Injuries in Skydiving

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Photos courtesy of Craig O’Brien, Ori Kuper, Peter Degerfeldt and Linda Persson.
Skydiving, sport parachuting from aircraft, is popular.

During 2011, more than six million skydives were made by more than one million persons in 36 countries.

There are several disciplines and events.
A standard skydiving harness contains a main and a reserve parachute.

Main parachute deployment is initiated by manually releasing a small round "pilot chute" into the airstream.

Should the main parachute malfunction, it is manually disconnected and the reserve deployed.
This is a parachute design by Leonardo da Vinci.

July 25, 2000, Adrian Nicholas test-jumped Leonardo’s parachute design from 10 000 feet over Mpumalanga, South Africa.

It worked fine.
As you can see, Adrian is a rather passive passenger.
So were these parachutists.

Prior to the 1970s, sport and military parachutists were passengers under their round canopies.

In the 1960s, Domina Jalbert invented the ram-air, or wing, parachute.

A flyable, textile wing that self-inflates by ramming air and creates aerodynamic lift, like a glider aircraft.

This landmark invention changed parachuting.

This presentation is largely about that change.

This is not a passive passenger.

This is a pilot.
These three pilots are all flying ram-air wings.

What differs is the ratio of suspended weight to wing platform area.

This measure, called wing loading, is a determinant of airspeed.

High wing loading = high speed = high energy.
Typical nonfatal injuries in skydiving are caused by miscalculated landings of perfectly functioning wing parachutes.
Mechanisms in reported non-fatal skydiving injury events in Sweden 1999-2003 (n=257) in relation to phase of jump and experience level (student (Stud.) vs licensed (Lic.)).
Same data visualized in a different way: Reported non-fatal skydiving injury events in Sweden 1999-2003 (n=257) in relation to phase of jump when the injury occurred. Of a total 94 landing incidents with student skydivers, 31% (29) were off drop zone.
From the same dataset: Distribution of injuries (n=311) sustained in reported nonfatal skydiving incidents in Sweden in 1999–2003 (n=257), every dot representing an injury.

Bar diagrams show injury severity categorized with the Abbreviated Injury Scale (AIS).

All numbers are absolute except where stated as percent of total.
Healthcare consumption and impact on life

Table 6  Healthcare consumption and impact on life in responses (n = 229) to a questionnaire sent to all living people having reported a skydiving injury event in Sweden during 1999–2003 (n = 257) (response rate 89% including serious incidents)

<table>
<thead>
<tr>
<th></th>
<th>Licensed</th>
<th>Students</th>
<th>Total</th>
<th>Serious incidents*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total responses</td>
<td>138</td>
<td>87</td>
<td>229</td>
<td>29</td>
</tr>
<tr>
<td>Medical treatment†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consultations/follow-ups</td>
<td>117</td>
<td>74</td>
<td>193</td>
<td>29</td>
</tr>
<tr>
<td>Total‡ (%)</td>
<td>952 (70)</td>
<td>395 (29)</td>
<td>1359</td>
<td>542 (40)</td>
</tr>
<tr>
<td>Median (range)</td>
<td>3 (1–200)</td>
<td>3 (1–50)</td>
<td>3 (1–200)</td>
<td>12 (1–200)</td>
</tr>
<tr>
<td>Inpatient treatment</td>
<td>46</td>
<td>29</td>
<td>76</td>
<td>28</td>
</tr>
<tr>
<td>Time in hospital (days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accumulated total‡ (%)</td>
<td>948 (83)</td>
<td>178 (16)</td>
<td>1140</td>
<td>888 (78)</td>
</tr>
<tr>
<td>Median (range)</td>
<td>5 (1–270)</td>
<td>3 (1–50)</td>
<td>4 (1–270)</td>
<td>11 (1–270)</td>
</tr>
<tr>
<td>Residual disability/discomfort</td>
<td>69</td>
<td>44</td>
<td>114</td>
<td>27</td>
</tr>
<tr>
<td>Stopped skydiving§</td>
<td>16</td>
<td>44</td>
<td>61</td>
<td>11</td>
</tr>
<tr>
<td>Work/leisure time changes§</td>
<td>28</td>
<td>20</td>
<td>49</td>
<td>15</td>
</tr>
</tbody>
</table>

*n=29 (serious incidents response rate 97%). The one non-responder of a total 30 maximum Abbreviated Injury Scale ≥3 cases, a first-jump student with an open calf fracture, was reportedly admitted to inpatient care and operated on.
†At a municipal health centre or hospital.
‡A postal error rendered four questionnaire responses with a total of 14 days in hospital and 12 medical consultations unrelated to experience level. Two of these four sought medical treatment, and one reported residual disability/discomfort to work/leisure time changes and having stopped skydiving as a result of the injury.
§As a result of the injury.
Overall incidence of non-fatal injury events was 48 per 100 000 jumps.

The risk of an injury event of any kind was six times higher per jump for students than for licensed skydivers.

Overall incidence of serious (MAIS≥3) non-fatal injury events was 6 per 100 000 jumps, or 17 996 jumps per serious non-fatal injury event.
So, how dangerous is skydiving?

- As you saw, Sweden 1999-2003 had an overall incidence of non-fatal injury events of 48 per 100 000 jumps.

- A study of injuries treated at first-aid stations at skydiving conventions in the United States between 2000 and 2001 reported a total injury rate of 170 per 100 000 jumps.

... should one avoid skydiving conventions in the United States?

So, how dangerous is skydiving?

- The overall sensitivity of the Swedish Parachute Association national registry of skydiving injuries 2006/2007 was 0.37 (95% CI 0.24–0.51). The specificity was 0.91 (95% CI 0.83–0.95).

- No significant effect on reporting for gender, age, license level, years in the sport or total number of jumps.

- Self-stated non-minor injuries sensitivity was 0.67 (95% CI 0.43–0.85).

- $48/0.37 = 130$, comparable to those US skydiving conventions.
So, how dangerous is skydiving?

One answer is that the risk of a MAIS≥3 injury is circa one in 20 000 jumps.
The wing parachute has promoted the parachutist from passenger to pilot.

Flying and landing a wing parachute, especially a high performance one with high wing loading, requires specialized aviator skills and considerations.

Proposed skydiving injury prevention measures include implementation of appropriate aviation school training philosophies, and further development of specialized aviation technology.
Thank You.
Questions?
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