

CATASTROPHIC INJURIES IN CIRCUS

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The objective of this study was to characterize incidents resulting in fatal and non-fatal catastrophic injuries in circus. Since there was no usable data in the scientific literature or occupational databases, a systematic search of the gray literature was used to identify incidents that occurred between January 2000 and March 2020 in which a circus artist or technician incurred catastrophic injury. Mortality rates were estimated. Thirty-eight incidents that resulted in 39 catastrophic injuries (n=20 fatal; n=19 non-fatal, including n=14 spinal cord injury, n=3 serious head injury, n=2 unknown) were described. For artists (n=32), incidents occurred during performance (n=22) and training or rehearsals (n=10), with the majority in the aerial discipline (n=21) followed by ground acrobatics (apparatus propulsion) (n=6). The mechanisms of injury were direct contact with the ground (n=31), direct contact with an object (n=1) and direct contact with another artist (n=1) for artists, and direct contact with an object (n=4) and electrocution (n=2) for technicians. Ten-year mortality rates were estimated as 0/100,000 students, 37.5/100,000 FTE for artists and 25.0/100,000 FTE for technicians. Most catastrophic incidents that occurred in circus contexts were characterized as falls (direct contact with the ground) during professional performance. The understanding gained from these data provides a starting point,

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but more detailed reporting is needed to properly support informed decision-making to improve safety in circus.

Cette étude avait pour but de caractériser des incidents entraînant des blessures graves (mortelles ou non) dans le milieu du cirque. Comme il n’existait pas de données exploitables ni dans la littérature scientifique ni dans les bases de données professionnelles, une recherche systématique a été conduite sur la documentation parallèle. Cette recherche a permis d’identifier des incidents survenus entre janvier 2000 et mars 2020 ayant entraîné une blessure grave chez un-e circassien-ne ou un-e technicien-ne. On a également estimé le taux de mortalité. Nous avons répertorié 38 incidents ayant provoqué 39 blessures graves (n = 20 mortelles; n = 19 non mortelles, dont n = 14 lésions médullaires, n = 3 traumatismes crâniens graves et n = 2 blessures inconnues). Pour les artistes (n = 32), les incidents se sont produits pendant les performances (n = 22) et l’entraînement/les répétitions (n = 10). La majorité des incidents concernaient les disciplines aériennes (n = 21) ainsi que les acrobaties au sol impliquant la propulsion (n = 6). Le mécanisme de blessure pouvait provenir du contact direct avec le sol (n = 31), du contact direct avec un objet (n = 1) et du contact direct avec un-e autre artiste (n = 1). Pour les technicien-ne-s, il s’agissait du contact direct avec un objet (n = 4) et d’une électrocution (n = 2). Sur dix ans, le taux de mortalité a été estimé à 0/100 000 élèves, 37,5/100 000 ETP pour les artistes et 25/100 000 ETP pour les technicien-ne-s. La plupart des incidents graves survenus dans un contexte circassien ont été catégorisés comme des chutes (contact direct avec le sol) lors d’une performance professionnelle. La compréhension de ces données offre un point de départ, mais il est nécessaire de constituer un rapport plus détaillé sur lequel s’appuyer pour prendre des décisions avisées et améliorer la sécurité dans les arts du cirque.

KEYWORDS: risk management, safety, traumatic injury, death, gestion des risques, sécurité, blessure traumatique, la mort

Introduction

Contemporary circus embodies the tension between risk and death with its “death-defying” stunts and emotive narratives.¹ Audiences are drawn to watching acrobatic performers face and overcome real or staged risks. Show creators seek to ensure that this sensation remains an aesthetic element² since the audience does not expect to see death.³ When catastrophic incidents (i.e., resulting in death, permanent disability, temporary paralysis or activity-induced heat stroke or cardiac event)⁴ occur publicly, media coverage is often characterized by sensationalized, risk-averse discourse that calls for increased

safety, further contributing to the perception of danger in circus.⁵ Although these incidents are acknowledged and discussed by the industry, the data have not been compiled in a way that can support rational approaches to safety.

Catastrophic injuries in circus have not been characterized in the literature. The majority of research does not specify whether any have occurred and been classified with severe injuries,^{6,7} although a recent consensus specified that this should occur.⁸ Selected catastrophic incidents have been included in the narrative of published articles^{9,10} or as case studies,¹¹ but the objective characteristics of the incidents and consequent injuries remain unknown. Furthermore, circus performers are classified with other entertainers in occupational databases, which makes it infeasible to use these data to support circus-specific safety. Thus, there is no data to support a greater understanding of these injuries in the unique circus context, which is needed to investigate underlying mechanisms, establish enhanced safety protocols and legislation, foster the creation of injury surveillance mechanisms (e.g. protocols and registry) and provide public-facing information related to the actual risks involved in circus. We attempted to address this issue by conducting a systematic review of the scientific literature, but since our search strategy returned zero relevant papers, we turned to the gray literature as a first step¹² to characterize incidents resulting in catastrophic injury in circus.

Methods

A systematic search strategy was developed¹³ to identify incidents resulting in catastrophic injury in circus from the gray literature. The Google search engine was used to identify incidents that occurred between January 2000 and March 2020 in which a catastrophic injury was incurred by a circus artist (professional or student) or technician. The keywords *circus* and *cirque* were searched in combination with *death*, *fatal*, *mortality*, *accident* and *spinal cord injury*. Incidents involving suicide, natural disasters or circus animals were excluded. Incidents resulting in temporary paralysis were excluded due to vague details in reporting. Only incidents prior to March 2020 were included since sudden changes in training and performing practices due to COVID-19 pandemic-related closures may have resulted in incidents occurring due to atypical conditions. Context (performance, training, rehearsal, technician), age, sex, discipline (as previously described⁸) and mechanism of injury (as previously described,⁸ modified to add electrocution and classify falling to the mat, net or floor as “direct contact with ground” since it was not always clear where the artist landed) were extracted

from articles. Attribution was inferred based on the incident description. External attribution was indicated if there was information about environmental contributions, including equipment failure. Internal attribution was indicated otherwise. A table of incidents was shared with two experts in the field who contributed additional events from their experience.

Descriptive analyses were completed to characterize the incidents. Mortality rates were calculated for artists and technicians in a professional circus company (/100,000 FTE) based on publicly available data, as well as in a circus college (/100,000 students) based on data from our college over a ten-year period (2009–2018), selected according to the period with the maximum number of known incidents.

Results

A total of 1,460 articles were retrieved, of which 208 were duplicates. The headlines of the remaining 1,252 articles were screened, and 774 were considered irrelevant and excluded. The full contents of the remaining 479 articles—which described 25 incidents—were reviewed, and the experts contributed an additional thirteen incidents, six of which came from a book published in Portuguese.¹⁴ Overall, 38 incidents that resulted in 39 catastrophic injuries (n = 20 fatal; n = 19 non-fatal, including n = 14 spinal cord injury, n = 3 serious head injury, n = 2 unknown; see Table 1) were described. Females accounted for 33% and 37% of fatal and non-fatal injuries, similar to the sex distribution of artists in professional companies. For artists (n = 32), incidents occurred during performance (n = 22) and training or rehearsals (n = 10). The majority were in the aerial discipline (n = 21), followed by ground acrobatics (apparatus propulsion) (n = 6) (see Table 1).

For artists (n = 32), the mechanism of injury—with one exception—was direct contact with the ground (n = 31; one incident also involved direct contact with another artist) with greater attribution to intrinsic (n = 20) compared to extrinsic (n = 12) factors for ground contact (n = 1, not reported; n = 1, classified as both intrinsic and extrinsic). For technicians (n = 6), the mechanisms of injury were direct contact with an object (i.e. hit by props/equipment: n = 4) and electrocution (n = 2).

Over ten years, there were no deaths at a circus college and five deaths at a professional circus company (three artists and two technicians), resulting in estimated ten-year mortality rates of 0/100,000 for students, 37.5/100,000 FTE for artists and 25.0/100,000 FTE for technicians.

Table 1. Catastrophic Incident Characteristics

Characteristic	Fatal	Non-Fatal
Total (n = 38)	20	18
Context		
Performance	12 (60%)	10 (56%)
Training	3 (15%)	6 (33%)
Rehearsal	0 (0%)	1 (6%)
Technicians	5 (25%)	1 (6%)
Age (y) mean (SD)	29.6 (8.9) ^a	26.3 (6.5) ^b
Sex ^c		
Male	13 (65%)	9 (47%)
Female	6 (30%)	7 (37%)
NR	1 (5%)	3 (16%)
Discipline		
Aerial acrobatics	11 (55%)	10 (55%)
Aerial acrobatics (with ground elements)	1 (5%)	0 (0%)
Ground acrobatics (apparatus propulsion)	2 (10%)	4 (21%)
Ground acrobatics (human propulsion)	0 (0%)	1 (6%)
Ground acrobatics (balance/control)	0 (0%)	1 (6%)
Other	1 (5%)	1 (6%)
Technicians	5 (25%)	1 (6%)
Mechanism of Injury ^d		
Direct contact with the ground	15 (75%)	16 (89%)
Direct contact with an object	3 (15%)	2 (11%)
Direct contact with another artist	0 (0%)	1 (5%)
Electrocution	2 (10%)	0 (0%)
Attribution ^e		
Intrinsic	12 (60%)	7 (39%)
Extrinsic	9 (45%)	10 (55%)
Unknown	0 (0%)	1 (6%)

NR = not reported; ^an = 16; ^bn = 8; ^cfor non-fatal injuries, sex, n = 19 since one incident resulted in two non-fatal injuries; ^dfor non-fatal injuries, mechanism of injury, the percentage adds up to 105%, since two mechanisms of injury (direct contact with another artist and with the ground) contributed to a single incident; ^efor fatal injuries, one incident had both intrinsic and extrinsic attribution.

Discussion

This study provides the first approximation of the characteristics of catastrophic injuries in circus, which most commonly involve a fall (direct contact with the ground) during professional performance. Although the details available through gray literature were insufficient to support concrete recommendations for risk assessment and safety protocols, they provide basic information and support the need for more systematic data collection and reporting of catastrophic incidents in circus. Contrary to previous work estimating that 75% of severe accidents experienced by professional aerialists were caused by rigging failure,⁹ this review found that from 2000 until the onset of the COVID-19 pandemic, the attribution of intrinsic vs. extrinsic factors was approximately equal (seventeen vs. nineteen incidents, one both). This may be partly due to recent advancements in engineering and biomechanical knowledge.^{15,16} Extrinsic risk factors that have been associated with general injury in circus include scheduling,¹⁷ discipline,¹⁸ warm-up,¹⁹ clothing, temperature and mats/safety equipment,²⁰ and numerous others have been postulated.^{21,22} Many of these factors have the potential to interact with or be falsely attributed to intrinsic factors, as seen with one incident with sufficient details to attribute both internal and external factors. Thorough details beyond those reported in media stories are needed to better understand the circumstances contributing to catastrophic injury in circus.

Intrinsic attribution may be faultily assumed to be due to reckless, sensation-seeking behaviour. However, artists tend to be more motivated by mastery and control than sensation-seeking.⁹ It may also be assumed that circus tricks are constantly becoming more difficult or “riskier” when, in fact, the risk is offset by increasing mastery and knowledge through movement research and pedagogical advancement.¹⁰ Artists have suggested that they are more likely to experience a mishap that may lead to injury when performing “simpler” moves or familiar sequences, when they fall into “autopilot” and are not 100% focused, than when they are performing more difficult stunts.²³ Other intrinsic risk factors such as age,^{18,24} disordered eating behaviours,^{18,25} self-efficacy, fatigue, emotional exhaustion, injury,²⁶ perceived risk, personality and emotion regulation²⁷ are associated with general injury in circus. These studies collectively suggest that holistic interventions²⁸ addressing psychosocial and physical factors should be prioritized for future study of performer safety, keeping in mind that several contextual factors can affect artists’ mindsets and performance.²¹⁻²³

The majority of fatal catastrophic injuries occurred during performance. While exact rates could not be calculated, mortality rate estimates in circus performers (37.5/100,000 FTE) and technicians (25.0/100,000 FTE) are similar to those of occupations with a risk of fall from height (roofers, 54.0/100,000

FTE; helpers in the construction industry, 40.0/100,000 FTE; grounds maintenance workers, 19.8/100,000 FTE).²⁹ From an occupational health and safety perspective, an international registry of circus-related injuries akin to general trauma or workforce registries would benefit the industry by enabling objective investigation of injury rates and characteristics. This, coupled with an environmental scan to estimate the workforce more closely, would allow for a proper evaluation of performance, injury and safety in circus. These data would provide sound information to estimate incident rates for comparison with other occupational mortality and long-term disability data, and they are essential for thorough risk assessment and subsequent rational decision-making to provide adequate safety.

Limitations

There is an unavoidable risk of bias in the use of gray literature, including publication bias, as incidents that occurred in a public space are more likely to be published than those occurring in private training settings. Of seven incidents from the expert reviewers' experience, five occurred in performance and two in training, demonstrating that while performance may make incidents more likely to be publicized, not all are. Additionally, the data are strongly biased to English-speaking countries, Brazil and France due to the location and language of the online search and the expert reviewers' experiences. Expert reviewers contributed approximately one-third of the incidents, which suggests that there are likely more incidents that have not been reported or are not easily searchable, which we expected due to the data sources available. Despite these biases, we felt that the authenticity of a number of items extracted from gray literature would be high, including sex, age, discipline, occurrence of a fatality and context of the injury (performance or training), with diminished trustworthiness for details of disabilities and the factors leading to the incident (intrinsic vs. extrinsic attribution). Since the mortality rate calculations were based on a single company, they are less likely to be skewed by missing incidents. Thus, while this may not be an exhaustive collection of incidents, it provides guidance for next steps toward collecting sufficient data to support risk assessment and subsequent decision-making.

Conclusion

While the data extracted from the gray literature were insufficient to support concrete recommendations to inform safety protocols, we demonstrated that the

majority of catastrophic incidents occurring in circus contexts were characterized as falls (direct contact with the ground) during professional performance. Mortality rates were within the range of occupations with a risk of falling from height. The analysis of non-systematic data, as shown in this article, appears limited and insufficient to establish recommendations or consensus, although it is an important step in delimiting the problem.¹² Improving protocols and tools for systematically recording accidents is an important next step to support evidence-informed decision-making in circus safety.

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