


ORIGINAL ARTICLE

General and dental injuries sustained at concerts: A questionnaire-based study

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Abstract

Background/Aim: Evidence on the risk of injury at concerts is scant. The aim of this study was to collect data on general and dental injuries incurred by concertgoers in Switzerland and to investigate whether the frequency of accidents was related to music genre, gender and consumption of alcohol.

Materials and methods: A questionnaire-based, cross-sectional study comprising 451 concertgoers in Switzerland was conducted on the timeframe January 2019 to February 2021. The survey gathered data on general and dental injuries, alcohol consumption and drug use. The statistical analysis included Fisher's exact tests, chi-squared tests, rank sum tests and logistic regressions ($\alpha = .05$).

Results: There were 28.8% of respondents who reported an injury incurred at a concert. Contusion was the most prevalent injury, accounting for 33.8% of all injuries. Legs were the most commonly injured body part (34.6%). Injuries to their mouth/lips/teeth were reported by 17.7% of respondents. Dental injuries, accounting for 4.6% of all reported injuries, comprised four tooth fractures, one lateral luxation and one avulsion. The risk of injury while attending punk rock concerts was 8.6 times higher than for pop concerts ($p < .001$). In comparison with pop concerts, metal and rock concerts had an increased risk of injury by factors of 5.1 and 2.3, respectively ($p \leq .029$). Neither gender nor drug use had a significant effect on the injury risk ($p \geq .3$). Heavy alcohol consumption (>5 standard glasses) increased the risk of injury by a factor of 2.3 ($p = .028$).

Conclusions: This study suggests that concert attendees at rock, metal and punk concerts face an increased risk of injury, which is likely due to the frequency of aggressive dance styles such as moshing. Heavy alcohol consumption leads to a greater risk of injury at concerts.

KEYWORDS

accident prevention, alcohol consumption, alcoholic intoxication, dentoalveolar trauma, recreational drug use, tooth injury

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1 | INTRODUCTION

A continuous increase in concert events was recorded in Switzerland until 2019.¹ Expenditure by private Swiss households on theatre and concert attendance amounted to 698 million Swiss francs in 2018.² In 2018 and 2019, 33% of the population attended at least four concerts per year. However, in 2020, the COVID-19 pandemic caused a drop of almost 70% compared with the number of concerts that took place the previous year.^{1,3}

Evidence on the risk of injury, and dental trauma specifically, while attending concerts is scant. A study of 208,000 rock festival attendees in Norway reported a total of 1349 injured persons, which corresponded to an injury rate of 0.7%.⁴ The most common injuries recorded were minor wounds and bruises.⁴ However, in terms of injury risk, concerts of different music genres are not alike. For example, it was reported that concerts where sections of the audience dance in a manner involving frequent physical contact entail an increased risk of injury of up to 1.3%.⁵ In particular, mosh pits, areas in front of a stage where very physical and rough dancing takes place at rock concerts, create injury hazards. Almost two thirds of the injuries sustained in mosh pits are head injuries.⁵

Considering the frequency of head injuries at concerts, the question arises as to how common dental injuries are. A study assessing emergency room treatments at a rock concert reported that 8 of 1064 attendees incurred a dental injury, which corresponded to a risk of a dental injury of 0.8%.⁶ Based on a review of cases treated at on-site emergency healthcare centres at Australian music festivals, a retrospective study reported a rate of eye and/or dental injuries of 0.5%.⁷

Given the paucity of data on dental injuries sustained at concerts, the aim of this study was to collect data on general and dental injuries incurred by concert attendees in Switzerland and to investigate whether the accident frequency shows differences depending on the music genre, gender and alcohol consumption.

2 | MATERIALS AND METHODS

The local ethics committee waived the need for formal approval for this survey study, which gathered exclusively anonymous data (EKNZ 2016/270). Informed consent was obtained from study participants, who voluntarily took part in the survey, to use generated data for research purposes.

In 2019, concertgoers in Switzerland were randomly selected and consulted personally before and after concerts in concert halls and stadiums. The interviews were conducted by one investigator using a standardized questionnaire which was modelled on questionnaires used in previous studies.⁸⁻¹³ The responses of survey participants were recorded with multiple choice answers. No data were acquired of persons who declined to take part in the survey.

With the onset of the COVID-19 pandemic, which prohibited concert attendance until the conclusion of this study, the same questionnaire was posted online and disseminated via social media

channels to concertgoers in Switzerland. Only fully completed questionnaires were included in the evaluation. The questionnaire, reported in detail in Table 1, contained nine questions (plus six potential follow-up questions) regarding age, gender, music genre, alcohol consumption, drug use, and additional questions regarding the type and localization of injuries that concertgoers had either incurred or observed.

To avoid transcription errors, data from the interviews were recorded in duplicate in a spreadsheet. The dataset generated and analysed during the current study is available from the corresponding author on request. Data of all surveyed persons were analysed regarding injuries in relation to the music genre of the concert at which the injury was picked up.

A preliminary statistical analysis showed no differences in the data sets collected in person and online. The *p* values were calculated using appropriate significance tests such as Fisher's exact tests, chi-squared tests and rank sum tests. Logistic regressions were calculated between the different music genres with pop music as the reference group for the comparisons (eg, injury vs no injury). Additional co-factors such as gender, concert years (number of concerts per year multiplied by years), alcohol consumption and drug use were analysed stepwise to control the estimated regression parameters. Adjusted odds ratios (OR) with the corresponding 95% confidence intervals (CI) and *p* values were calculated from the regression model. For all test procedures, a two-sided probability of error of 5% was set as the significance level, with *p* values of <.05 defined as statistically significant. Owing to the descriptive nature of the study, an adjustment for the probability of error for multiple comparisons was omitted. All statistical calculations were performed by a statistician with the program R version 3.5.1 (R Foundation for Statistical Computing).

3 | RESULTS

The study comprised complete data sets of 451 respondents, whose ages ranged from 16 to 69 years. In the survey, 53.9% (*n* = 243) of respondents were females and 46.1% (*n* = 208) were males. Two hundred and thirty (51%) individuals were interviewed in person between January 2019 and August 2019, and 221 (49%) filled out the online questionnaire between May 2020 and February 2021. The statistical assessment revealed no significant differences in the data sets collected in person and online. Therefore, these data sets were combined.

Visitors of pop concerts were chosen as the reference group owing to the low number of injuries sustained at pop concerts. In the survey, 28.8% (*n* = 130) of respondents stated that they had sustained an injury at a concert. The most common injury was contusion (33.8%; *n* = 44) followed by distortion or ligament injuries (15.4%; *n* = 20). The most frequent injuries affected the legs (34.6%; *n* = 45). The head and neck were the second most prevalent injury sites (18.5%; *n* = 24). Injuries to the mouth/lips/teeth were reported by 23 respondents (17.7%). Dental injuries reported by respondents comprised four tooth fractures, one lateral luxation and one avulsion.

Item	Question
1	Age
2	Gender (female, male, other)
3	Number of concerts attended per year
4	Number of years of concert attendance
5	Music genre (hip hop, metal [including heavy metal], pop, punk rock, rock, other)
6	Alcohol consumption at concert (no, moderate [≤ 4 –5 standard glasses]), heavy [> 5 standard glasses]
7	Drug use at concert (no, yes)
8a	Injury at concert (no, yes)
8b	Injured body part (arm including elbow joint and wrist, head/neck, leg including knee and ankle joints, mouth/lips/teeth, trunk, other)
8c	Type of injury (contusion, cut, fracture, laceration, distortion or ligament injury, tooth avulsion, tooth luxation [extrusive, lateral, intrusive], tooth fracture, other)
8d	Medical attendance required (no, yes)
9a	Observation of an injury of fellow concert attendees (no, yes)
9b	Injured body part (arm including elbow joint and wrist, head/neck, leg including knee and ankle joints, mouth/lips/teeth, trunk, other)
9c	Type of injury (contusion, cut, fracture, laceration, distortion or ligament injury, tooth avulsion, tooth luxation [extrusive, lateral, intrusive], tooth fracture, other)
9d	Medical attendance required (no, yes)

TABLE 1 Questionnaire with multiple choice answers given in brackets

	Crude OR (95% CI)	Adjusted OR (95% CI)	<i>p</i> (Wald's test)
Pop	Reference	Reference	N/A
Rock	3.2 (1.55, 6.61)	2.3 (1.09, 5.02)	.029
Hip hop	1.5 (0.47, 4.64)	1.0 (0.29, 3.22)	.964
Metal	7.4 (3.5, 15.48)	5.1 (2.35, 11.27)	<.001
Punk rock	12 (4.77, 30.17)	8.6 (3.28, 22.36)	<.001
Other	1.3 (0.48, 3.68)	1.0 (0.33, 2.93)	.974
Gender (female vs male)	0.7 (0.47, 1.06)	1.1 (0.66, 1.7)	.818
Concert years	1.1 (0.97, 1.14)	1.1 (0.95, 1.17)	.3
Moderate alcohol consumption (≤ 4 –5 standard glasses)	1.2 (0.62, 2.24)	1.2 (0.57, 2.31)	.7
Heavy alcohol consumption (> 5 standard glasses)	3 (1.56, 5.77)	2.3 (1.09, 4.79)	.028
Drug use (yes vs no.)	2.1 (1.13, 3.72)	1.7 (0.88, 3.29)	.115

TABLE 2 Results of the regression analysis regarding the risk of injury at concerts

Two of the four tooth fractures occurred at punk rock concerts, and one each at a pop and a metal concert. The lateral luxation and the avulsion both occurred during a metal concert. Another seven tooth fractures, one lateral luxation and four avulsions were observed by concertgoers in fellow attendees.

Drug use was reported by 11.3% ($n = 51$) of respondents. Alcohol consumption was reported by 83.4% ($n = 376$) of the concertgoers taking part in the survey. Of the concertgoers reporting alcohol consumption, 60.9% ($n = 229$) and 39.1% ($n = 147$) reported moderate and heavy alcohol intake, respectively.

The risk of injury while attending punk rock concerts was 8.6 times higher compared with pop concerts ($p < .001$). In comparison with pop concerts, metal and rock concerts had an increased risk of

injury by factors of 5.1 and 2.3, respectively ($p < .001$ and $p = .029$, respectively).

Neither gender, drug use, nor number of concert years had a significant effect on the injury risk ($p \geq .3$). Heavy alcohol consumption (> 5 standard glasses) increased the risk of injury at concerts by a factor of 2.3 ($p = .028$). Detailed results of the regression analysis are reported in [Table 2](#).

4 | DISCUSSION

The aim of this study was to investigate general injuries and dental injuries at music concerts in Switzerland. The findings underpinned

by data of 451 survey participants showed that nearly 3 out of 10 concertgoers had sustained an injury at a concert. Contusion, distortion and ligament injuries were the most common types of injuries, with the lower extremities the most frequently injured body part. The close proximity of concertgoers to others, especially when dancing, in combination with low lighting is a likely reason for this predominant type of injured region. Punk rock and metal concerts were found to entail a substantially increased risk of injury for attendees compared with pop concerts. Almost a fifth of the reported injuries involved the mouth, lips or teeth, which suggests that some activities at concerts pose a hazard for oral and/or dental injury.

Studies that have assessed patients seeking care at a medical centre at concerts reported that out of all emergencies between 0.5% to 0.8% were dental injuries.^{6,7} In contrast, the present study found a higher proportion of dental injuries, because out of a total of 130 injuries, 6 involved teeth. This corresponded to a proportion of 4.6%. The higher proportion may have been due to the study being based on patient reports rather than medical records. Minor dental injuries and injuries that were not treated by on-site emergency medical services were likely captured in the present study, whereas previous studies exclusively examined data on dental injuries of patients who had presented to the said emergency medical services.

According to the present investigation, drug use did not significantly influence the risk of injury at concerts whereas heavy alcohol consumption significantly increased the likelihood of an injury. This finding is in line with a substantial body of evidence on alcohol as a cause of injury.¹⁴ This increased injury risk is likely due to impaired self-perception and the lowered inhibition threshold under the influence of alcohol, a known neurotoxin and central nervous system depressant. The present study revealed that consumption of more than five standard glasses of alcohol is associated with injury occurrence at concerts. This findings corroborates data reported in a study that assessed alcohol and drug use patterns in patients presenting to first aid stations at major rock concerts.¹⁵ As alcohol-related injuries are preventable, effective measures aimed at reducing alcohol intoxication at concerts must be taken within the legal framework. So, as a first step, it is important to promote awareness among concertgoers and concert promoters that excessive alcohol consumption entails a significantly increased risk of injury.

The results of the present study suggest that audiences at metal, punk rock and rock concerts face greater injury hazards compared with other genres. These findings confirmed previous research that demonstrated a higher frequency of injuries among rock concert attendees compared with patrons at pop concerts.^{16,17} The reasons underlying this are numerous and they range from a different demographic composition of the audience, differences in the frequency of alcohol intoxication to genre-specific dance habits. For example, it has been shown that moshing, a violent form of dancing that involves surfing, shoving and moving in circular rotation, poses a significant risk of injury.^{5,18} Moshing is a regular feature of audience behaviour at rock, punk rock and metal concerts, whereas it occurs less frequently at concerts of other genres.⁵

Given the injury hazards created by moshing, moshing has been forbidden at Wacken Open Air, one of the largest heavy metal festivals in the world.¹⁹ If a prohibition on moshing proves effective in reducing injuries, it appears advisable for other concert organizers to follow suit.

It is important to consider that substantial concert-to-concert variability was reported in a retrospective study that scrutinized patient loads at concert first-aid stations.¹⁷ That retrospective study comprised a sample of 1492 patients out of 4,638,099 total attendees at 405 separate concerts, which permitted a fine-grained analysis of factors playing a role in accident frequency.¹⁷ In comparison, data collected in the present investigation are not as comprehensive and detailed. To ensure appropriate and efficient medical coverage, the level of on-site medical care should therefore be based on the type of concert, venue, duration of the event, weather, particular concert performers, and local emergency medical services access and resources.^{17,18,20}

No gender-specific influence on the risk of injury was found in the present study. This result varies from data reported in studies based on emergency service report forms, which reported that females have a lower risk of sustaining an injury than males at concerts.^{5,7} These discrepant results likely occurred because the present study gathered data at various concert venues, whereas other studies collected data from outdoor festivals or concerts at which sections of the audience engaged in mosh pits, which are known to increase the risk of injury.⁵

The present study was based on interviews of concertgoers and self-reported injuries via the online questionnaire. As the investigation relied on the answers given by interviewees, the limitations of self-report studies need to be considered. For instance, participants may fail to disclose pertinent details and self-reported answers may be factually inaccurate. In addition, the gender ratio in the sample of volunteers who took part in the survey was skewed towards females, which may be indicative of selection bias. However, in contrast to studies based on data provided by healthcare providers, the present study had the advantage of being able to collect data on injuries that did not receive immediate medical attention. Given the limited sample size of the present study, conclusions should be drawn with caution. Further investigations are needed to validate the findings of this study and to analyse the effectiveness of accident prevention measures at mass events such as concerts.

5 | CONCLUSION

Rock, metal and punk rock concerts involve an increased risk of injury for concertgoers compared with pop concerts, which may be due to moshing being more common at such events. Alcohol intoxication is major risk factor for sustaining an injury at a concert.

AUTHOR CONTRIBUTIONS

Urs Simmen was responsible for the statistical analysis.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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