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Abstract Introduction Hotair balloon tours are FAR Part 91governed balloon rides conducted for compensation or hire. Part 91, General Aviation, in general involves the least strict federal regulations and accounts for the majority of aviation crashes and fatalities. Methods National Transportation Safety Board reports of hotair balloon tour crashes in the United States from 2000 through 2011 were read and analyzed. Results During the 12yr period, 78 hotair balloon tours crashed, involving 518 occupants. There were 91 serious injuries and 5 fatalities; 83% of crashes resulted in one or more serious or fatal outcomes. Of the serious injuries characterized, 56% were lower extremity fractures. Most crashes 81% occurred during landing; 65% involved hard landings. Fixed object collisions contributed to 50% of serious injuries and all 5 fatalities. During landing sequences, gondola dragging, tipping, bouncing, and occupant ejection were associated with poor outcomes. Of the crashes resulting in serious or fatal outcomes, 20% of balloons were significantly damaged or destroyed. Discussion The incidence of morbidity and mortality is high among hotair balloon tour crashes, and the proportion of balloon crashes attributed to paid rides appears to have increased over time. In addition to examining the role of restraint systems, personal protective equipment, and power line emergency procedures in ballooning, injury prevention efforts should target factors such hard landings, object strikes, gondola instability, and occupant ejections, which are associated with balloon injuries and deaths. Crash outcomes may also improve with vehicle engineering that enables balloons themselves to absorb impact forces. Keywords commercial air tours, paid ride, lighterthanair, sightseeing, power lines The Epidemiology of fatal and nonfatal crashes of hotair balloon rides conducted for compensation or hire in the U.S. is investigated here for the first time.http://www.sport-foods.ru/userfiles/edge-fitness-manual-treadmill.xml

- **cameron balloons flight manual, cameron balloons manual, cameron balloon maintenance manual, cameron hot air balloon flight manual, 1.0.**

Recent data show that helicopter and fixedwing commercial air tour operations in the U.S. have high crash rates compared with similar commercial aviation operations, and crash rates increase with decreasing regulation 2 . The inverse relationship between crash rates and oversight raises concerns about the public health impact of lessregulated commercial air tour operations, such as paid hotair balloon rides. This study examines the characteristics of crashes of commercial hotair balloon tours conducted under Part 91 of United States Federal Aviation Regulations FARs. The majority of aviationassociated crashes, deaths, and injuries in the U.S. involve flights operated under the governance of FAR Part 91, General Aviation 15 . However, few published studies describe the contribution of hotair balloons to Part 91 morbidity and mortality, and none of them examines the subset of hotair balloon crashes that occur in the setting of commercial balloon tours. This study informs hotair balloon patrons about the risks associated with crashes that occur during this recreational activity, and it serves as a tool for operators and policy makers wishing to employ targeted prevention strategies to reduce balloon ride crashes and crashrelated injuries and deaths. METHODS We defined commercial hotair balloon tours, or “rides,” as flights conducted for compensation or hire in a hotair balloon where a purpose of the flight was sightseeing. The National Transportation Safety Board NTSB defines an aviation “accident” as “an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage” 19 . A fatality occurring within 30 d of the crash is classified as a “death” 19

.http://everfunart.com/everfun/uploadfiles/1605691123.xml

In order to identify hotair balloon crashes occurring from 2000 through 2011, the NTSB Aviation Accident Database was electronically queried by selecting “ balloon ” in the aircraft category dropdown menu on the search page. Crashes of paid hotair balloon rides occurring from 2000 through 2011 were identified through “Yes” responses in the “Revenue Sightseeing Flight” field of the factual report and excluding all such crashes that did not occur in hotair balloons. Two reviewers read the probable cause and factual reports from the Board’s online Aviation Accident Database and abstracted information concerning crash circumstances and outcomes 19 . A third reviewer adjudicated cases in which the reviewers’ abstracted data disagreed. Data describing the number of hotair balloon flights and number of hours flown during the study period were not available. The study was based on publicly available records and was exempt from review by the Johns Hopkins Bloomberg School of Public Health’ s institutional review board. RESULTS During the 12yr period from 2000 through 2011, the NTSB reported 169 hotair balloon crashes. Of these crashes, 78 46% occurred during hotair balloon tours involving 519 occupants, of which 94 18% suffered minor injuries, 91 18% sustained serious injuries, and five 1% died. Of these 78 hotair balloon tour crashes, 65 83% resulted in at least one serious or fatal injury. Among crashes of paid balloon rides, collision with fixed objects contributed to 50% of serious injuries, 85% of minor injuries, and all five fatalities. Collision with trees accounted for one fatality and 39% of all injuries; collision with the ground accounted for one fatality and 26% of all injuries; collision with power lines accounted for two fatalities and 10% of all injuries; and collision with buildings accounted for one fatality and 6% of all injuries Table I . Four of the five fatalities involved the ejection of occupants from the balloon.

TABLE I PAID HOTAIR BALLOON RIDE OCCUPANT INJURY SEVERITY IN RELATION TO TYPE OF COLLISION, UNITED STATES, 20002011 Injury Severity Collision Fatal Serious Minor None Total % Tree 1 22 21 62 106 20.4 Ground 1 9 20 41 71 13.7 Multiple 0 5 13 22 40 7.7 Power line 2 5 4 26 37 7.1 Balloon 0 0 0 10 10 1.9 Building 1 2 4 0 7 1.3 Fence 0 3 1 1 5 0.1 Tower 0 0 0 3 3 0.1 No collision 0 45 31 164 240 46.2 Total 5 91 94 329 519 % 0.1 17.5 18.1 63.4 Open in a separate window Ten occupants sustained serious injuries when passengers did not adhere to procedures as instructed in the preflight briefing. One of these injuries occurred during boarding and nine during landing, and most involved failure of passengers to maintain correct positioning within the balloon. In one instance, two passengers jumped out of the basket before the landing sequence was complete; the sudden and drastic decrease in weight resulted in the pilot’s loss of control of the aircraft, substantial aircraft damage, and serious injury to one passenger. In another, the pilot was ejected from the basket while attempting to restrain a passenger who, against instructions, stood up during the landing sequence. Pilot error contributed to 63 81% crashes and was at least a partial contributor to all 5 fatal crashes Table II . Most commonly, pilots erred by descending at an excessive rate 28 cases or failing to maintain clearance of obstacles 22 cases. The NTSB reports also cited improper fuel planning 6 cases, flying into adverse weather 5 cases, and inadequate passenger briefings 3 cases as pilot errors that contributed to crashes. Two pilots erred by not issuing protective helmets to balloon occupants; these crashes resulted in three head injuries, including the death of one pilot from blunt force trauma to the head and neck. Helmet use was not described in the other two cases of head injury.

Wind was a factor, typically the precipitating factor, in 78% of crashes, with high winds 28% and gusts 21% most commonly contributing to crashes. Wind speeds were 12 knots per hour or less in half of the crashes with wind cited as a factor. The majority of crashes 63, 81% occurred during landing, with hard landings contributing to 51 crashes 65% Fig. 1 . Open in a separate window Fig. 1 Risk factors in hotair balloon tour crashes in relation to injury severity, United States, 20002011. Some crashes had multiple risk factors and are counted in each relevant group. There were 43 balloons that hit fixed objects during crashes. The most frequently struck objects were trees 15

cases and power lines 11 cases. Likewise, the avoidance of power lines contributed to eight crashes. Fire erupted in seven balloons during flight, resulting in one death and 17 serious injuries. During landings, the wind dragged 31 balloons along the ground until they crashed into an obstruction 10 cases or eventually came to rest 21 cases. During crash sequences, 26 balloons tipped over, ejecting occupants half the time. Crashes were most common in the month of October 15 cases, followed by July 13 cases, May 10 cases, and August 10 cases. Generally, these hours are considered the safest times for ballooning since the winds are calmest at these hours, and therefore are the times when flights are most likely to have occurred. The seven crashes that occurred outside these two theoretically optimal “windows” resulted in eight serious injuries, six minor injuries, and no fatalities. Wind was a contributing factor in five of these seven crashes. Equipment failure or malfunction played a role in 10 crashes 13%. Fuel system problems contributed to 4 of these crashes, resulting in 2 fatalities and 12 serious injuries. Envelope or vent malfunction, failure, or damage contributed to five more of these crashes, resulting in two serious injuries.

In the remaining crash, two of the tether ropes in the balloon’s threepoint harness system snapped after an accidental balloon launch that occurred while loading passengers in gusty wind conditions, “leaving the balloon dangling about 100 ft in the air over power lines” 19 . The pilot stabilized the balloon and executed an emergency landing. No injuries resulted from this crash. Improper maintenance contributed to 3 of the 10 equipmentrelated crashes. In these three crashes, incorrect drop line rigging, incorrect deflation activation line rigging, and the installation of a nonFAAapproved fuel hose resulted in one fatal and two serious injuries, respectively. Throughout the study period, a total of 33 balloons 42% involved in crashes sustained damage 14 were damaged “substantially,” 10 sustained “minor” damage, and 2 were “destroyed.” Of the 65 crashes with serious or fatal outcomes, 13 balloons 20% sustained serious damage or were destroyed. DISCUSSION The frequency of paid balloon ride crashes appears to have increased over the past several decades, and the proportion of balloon crashes attributed to paid rides has increased since the year 2000. In a study of 495 balloon crashes occurring in the U.S. from 1964 to 1995, Cowl and colleagues found that paid passenger flights comprised 31% of all hotair balloon crashes 6 . Frankenfield and Baker reported a similar proportion 28% of paid passenger flights in their study of 138 hotair balloon crashes occurring from 1984 through 1988 9 . A recent study by de Voogt and van Doorn on crashes of all categories of general aviation aircraft 8 permits comparison of our study results with those of all hotair balloon crashes. De Voogt and van Doorn found that 7% of the 530 balloon crashes that took place during the 26yr period from 1982 through 2007 resulted in fatal outcomes, but they did not report the number of serious injuries that occurred in these crashes.

Whereas hard landings contributed to 35% of balloon crashes in their study, hard landings contributed to nearly twice this proportion of hotair balloon tour crashes. The occurrence of an aircraft fire, which is highly correlated with fatality in crashes of motorized aircraft, led to a fatality in 31% of crashes of balloons, blimps, gyroplanes, and ultralight aircraft. However, only one of the seven hotair balloon tour crashes involving fire in our study resulted in a death. Overall, de Voogt and van Doorn’s study highlights the relatively low risk of fatal balloon crash outcomes, but their study did not report the burden of serious crashassociated injuries which, combined with fatalities, occurred in 83% of the balloon tour crashes in our study and may be improved by targeted interventions. In the literature, hotair balloon crashes involving power lines have disproportionately high death rates. From 1976 through 1983, 38% of the 231 balloon crashes that occurred in the United States involved power lines, and these crashes contributed to twothirds of hotair balloon crash deaths 20 . Similarly, from 1984 through 1988, the 33% of crashes that involved power lines resulted in 83% of deaths and 30% of occupant injuries 9 . In our study, only 7% of paid balloon ride crashes involved power lines, although these crashes resulted in two of the five deaths. This apparent decrease in the proportion of crashes involving power lines may partially explain the relatively low incidence of death and serious injury among paid ride occupants in our study;

however, the small number of fatalities in our study limits this comparison. Further, although these crash reports in our study lacked detailed data for evaluation, a 3yr study of power line collisions conducted by Aerostar International found abovetheequator envelope collisions reduced the risk of serious and fatal injuries by over half, compared with belowtheequator envelope collisions 1 .

This suggests that training pilots to impact power lines above the envelope's equator may improve crash outcomes. Compared with commercial air tour crashes in motorized aircraft, hotair balloon tour crashes resulted in a high proportion of serious or fatal injuries, but poor outcomes were not associated with balloon damage. The rarity of concurrent occupant injury and balloon damage raises the question of whether balloons themselves can be sacrificed during crashes to better protect occupants from injury. Indeed, all eight crashes resulting in substantial balloon damage but no occupant injuries occurred during collisions with fixed objects in which destruction of the balloon envelope absorbed the impact of the collision. Two of these eight crashes involved envelope collision with power lines, which have been associated with fatal outcomes 9, 20 . Previous studies emphasize the high proportion of maintenancerelated crashes associated with less regulated aviation operations. In Hasselquist and Baker's 1999 study on homebuilt aircraft, mechanical failure led directly to 43% of crashes and played a direct or contributory role in 63% of crashes 12 . A later study of gyroplane crashes, however, found that crashes related to mechanical problems were less likely to result in fatal outcomes than crashes not so related, and maintenance issues were associated with neither fatalities nor aircraft damage in these crashes 21 . Likewise, a study of helicopter and airplane commercial air tour crashes found that improper maintenance was not associated with fatal outcomes in commercial air tour crashes of helicopters and airplanes 2 . While improper maintenance contributed to 11% of commercial helicopter and airplane tour crashes, it contributed to only 4% of balloon crashes in this study.

This difference may be due to the relative simplicity of balloon mechanical systems and maintenance, although it is not clear whether balloon owners and pilots are as likely to perform their own maintenance as those of other categories of aircraft. Despite incomplete injury data, preliminary conclusions can be drawn about potential interventions to reduce balloon tourassociated mortality and morbidity. Similarly, over half of the serious injuries characterized in our study were lower extremity fractures sustained during landings, which were the most common phase of flight in which crashes occurred. These results suggest that reducing landing forces could decrease balloonassociated injuries. This would, by definition, reduce the overall crash rate since the FAA's accident criteria include serious injury and death. Potential strategies for reducing landing forces include cushioning the bottom of the basket or employing crashworthy auxiliary crew seats during landings. Restraint systems endeavor to maintain occupants within a known space, thereby attenuating crash dynamics and avoiding secondary impacts with equipment and other passengers. The protective effects of restraint systems have been documented for multiple transportation modes, including aviation crashes 14 16 . Since 80% of paid balloon ride fatalities involved ejection in this study, the data suggest that using restraint systems to prevent ejection could dramatically decrease the incidence of fatal crashes. Moreover, since most power linerelated balloon fatalities result from blunt trauma from falls, rather than electrocution, restraints could be useful in mitigating the risk of this frequent contributor to balloonrelated injury and death 17, 18 . No FAA regulations currently mandate the use of flight helmets in General Aviation, including balloon flights. However, our results suggest that this simple intervention could influence crash outcomes.

Of the five serious head injuries reported in our study, three were sustained during flights in which the tour company deviated from the requirements specified in FAAapproved balloon flight manuals by failing to provide balloon ride occupants with helmets 4, 11, 19 . Helmets can prevent head injuries or reduce their severity by distributing impact loads and preventing skull deformation. This effectively increases the skull's tolerance to linear acceleration up to 300 g 10 . Moreover, even

transient concussion avoidance could allow a balloon pilot or occupant to execute emergency procedures during a crash sequence. A major limitation of this study is the lack of denominator data needed to calculate crash, death, and injury rates for commercial hotair balloon tour flights. Without reliable estimates of hot air balloons in use or of the number of flight hours flown in this subset of balloonists, it is difficult to estimate the incidence of balloon crashes, which would provide additional context to our results. Moreover, the use of absolute figures in crash analysis has faced criticism in the past for not providing adequate denominator data to allow appropriate analysis and interpretation 13 . However, the crash analysis performed in this study differs fundamentally from risk analysis, which is a broader approach requiring highly specific denominator data 13 . For instance, a thorough risk analysis for hotair balloon tours would require detailed information about each landing approach, object avoidance maneuver, and adverse wind encounter during flight. Crash analysis, while narrower in scope than risk analysis, serves as a starting point for targeting interventions to decrease the high morbidity and mortality associated with balloon tour crashes. Another limitation to this study is the likelihood that hotair balloon tour crashes are underreported, particularly those that do not result in passenger injuries or substantial damage to the balloon.

According to current FAA regulations, occupant injuries must be reported within 10 d of a flight, and deaths must be reported within 30 d. Nevertheless, injuries of tourists may not be diagnosed until after the tourists return home, and the injuries may not be reported to air tour companies or the FAA. In our study, the NTSB discovered one crash after receiving a call from a seriously injured passenger. The pilot, who had been allowing a student to command the balloon in violation of FAA regulations, had not reported the crash. Additionally, we could not assess the role of drugs and alcohol in balloon tour crashes since pilots apparently were not tested. Although alcohol testing of fatally injured commuter and air taxi pilots is common, such testing is rare for Part 91 pilots 3 . Since balloon crash reporting often occurs hours to days after crashes occur, it is difficult to ascertain drug and alcohol levels at the time of the crash. In contrast to FAR Part 135 regulated airplane and helicopter air tour operators, for whom the FAA mandates drugscreening programs, Part 91 tour operators are not required to have drugscreening programs for pilots. Finally, the data collected using standardized NTSB reports are not ideal for balloon crash analysis. Object strikes, occupant ejections, rollovers, and the use of personal protective equipment appear to play an important role in determining balloon crash outcomes. However, the NTSB forms do not standardize the reporting of this information, so data on these occurrences may be incomplete if this information is not included in the form’s narrative section. Further, the lack of specific injury information recorded on the form inhibits the development of injury prevention strategies that address the risk factors faced by all individuals involved in aviation crashes. In conclusion, the incidence of hotair balloon tour crashassociated morbidity and mortality is high, and targeted interventions may improve crash outcomes.

In addition to examining the role of restraint systems and personal protective equipment in hotair ballooning, injury prevention efforts should address highrisk factors, such as hard landings, ejections, and object strikes, which are associated with balloon injuries and deaths. More detailed information about the nature and outcomes of balloon crashes would assist the development of targeted interventions aimed at decreasing the number and reducing the severity of balloon crash injuries. Footnotes The views expressed in this manuscript are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government. Contributor Information SarahBlythe Ballard, Johns Hopkins Bloomberg School of Public Health, Department of International Health, Baltimore, MD, and U.S. Navy. Leland P. Beaty, Johns Hopkins Center for Injury Research and Policy, Baltimore, MD. Susan P. Baker, Johns Hopkins Center for Injury Research and Policy, Baltimore, MD. US commercial air tour crashes, 20002011 burden, fatal risk factors, and FIA score validation. Balloon crash damage and injuries an analysis of 86 accidents, 20002004. Sports aviation accidents Fatality and aircraft

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Rare electrocution due to powerline contact in a hotair balloon comparison with fatalities from blunt trauma. Ultralight aviation accident factors and latent failures A 66case study. Our balloon envelopes have been in demand for almost 35 years we guarantee best and durable quality as well as perfect execution down to the smallest detail. Selected materials and the utmost care in craftsmanship are the hallmarks of our baskets of course. Our basket variants offer a maximum of flexibility and thus free space for your wishes. The FB 7 burner convinces with every cylinder pressure by enormous performance, without annoying condensation water. 8.000 PS DragonFire! SCHROEDER fire balloons since 1985 a benchmark for quality made in Germany. To the Schroeder fire balloons products. Annual audits will continue to take place. However, we would like to ask you to simply park the trailer. Unloading and loading is carried out exclusively by our team. Unfortunately you have to spend the waiting time of the airworthiness test on your own. For example with a car ride along the beautiful Moselle. In about 1.5 hours the balloon unit will be completely tested. Many thanks for your understanding and assistance. The Schroeder Team. No apologies are made for nontechnicaltype talk but if you don’t have a bit of lightness here and there then it will bore you senseless. Having said that it is not intended as a light read. As I am not the best at links and interwebbing then it is, by nature, simple. Any problems or improvements please let us know. It will be updated weekly but please check the issue date at the top and remember that details can change overnight so use the links and doublecheck if you are in any doubt. All the links are summarised at the end. We do try to check and update every few days. So order of events is look up the EASA TCDS list. If your chosen subject isn’t there then move swiftly onto the UK CAP 747.

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