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## **Selected Topics: Sports Medicine**

### **THE EPIDEMIOLOGY OF SKYDIVING INJURIES: WORLD FREEFALL CONVENTION, 2000–2001**

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□ **Abstract**—The purpose of this study is to describe the prevalence and types of injuries incurred by civilian skydivers using contemporary equipment under conventional conditions. Injury data were collected at the World Freefall skydiving convention (WFFC), during two consecutive periods of operation, August 4–13, 2000 and August 3–12, 2001. During the study periods, 8976 skydivers made 117,000 skydives. The First Aid Station at the WFFC treated 204 patients for injuries related to skydiving, at a rate of 17.4/10,000 (injuries/skydives). Most injuries were minor (66%) and required only simple first aid. Significant injuries, defined as those requiring treatment in the emergency department, occurred at a rate of 6.0/10,000 (injuries/skydives). The rate of hospitalization was 1.8/10,000 skydives. There was one fatality during this study. We believe these results provide a current update regarding the risk and types of injury related to recreational skydiving. © 2005 Elsevier Inc.

□ **Keywords**—skydiving; sports injuries; mass gathering; injury epidemiology

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This study was conducted while all authors were affiliated with the University of Texas, Southwestern Medical Center, and was approved by the UTSW IRB.

#### **INTRODUCTION**

The sport of skydiving continues to grow in popularity in the United States and throughout the world. According to the latest published data from the United States Parachute Association (USPA), 3.5 million skydives were made in the United States during the year 2000 (1). The USPA also reports that, during 2000, 317,741 people made at least one skydive in the United States, and 34,217 new licenses were issued (1). The USPA grants licenses based on skill level. The Student classification is technically unlicensed and means all skydives must be made with an instructor. After completing a basic, standardized safety course and 25 skydives with an instructor, one is eligible for a USPA-A (beginners) license. To be eligible for a USPA-B license it takes at least 50 skydives, for a USPA-C it takes 200 skydives, and for a USPA-D license, one needs at least 500 skydives. Most skydives in the United States are completed at USPA-affiliated airfields (drop zones) that adhere to standardized safety requirements. Although the USPA has tracked fatality statistics, there are no clear estimates of injury rates related to sport skydiving in the United States.

Skydiving conventions, known as “boogies” to skydivers, are regulated mass gatherings of skydivers. The

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World Freefall skydiving convention (WFFC) is an annual skydiving event, held each fall at the Quincy Regional Municipal Airport (Baldwin Field) in Quincy, Illinois. The WFFC is the largest annual skydiving convention, and in 2000 it gained distinction as the largest skydiving drop zone in the world. Skydivers from 55 countries registered at the WFFC during 2000, and from 42 countries in 2001.

Comparative analysis of previous skydiving injury studies is complex due to the variation in types of injuries documented, different study populations, and the continuous evolution of skydiving technology and equipment. This study, of injuries recorded during 2 consecutive years at the WFFC (2000–2001), is the first to examine types and rates of injuries in civilian skydivers using contemporary equipment in the United States.

## MATERIALS AND METHODS

This study was IRB approved.

### *Study Population*

The study population consists of 8976 skydivers who logged a total of 117,000 skydives during 2 years of the World Freefall Convention (WFFC). During the period of operation, August 4–13, 2000, 5732 skydivers made 63,000 skydives. During the period of operation August 3–12, 2001, 3244 skydivers logged a total of 54,000 skydives. Entry into the WFFC requires either Student status or, at minimum, a USPA-B class license (or international equivalent). Student jumpers made up a small minority of the skydivers (0.26%) and student jumps made up a small percentage of the total skydives (0.80%). The number of skydivers and skydives is based on the number of ticket sales recorded at the convention (the purchase of one ticket is necessary for each jump).

During the WFFC, skydivers jumped from a variety of aircraft. Most aircraft were fixed-wing, and as with most skydiving jumps, the majority of the exits were at a height of around 13,500 feet and a speed of approximately 100 mph. Additional aircraft included Balloons and a Bell-412 Helicopter.

### *Data Collection*

Surveillance for injuries was conducted prospectively on the drop zone and at a local emergency department. All registered skydivers signed consent for transport to one designated local hospital in the event of injury as part of the WFFC liability waiver.

Medical management of the convention consisted of several levels of health care providers. A first aid station was positioned near the main landing area, and was operated by three emergency physicians, a dentist, four registered nurses with critical care or emergency medicine backgrounds, and a medical student. These health care providers managed not only ambulatory patients who presented directly to the first aid station, but also provided field response to other drop zone injuries.

A Mobile Intensive Care Unit, provided by Adams County, Illinois Emergency Medical Services (EMS) and staffed by two Adams County paramedics, was stationed on the drop zone during operating hours throughout the convention. Additional Adams County and town of Quincy EMS units were on standby to provide assistance in the event of an injury occurring while the primary EMS unit was off the drop zone. The National Guard provided a rotating staff of 15–20 guardsmen for the convention, providing primarily air traffic control functions, but who were also involved in disaster response. An additional 2–6 police officers worked the convention.

The first aid tent personnel obtained data on all injured skydivers at the drop zone, whether they were treated and released, or transported to the emergency department. Data sheets at the first aid tent included diagnosis, and treatment provided. Data collection was supervised by the same emergency physician during both years of the study. One of the other primary data collectors (an emergency physician) was also present during both events. The other medical personnel (nurses, medical student) varied between years.

Triage workers at the designated emergency department were asked to identify all patients affiliated with the WFFC. The hospital staff then completed a data form with the patient's age, gender, presenting complaint, diagnosis, and disposition. This emergency department has been the designated center for medical care patients transferred from the WFFC for many years and maintained a backup staff schedule covering the convention dates.

### *Variable Definitions*

Skydiving injury rates are traditionally defined as injuries per 10,000 skydives or "jumps." In our study, an injury was determined to be skydiving related if it occurred at any point from the time of exit from the aircraft to completion of the landing. Minor injuries were defined as injuries treated and released by the medical staff at the drop zone. Significant injuries were defined as injuries evaluated at the drop zone and transferred to the emergency department for further evaluation. Hospitalizations were defined as injuries necessitating admission to an

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