A Systematic Review of Noncommunicable Health Issues in Mass Gatherings

Ahmed H. Alquthami, MD, MHSA;[1] Jesse M. Pines, MD, MBA, MSCE[2]

1. Department of Health Services Administration and Leadership, George Washington University, Washington, DC USA and Civil Defense Aviation, Mekkah Province, Kingdom of Saudi Arabia
2. Department of Emergency Medicine and Health Policy, George Washington University, Washington, DC USA

Correspondence:
Ahmed H. Alquthami, MD, MHSA
1301 N. Troy Street #05
Arlington, VA 22201 USA
E-mail: Bin_hmood@hotmail.com

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Abbreviations:
AHRQ: Agency for Healthcare Research and Quality
CPR: cardiopulmonary resuscitationl
ICU: intensive care unit
MG: mass gathering
MUR: medical usage rate
NLM: National Library of Medicine
PPR: patient presentation rate
PRISMA: Preferred Reporting Items for Systematic Review and Meta-analysis
TTHR: transfer to hospital rate
WHO: World Health Organization

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Abstract

Introduction: The review was conducted to evaluate if the field of mass-gathering medicine has evolved in addressing: (1) the lack of uniform standard measures; (2) the effectiveness of and needs for various interventions during a mass gathering; and (3) the various types of noncommunicable health issues (trauma and medical complaints) encountered and their severity during a gathering.

Methods: A systematic review of papers published from 2003 through 2012 was conducted using databases of MEDLINE, Ovid, CINHAL, EBSCOHost, National Library of Medicine (NLM), Agency for Healthcare Research and Quality (AHRQ), Elsevier, Scopus, and Proquest databases. Of 37,762 articles, 17 articles were included in this review, covering 18 mass-gathering events; 14 were multiple-day events.

Results: Across all events, the patient presentation rate (PPR) ranged from 0.13 to 20.8 patients per 1,000 attendees and the transfer to hospital rate (TTHR) ranged from 0.01 to 10.2 ambulance transports per 1,000 attendees. In four out of the seven studies, having on-site providers was associated with a lower rate of ambulance transports. The highest frequencies of noncommunicable presentations were headaches, abdominal complaints, and abrasions/lacerations. Most presentations were minor. Emergent cases requiring hospitalization (such as acute myocardial infarction) were rare.

Conclusions: The rate of noncommunicable health issues varies across events and very serious emergencies are rare.

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Introduction and Background

Large public gatherings, such as sporting events, religious congregations, and others are called mass gatherings, and these gatherings typically have more than 1,000 people in attendance.[1] Participants at a World Health Organization (WHO) workshop agreed to define mass gatherings as "an occasion, either organized or spontaneous, that attracts sufficient numbers of people to strain the planning and response resources of the community, city, or nation hosting the event."[2] While gatherings encompass many disciplines, in health care, the importance of a gathering is its potential to involve a delay in medical response to patients in the field due to barriers of the environment and the gathering itself.[3] Medical resources are necessary at various points of a mass gathering to prevent illness, injury, and to deliver effective care to the targeted population. Human and capital assets, such as medical supplies, ambulances, and effective communications infrastructure, are required during mass gatherings to ensure individuals receive timely medical care.

Mass gatherings carry an increased risk for participant health problems for several reasons: (1) exposure to variable weather conditions; (2) potential for traumatic injury; (3) widespread substance use; (4) transmission of communicable diseases; and (5) the activity of participants within an event (such as walking and running).[4] In addition, the nature of the gathering and the underlying characteristics of the participant population raise the risk for medical problems.[4] There are two types of planning for health care during mass gatherings: (1) planning for preventive measures through safeguarding food conditions, hygiene, water sanitation, and waste disposal and (2) planning for the management of health problems during events, such as on-site treatment capacity for minor conditions, and emergent medical response capacity (medical providers, ambulances, clinics, and hospitals) when more advanced services are required. A review

in 2002 explored how various characteristics of the environment and population contribute to the utilization rate for on-site health problems, specifically the patient presentation rate (PPR).[1] Several issues were raised in the review regarding the literature on mass gatherings, specifically, that there were: (1) a lack of uniform standard measures; (2) minimal evidence about the effectiveness of and needs for various interventions during a mass gathering; and (3) few reports of the types of illness encountered and their severity. In addition, much of the existing literature on health-related problems during mass gatherings has focused on communicable diseases, such as infectious disease. To the authors' knowledge, there has been no systematic review focusing specifically on noncommunicable health issues, specifically heat-related illness, trauma, or more serious emergencies, such as asthma or acute myocardial infarction.

A systematic review was conducted of mass-gathering research to report data on the rate of medical service use for noncommunicable health issues.

Materials and Methods

Review Design

A review of the literature published in 2003 or later on noncommunicable health problems during mass gatherings was conducted. The research period was started in 2003 because the publication date of the last review on interventions during mass gatherings was the previous year; however, the scope of the review was more narrow as only articles that reported data on noncommunicable health issues were only included.[5-21] This review did not include any medical records or review of personal health information.

A database search strategy was created and the following databases were used: MEDLINE (Medline Industries, Inc., Mundelein, Illinois USA), Ovid (Ovid technologies, Inc., New York City, New York USA), CINHAL (EBSCP Industries, Inc., Ipswich, Massachusetts USA), EBSCOHost (EBSCP Industries, Inc., Ipswich, Massachusetts USA), National Library of Medicine (NLM) (U.S. National Library of Medicine, Bethesda, Maryland USA), Agency for Healthcare Research and Quality (AHRQ) (Agency for Healthcare Research and Quality, Rockville, Maryland USA), Elsevier (Elsevier, Inc., Philadelphia, Pennsylvania USA), Scopus (Elsevier, Inc., Philadelphia, Pennsylvania USA), and Proquest (Proquest, L.L.C., Ann Arbor, Michigan USA). The Ovid search used a combination of keywords including "mass," "gathering," and "medicine." These terms were translated to equivalent terms for other databases. No language, age, or publication limits were applied. Given the heterogeneity of designs, interventions, and outcome measurements in the reports of the studies in this field, a qualitative systematic review was conducted rather than a quantitative meta-analysis.

For the review, the definition of a mass gathering was a place where a sufficient number of individuals gather for an event causing a potential delay for an effective emergency response because of features of limited access through the environment and location.[3] The research only included reports of original data on mass gatherings that met the following criteria:

1. Papers published after December 2002;
2. Articles that reported one or more of the prehospital measures of: patient presentation rates (PPR) – number of patients presenting during an event per 1,000 people in attendance; transfer to hospital rates (TTHR) – number of patients transported to hospitals during an event per 1,000 attendance; and medical usage rate (MUR) – percentage of visits as patients requiring medical care per 10,000 in attendance (percentage of patients per ten thousand);[1,3]
3. Articles that reported data on noncommunicable health problems in prehospital settings. Noncommunicable health problems were defined as any health issue for which participants sought care with the exclusion of communicable health issues such as infectious diseases.

Data Collection and Processing

Data were collected and processed by a single author who was trained through a series of meetings between the authors to discuss the purpose of the study, search terms, and inclusion criteria. For each database, the reviewer screened all retrieved titles and abstracts for eligibility. Articles meeting inclusion criteria through the screening process underwent a full-text review, and bibliographies of full-text articles were screened for additional articles to be included in the full-text review. All included studies underwent data abstraction directly into Table 1. The data extracted from included articles were description of event, number of attendees, description of the environment (indoors/outdoors, humidity, month event occurred, and weather), description of intervention of prehospital planning (interventions or outcomes generated by the articles), PPR, and TTHR.

To summarize evidence accurately and reliably, the review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.[22] A PRISMA flow diagram with its four phases was created (Figure 1). In order to create comparable prehospital measures between multiple-day and single-day events, researchers averaged the total number of attendees to the number of attendees per day, patient presentations per day, and ambulance transfers to hospitals per day in multiple-day events so they could be interpreted as single-day measures for comparison. Also, researchers used multiple-events (multiple locations across multiple days) and multiple-day events interchangeably.

Results

The literature search identified 37,762 related records, with 318 articles available in the databases that had the combination of keywords. After duplicates were removed, 246 articles remained. Of those, 172 articles were excluded following title and abstract review. A total of 82 full-text articles were reviewed to assess whether or not they met inclusion criteria. References of the reviewed articles were assessed and eight additional articles were identified to include in the review.

A total of 17 articles ultimately were included, spanning 18 events. Of those, seven were multiple-day events, four were single-day events, and seven involved multiple events (Table 1). The number of attendees ranged from 5,475 at the Adelaide Schoolies Festival[20] to 3.5 million at the Melbourne Commonwealth Games.[18] The articles also showed that 16 of the events were outdoors and two were indoors. Across the included papers, the PPR ranged from 0.13-20.8 patients per 1,000 attendees and the TTHR was 0.01-10.2 ambulance transports per 1,000 attendees.

Some of the common themes across the included articles were: events with on-site providers (physicians, paramedics, and clinics) had lower ambulance transfers (four studies),[5,11,13,16] the smaller the number of attendees the higher the rate of prehospital

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Study	Period of Study	Event Description	Event Attendance	Event Environment	Lessons Learned/Results	PPR *(Presentation/ 1,000)*	TTHR *(Transfers/ 1,000)*
Astrodome events[5]	1996-1997	Houston, Texas USA 253 events analyzed in a 10-month period	3.3 million	Indoors	Even with the large number of attendees at each event, spectators seeking care did not require CPR, ICU admission. Cardiac arrests were not noticed.	0.83	0.02
California Speedway[6]	1996-1997	California USA 3 days	147,000	Outdoors	The presence of on-site field physician-level care at the event reduced the required transports to hospitals.	3.29	1. 0.79 2. 0.089[a]
Football stadium (South Eastern USA)[7]	1999-2003	South Eastern USA 4 football seasons; 20 games	53,371 to 61,625	Outdoors	A positive correlation of heat index with the volume of patients seen in the event was noticed.	0.28-1.2	-
Virginia football stadium[8]	2001-2004	University of Virginia in Charlottesville, Virginia USA 4 years	Mean attendance: 59,394 Full capacity of stadium: 60,000	Outdoors	High numbers of providers in an event increased health care utilization, while the presence of on-site physicians decreased the number of patients requiring transport to hospitals.	1.09	0.07
Royal Adelaide[9]	2002	Australia 9 day agricultural and horticultural show	622,234 (for all 9 days)	Outdoors and Indoors	Injuries occurred in ¼ of the patients being treated, indicating an injury burden in events. With effective risk management and public education, the burden can be decreased.	1.65	0.01
Nan-Tou Festival (Sun-Moon Lake)[10]	2002	Nan-Tou, Taiwan 30 km long distance swim 6 hours	15,189	Outdoors	Unbounded, cold weather, and swimming in a unique MG that required allocation for more resources than traditional MGs.	4.15	0.13
FIFA World Cup Korea/ Japan[11]	2002	Japan and Korea 32 games 30 days	1,439,052 (total) 44,970 (mean/ game)	Outdoors	Obtaining epidemiological data of a MG can develop a sound prediction, and can determine risk factors of PPR. This can be useful in planning appropriate medical care.	1.15 Total (1.21/game)	0.05

Table 1. Articles Published 2003 or Later on Mass-Gathering Events that Discussed Prehospital Measures and Described Conclusions and Outcomes on Noncommunicable Health Issues *(continued)*

Study	Period of Study	Event Description	Event Attendance	Event Environment	Lessons Learned/Results	PPR *(Presentation/ 1,000)*	TTHR *(Transfers/ 1,000)*
1st East Asian Football Championship (EA) and the 24th European/South American Cup (Toyota Cup)[12]	2002	Tokyo, Saitama, and Yokohama 1 week (the collection of data occurred in 4 days of the event)	52,895 (mean attendance)	Outdoors	Presence of on-site medical facilities decreases the TTHR and decreases the burden on hospitals during MGs.	0.96 (0.25)[b]	0.15
Toronto Rock[13]	2003	Rolling Stones concert 12 hours	450,000 (with a planned capacity of 500,000)	Outdoors	Types and frequencies of complaints at a single day event are similar to multi-day events. Also, on-site doctors play a critical role in treating patients who cannot be transported.	4.16	0.05[c]
Toronto Rock[14]	2003	Rolling Stones concert 12 hours	450,000 (with a planned capacity of 500,000)	Outdoors	Treat-and-release medical directives for paramedics at MGs can decrease the TTHR.	4.16	0.087c
TV- Fun Fair[15]	2003	In a city center with a site that measured 3 kilometers 9 hours	100,000 children	Outdoors	This event revealed that half of the PPR were children under the age of 14; 33% were not accompanied by an adult. This indicates a requirement for specialized pediatric staffing and appropriate resource allocation during MGs.	1.92 (0.96 children; 0.96 adults)	0.02 (0.04)[b]
Suwa Onbashira Festival[16] *UY: Upper Shrine, Yamadashi Festival* *US: Upper Shrine, Satobiki Festival* *LY: Lower Shrine, Yamadashi Festival* *LS: Lower Shrine, Satobiki Festival*	2004	Suwa Grand Shrines in Suwa City, Nagano, Japan Occurs every six years for a 2-month period Collection of data occurred during 12 days of the events.	1.8 million (total) 460,000 (UY) 413,000 (US) 618,000 (LY) 420,000 (LS)	Outdoors	Adequate medical coverage of the event decreased the occurrence of serious medical incidents. Also, appropriate triage led to efficient coverage of the PPR and decreased the TTHR.	0.13 0.03 (UY) 0.06 (US) 0.24 (LY) 0.11 (LS)	0.04 0.03 (UY) 0.01 (US) 0.06 (LY) 0.02 (LS)
NY State Fair[19]	2004- 2008	New York State Fair, New York USA 12 days	1-3 million	Outdoors	This event revealed that MGs consisted mainly of females with the common presentation of dehydration/ heat-related illness.	0.48 (SD = 0.11)	0.027 (SD = 0.01)

Table 1. Articles Published 2003 or Later on Mass-Gathering Events that Discussed Prehospital Measures and Described Conclusions and Outcomes on Noncommunicable Health Issues *(continued)*

Study	Period of Study	Event Description	Event Attendance	Event Environment	Lessons Learned/Results	PPR *(Presentation/ 1,000)*	TTHR *(Transfers/ 1,000)*
The Rainbow Family of Living Light[17]	2005	Cranberry Glades Area of the Monogahela National Forest, West Virginia USA 2 weeks	10,000	Outdoors	Participants were mainly an underserved population without health care causing them to increase the utilization of hospitals during the event.	There were no on-site facilities	10.2 (1.02)[b]
Melbourne Commonwealth Games[18]	2006	Melbourne, Australia Multiple cultural events in 21 different venues during 12 days	3.51 million	Outdoors	Majority of first-aid presentations were of low acuity, which decreased the TTHR. Also, the effective prehospital health care services decreased the TTHR.	1.0 (0.86)[b]	0.02
Adelaide Festival[20]	2009	Australia in the summer for school festivals that lasted for 3 days	5,475	Confined Outdoors	Arbon's conceptual framework highlights the understanding of the inter-relationships of various characteristics of MGs and sheds light on the PPR, risk behaviors, and its contributing factors. Also, this event presented that females utilized care more.	20.8[b]	6.7[b]
A. Oakbank Racing Carnival[23] *B. Royal Adelaide Show*[9]	2002-2004 & 1994-2004	Two mass gatherings in Australia A. Racing carnival 2 days B. Adelaide show 9 days	A. 111,374 (mean) B. 617,619 (mean)	Outdoors	Performing "live" injury surveillance, with real time data at MGs established better recognition of hazards and enhanced the surveillance and improved public safety.	A. 0.97 (mean) B. 9.7 (mean)	A. 0.02 (mean) B. 0.04 (mean)

Table 1 *(continued)*. Articles Published 2003 or Later on Mass-Gathering Events that Discussed Prehospital Measures and Described Conclusions and Outcomes on Noncommunicable Health Issues

Abbreviations: CPR, cardiopulmonary resuscitation; ICU, intensive care unit; MG, mass gathering; PPR, patient presentation rate; TTHR, transport to hospital rate.

[a]The first TTHR represents the ambulance transports without on-site physicians; the other TTHR represents the ambulance transports with physicians on site.

[b]Value as presented in the paper. This value is not the same as calculated by the authors of this study.

[c]The discrepancy in TTHR between the Toronto Rock events is because the first study used 22 ambulance transports to offsite hospitals, while the second used all the on-site and off-site hospital transfers (total of 39).

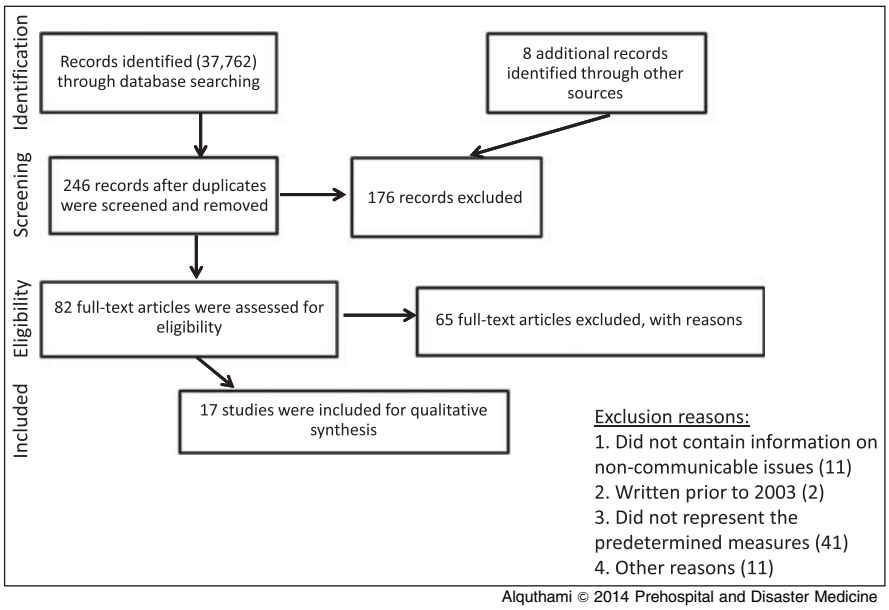

Figure 1. Flow of Information Through the Phases of a Systematic Review Using the PRISMA Approach[22]
Abbreviation: PRISMA, Preferred Reporting Items for Systematic Review and Meta-Analysis.

medical use (seven studies),[6,9,10,13-15,20] the presence of non-communicable health issue surveillance systems (three studies),[17,20,23] and abundant availability of health resources increased the rate of utilization (two studies).[13,23]

The most frequent noncommunicable health issues presented in mass gatherings were headaches (seven studies, comprising 24%-27% of cases),[5,6,10-13,18] and abdominal complaints (seven studies, comprising 1.4%-31% of cases),[5,6,8,10-12,18]. These were followed by presentations of abrasion/lacerations (five studies)[5,6,9,10,18] with a prevalence of 15%-60% across events, orthopedic lesions (five studies),[5,6,9,11,12] ocular injury (five studies),[5,6,9,10,18] and syncope/dizziness (five studies);[5,8,10,11,13] and by burns (four studies),[5,6,9,18] chest pain (four studies),[5,6,8,11] and heat-related illness (four studies).[5,6,11,13]

Discussion

The research assessed papers on mass-gathering events published over 10 years and reported data on noncommunicable health issues. Variation was found in the reported rates of both on-site medical usage (treat and release, 0.13-20.8 presentations per 1,000), and ambulance transport rates (0.01-10.2 transports per 1,000). De Lorenzo and colleagues found that PPRs varied from 0.14-90 patients per 1,000 attendees, with most values ranging from 0.5-2 patients per 1,000 attendees.[24] A low PPR of 0.13 was reported in the Suwa Onbashira Festival, a religious event, and could have been due to lower rates of substance use or the tendency to defer medical care in order to keep participating.[16] By comparison, a PPR of 20.8 was observed in the Adelaide Schoolies Festival which had a small number of attendees.[20] Both reporting of low and high rates may represent a reporting bias. In the case of the Adelaide Schoolies Festival, the high rate may be the result of the fact that all utilization of care required documentation. This differs from other events where many health issues go unrecorded for reasons such as going to offsite providers for care, deferring care until after the event, and minor or other health issues not documented because of incomplete data collection. The variation in presentation rates also may be a result of different methods of capturing prehospital data.

A similar wide variation in the TTHR was found, ranging from 0.01-10.2 ambulance transfers per 1,000 attendees. The lowest TTHR of 0.01 was in the Royal Adelaide Festival of 2002; this could have been low due to proper event planning for both staffing and available resources with the proper communication which limited the need for transportation to hospitals.[9] Another possible reason for the small numbers of transports to hospital is the study only reported injuries and not noncommunicable medical complaints. By comparison, the Rainbow Family of Living Light had a high rate of 10.2 ambulance transfers per 1,000 attendees; this could have been so high because of the lack of on-site health providers.[17]

Four of seven studies involving on-site providers (physicians, paramedics, and clinics) reported lower ambulance transports to hospitals.[5,11,13,16] This may be because many minor complaints often can be evaluated and treated by on-site providers; only the more serious cases would require transport to the hospital after screening. On the other hand, three articles, reporting on a Virginia football stadium,[7] the Suwa Onbashira Festival,[16] and the New York State Fair,[19] had high patient presentations and high ambulance transport rates because the ambulance presence of on-site providers allowed spectators to over-utilize the services. In most cases, multiple-day events were associated with higher rates of medical use, confirming the previous systematic review of data before 2002 on this topic;[1] however, the "Toronto Rock" single-day event had higher rates of use than many of the multiple-day events due to the youthful crowd, the usage of alcohol, and the confined space.[1] Somewhat paradoxically, smaller events had higher rates of use of medical resources, confirming findings from the Milstein et al article.[1] The reasoning was that decreased attendee flow allowed more spectators to utilize health services. By contrast, the FIFA 2002 World Cup article,[11] which pertained to a multiple-day, multiple-location event, reported no relation between crowd attendance and

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	Astrodome[5]	Speedway[6]	University of Virginia[8]	2002 Royal Adelaide[9]	Sun-Moon Lake[10]	FIFA 2002 World Cup[11]	EA/Toyota Cup[12]	Toronto Rock[13]	Melbourne Games[18]
1.Trauma: (*TOTAL*)	*37.6%*	*44.3%*	*6.8%* (classified all trauma in one group)	*99%* (only documented trauma)	*84%*	*23.5%*	*15.8%*	*10.2%* (classified all trauma in one group)	*49.4%*
Abrasion/ lacerations	19.9%	28.8%	N/A[a]	27%	54% abrasions 6% lacerations	N/A	N/A	N/A	15% minor wounds
Orthopedic (Strains/ Sprains)	4.8%	7.4%	N/A	14% falls	N/A	3.6%	15.8%	N/A	N/A
Burns	0.3%	2%	N/A	6%	N/A	N/A	N/A	N/A	2.6% (excluding sunburns)
Musculoskeletal (soft tissue) Issues	3.4%	N/A	N/A	N/A	11%	N/A	N/A	N/A	9%
Ocular Injury	1.4%	5.1%	N/A	9%	13%	N/A	N/A	N/A	2.8%
Blisters	2.8%	N/A	N/A	N/A	N/A	19.9%	N/A	N/A	20%
Other Trauma	3.6% previous injuries	1%	N/A	12% ride/ Amusement-related, 6% animal-related, 3% sport-related, 1% apparent assault, 1% moving vehicle, 7% other injury, 13% unknown	N/A	N/A	N/A	N/A	N/A
2. Medical Complaints: *(TOTAL)*	*62.4%*	*55.7%*	*92.5%*	*N/A*	*17%*	*77%*	*79.6%*	*89.9*	*50.6%*
Headaches	29.8%	26.8%	N/A	N/A	2%	11.5%	5.3%	26.6%	24.2%
Syncope/ dizziness	2.7%	N/A	52% altered mental state	N/A	2% altered mental state	0.2% syncope, 2.1% dizziness	N/A	3.8%	N/A

Table 2. Type and Frequency of Noncommunicable Health Issues During Mass Gatherings (only 9 articles presented reported clinical data) *(continued)*

	Astrodome[5]	Speedway[6]	University of Virginia[8]	2002 Royal Adelaide[9]	Sun-Moon Lake[10]	FIFA 2002 World Cup[11]	EA/Toyota Cup[12]	Toronto Rock[13]	Melbourne Games[18]
Chest Pain	1.1%	0.8%	12.7%	N/A	N/A	0.7%	N/A	N/A	N/A
Heat Related Illnesses	1%	2.7%	N/A	N/A	N/A	4.1%[b]	N/A	12.3%	N/A
Abdominal Complaints	1.4%	3.9%	0.5%	N/A	5%	6.9%	31.6%	N/A	2.5%
Nausea/ vomiting	2%	0.2%	N/A	N/A	N/A		N/A	7.6%	N/A
Shortness of Breath	N/A	N/A	7.3%	N/A	N/A	0.3%	N/A	6.6%	N/A
Alcohol/drug Intoxication	N/A	N/A	N/A	N/A	N/A	0.7%	5.3%	2.5%	N/A
Convulsions	N/A	N/A	N/A	N/A	3%	0.2%	5.3%	N/A	N/A
Other Medical Complaints (included the problems that the table did not include)	3.3% asthma exacerbation, 5.6% heartburn, 2.9% Cold/flu symptoms, 4.4% menstrual symptoms, 1.1% dental pain, 0.3% blood pressure checks, 1.5% allergic reactions, 5.3% other	1.9% asthma exacerbation, 0.2 allergic reactions, 19.2% other	10.7% weakness, 9.3% other	N/A	5% chills	3% menstrual complaints, 0.1% cardiac arrest, 0.6% insect bites, 24.9% other, 21.7% unrecorded	26.3% cold/flu symptoms, 5.3% skin trouble, 5% alcohol	16.7% other, 13.8% not specified	5.5% pain, 2.3% insect bite, 5.7% other, 10.4% not specified

Table 2 *(continued)*. Type and Frequency of Noncommunicable Health Issues During Mass Gatherings (only 9 articles presented reported clinical data)

[a]N/A: Information was not available in the article.

[b]The study did not indicate the reason for the heat-related illness in the cold weather.

presentation rates; this could be due to indoor settings and limited number of spectators.

One study reported a positive correlation of heat index with the rate for medical use during an event.[7] By contrast, the authors of the paper on the Sun Moon Lake Festival concluded that very cold weather, too, can increase the need for medical usage.[10] This indicates that extremes of weather are contributors to higher rates of medical use, confirming the findings of Milstein and colleagues.[3]

Table 2 illustrates the frequency and severity of cases of noncommunicable health issues found during mass gatherings. Non-emergent cases in events were mainly headaches, abdominal complaints, and abrasions/lacerations. Emergent cases that posed a significant threat to life, such as cardiac arrest (0.1% in the FIFA 2002 World Cup),[11] allergies (0.2-1.5% in two studies),[5,6] and asthma (0.9-1.3% in two studies)[5,6] were relatively rare, confirming findings in a prior study.[4]

An important observation from this review of noncommunicable health issues is that they seem to vary according to the nature and characteristics of the event. For example, cardiac arrest that occurred in the FIFA World Cup of 2002 was associated with the strenuous exercise.[11] In addition, insect bites were noticed at outdoor events, as seen in the FIFA World Cup[11] and the Melbourne event.[18] Several studies suggested heat-related illness as a major issue in mass-gathering events, but it only represented 1%-12% of the cases; this could have been under diagnosis of heat exhaustion with headache.[5,6,11,13]

Limitations

First, this review included only studies conducted for the explicit purpose of evaluation of noncommunicable health issues post 2002 in mass gatherings; this could have caused sampling bias. This method may have excluded certain descriptive studies that readers might consider relevant to the field of mass-gathering medicine with regards to planning, preparation, and delivery of care. During the review selection, a single reviewer assessed and made decisions about inclusions for title, abstract, and full-text review. The researchers were unable to assess objectively whether this process excluded articles; however, there was substantial training with multiple sample full-text reviews with the reviewer, and any questions about inclusion were resolved between the two authors. In addition, the bibliographies of all full-text articles were screened to find additional articles of interest.

It was challenging to draw definitive conclusions when comparing each of the reference studies, given the differences between interventions and outcomes. Studies were performed at different locations, which limits the ability to assess each researcher's understanding of the subject matter of mass gatherings. Generalizations of outcomes from interventions in each study reviewed may be biased because of the multinational nature of reported data.

Future research could be directed towards the assessment of the severity and acuity of noncommunicable disease. In addition, follow-up of patients during mass gatherings could be assessed to identify the efficacy of these planned measures on patient outcomes. Another important aspect is the use of information technology to assess and better understand the dynamics of interday variability of events.

Conclusion

This article explored prehospital measures during mass gatherings for noncommunicable issues in the last 10 years. Several observations were made: (1) during large events, there were paradoxically low presentation rates; (2) single-day events can utilize as many resources, if not more, as some multi-day events; (3) headaches and abdominal complaints were the most frequent disorders documented; and (4) emergent cases (such as cardiac arrest, allergies, and asthma) contributed to a small portion of the documented complaints.

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