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Research Paper

Understanding the drivers on medical workloads: an analysis of spectators at the Australian Football League

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Abstract

Objective. The present study was designed to further understand the psychosocial drivers of crowds impacting on the demand for healthcare. This involved analysing different spectator crowds for medical usage at mass gatherings; more specifically, did different football team spectators (of the Australian Football League) generate different medical usage rates.

Methods. In total, 317 games were analysed from 10 venues over 2 years. Data were analysed by the ANOVA and Pearson correlation tests.

Results. Spectators who supported different football teams generated statistically significant differences in patient presentation rates (PPR) ($F_{15, 618} = 1.998$, $P = 0.014$). The present study confirmed previous findings that there is a positive correlation between the crowd size and PPR at mass gatherings but found a negative correlation between density and PPR ($r = -0.206$, $n = 317$, $P < 0.0005$).

Conclusions. The present study has attempted to scientifically explore psychosocial elements of crowd behaviour as a driver of demand for emergency medical care. In measuring demand for emergency medical services there is a need to develop a more sophisticated understanding of a variety of drivers in addition to traditional metrics such as temperature, crowd size and other physical elements. In this study we saw that spectators who supported different football teams generated statistically significant differences in PPR.

What is known about this topic? Understanding the drivers of emergency medical care is most important in the mass gathering setting. There has been minimal analysis of psychological 'crowd' variables.
What does this paper add? This study explores the psychosocial impact of supporting a different team on the PPR of spectators at Australian Football League matches. The value of collecting and analysing these types of data sets is to support more balanced planning, better decision support and knowledge management, and more effective emergency medical demand management.
What are the implications for practitioners? This information further expands the body of evidence being created to understand the drivers of emergency medical demand and usage. In addition, it supports the planning and management of emergency medical and health-related requirements by increasing our understanding of the effect of elements of 'crowd' that impact on medical usage and emergency healthcare.

Additional keywords: crowd safety, crowd size, emergency medical workload, mass gathering, patient presentation rate.

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Introduction

There is an on-going need to better understand the drivers of patients seeking healthcare services.[1] This includes not only drivers of the pathway to access care but also individual variables that drive volume. Although there has been work identifying why people use emergency departments[2] and even general practice,[3] there is limited detail on other drivers to the use of acute and primary care services. One setting where there is a strong body of evidence of the drivers that influence people seeking healthcare is in the setting of mass gatherings. It is well recognised both within mass gatherings[4,5] and emergency departments that factors such as weather increase patient presentation rates (PPR).[6] The mass gathering medicine literature presents an increasing understanding of the factors that have an impact on emergency medical usage.[7]

To provide a better understanding of mass gathering health, Arbon introduced a conceptual model to identify key characteristics of three domains: biomedical, psychosocial and environmental.[8] The biomedical domain focuses on the number and type of patients and the environmental domain concentrates on factors such as temperature or terrain. The psychosocial domain is concerned with psychological and social factors, including crowd type, mood and behaviour.[9,10]

Whereas the relationships between the biomedical and environmental domains are well identified in the literature, there is limited research on understanding psychological elements and crowd profile as emerging drivers of emergency medical usage in mass gatherings.[9] The present study was designed to further understand the impact of psychosocial factors on emergency medical usage; more specifically, do different groups of spectators generate different levels of medical usage. We evaluated the impact of the same mass gathering event, an Australian Football League (AFL) match, where several variables (such as bounded location, mobility of crowd, event type and duration) were fixed, to provide insight into the impact of the crowd supporter base.

The AFL was chosen as it had the highest attendance of any sporting event in Australia, with almost 2.5 million people aged 18 years or over reporting that they had attended at least once in the 12 months before 2002.[11] This research focussed on studying and analysing the impact of a suite of variables of football team supporters and crowd density on medical usage rates, as measured by PPR. PPR was calculated as the number of patients presenting per 1000 patrons.[4]

Our hypothesis was that spectators who supported different football teams generated different PPR. The results could inform better decision making regarding the emergency medical services support required at different sporting events by providing evidence of statistically significant relationships between the identified variables.

Background

There is a strong body of knowledge regarding mass gathering medicine that focuses on predicting emergency medical workload.[10] In 2001 a model was developed for predicting patient presentations and the number of patients that can be expected to require transfer to hospital.[4] However, this and other models treat all venues as equal and have minimal incorporation of psychological 'crowd' variables.[9,10]

A study by Hutton *et al*. developed an emerging process to measure and monitor crowd behaviour in an attempt to assess the psychosocial elements of a mass gathering.[9] Their work highlighted that there is a need for more consistent descriptive datasets with elements such as measures of crowd density to better illuminate the psychosocial domain.

Crowd variables at sporting events have been studied by many researchers. Milsten *et al*. conducted a study of football and baseball games and rock concerts and found that football is a demanding sport in terms of PPR due to alcohol use, team rivalry and weather conditions.[12] It has also been proposed that 'emotional intensity' is a crowd characteristic that can be caused by team rivalry in sporting events and playoffs or finals.[13] In addition, a number of catalysts (i.e. factors) can cause a manageable crowd to degenerate into one that requires control. Examples of these factors are event activities, event management, performance actions, security and spectator and social factors such as team rivalries.[13] Moreover, it has been suggested that the rivalry between sporting teams is an important variable affecting the spectator crowd mood.[7]

The purpose of this research was to further understand the variables that influence emergency medical and healthcare usage by comparing mass gathering events where several of the traditional variables are controlled.[4,7]

Method

This research is a retrospective, descriptive statistical review of the medical workload generated at 2 years of AFL matches, focusing on the impact of the variables football team supporter base and crowd density on PPR.

Settings

This research is based on analysis of 2 years of historical data collected by St John Ambulance (SJA) from the AFL matches. The AFL is a football code involving 16 teams, consisting of 22 rounds, played across Australia. SJA is the main provider of public first aid services at all venues except the Sydney Cricket Ground. The average time of a football match is around 2.5 h and the first aid services cover 5 h on average.

The data sourced covered two aspects; data from SJA patient care records generated at AFL matches by SJA personnel and event profile data captured from a variety of sources, including the fixture program and event organiser's records. Crowd size is based on the number of people attending the event, including ticketed and guest spectators. Patients include all spectators presenting for treatment to SJA. One of the advantages of this analysis was that the dataset was collected for the same sporting event and some of the variables, such as duration, remained the same for all of the events. PPR was calculated as the number of patients presenting per 1000 patrons.[4]

The team supporter bases and venues were analysed anonymously and are represented by numbers from 1–16 in no particular order. To perform the statistical tests, SPSS Statistics version 17.0.0 (IBM Corporation, New York, NY, USA) was used. Several tests were conducted, including one-way and two-way ANOVA, Tukey and Dunnett post hoc tests,[14] and the Pearson correlation test.

Sample

Of a possible 352 games, 35 games had no patient records documented, resulting in 317 games for analysis (90%). With over 11 million attendances the average attendance per game was 35 471. Table 1 provides a summary of the sample.

This research adhered to the National Statement on the Conduct of Human Research by the Australian National Health and Medical Research Council and was approved by the SJA Australia Research Ethics Committee.

Patient presentations considering different team supporter bases

The focus of this research was to study the impact of supporting different football teams on the PPR. Fig. 1 illustrates the differences between PPR means of different teams.

One-way ANOVA enables comparison of differences between multiple unmatched groups. The dataset included the 'Home' and 'Away' teams as separate fields. The interest was on whether supporters of different football teams generated different PPR regardless of them playing home or away.

Records were duplicated such that 'Home' and 'Away' teams were included in two separate rows but with the same PPR value. This doubled the number of records from 317 to 634. Table 2 shows an example of one record and how we duplicated it.

The results for the ANOVA test revealed that there was a statistically significant difference at the level of $P < 0.05$ between team supporters ($F_{15,\,618} = 1.998$, $P = 0.014$).

Patient presentations considering crowd size and density

We performed a Pearson's correlation test to study the crowd size and PPR to determine any correlation between the two variables. The crowd size averaged 35 759 ± 10 303. A Pearson's correlation test showed that there was a significant positive relationship between the crowd size and PPR (r = 0.124, n = 317, P = 0.028).

To further investigate the crowd size effect on PPR, we focussed on the density characteristic. As a measure of density, we analysed the venue capacity and crowd size. A venue can have a larger crowd size but a lower density compared with another venue because of its capacity. Fig. 2 shows the capacity and average attendance for each venue for AFL games during 2004–05. The graph shows the venues in ascending order according to the differences between the capacity and attendance.

Based on the capacity of each venue and the attendance number, we calculated the density variable (i.e. crowd number/capacity). We then applied Pearson's correlation test to find out the correlation between the density and PPR. Interestingly, the test revealed that there was a statistically strong, negative relationship between the density variable and PPR (r = –0.206, n = 317, P < 0.0005). Fig. 3 shows the crowd density and PPR rates for each event. The black line illustrates the negative correlation found by the Pearson's test.

Table 1. Summary of Australian Football League game sample

	Season 2004	Season 2005	Total
Rounds	22	22	44
Total games	176	176	352
Total games analysed	156	161	317
Venues analysed	10	9[A]	10

[A]Optus Oval no data for 2005.

Discussion

Understanding and estimating the workload at mass gatherings is important for planning and managing these events to ensure crowd safety and to predict changes in emergency medical demand. There is an abundance of studies that focus on investigating the biomedical and environmental attributes that impact PPR. In this paper we focussed on one factor, the spectator crowd psychosocial element at the AFL, and a set of attributes that included supporters of different teams and crowd size and density. The key findings are:

- Supporters of different football teams generated different PPR. The one-way ANOVA test showed that there was a statistically significant difference between the different supporter bases.
- Pearson's correlation test verified the findings of previous studies in which there was a positive correlation between crowd size and PPR.

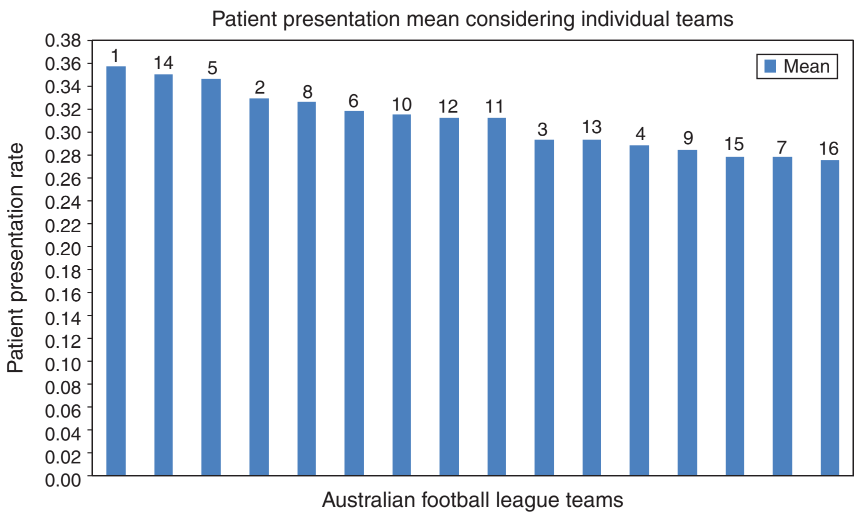

Fig. 1. Patient presentation rate means of Australian Football League teams.

- To investigate the impact of density on PPR Pearson's correlation test was conducted. The results revealed that there was a negative correlation between density and PPR.

Although many studies verify that crowd size and PPR have a positive correlation,[7,15] it has also been found that when the crowd size increases to a certain point the number of patients tends to decrease.[7] A study by De Lorenzo *et al*. reported that in the basketball and football events they investigated the PPR was mainly independent of crowd size and for concerts there was a weak correlation between crowd size and PPR.[16] It has been reported that events with a crowd size larger than 1 000 000 result in a lower rate of patients compared with events with less than 1 000 000 spectator units.[17] To further investigate the crowd size effect on medical usage rate, we focussed on the density attribute.

The density of the crowd in mass gatherings has been reported as an important factor that contributes to the number of patients.[18,19] It has been suggested that density has four possible causal factors:[7] increased exposure to microbes; effects on mood; decreased access to patients; and decreased access to water, family and bathrooms. Density is impacted by the venue capacity and crowd size. A venue can have a larger crowd size compared with another venue but a lower density because of its capacity. We expected that as the density increased, the PPR would increase. However, our study reveals a negative relationship. This may be due to different levels of first aid presence, the shorter duration of the event, or may even relate to challenges in accessing medical support. The issue of crowd density is worthy of further exploration.[9]

PPR has been used in this study as a key outcome measure but the other element in the mass gathering debate that has been missing is whether a high PPR reflects good or poor practice. High PPR might in actual fact reflect good practice in relation to access and visibility of medical services. Low PPR may reflect good crowd preparation before arrival. In addition to traditional factors that influence PPR the present study starts to reveal issues such as other social demographics that may influence medical usage at mass gatherings, in addition to physical factors such as the presence and visibility of first aid services.

Table 2. An example of duplication of data
PPR, patient presentation rate

Team away	Team home	PPR	Team	PPR
1	2	0.292	1	0.292
			2	0.292

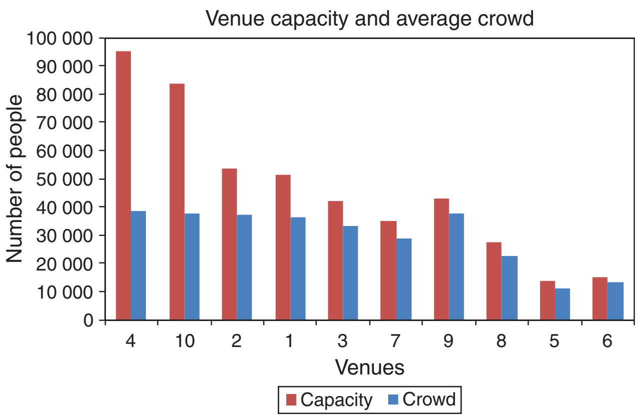

Fig. 2. Capacity and average attendance for Australian Football League game venues.

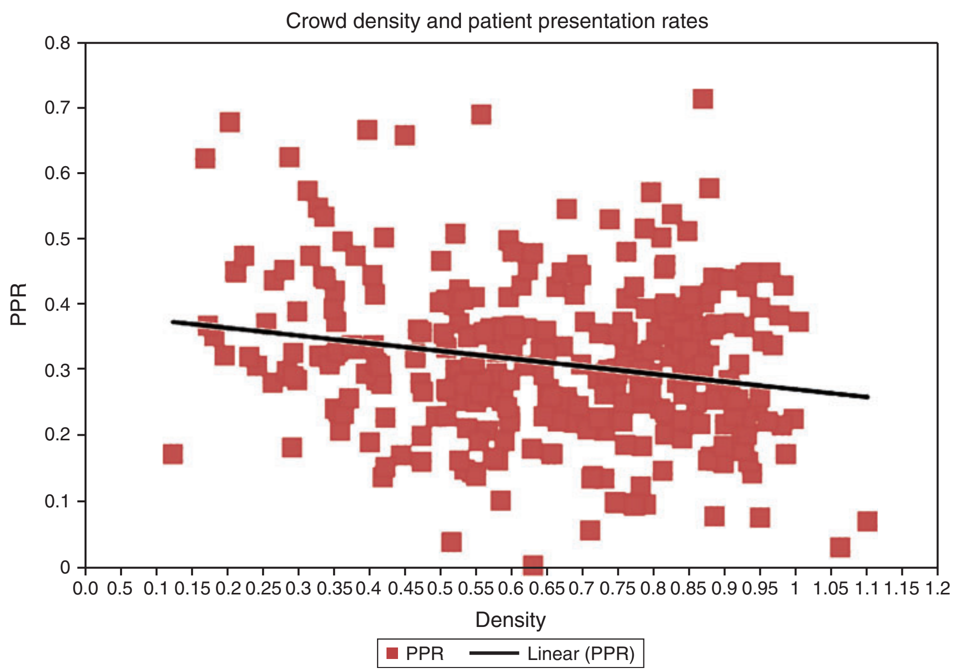

Fig. 3. Results of correlation test for crowd density and patient presentation rate (PPR).

Conclusion

The present study has shown the importance of understanding psychosocial elements of crowds as a driver of emergency medical usage. The study revealed that there are differences in PPR between different supporter bases. Whilst confirming the previous finding that there is a positive correlation between the crowd size and PPR, this study has shown a negative correlation of crowd density and PPR. The findings add to the evidence base increasing our understanding of the effect of psychosocial elements that influence the load on healthcare services. The value of collecting and analysing these types of datasets is to support more-balanced planning, better decision support and knowledge management. The ongoing opportunity is to apply this thinking to the acute healthcare system.

Competing interests

The authors declare these are no competing interests.

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