The Bridge Between Need and Access: Distribution of Trauma Care Facilities at a Religious Mega Mass Gathering

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Abstract- Participating in mass gatherings puts people at risk of incidents. The distribution of resources should be based on need. The purpose of this study was to investigate the distribution of trauma care facilities based on need and access at a religious mass gathering in Iran. This national cross-sectional study is based on obtained data including the number of visits to health centers (NVHC) and the number of injuries visits health center (NIVHC) as needs and the number of physicians, paramedic, ambulance, and treatment center as access in border cities of Iran and Iraq in 2016. Gini coefficient, Lorenz curve and the Pearson correlation coefficient were applied to measure the level of equality in the distribution of trauma care and the correlation between access and need. The facilities were relatively distributed equally at the border towns in Iran; however, were not equally distributed in Iraq. There is no significant association between the paramedic for NIVHC and ambulance for NIVHC and NVHC. Moreover, there was a significant association between physician for NIVHC and NVHC, a paramedic for NVHC, and treatment centers for NIVHC and NVHC. The consequences of incidents could be reduced if distributing trauma care facilities equals at mass gatherings.

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Introduction

Human mass gatherings refer to the accumulation of a specific number of people with a specific purpose in a specific place and time so that the density causes pressure on the health system at the local and regional level (1). Mass gatherings are conducted to political, musical, social, and spiritual purposes (1). Arbaeen ceremony is one of the great religious mass gatherings (2), and every year pilgrims move from different countries to Karbala to commemorate the martyrdom of Imam Hussein (Peace upon him), the third Imam of Shiite Muslims. According to the report of Iran's Hajj and Pilgrimage Organization, the number of Iranian pilgrims participating in the Arbaeen ceremony in 2016 was 2.5 million (3) .

Since many people gather in a particular area, the likelihood of accidents may increase, so in this situation, the balance of supply and demand and the providing of emergency medical services is essential (4,5). According to the report of the Iran Emergency Organization, 305, 373 trauma cases occurred at the Arbaeen ceremony in 2016 that required trauma services (6). One of the most important elements of mass gathering management is on-site health care because persons may be injured or sometimes lose their lives during large-scale public events (7). Appropriate access to facilities decreases the burden of fatality following injury in mass gatherings (8). Several studies have suggested that resource management such as ambulances, health centers, and staff should begin before the mass gathering event (9-12). Significant determinants of the facilities are the number of pilgrims, the meantime of the event, and the mean expected time to use the facilities(13). Distribution of facilities based on need and access is used not only in pre-hospital trauma care, disasters, and Mass Casualty Incident (MCI) (14-16); but also can be applied in in mass gatherings.

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Regarding the importance of the of facilities distribution based on access and need, it is important to note that even, low access to health services is one of the most important causes of road traffic mortality and access to pre-hospital care resources for trauma; that can reduce traffic-related mortality and morbidity (14,17,18).

Various factors such as population mobility, crowd size, weather, daily average humidity, location, type and time of event, patient presentation rates (patients presenting per 1,000 participants), types of patients at mass gatherings, crowd demographics including age and general health of audience, crowd mood, indoors or outdoors of the event, preparation for disaster/mass casualty incidents are considered to plan, estimate, and predict medical services in mass gatherings (19-21). Understanding these factors is essential in decision making for the allocation of medical resources in mass gatherings (19). The aim of this study was to investigate the distribution of trauma care facilities at a mega religious mass gathering in Iran.

Materials and Methods

Study context

The Arbaeen ceremony is held annually in Safar month, one of the lunar months. The time of the ceremony depends on the Islamic (Hijri) calendar, which is 10 days shorter than the solar year. Iranian pilgrims and some countries such as Afghanistan and Pakistan have entered Iraq from the three border towns Shalamcheh, Mehran and Chazaba. Route of the Arbaeen's pedestrianism from Najaf to Karbala is 80 kilometers. In the border towns and route of the Arbaeen's pedestrianism in Iraq, all of the health services are provided to the pilgrims.

Data sources

Two organizations were responsible for providing basic health care in Arbaeen mass gathering in Iran. Ministry of Health and Medical Education (MOHME) was responsible for examination, treatment, and observation of patients at the Arbaeen ceremony in Iran. Iranian Red Crescent (IRCS) also was responsible for treatment and care patients in Iraq, so information about the resources and facilities of Iran were obtained by MOHME and information about the resources and facilities of Iraq were captured by IRCS. In this study, access was defined as the number of physicians, paramedics, ambulance and treatment centers facilities and need were defined as number visits to health centers and the number of injuries visits health center. Four variables were used as indicators for access; including the number of physicians (General Physician and specialist), number of paramedics (nurse, EMS and rescuer), number of ambulances (ambulance, bus ambulance and ambulance motor) and number of treatment centers (field hospital, outpatient clinic and hospitals supporting the first ring). Two variables were used as indicators for need, the number of visits to health centers (NVHC) and the number of injuries visit the health center (NIVHC). NVHC was defined as the number of cases referred to the treatment centers as well and NIVHC was defined as the number of injuries recorded.

Lorenz curve was used to distribute the trauma care facilities based on need and access. Lorenz curve can compare the distribution of a particular variable with an equal distribution that demonstrates equality (22-24). The equality distribution curve is demonstrated by an oblique line, and the smaller the deviation of the Lorenz curve from this line, the smaller the equality (24). The cumulative proportion of NVHC and NIVHC is shown on the Y-axis and the cumulative proportion of the access variables on the X-axis. The Gini coefficient is concluded from the Lorenz curve and accounted as the proportion of the zone between the oblique line and the Lorenz curve, to the whole zone below the oblique line (24,25).

Data analysis

The number of physicians, paramedics, ambulance and treatment centers facilities and NVHC, and NIVHC was calculated for border cities of Iran (Mehran, Shalamche, and Chazaba) and route of the Arbaeen's pedestrianism (Najaf, Najaj to Karbala, and Karbala). Gini coefficient and Lorenz curve were applied to measure the level of equality in the distribution of trauma care facilities and number visits to health centers and numbers of injuries at Arbaeen mass gathering.

Statistical analyses were performed using SPSS version 15. The Pearson correlation coefficient was used in order to see if trauma care facilities were distributed based on NVHC and NIVHC rates and possible association with access. The current study was carried out with the permission of the Ethics Committee of Shahid Beheshti University of Medical Sciences on 2017/08/10 No IR.SBMU.RETECH.REC.1396.349.

Results

Table 1 showed the distribution of trauma care facilities (including physicians, paramedics, ambulance, and treatment centers) as access and NVHC and NIVHC as need at Arbaeen mass gathering. In this study, border towns in Iran were Mehran, Shalamche, and Chazaba and

route of the Arbaeen's pedestrianism in Iraq was Najaf, Najaj to Karbala, and Karbala.

The Lorenz curves demonstrated that the trauma care facilities were relatively distributed equally at the border towns in Iran; however, it was not equally distributed in Iraq (Figure 1).

Table 1. Distribution of trauma care facilities based on need and access at Arbaeen mass gathering in 2016

		Need		Access			
		NVHC	NIVHC	Physicians	Paramedics	Ambulance	Treatment centers
1	**Mehran**	275937(16%)	28494(9.3%)	353(38.7%)	2881(50.1%)	357(67.9%)	61(40.1%)
2	**Shalamche**	132450(7.7%)	12212(4%)	169(18.5%)	1383(24%)	87(16.5%)	29(19.1%)
3	**Chazaba**	110375(6.4%)	10177(3.4%)	141(15.4)	1152(20.1%)	52(9.9%)	28(18.4%)
4	**Karbala**	547896(31.7)	154490(50.6%)	120(13.1%)	150(2.6%)	14(2.7%)	22(14.5%)
5	**Najaj to Karbala**	201018(11.6%)	17431(5.7%)	30(3.3%)	80(1.4%)	6(1.1%)	8(5.3%)
6	**Najaf**	459324(26.6%)	82569(27%)	100(11%)	100(1.8%)	10(1.9%)	4(2.6%)
	Sum	1727000(100%)	305373(100%)	913(100%)	5746(100%)	526(100%)	152(100%)

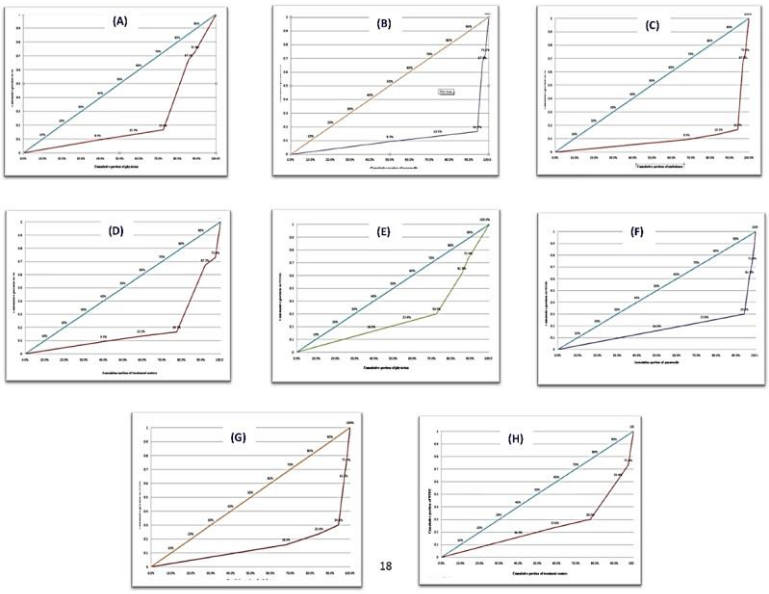

Figure 1. Lorenz curves of distribution of trauma care facilities based on need and access at Arbaeen mass gathering in 2016; (A) Physician, NIVHC; (B) Paramedic, NIVHC; (C) Ambulance, NIVHC; (D) Treatment centers, NIVHC; (E) Physician, NVHC; (F) Paramedic, NVHC; (G) Ambulance, NVHC; (H) Treatment centers, NVHC

Substantial differences were observed in the distribution of trauma care facilities in Iran and Iraq. The distribution of resources in the border towns is more equally to that of the route of the Arbaeen's pedestrianism in Iraq. Among the facilities, physicians for NIVHC, physician for NVHC, and treatment centers for NVHC were most equally distributed and the distribution of paramedic for NIVHC was least equally. The calculation of the Gini coefficients supported the results of the Lorenz curves (Table 2).

Table 2. Gini coefficients for trauma care facilities based on need and access at Arbaeen mass gathering in 2016

Variables	Gini coefficient
Physician, NIVHC	0.4342
Paramedic, NIVHC	0.927
Ambulance, NIVHC	0.683
Treatment centers, NIVHC	0.623
Physician, NVHC	0.405
Paramedic, NVHC	0.757
Ambulance, NVHC	0.693
Treatment centers, NVHC	0.432

The correlation analyses demonstrated no significant association between the paramedic for NIVHC and ambulance for NIVHC and NVHC. This means that increasing NIVHC and NVHC does not increase the number of ambulances, and increasing NIVHC does not increase of paramedics. Moreover, there was a significant association between physician for NIVHC and NVHC, a paramedic for NVHC, and treatment centers for NIVHC and NVHC. This means that increasing NIVHC and NVHC increases the number of physicians and treatment centers and increasing NVHC increases the number of paramedics (Table 3).

Table 3. Correlation between need and access at Arbaeen mass gathering in 2016

Access	NIVHC	NVHC
Physician	.030	.006
Paramedic	.108	.039
Ambulance	.141	.059
Treatment centers	.041	.011

Discussion

This study is the first of its kind conducted in distribution trauma care facilities based on need and access in a mega mass gathering. The trauma care facilities were relatively distributed equally at the border towns in Iran; however, were not equally distributed in Iraq. The correlation analyses demonstrated no significant association between the paramedic for NIVHC and ambulance for NIVHC and NVHC. Moreover, there was a significant association between physician for NIVHC and NVHC, a paramedic for NVHC, and treatment centers for NIVHC and NVHC.

There is a difference in the distribution of health resources in all countries. These variations can be estimated from standard health statistics. However, not all of these differences can be explained as inequities. The word equity has an ethical burden. Therefore, to explain a particular condition as inequitable, the cause must be measured and judged as unfair in the rest of the community (25). One example of equality is the fair distribution of resources. Resource allocation to mass gatherings generally may be conducted by the experience of people and historical records of the event or based on "trial and error" (19,23), While the allocation and distribution of medical resources should be based on valid evidence rather than guess and doubt (19). Several factors such as the number of pilgrims, the time and place of the event, are involved in determining the facilities (13). Planning the resources needed for mass gatherings should begin before the event and various organizations are involved locally, regionally, and nationally (5). Medical service planning is different based on the type of mass gatherings, which is referred to them. For example, the study of Kumbh Mela mass gathering in India showed that in 1966 only 20% of the budget was allocated to health, while in 2013, the rate increased to 45% (9). In 1966, there was only one hospital with 100 beds at the event venue, while in 2013, out of every 14 region 1936-hectare areas, a field hospital, a central hospital, 24 alternative hospitals, 150 first-aid centers with a physician and one pharmacist, as well as 120 ambulances, about 250 specialist physicians, along with hundreds of health workers to provide 24-hour services, as well as a level 3 hospital with 100 beds, were considered for referral (9). In other religious gatherings, such as Hajj, there are 24 hospitals with 4964 beds along with 141 primary health care centers. The most advanced crisis management systems are set in 136 health care facilities with 17,609 expert personnel. More than 15,000 physicians and nurses also provide services (12). Distribution of resources in sporting mass gatherings such as the Olympics also plays an important role. The number of logistics required at the 2004 Athens Olympics included 270 ambulances, 25 mobile Intensive care units, 12 motorcycles, 2 mobile co-ordination centers, 2 vehicles for managing mass casualties as well as equipment for managing hazardous materials (11). In planning, agreements based on the existing property between neighboring countries to respond to any unforeseen events must be concluded (26). There are no international standards for the number of staff and equipment in mass gatherings and the number of medical personnel required may be determined based on evidence or local laws (27). The perfect level of medical care that should be provided has been opposed (16). While Boyle believes that planners and executive managers should contribute appropriately to trained staff, but they should

avoid over-staffing (16). However, Koenig believes that when the event is held for the first time, overestimation of personnel and equipment is better than under-staffing or under-resourcing (28). It should be noted that most mass gatherings are often associated with severe traumatic injuries, so the presence of skilled and enough physicians and paramedics on-site is required (16). In this study, the trauma care facilities were relatively distributed equally at the border towns in Iran; however, they were not equally distributed in Iraq. The involvement of Iraq in internal and external wars has weakened the health services system in the country. The analysis of results can be useful for stock supplies or equipment that is essential during mass gatherings (28) can help planning, preparedness, and training in mass gathering event s (29,30).

This study indicated that the distribution of trauma care facilities does not reflect needs in terms of NIVHC and NVHC rates in Iraq, despite the governmental policy. Moreover, the study showed trauma care facilities were relatively distributed equally at the border towns in Iran. The involvement of Iraq in internal and external wars has weakened the health services system in the country. It is suggested that the consequences of incidents could be reduced if the needs in terms of NIVHC and NVHC are taken into consideration when distributing trauma care facilities equals at mass gatherings.

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