles which move along the walking pilgrims toward Karbala or exposure to cigarette smoke of other pilgrims (second hand smoke), especially in indoor environments. In one study, 24.8% of 3500 participants in Arbaeen ceremony were smokers .	55,56,24

Table 5: Health recommendations for Iraqi mass gathering events

Before the event

General measures

- General Physical examination of all participants at least one month before trip[66]
- Cardiovascular and orthopedic examination of high risk long distance walkers[67]
- Carry prescript drugs
- Carry primary health tools including Face masks, hand sanitizer, water purification tablets, sunscreen(SPF 15 or greater),sunglasses and hat, drugs for controlling diarrhea(ORS ,Ciprofloxacin, loperamide), Aloe gel for sunburn, 1% hydrocortisone cream Anti-itch gel or cream, antifungal/antibacterial ointments, moleskin or molefoam for blisters, eye drops, elastic compression bandage wrap, digital thermometer , sterilized dressing and betadine for disinfection, disposable gloves, Permethrin(insect repellent for clothing), insect repellent containing DEET for topical usage on skin[68]
- Wear new shoes before walking[69]

Vaccination and Immunoglobulin

- Complete Covid 19 vaccination[66]
- Influenza vaccine[66]
- Pneumococcal vaccine for participants with more than 65 years old, chronic medical conditions and immunocompromised (2 doses)[70]
- Hepatitis B vaccine for all ages[66]
- Hepatitis A vaccine for unvaccinated participants one-year-old or older[66]

(single dose of immunoglobulin Hepatitis A for infants younger than 6 months)[66]

- Routine Polio vaccination (Single adult booster recommended)[66]
- Routine Diphtheria, Pertussis and Tetanus vaccination (1 dose booster every10 years)[66]
- Tuberculosis vaccination for participants with negative PPD test for participants from low tuberculosis endemicity countries[71]
- Complete routine Measles, Mumps and Rubella(MMR) vaccination (if adults previously did not receive any doses of MMR need 2 doses 4 weeks apart, if received one dose before need 1 dose), Infants 6 to 11 months should get 1 extra dose of MMR vaccine before travel)[66,72]

Yellow fever vaccination for participants 9 months or older from endemic countries[66]

- Typhoid vaccination[66]
- Chickenpox vaccination for children, adolescents, and adults who have never had chickenpox[66]
- Shingles vaccination (adults 50 years and older)[66]
- Cholera vaccination if possible[53,73]
- Rabies vaccination (for long distance walkers)[66]
- Meningitis vaccination[74]

During the event

General measures

- Facemask use over nose and mouth[75]
- Hand hygiene with frequent washing or use of sanitizer with at least 60% alcohol[75]
- Social distancing (with about 2 arm lengths from anyone who did not travel with you especially in indoor and eating places)[75]
- Safe drinking (bottled sealed water, disinfected water, hot coffee or tea, Carbonated drinks, pasteurized milk, Ice made with bottled or disinfected water)[76]
- Safe eating (food that is cooked and served hot, Hard-cooked eggs, Fruits and vegetables you have washed in clean water or peeled yourself, Pasteurized dairy products)[76]
- Avoid sick people[75]
- Continue pre- event medications
- Use individual bed and blanket
- Use bed nets if sleeping place is exposed to the outdoors[76]
- Use permethrin-treated clothing and equipment (such as boots, pants, socks, and tents). Direct use of permethrin on skin is prohibited[76]
- Minimize the amount of exposed (uncovered) skin[76]
- Apply insect repellent to exposed skin (especially dusk to dawn)[76]
- Use an insect repellent that contains 20% or more DEET (protection lasting to several hours[76].
- Avoid contact with ticks and livestock (CCHF prevention)[76]
- Check your clothing and gear for ticks[77]
- Shower soon after being outdoors (find and remove ticks)[77]
- Stick to security guidelines (prevention of terroristic attacks)
- Avoid heavy crowds (stampede protection)
- Avoid self-harm especially with common knife or sword (prevention of blood borne infections)
- Be careful in driving

For long distance walkers

- Use supportive and comfortable walking boot instead of flat flexible ones[78]
- Use socks with moisture wicking fabrics including polyester, merino wool, and nylon (combination of fibers is preferred)[79]
- clip and file toenails
- Use hat and sunscreen with SPF of at least 15[76]
- Walk at night if possible (limit physical activity during high temperatures)[76]

- Adequate hydration (Eat and drink regularly, wear loose and lightweight clothing, use heavy colored morning urine color as indicator of dehydration)[76,80]
- Use diluted fruit juice or sports drink for walking more than 1 hour, providing 6- 8 grams' carbohydrate,12.5 mg potassium and 45 mg sodium per 100 cc water (prevention of hypoglycemia and muscle spasm)[81]
- Use tape on pressure points of the feet[82]
- Wash, Dry and moisturize the feet after walking[82]
- Rest the feet with taking off the boots and socks alternately
- Change socks alternately and use of dry, clean ones
- Lubricate and tape the blisters early[83]
- Puncture just large, irritated and painful blisters with sterile needle[84]
- Maximum backpack weight must be about 15 percent of body weight[85]
- Use walking poles[86]

After the event

- Get a viral Covid-19 test (nucleic acid or antigen test) 3-5 days after travel[87]
- For just unvaccinated participants (no complete Covid 19 vaccination), even if the test is negative, self-quarantine for the full 7 days[87]
- For test positive participants (vaccinated or not) at least 10-day isolation is necessary[88]
- If you don't get tested and asymptomatic, self-quarantine for 10 days after travel[87]
- Avoid contact people at increased risk for covid 19 for 14 days[87]
- Isolate yourself and get tested if you develop symptoms[87]
- Medical follow- up (for health authorities)
- National and international disease surveillance especially with neighboring countries (for health authorities)
- PPD testing for participants from low tuberculosis endemicity countries[71]

Table 6: Potential public health risks in Iraqi mass gathering events.

High risk	Low risk
Terrorist attacks, stampede , road accidents, drug shortage, Cardiovascular disease, Respiratory tract(including Covid-19)infections, unhealthy food and drink, gastrointestinal infections(including hepatitis), zoonotic infections(including CCHF and leishmaniosis), self-harm.	Musculoskeletal problems, sunburn,

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Conflict of Interest Disclosures

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Authors' Contributions

Authors independently reviewed the appropriate studies according to the inclusion criteria. The second author responsible for study design and preparing of the manuscript.

Ethical Statement

This study was approved in ethical committee of red crescent society of Islamic republic of Iran (IR.RCS.REC.1400.009)

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