Descriptive Epidemiology of
USAF Lost Workday Injuries, FY93-FY02

Part II. Detailed Analysis for Mishap Prevention

Research and Epidemiology Branch

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Introduction

Part II of our lost workday (LWD) injury report takes a closer look at the top producers of LWDs. Our goal was to provide details on those "big rocks" identified in Part I by drilling down into each external cause's information and deriving "preventable elements". We analyzed the narrative information within each of those external causes (e.g., slips/trips/ falls, softball injuries, injuries from power tools), then developed a detailed "how they were injured" classification scheme unique to each of those causes.

The results of our analyses are obviously meant to be used for preventing mishaps: safety leaders and commanders taking this information and developing operationally relevant strategies and programs to reduce injuries. The Air Force Safety Center's functional divisions (Flight, Ground, Weapons, and Space) will provide consultation to MAJCOM and base-level safety officials and commanders as requested. MAJCOM safety offices are particularly encouraged to contact the Research and Epidemiology Branch (SEPR) when command-wide injury reduction initiatives/programs are fielded. We can provide assistance on measuring the new program's effectiveness and, if requested, conduct a scientific, statistical evaluation of that program. Interested parties may contact us at AFSC.SEPR@kirtland.af.mil.

Many of the prevention recommendations in this report were the result of brainstorming, using two tools designed specifically for that purpose by Dr William Haddon, Jr: Ten Strategies for Control of Hazards of All Types (Appendix A) and the "Haddon Matrix" (Appendix B). These tools were designed for practical use, thus AF and DoD safety officials will benefit by using them for brainstorming at their bases. Surely techniques other than those listed in this report will be revealed by using these tools. Please contact SEPR if you need assistance in applying these two thought-provoking frameworks. These two tools are primarily aimed at "hard" engineering controls, not "soft" behavioral interventions. Besides consulting your own Life Skills Development professionals regarding behavioral interventions, we recommend that you obtain a copy of the U.S. Army Research Institute of Environmental Medicine's Technical Report No. TN00-4, dated January 2000, Injury Control Part II: Strategies for Prevention. This is available through the Defense Technical Information Center (http://www.dtic.mil/). Not only will you be introduced to the behavioral models, but Haddon's frameworks--briefly presented in Appendices A and B in this report--are also more fully described.

Special thanks are in order to the hundreds of Ground Safety personnel world-wide who for the past 10 years have diligently reported mishaps to the Center via various reporting systems that have evolved over the years. Further inroads into mishap prevention and injury reduction would be impossible without knowledge of what caused the mishaps. This report is only the beginning of our efforts to move more processed data and information out to the safety offices to be used to prevent future mishaps. On-line dynamic queries will soon be possible via the Air Force Safety Automated System (AFSAS) so that MAJCOMs and bases have access to their data. Until that time--and unless indicated otherwise in this report--all commands should assume that they are "not that different" from the rest of the Air Force regarding what types of mishaps cause lost workdays.

Finally, let us give one last note on the use of this report. As you will quickly find out once you begin reviewing this report, it is not a glossy, top level view of the injury problem with the main purpose of producing more PowerPoint® presentations. Reducing the lost work day rate due to injuries will be difficult, tedious, and detailed work. Reading this report will likewise be tedious. Although we discuss a number of injury prevention concepts in the appendices, the bulk of the report is made up of describing the injury problem in the USAF. So, if you want to study the details of reducing injury, we hope this will be one resource that you use to address that goal. If you want a source of glowing generalities and quick answers, you will be disappointed.

Although this report was not a response to the Secretary of Defense's reduction goal (50% in the next two years) timing is everything and we hope the report will be at least a partial answer to that end. However, we know that there will be many additional questions, some no doubt in response to this report. Please let us know how we can help you meet the SECDEF's lofty goal by reducing the burden of injuries in our population.

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Disclaimer

This report is an attempt to identify and describe the causes of lost workday injuries in the USAF at the greatest level of detail possible and to suggest prevention methods specific to those injuries. The suggested methods are not a comprehensive listing, but only an *additional* resource for safety training. Therefore, we did not include general safety rules--important for safety training--in this report unless one of these rules seemed particularly germane to a particular type of mishap found in the AFSAS database. The fact that units already implement and follow many safety guidelines does not diminish their importance; they should be continually included in safety briefings and not treated as merely perfunctory. For example, the following general safety rules from the Occupational Safety and Health Agency (OSHA) for the use of hand and power tools are not otherwise stated in this report but are still critical to safety training:

- Keep all tools in good condition with regular maintenance.
- Use the right tool for the job.
- Examine each tool for damage before use and do not use damaged tools.
- Operate tools according to the manufacturers' instructions.
- Provide and use properly the right personal protective equipment.

Many of our prevention recommendations come from "common knowledge" for those of us in the injury prevention or safety arenas. Many other recommendations are based on common sense or logic, using Haddon's 10 Strategies for Preventing Injuries (Appendix A) as the underlying framework. Many of these techniques have not been subjected to a high level of scientific scrutiny such as a randomized control trial or a prospective cohort study, but they logically appear to hold some promise, either in the literature or (again) by logic. Keep in mind that only a relative few injury prevention techniques or methods have been subjected to rigorous evaluations and far fewer still have been *scientifically proven* to work. Regardless of proof in either direction, most of those methods that *have* been studied haven't been studied to any great extent. Additionally, whatever studies exist were often done within a niche of the population that may not apply well to the military. While a detailed literature review was beyond the scope of this report, our description of like-type injuries may be used to guide future research on injury prevention. Besides the SEPR research staff and safety experts, AFIT-funded students (as one example) could explore ways to prevent a specific type of injury using the medical and safety literature.

Also not always stated are those interventions that fall under the concept of universal precautions which may be used to prevent injuries with a vast array of external causes. This concept is discussed in Annex C.

Executive Summary

The overall picture shown by the Lost Workday Injury (LWI) Part I analysis is one of low rates of injury, which are steadily decreasing in most areas. However, this picture has changed in the past two years with military mishaps increasing, as civilian mishaps continue to decline. These changes are due in part to a change in active duty demographics, in particular, older more experienced troops being replaced by younger risk takers. The 17-24 year-old age group increased nearly 20% from FY98 to FY02 while the 25-and-older population decreased by that proportion.

Part II, the more detailed analysis for injury prevention contains the following findings and conclusions:

- Two-thirds of the lost workdays are accounted for by a younger military group (vs. older civilians), the majority being off-duty PMVs mishaps
- The remaining one-third of the lost workdays are accounted for by civilians in the industrial setting (on-duty)
- The top three **functional areas** for *overall* (combined military and civilian) lost workdays:
  1. aircraft maintenance
  2. civil engineering
  3. services
- The top three **activities** for *overall* lost workdays:
  1. operating a motor vehicle
  2. slips trips and falls (not on a ladder or stairs)
  3. lifting and carrying objects
- The top three **activities** for *military* lost workdays:
  1. operating a vehicle
  2. slips, trips and falls (not on a ladder or stairs)
  3. riding in/on a motor vehicle
- The top three **activities** for *civilian* lost workdays:
  1. slips, trips and falls (not on a ladder or stairs)
  2. lifting and carrying objects
  3. slips/trips/falls while climbing or descending stairs or ladders
- The lost workday problem is complicated and diverse, and therefore cannot be solved by a single, easy solution
- Strategies to prevent running injuries must be immediately implemented to avoid increases in the mishap rate due to the addition of running to annual fitness testing

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Overview: Major LWD injury-producing activities by functional area

Combined civilian & military--Top 15 injury-producing functional areas

Key

	<15% of injuries associated with this activity found within this functional area
	15% - 29% of injuries associated with this activity found within this functional area
	30% - 49% of injuries associated with this activity found within this functional area
	> 50% of injuries associated with this activity found within this functional area

	Activity					
Functional area	Slips, trips & falls	Climb stairs/ ladder	Operate veh or equip	Ride in/on vehicles or equip	Hand tools	Power tools
Military off-duty	1,135	674	4,125	1,016	117	70
Aircraft maintenance	981	553	52	55	87	47
Civil engineering	592	292	75	25	65	44
Services/MWR	825	120	45	24	38	17
Supply/Logistics	195	52	17	7	5	1
Transportation	105	24	28	9	6	7
Security forces	112	14	83	42	2	1
Communication/computers	86	30	16	6	5	2
Medical services	124	17	8	6	5	0
Operations	94	24	14	7	5	3
HQ Base command/comm	106	46	12	6	4	0
Personnel	73	33	10	1	1	0
Combat training	40	13	16	3	4	0
Aerial port	25	12	4	1	0	0
Finance	57	14	1	0	0	0

	Activity					
Functional area	Power equipmt	Handling objects	Dropped object	Lift or carry objects	Struck or struck by object	Gun
Military off-duty	85	180	103	507	403	85
Aircraft maintenance	42	69	124	1,246	602	0
Civil engineering	33	74	54	632	244	0
Services/MWR	19	48	70	609	260	0
Supply/Logistics	8	9	15	258	63	0
Transportation	4	13	17	125	70	0
Security forces	0	17	5	37	24	13
Communication/comp	2	1	17	90	36	1
Medical services	0	9	4	89	24	0
Operations	4	3	8	78	26	2
HQ Base command/comm	0	3	8	42	12	0
Personnel	0	2	4	49	15	0
Combat training	0	8	3	15	10	7
Aerial port	0	1	5	28	34	0
Finance	0	0	1	16	4	0

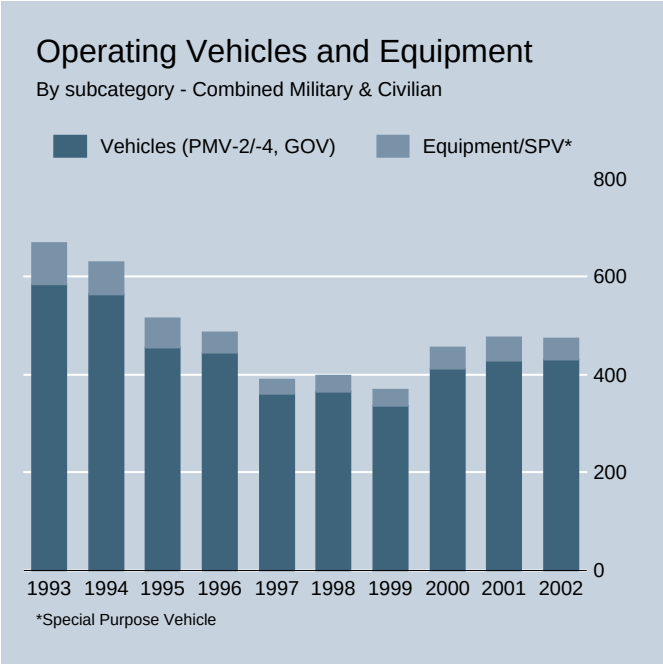
Note: Sports and recreation injuries not included in this table since these occur almost exclusively in off-duty military personnel

Operating Vehicles or Equipment	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	2	1	6
Total lost workdays	1	1	5
Severity*	3	3	2

Note: Rankings for top 12 injury-producing activities only

**Combination of % fractures/concussions/dislocations + median LWD*

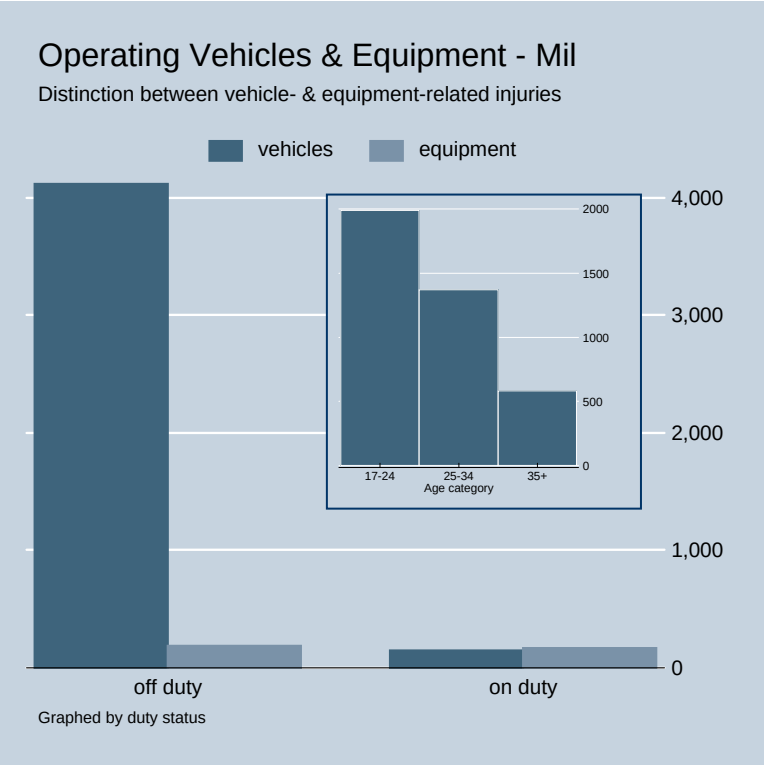
Abbreviations used below: PMV = personal motor vehicle; GOV = government-owned vehicle; LWI = lost workday injuries



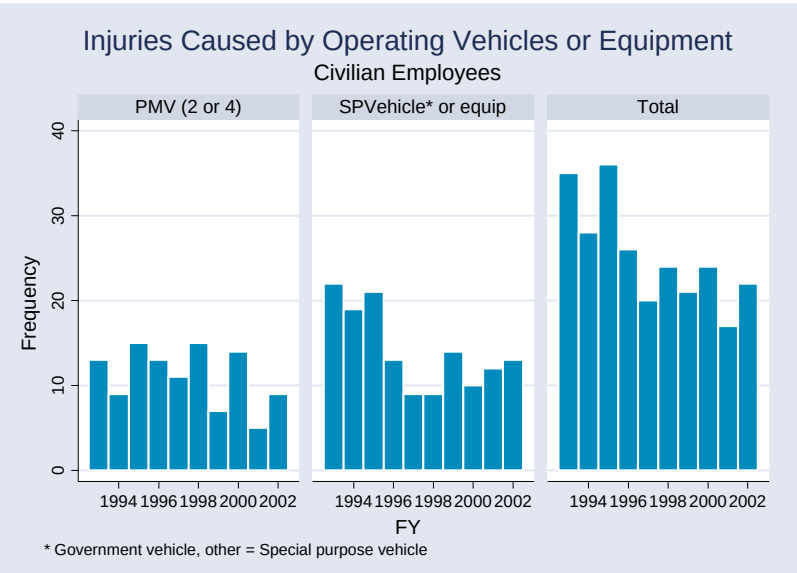
Operating vehicles and equipment represents the number one generator of lost workdays while being second only to slips, trips, and falls in the number of injuries produced. As seen in the chart to the left showing overall numbers, most of the injuries are due to operating vehicles (all types of personal motor vehicles, and government-owned vehicles which include rentals) vs. equipment which includes special purpose vehicles. These injuries are currently on a 3-year plateau but this may be due to increased reporting after the USAF fielded its Safety Automated System (AFSAS).

Operating vehicles or equipment: statistical breakdown	Vehicles (PMV-2/-4, GOV)	Special Purpose Vehicles or Equipment	Total
Civilian	111 43.9%	142 56.1%	253 100.0%
Military	4,265 92.7%	338 7.3%	4,603 100.0%
Total	4,376 90.1%	480 9.9%	4,856 100.0%

Military injuries comprised 90% of the chart above, and 95% of those injuries occurred when operating PMVs (primarily) or GOVs, passenger motor vehicles in any case. Most of the civilian injuries occurred while operating equipment. Overall, equipment operation, whether on- or off-duty, represented only 10% of the total.

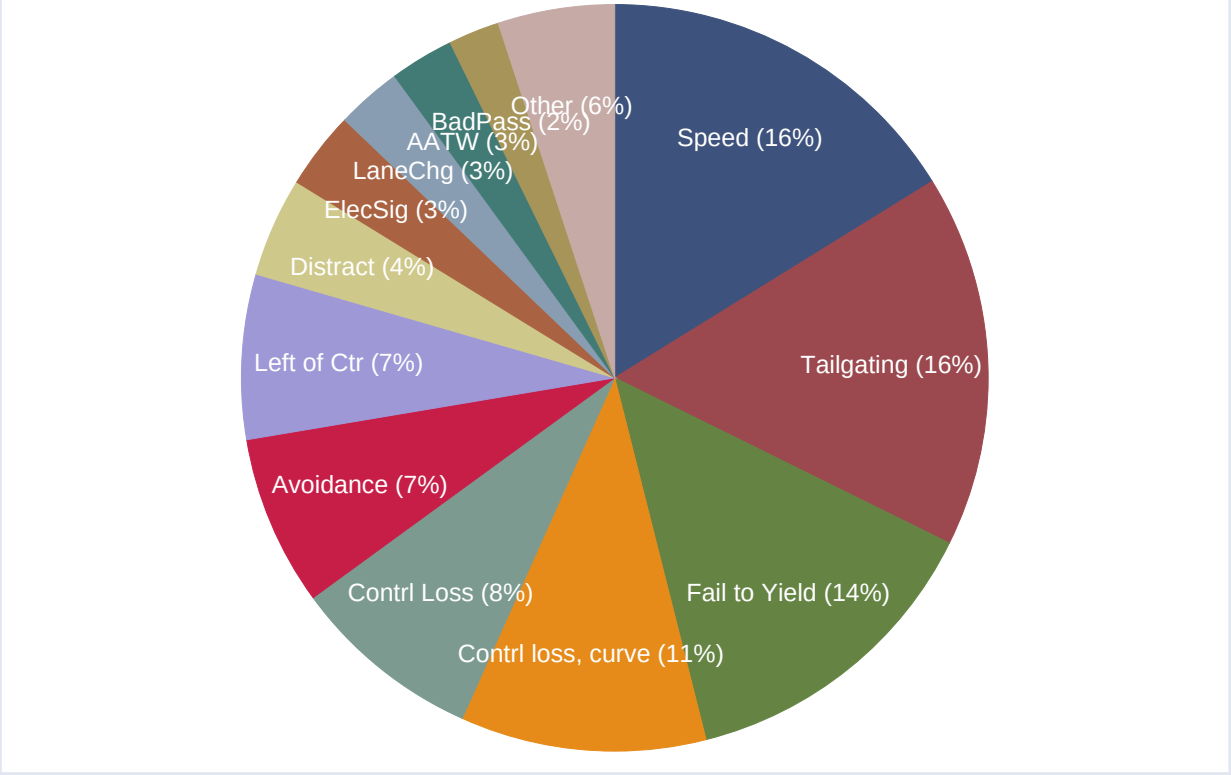


The graph at left indicates that the lost workday problem in this category for airmen is synonymous with "operating vehicles off-duty". Special purpose vehicles (e.g., tugs, backhoes) are categorized here as equipment since their use is purely for their utility, not transportation. The inset suggests that the 17-24 age group is a particularly attractive target for overall LWI reduction (both on- and off-duty vehicle-related are shown). This group has both high numbers of mishaps (about 200/year) and high incidence rate (177 LWI/100,000 airmen, data not shown). This particular group produced about half of all LWIs in this category but represents only about 32% of the AF population.



Civilian personnel were much more likely than military to incur LWIs while operating special purpose vehicles or equipment. Still, civilians have been averaging only 7 on-duty non-PMV mishaps over the past 7 years. While the overall numbers of reported injuries in this category was unsteady from year to year, the general overall trend was downward.

The pie chart below shows the driving behaviors associated with 1,321 of the 1,536 Class C lost workday motor vehicle mishaps that occurred from FY97 through FY01. This information was drawn from the mishap reports that were sufficiently detailed to acquire the desired data. This analysis was part of a special research project and represents the most detailed data available on the causes, circumstances, and outcome of these motor vehicle mishaps.



AATW. Asleep at the wheel

Indicators of aggressive driving, excessive speed and following too closely (tailgating) were each associated with 16% of the injury-causing motor vehicle mishaps. Failure to yield the right-of-way and control loss in curves was causal driving behavior factors in 14% and 11% of the mishaps, respectively. Any type of loss of control, in curves or otherwise, was causal in 19% of the mishaps. In many of these cases, speed could well have been the actual culprit, yet there was nothing in the police or safety report affirming that to be the case.

For contributing causes (data not shown), 88 (8%) of the 1,321 vehicle operators involved in those mishaps during that 5-year period were documented as having used alcohol before or during driving. This is a very conservative estimate since nearly 90% of operator-airmen were not tested for alcohol after the mishap. An airman was at fault in 70% of those mishaps that involved alcohol use and in 42% of non-alcohol related mishaps. Operator fatigue was found to have been a contributing factor in 70 (6%) of these mishaps. Weather was a contributing factor in only 12% of the mishaps. A total of 473 airmen were injured on motorcycles, 452 (96%) of those being the motorcycle operator. Five percent of the injured operators were cited for drinking, again a conservative estimate.

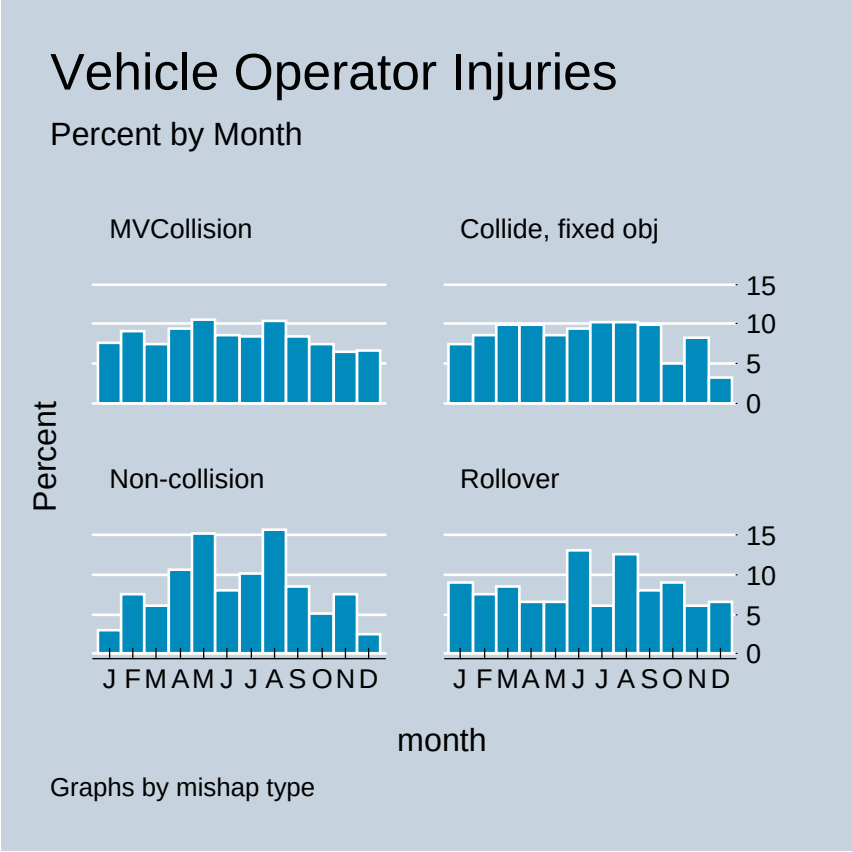
The mishap database indicated that 200 (13%) of the operators were injured in rollovers (see table below). Passenger trucks and sport utility vehicles were overrepresented in these mishaps. Rollovers and non-rollovers each produced a relatively large percentage (38%) of head injuries. However, 45% of rollover head injuries in rollovers were concussions or fractures vs. 15% for the non-rollovers. This indicates a significantly higher level of head injury severity--with more lost workdays per injury--in rollover injuries which is also seen in national data. The median number of lost duty days for rollovers was not particularly high in spite of the injury breakdown which indicates that these mishaps are distributed in a bi-polar fashion: either (and mostly) of low severity at one extreme or of particularly high severity at the other extreme. Forty-six percent of these injuries produced only 1-2 lost duty days; surprisingly, the same percentage produced more than 5 lost workdays. Ten percent of these injuries generated 30 or more lost duty days. These higher severity injuries could easily have been a Class A--a fatality or permanent disability if, for instance, guard rails were not present or safety belts had not been worn.

Distribution of PMV and GMV operator injuries by mishap category with median lost duty days by category

Mishap Category	Injuries Reported	Percent	Median Lost Duty Days
Collision with another MV	862	56.1%	3
Collision with fixed object	247	16.1%	6
Non-collision	200	13.0%	6
Rollover	198	12.9%	3.5
Collision with animal	29	1.9%	6
Total	1,536	100.0%	3

The majority of the lost workday/Class C mishaps were due to collisions with other motor vehicles. As noted above, many of these were rear-enders as opposed to head-on collisions more commonly seen in Class A mishaps. In fact, 303 (35%) of the 862 Class C injuries were from tailgating. Approximately 42% of these mishaps were single-vehicle crashes. Of those, 15% were avoidance situations, leaving at least 27% of these mishaps being caused *exclusively* by the airman-operator's misjudgment and

control loss[1]. Documentation of alcohol use was highest in these single-vehicle categories, 14% for collision with fixed objects and 16% in rollovers, high numbers indeed when considering that few operators were even tested for alcohol. This finding indicates the need for more thorough investigations to include alcohol testing for airmen involved in non-collision mishaps. Perhaps some corrective action with alcohol-involved drivers after their Class C mishap could prevent a more severe mishap in the future--a mishap involving other vehicles and people.



The monthly distribution of the 4 predominant PMV/GOV mishap categories is shown at left. Of particular note is that only the non-collision categories had a strong summertime cluster of months in which 10%-15% of the mishaps and injuries occurred each month. Note that rollovers are a subset of all non-collisions. Given the higher reported alcohol involvement in these mishap categories, much of the summertime excess in these mishaps is likely due to alcohol use. Overall, August has historically been the worst month.

In Part I of our analysis, the activity labeled as "Riding in or on vehicles or equipment" was listed as the #5 producer of lost workdays. That activity will not be covered here since those injured riders/passengers had little or nothing to do with the mishap's occurrence. In short, people should be very selective with whom they ride. Passengers should also adopt a personal risk assessment mindset, ensuring their own safety by always wearing seatbelts, finding and/or demanding that a sober person drive, or seeking an alternative mode of transportation as the circumstances dictate.

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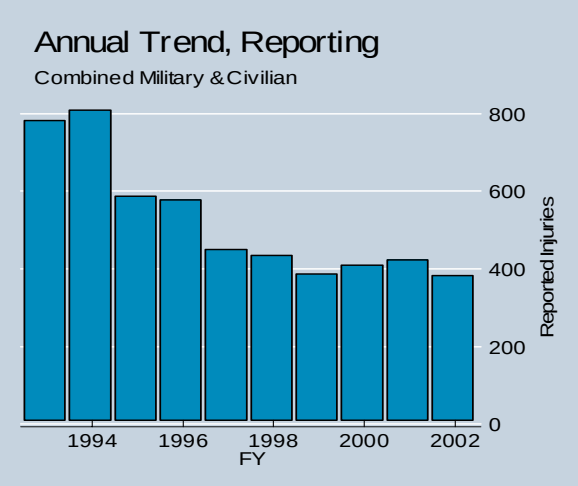
[1] This doesn't account for *collisions with other vehicles* in which operator-airmen were totally at fault including the conservative 4% in this category which involved alcohol., thus a conservative estimate

Slips, Trips, & Falls (STFs)	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	1	3	1
Total lost workdays	2	2	1
Severity*	6	4	4

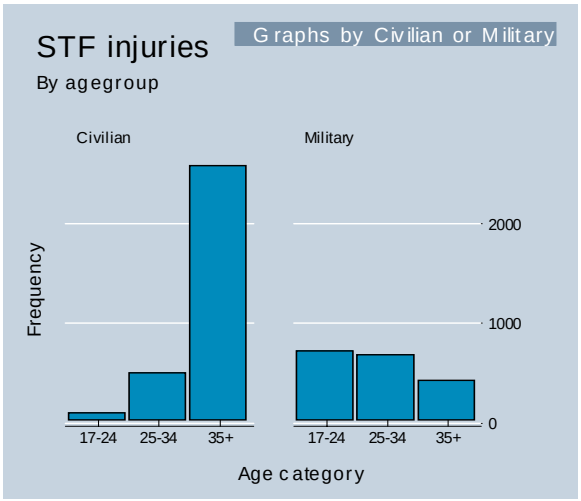
Note: Rankings for top 12 injury-producing activities only

**Combination of % fractures/concussions/dislocations + median LWD*



STFs are the leading overall producer of LWDs and second only to operating vehicles or equipment in numbers of LWIs (events). STFs are the leading external cause of injury in *both* metrics in civilian workers. Reports of STF-caused injuries are holding steady. Since the Air Force personnel strength has not changed significantly over the past few years, the report-based trend depicts the trend in the incidence rate of these injuries. These injuries do not include STFs in sports and recreation activities where individuals purposefully engage in "controlled voluntary falls". Falls from platforms, stands, and ladders--subsets of this category--are also excluded in this section, given their special utility in AF operations. Each of these excluded injury categories are described in a subsequent section of this report.

Age and Gender. Civilian employees contributed 51% of all STFs during the period even though their population size was less than one-half that of the military population.



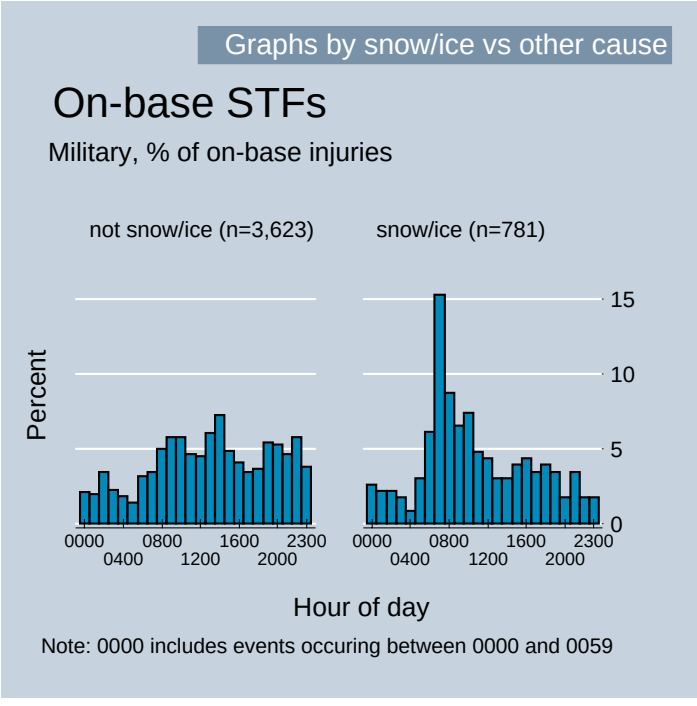
Most (62%) STFs occurred in civilians age 35 and greater. Of the civilian STFs, 81% occurred in that oldest age group. The frequencies in each age group in the graph at left are relatively proportional to each age group's population as long as one views each side of the graph separately--meaning that the incidence rates (not shown) were approximately equal across age groups. This one-side-at-a-time view (military vs. civilian) is necessary since the age distribution differs

greatly across the military-civilian divide. Given that the locus of STFs is the civilian age 35+ subgroup, this is the highest priority target group for intervention. There were no disproportionate contributions by either males or females in either demographic group.

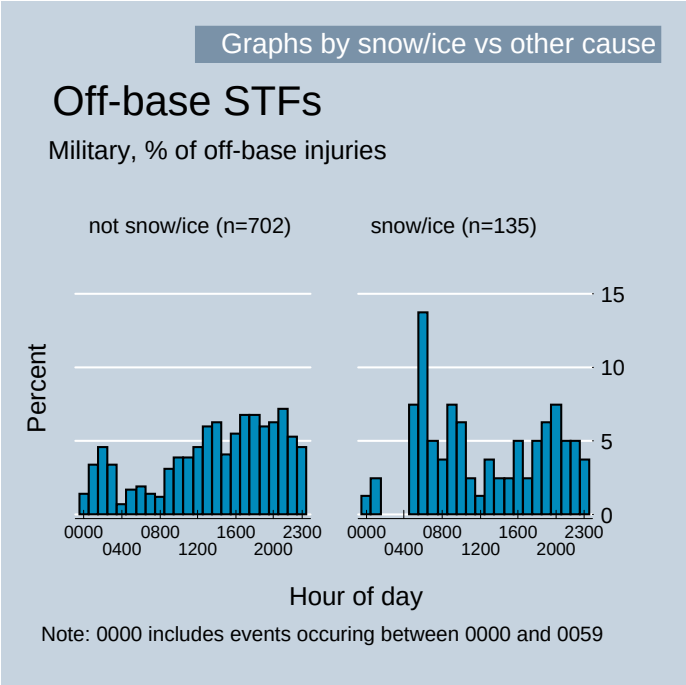
Base/Duty Status. The majority (64%) of military STF injuries occurred off-duty while 36% were on-duty. Almost all off-duty injuries occurred off-base, so the two categories are nearly synonymous. (We generally prefer the on/off-base designation which reporting officials are less likely to confuse with line of duty, thus we use on/off-base as a surrogate determinant of duty status in some of our analyses).

Military STF injury reports by duty status and on or off-base occurrence			
	Off-duty	**On-duty**	**Total**
Off-base	703 (95.8%)	31 (4.2%)	734 (100.0%)
On-base	548 (44.4%)	685 (55.6%)	1,233 (100.0%)
Total	1,251 (63.6%)	716 (36.4%)	1,967 (100.0%)

Time of Day. Military STF time-of-day trends differed by the cause of the STF, whether snow/ice-related (17% of all military STFs) or otherwise *On*-base *non*-snow/ice STFs in airmen occurred most often in mid-morning, mid-afternoon, and the late evening/nighttime but without any remarkable peak (see graph at left). Snow/ice STFs, on the other hand, peaked notably in the 0700-0759 time block before tapering off during the remainder of the day. Over 15% of snow-ice related mishaps during the period occurred in that single hour of the day. A more detailed analysis of on-base ice/snow STFs indicates that the morning surge began around 0700 and began to taper off after 0930 (data not shown). Our detailed analysis of snow/ice STFs will be discussed more fully in a separate sub-section.



Most of the non-snow/ice related injuries were reported at mid-day and in the evening; however, none of the 1-hour time periods contributed more than 7% to the time distribution (see graph at right). Nearly one-half of these injuries occurred on weekends as expected (data not shown). On the other hand, most ice/snow STFs occurred prior to the beginning of the standard duty day--about 14% of them between 0600 and 0659 when leaving home for work--or sometime after the duty day had ended. These injuries showed only a mild weekend tendency (data not shown). A separate, detailed analysis for snow/ice related STFs is presented in a separate section.



Major command. Civilian STFs occurred primarily, as expected, in AFMC which has the highest population of AF civilian employees. That command experienced 53% of STFs while ACC and AETC experienced 12% and 11% respectively (data not shown). The STF distribution in airmen, however, was far less concentrated as 5 of the major commands each contributed at least 10% to the AF total (see table at left). The commands did not report STF mishaps equitably. While 36% of all AF STFs occurred on-duty, the top 3 STF-producing commands (ACC, AMC, and PACAF) each contributed a higher percentage. Each also contributed unequally to STFs overall based on their active duty strength (census).

Distribution of military STFs and population by major command

Command	STF Injuries Reported	Percent of STFs on-duty	Percent of AF STF Injuries	Percent of AF Population
ACC	573	40%	29%	20%
AMC	304	41%	15%	11%
PACAF	262	38%	13%	7%
AETC	219	29%	11%	16%
USAFE	204	36%	10%	6%
AFMC	163	37%	8%	5%
Other†	118	18%	6%	29%
AFSPC	104	38%	5%	4%
AFSOC	44	27%	2%	2%
Total	1,991	36%	100%*	100%

** Total not 100% due to rounding*

† includes direct reporting units and field operating agencies.

Key to following charts

	<15% of STF injuries are associated with this causal factor
	15% - 29% of STF injuries are associated with this causal factor
	30% - 49% of STF injuries are associated with this causal factor
	> 50% of STF injuries are associated with this causal factor

Slips, Trips, & Falls

3,250 lost workday injuries

Chart limited to activities/factors causing 40 or more lost workday injuries

AF Civilian Employees

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Snow/Ice	- Slipped on ice exiting (or entering) vehicle in parking lot - Slipped & fell on snow-covered walkway into building - *Excludes*: Slipped on ice formation in walk-in freezer	488 (15%)	- Implement effective snow/ice removal program - Wear footwear appropriate for weather - Parking lot shuttle service
Liquids, beverages, water/wet surface	- Slipped/fell on rain-slicked parking lot - Slipped on ice formation in walk-in freezer - *Excludes*: Stumbled/fell while carrying a water container	477 (15%)	- Shop/office hygiene - Caution signs after wet cleaning - Fix plumbing/fixture leaks - Keep floor drains open - Install non-skid surfaces
Breakout: - Wet floor/surface, indoors .....239 - Wet surface, specifically food prep or dining area.....119 - Wet surface, outdoors..... 54 - Wet surface, child development center..... 39 - Wet surface, misc 26			
Oils, fuels, petro fluids, wax residue, food; “slick floor”	- Slipped in hydraulic fluid puddle - Slipped on freshly-waxed tile floor - *Excludes*: Stumbled on a case of motor oil	212 (7%)	- Shop/office hygiene - Non-skid surfaces around vulnerable areas (e.g., dishwashing area)
Sidewalks, curbs, parking lots	- Tripped on curb while crossing street - Lost balance in parking lot, fell - *Excludes*: Slipped & fell on slick parking lot (see snow/ice)	174 (5%)	- Lower curbs at crosswalks - Use crosswalks - Don’t wear high heels
Walking, not otherwise specified	- Fell onto floor of aircraft while walking to rear of plane - *Excludes*: Slipped and fell on slick floor	162 (5%)	- This activity code is insufficiently specific--cannot determine prevention factors
Vehicle or equip--on/over/from *(aircraft excluded--separate category)*	- Fell over bowling pin setter onto floor - Fall from top of truck while doing body work - *Excludes*: - Fell onto lot while exiting vehicle - Fell from ladder/stairs/platform (separate category)	149 (5%)	- Adherence to good safety practices - Weight management and physical conditioning

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Fall from chair/stool	- Fell from chair while reaching for book - Intended to sit down, but missed chair - *Excludes*: Tripped over chair while responding to alarm	145 (4%)	- Adherence to good safety practice - Weight management & physical conditioning
Carry or lift object or application of force	- Slipped while transferring patient - Slipped & fell while pushing refrigerator into its compartment - *Excludes:* Unstable crate fell over onto the person	124 (4%)	- Risk assessment before lifting (assess load) - Wear appropriate footwear for traction - Use devices designed to move heavy objects
Uneven surface, loose dirt, rock, root, pebble, abrupt surface transition (uneven)*	- Slipped and fell in loose gravel while hiking - Tripped and fell on edge of astroturf on patio - *Excludes*: Tripped over tent rope	120 (4%)	- Sweep surfaces more often - Eliminate or smooth gaps/interfaces between contrasting types of surfaces
Cables, cords, hoses, lines, chains	- Tripped over power cord - Tripped on dishwasher drain pipe - Stumbled on fire hose, fell - *Excludes*: Fell while holding on to lift chain 20' above floor	96 (3%)	- Place permanent obstructions under flooring, carpet, or walls - Keep temporary obstructions to minimum
Objects/debris, *tripped over* *(items not part of "what's supposed to be on the floor at home or work")*	- Tripped on plywood panel left in floor by carpenter - Tripped over power cord - *Excludes:* - Slipped on unfolded newspaper left on hardwood floor for paint covering	84 (3%)	- More attention to "housekeeping" details - Assign housekeeping duties to specific person(s)
Childcare	- Chasing after kid, slipped on toys on floor - Person bent over, child climbed on back, person fell onto floor, injured - *Excludes*: Slipped & fell on wet floor in child development center	76 (2%)	- More attention to "housekeeping" details - Weight management & physical conditioning - Rules for kids to follow: do's and don'ts
Lost balance	- Fell from footstool while reaching into high cabinet - *Excludes*: Falls from ladders, stairs, or platforms	70 (2%)	- Weight management - Balance training - Awareness of unbalanced loading and avoiding that
Mat, rug, carpet runner	- Tripped on carpet seam, fell - Slipped on throw rug on wood floor - *Excludes*: Tripped on metal carpet threshold, fell	69 (2%)	- Restrict use of these items - Put non-skid/slip pad underneath
Fall--one level to another	- Fell from roof - Fell from working level of ladder - Fell from balcony/window - *Excludes*: Fell while climbing ladder	66 (2%)	- Wear harnesses or other fall prevention devices - Work from scaffolding, not ladder - Don't work from ladder top

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Holes, depressions, and potholes	- Foot got caught in gopher hole while walking, fell - *Excludes*: Shovel slipped while digging a hole, struck victim	60 (2%)	- More careful observation - Search for and cover holes beforehand
Objects/debris, *slipped or stepped on* *(items not part of "what's supposed to be on the floor at home or work")*	- Stepped on loose PVC pipe at construction site, fell - Slipped on unfolded newspaper left on hardwood floor for paint covering - *Excludes*: Tripped on power cord	54 (2%)	- More attention to "housekeeping" details
Fall or trip on/over furniture or general workplace items	- Tripped over leg of desk - Tripped on open file cabinet drawer - *Excludes*: Tripped over a piece of wood left by carpentry crew	54 (2%)	- Proper placement of furniture & other items - More attention to "housekeeping" details
Manhole/drain/grate/ floor opening	- Foot caught in drain hole, fell - Slipped on manhole cover, fell - *Excludes*: Fell into auto repair maintenance pit	52 (2%)	- Appropriate non-slip footwear (occupational) - Don't walk over metal coverings
Enter or exit vehicle	- Fell onto lot while exiting vehicle - *Excludes*: Going out for a pass "throwing around the pigskin", fell over vehicle hood	50 (2%)	- Timely snow/ice removal - Weight management & physical conditioning, incl balance training
Doorway or elevator threshold	- Heel of shoe caught in gap between floor and elevator, fell - Tripped on metal doorway threshold *Excludes*: - Slipped/fell due to loose carpet runner - Slipped while exiting vehicle	48 (2%)	- Don't wear heels - If heels worn at office, wear thicker ones - Maintain thresholds flush with floor and as narrow as possible
Ramp/slope	- Slipped on dock ramp - Slipped on wet grassy hill at golf course - *Excludes*: Fell off back loading dock at NCO Club	45 (1%)	- Wear appropriate footwear for adequate traction - Use dock stairs instead - Generally avoid walking on wet surfaces
Enter or exit building	- Fell at doorway entrance after foot caught in door - Tripped and hit the exit door *Excludes*: Foot got caught in elevator threshold, fell	45 (1%)	- Slow down, pay attention at doors - Replace heavy cumbersome doors - Proper-fitting doors - Lubricate hinges
Aircraft, inside *(Note: separate categories exist for STFs on or from exterior of A/C; from A/C openings; and around the A/C while parked--frequency is too low to be shown in this table)*	- Fell while walking inside aircraft during in-flight inspection - Stepped into open cockpit panel, fell *Excludes*: - Fell from C-5 wing - Fell from cargo door onto tarmac - Tripped over A/C wheel, fell (event occurred outside aircraft)	44 (1%)	- Adhere to general crewmember in-flight safety - Flag open panels inside aircraft - Maintenance worker familiarity with all interior features of aircraft - Wear proper shoes for traction on metal surfaces

Slips, Trips, & Falls - Off-duty
1,275 lost workday injuries
Chart limited to activities/factors causing 4 or more lost duty day injuries per year

AF Active Duty

Activity/Factor	Example(s)	Injury Reports (% of total)	Prevention
Snow/Ice	- Slipped on ice exiting (or entering) vehicle in driveway - Slipped & fell on snow-covered walkway into house - *Excludes*: Slipped on ice cube on the floor	243 (19%)	- Implement effective snow/ice removal program - Wear footwear appropriate for weather - Parking lot shuttle service
Fall from one level to another, non-aircraft	- Fell from roof - Fell from top of ladder - *Excludes*: Fell while climbing ladder	204 (16%)	- Use safety harnesses or other safety devices - Work from scaffolding - Don't work from ladder top
Breakout: - From window, balcony, ledge, fence, or railing..... 65 - From roof or ceiling..... 51 - From tree or ladder ..... 33 - From ramp, dock, ditch, or culvert ..... 22 - From furniture ..... 18 - Misc..... 5			
Liquids, beverages, water/wet surface	- Slipped/fell on rain-slicked parking lot - Slipped on ice formation in walk-in freezer - *Excludes*: Stumbled/fell while carrying a case of beer	91 (7%)	- Shop/office hygiene - Caution signs after wet cleaning - Assign housekeeping duties to specific person(s) - Fix plumbing leaks - Keep floor drains open - Install non-skid surfaces
Breakout: - Wet surface, outdoors..... 44 - Wet floor/surface, indoors ..... 39 - Set surface, specifically food prep or dining area..... 4 - Wet surface, misc 4			
Walking, not otherwise specified	- Fell onto floor while walking to car - *Excludes*: Slipped and fell on slick floor	69 (5%)	- This activity code is insufficiently specific--cannot determine prevention factors
Uneven surface, loose dirt, rock, root, pebble, abrupt surface transition (uneven)*	- Slipped and fell in loose gravel while hiking - Tripped and fell on edge of astroturf on patio - *Excludes*: Tripped over tent rope	68 (5%)	- Sweep surfaces more often - Eliminate or smooth gaps/interfaces between contrasting types of surfaces
Objects/debris, trip over *(items not part of "what's supposed to be on the floor at home or work")*	- Tripped on plywood panel left in floor by carpenter - Tripped over power cord - *Excludes:* - Slipped on unfolded newspaper left on hardwood floor for paint covering	65 (5%)	- More attention to "housekeeping" details - Assign housekeeping duties to specific person(s)

Activity/Factor	Example(s)	Injury Reports (% of total)	Prevention
Bathroom, shower, tub	- Slipped in shower, fell - Excludes: Slipped off stepladder while installing shower head	61 (5%)	- Non-slip material installed/applied - Don't stand in soapy areas - Weight management & physical conditioning
Sidewalks, curbs, parking lots	- Tripped on curb while crossing street - Lost balance in high heels in parking lot, fell - *Excludes*: Slipped & fell on icy parking lot	52 (4%)	- Lower curbs at crosswalks - Use crosswalks - Don't wear high heels - Weight management & physical conditioning incl balance training
Carry or lift object or application of force	- Slipped while transplanting shrub - Slipped & fell while pushing refrigerator into its compartment - *Excludes:* Unstable crate fell over onto the person	47 (4%)	- Risk assessment before lifting (assess load) - Wear appropriate footwear for traction - Use devices designed to move heavy objects
Holes, depressions, and potholes	- Foot got caught in gopher hole while walking, fell - *Excludes*: Shovel slipped while digging a hole, struck victim	47 (4%)	- More careful observation - Search for and cover holes beforehand

Slips, Trips, & Falls - On-duty

716 lost workday injuries

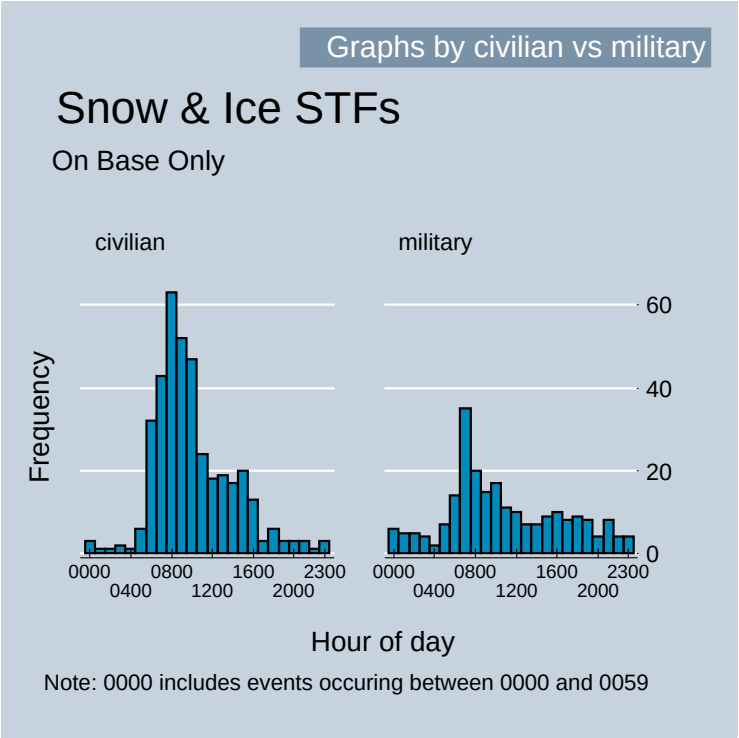
Chart limited to activities/factors causing 4 or more lost duty day injuries per year

AF Active Duty

Activity/Factor	Example(s)	Injury Reports (% of total)	Prevention
Snow/Ice	- Slipped on ice exiting (or entering) vehicle in driveway - Slipped & fell on snow-covered walkway into house - *Excludes*: Slipped on ice cube on the floor	185 (26%)	- Implement effective snow/ice removal program - Wear footwear appropriate for weather - Parking lot shuttle service
Liquids, beverages, water/wet surface	- Slipped/fell on wet parking lot - Slipped on ice in walk-in freezer - *Excludes*: Stumbled/fell while carrying a case of beer	67 (9%)	- Shop/office hygiene - Caution signs after wet cleaning - Scheduling wet cleaning before/after shifts, not during - Fix plumbing/fixture leaks - Keep floor drains open - Install non-skid surfaces
Breakout: - Wet surface, indoors ..... 37 - Wet floor/surface, outdoors ..... 15 - Set surface, specifically food prep or dining area..... 9 - Wet surface, misc 6			
Carry or lift object or application of force	- Slipped while transferring patient - Slipped & fell while pushing refrigerator into its compartment - *Excludes:* Unstable crate fell over onto the person	55 (8%)	- Risk assessment before lifting (assess load) - Wear appropriate footwear for traction - Use devices designed to move heavy objects
Fall from aircraft: on; from outside of; from top of *(Note: separate categories exist for STFs inside the A/C; from A/C openings; and around the A/C while parked--frequency is too low to be shown in this table)*	- Fell from C-5 wing during refueling - Fell from top of fuselage while installing NDI equipment *Excludes*: - Falls inside cargo hold or crew compartment - Falls from cargo bays or access portals opening onto tarmac below	48 (7%)	- Use appropriate safety harnesses or other equipment to prevent falling or to reduce falling distance - Wear appropriate footwear for increased traction - Physical conditioning including balance training
Fall from one level to another, *non-aircraft*	- Fell from roof while fixing dish - Fell while washing windows from top of ladder - *Excludes*: Fell while climbing ladder	44 (6%)	- Use appropriate safety harnesses or other equipment to prevent falling or to reduce falling distance - Wear appropriate footwear - Physical conditioning including balance training
Breakout: - From ramp, dock, ditch, or culvert .....15 - Unspecified .....15 - From roof or ceiling ..... 8 - From furniture ..... 4 - From window, balcony, ledge, fence, or railing 2			

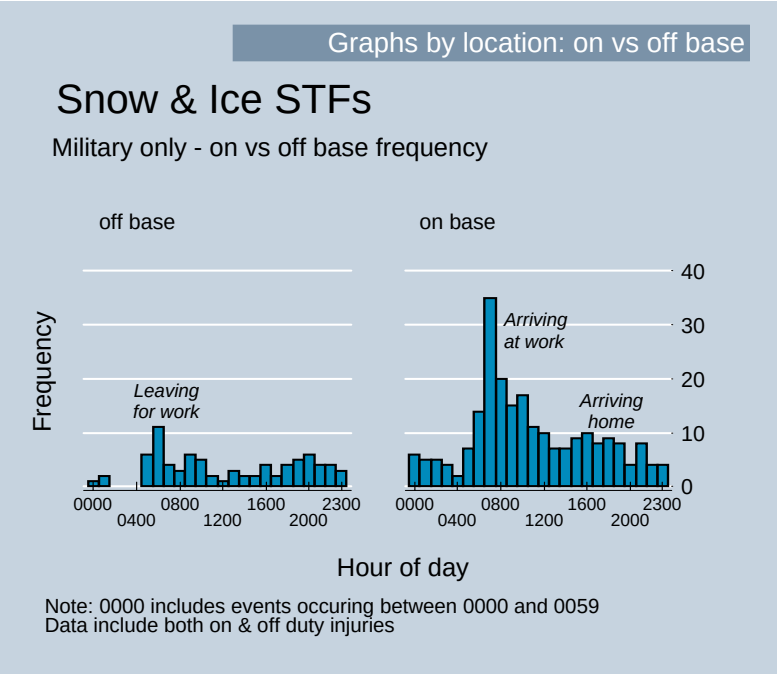
Slips, Trips and Falls – Snow & Ice

From FY 93 – FY 02, 916 (17.3%) of the 5,283 reported STF injuries were due to environmental (i.e., naturally-occurring) snow and ice. Civilian on-duty mishaps accounted for 53.3% (n=488) of these injuries; military off-duty mishaps, 26.3% (n=241); and military on-duty mishaps, 20.4% (n=187). Injuries due to snow and ice are obviously seasonal (November-March). The majority of the combined military-civilian snow and ice STFs occurred in January (36%, n=325) and February (24%, n=220). Besides the seasonal component, an analysis by time-of-day gives additional prevention clues.

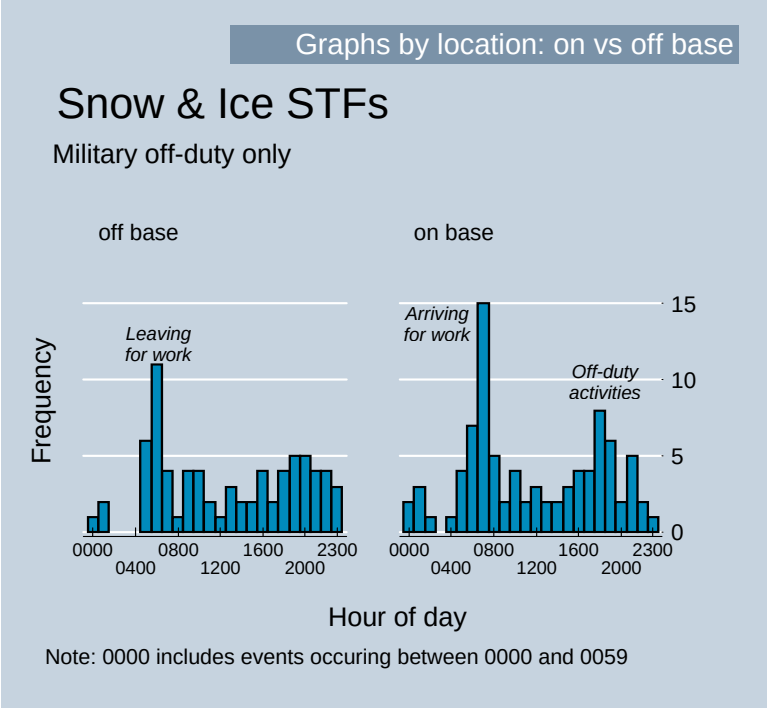


Snow/ice on-base STFs peaked during morning rush-hours-- obviously extended on snow days-- for both civilian and military personnel (see graph below). Notable in both groups is the low frequencies of these STFs in the afternoon rush period, obviously indicating that the snow and ice had been cleared or had melted. Also clearly seen is a rapid decline in civilian injuries after the 1600-1659 hour. Military injuries persisted at a relatively low level into the evening hours, likely a combination of on- and off-duty STFs.

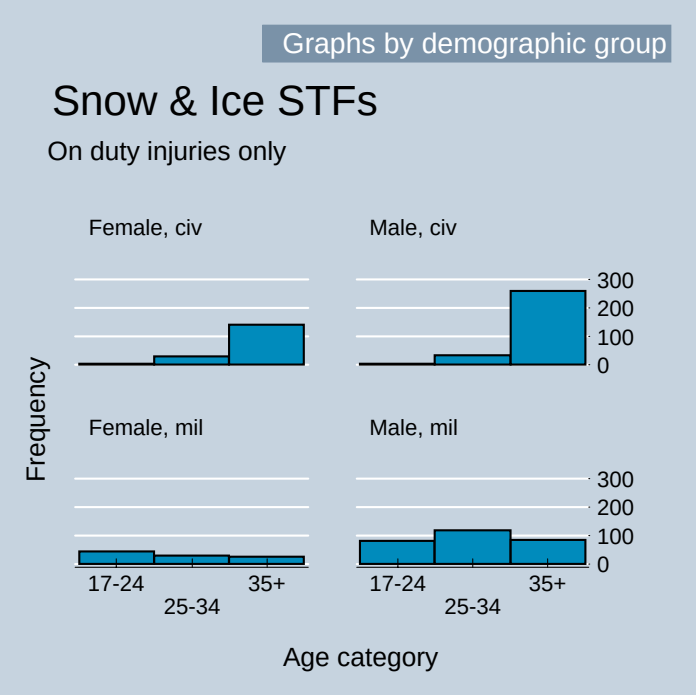
For military-only snow/ice STFs, the time-of-day distribution suggests that on-base snow and ice removal lags behind that of off-base apartment complexes or those or private homeowners in the military (see graph below). Unlike the on-base pattern that showed a mild increase in injuries when returning home (quarters or dormitories), the off-base pattern did not show a return-home spike. This suggests that some on-base outdoor walkways may have remained snow/ice-covered. Regardless of whether on or off-base, most (70%) snow and ice STFs were associated with walking on sidewalks and parking lots (data not shown). An additional 9% were associated with entering or exiting buildings or vehicles.



Over one-half (56%, n=241) of military snow/ice STFs occurred while off-duty. The off-base portion of these injuries peaked in the 0600-0659 hour as people were leaving their homes and apartments for work (see graph at right). Reports of on-base STFs peaked in the 0700-0759 hour as airmen arrived at their duty stations, and again (although only half as much) in a two-hour evening period, 1800-1959 hours, when airmen were conducting personal business or engaged in on-base leisure-time activities.



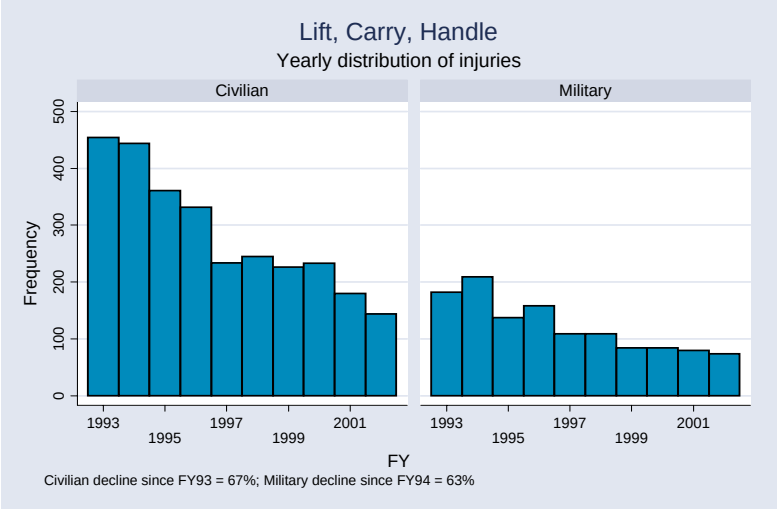
Looking at on-duty snow and ice STFs (n=650), civilians in the 35+ age group accounted for 61% (n=398) of the on-duty mishaps. This age group incurred the most injuries in both male and female civilians. The 35+ age group was the least injured in the military category. These differences do not represent military vs. civilian rate differences however, as the frequencies in the graph at left are nearly proportional to the number of military or civilians in those age categories. Among the injured military members, females were overrepresented in the youngest age group (17-24) as they experienced 35% of the STF injuries but represented less than 20% of the USAF population during the period. With increasing numbers of females in this age group serving in the USAF, more attention needs to be placed on preventing STF injuries in this group to achieve future LWI reductions in this area. We see the opposite situation in both sexes on the civilian side where the workforce is aging towards higher STF risk.



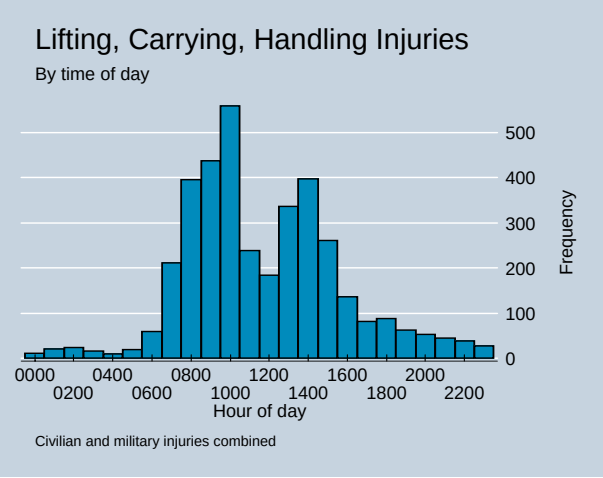
Lifting & Carrying	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	3	4	2
Total lost workdays	3	10	2
Severity*	8	7	5

Note: Rankings for top 12 injury-producing activities only
** Combination of % fracture/concussions/dislocations + median LWD*

Injuries sustained while lifting, carrying, or handling (LCH) objects were largely a civilian employee phenomenon, but this contribution was strong enough to elevate these injuries into third place overall. Readers should note that this external cause category excludes injuries already categorized as slips, trips, and falls (STFs) that were associated with the acts of LCH. (Covered in the previous chapter). The term "handling" in this context means "application of force" (e.g., shoving against a piece of furniture), not handling objects that are small enough to be handled without applying significant directional force.

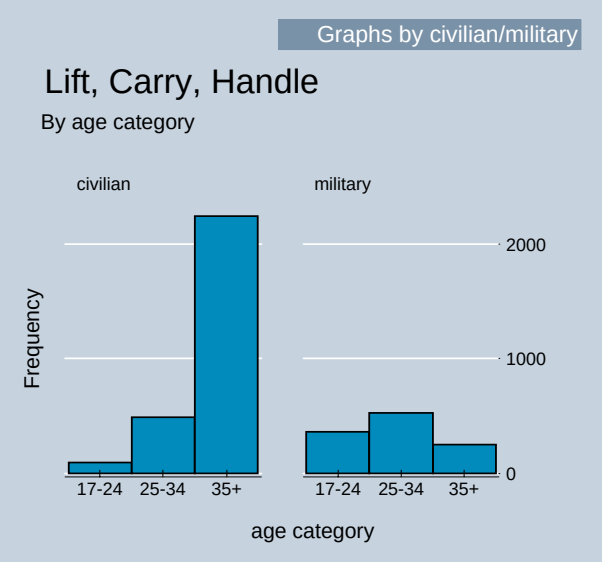


The frequency of these injury reports has subsided significantly over the past decade in both civilian and military groups (see graph above), but the military has seen little decline since FY99. While the civilian decline has continued, that sector still reported twice the number of LCH injuries (n=140) in FY02 as did the military (n=71).

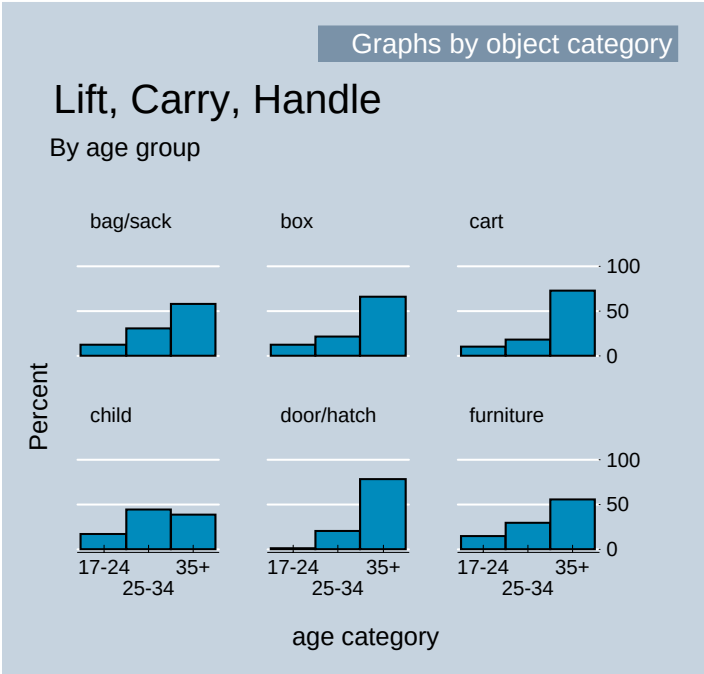


Analysis of LCH injuries shows exactly what one would expect: these injuries largely occurred during periods when work is normally performed (see graph at left). Noting the mid-morning surge toward the peak at 1000-1059 hours, this may indicate that workers were perhaps tiring before the lunch period due to the cumulative effects of exertion during the morning.

LCH injuries in civilian employees were concentrated in the age 35+ category as expected (see graph at left). Most of the AF's civilian employees are in this age category, and these injuries would be expected to occur--or at least produce a higher proportion in which a workday was lost--in these older workers vs. younger workers. These injuries occurred infrequently in AF uniformed members, but the 25-34 age group sustained about the same number of injuries as civilian employees in that same age group. Both on- and off-duty injuries are included on the graph at left. Older military members generally do not engage in manual on-duty work, thus this group reported few of these injuries.



The age relatedness above prevailed in most circumstances, regardless of which heavy or cumbersome object being lifted, carried, or moved (see graph below of the 6 highest frequency objects). Civilian workers heavily influenced the distribution below given their overall contribution to this injury category. But, injuries related to moving furniture were 42% military and 28% off-duty (military), and that same age pattern was noted. One notable exception to this pattern was LCH injuries due to lifting or carrying a child. The younger age distribution represents the younger ages of caregivers at child care centers since 107 (67%) of the 159 injuries of this type occurred in that functional area.



Key to following tables

	<15% of STF injuries are associated with this causal factor
	15% - 29% of STF injuries are associated with this causal factor
	30% - 49% of STF injuries are associated with this causal factor
	> 50% of STF injuries are associated with this causal factor

Lifting, Carrying, Handling Injuries - On-duty

724 lost workday injuries

Chart limited to activities/factors causing 3 or more lost duty day injuries per year

AF Active Duty

Object	Example(s)	Injury Reports (% of total)	Prevention
Aircraft components other than engines *(See Note 1)*	- Lifting aircraft tail - Lifting ECM pod - *Excludes*: Removing engines	393 (54%)	- Help from co-worker - Ergonomic consultation - Mechanical lifts
Boxes, loaded	- Lifting boxes of MREs onto truck - *Excludes:* Lifting boxes of paper files onto cart	60 (8%)	- Better risk assessment on load vs. physical strength - Use special equipment
Furniture, office	- Moving desk in orderly room - *Excludes:* Moving a computer or printer	51 (7%)	- Mechanical lifts - Get help in moving - Use special equipment - Rest periods during large projects
Bag/sack, loaded	- Loading or carrying sandbags *Excludes*: - Filling bags of sand - Pushing cart containing sandbags	32 (4%)	- Risk assessment on load vs. physical strength - Rest periods - Mechanical lifts
Toolbox	- Lifting toolbox - Excludes: Pushing cart loaded with toolboxes	30 (4%)	- Don't overload toolbox - Separate into smaller toolboxes, let others carry

Note 1: Assembly or disassembly tasks accounted for 373/393 = 95% of this category

Lifting, Carrying, Handling Injuries - Off-duty
502 lost workday injuries
Chart limited to activities/factors causing 3 or more lost duty day injuries per year

AF Active Duty

Activity/Factor	Example(s)	Injury Reports (% of total)	Prevention
Furniture	- Moving bed and mattress - *Excludes*: Lifting child from crib	94 (19%)	- Get help in moving - Move mattress/box springs separately
Boxes, loaded	- Carrying cases of beer/drinks *Excludes*: - Filling bags with food - Pushing cart containing loaded box	66 (13%)	- Better risk assessment on load vs. physical strength - Use special equipment
Child *(See Note 2)*	- Lifting child from crib - *Excludes:* Pushing playpen across floor with child inside	49 (10%)	- Physical conditioning - Proper lifting technique
Appliances/AV equipment (non-computer)	- Moving stove out from wall - Carrying TV upstairs - Pushing computer desk into corner - *Excludes*: Lifting or carrying a computer or printer	34 (7%)	- Better risk assessment on load vs. physical strength - Get help in lifting/carrying - Use "skid pads" to move furniture across floor

Note (2): Lifting, as opposed to carrying a child, accounted for 42/49 = 86% of this category

Lifting, Carrying, Handling Injuries - Work-related
2,849 lost workday injuries
Chart limited to activities/factors causing 5 or more lost duty day injuries per year

AF Civilian Employees

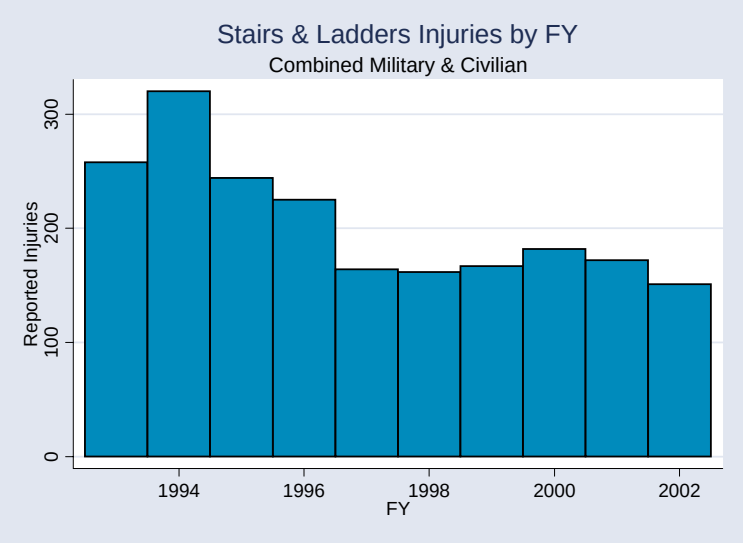
Activity/Factor	Example(s)	Injury Reports (% of total)	Prevention
Aircraft components other than engines	- Lifting aircraft tail - Lifting ECM pod - *Excludes*: Removing engines	783 (27%)	- Help from co-worker - Ergonomic consultation
Boxes, loaded (not with paper/files)	- Lifting boxes of auto parts onto truck - *Excludes:* Lifting boxes of paper files onto cart - *Excludes:* Lifting boxes of paper files	286 (10%)	- Better risk assessment on load vs. physical strength - Use special equipment
Furniture, office	- Moving computer desk - *Excludes:* Moving a computer or printer	193 (7%)	- Get help in moving - Use "skid pads" - Physical conditioning

Activity/Factor	Example(s)	Injury Reports (% of total)	Prevention
Child *(See Note 3)*	- Lifting child from bassinet - Bent over positioning baby - *Excludes:* Pushing walker/stroller with baby inside (*separate category--carts and "things that roll")*	110 (4%)	- Proper lifting technique
Stand *(See Note 4)*	- Moving maintenance stand - Pulling B-2 stand - *Excludes*: Moving a computer or printer	92 (3%)	- Get help when moving - Keep wheels oiled - Physical conditioning
Cart/Dolly	- Pulled battery cart up ramp - Loaded dolly onto back of truck - *Excludes:* Removed files from dolly	81 (3%)	- Push, don't pull - Assess weight - Get help for moving uphill
Door/hatch	- Pushed open hangar door - Moving metal doors - *Excludes*: Pulling cables through hatch	74 (3%)	- Keep doors in good repair & lubricated - Risk assessment on loading
Engines/motors/transmissions/ gearboxes	- Strained back pulling engine - Moving pump motor into truck - Lifting gear assembly - *Excludes*: Pushing an engine stand (with engine on it)	68 (2%)	- Use special lifting tools - Move with carts/dollies - Risk assessment on loading - Proper lifting technique
Boxes of papers	- Carrying box of printer paper - Pulling box of paper off cart - Lifting cardboard box full of files - *Excludes*: Lifting box of auto parts	57 (2%)	- Risk assessment on loading - Use carts/dollies - Proper lifting technique - Use/cut hand holds on boxes for lifting
Computer/computer equipment including printer	- Lifted/carried PC to new cube - *Excludes*: Moving a computer cabinet (no computer inside)	51 (2%)	- Proper lifting technique - Physical fitness

Note (3): Lifting, as opposed to carrying a child, accounted for 88/110 = 80% of this category
Note (4): More specialized engine or bomb stands made up 26/92 = 28% of this category

Stairs and Ladders	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	5	7	3
Total lost workdays	4	5	3
Severity*	5	2	3

Note: Rankings for top 12 injury-producing activities only
** Combination of % fracture/concussions/dislocations + median LWD*



Stairs, ladders, and platforms (SLP) are a leading producer of injuries found throughout many different subcategories during this period. These injuries are mutually exclusive from the Slip, Trip, and Fall (STF) external cause category above although many of these could be considered a unique subset of all STFs. Although decreasing in total number and incidence rate in the first half of the 1990's, reductions bottomed out in 1997. Overall, about half of these mishaps occurred on stairs and steps while one-quarter occurred while scaling or working from a ladder (see table below). The wide variety of causes, ranging from slipping on icy rungs to tripping over a cat on stairs, again makes the point that there is no single solution to this problem. One positive is that most (80%) of the SLP injuries occurred on-base, 67% on-duty, and are therefore more amenable to control efforts. Prevention efforts can be divided into two general categories, environmental and behavioral. Environmental strategies include ensuring ladders are structurally sound, and have all modern safety features such as non-slip feet. A surprising number (13%) of these injuries occurred on maintenance stands, which should be a very safe environment. Problems including unsecured safety rails and uncovered openings must be addressed. Stairs must be defect and obstacle-free, and dry. Behavioral strategies are basically of the "pay attention to safety rules" and individual risk assessment genre.

Structure	# Mishaps	% of total
Stairs & Steps	1,013	49%
Ladder	502	25%
Maintenance Stand	274	13%
Miscellaneous	219	11%
Platform	40	2%

Snow- and ice-related SLP injuries have decreased since 1997, perhaps due to milder winters, but can be reduced further. Behavioral modification of personal habits may

prove difficult since countermeasures consist of repeating time-honored principles which have already been stressed, perhaps to the point of neglect. Perhaps the most basic, "Watch your step!", if practiced conscientiously, would prevent a large proportion of injuries categorized in the slipped on, stepped on, tripped on, missed step, carrying, and all of the unspecified causes. Previous research done in the public sector regarding escalators identified "looking at the first step before entry" as the single most important factor for preventing falls.

Carrying objects on stairs is particularly hazardous since it not only can block the view of the stairs, but also degrades the sense of balance and multiplies the demand for energy which, when transmitted, stresses the muscles and joints to the breaking point. Many injuries on ladders could be avoided by simply ensuring the ladder is stabilized on a surface which will not allow the ladder to shift or tilt once the weight load on the ladder is increased.

Since all injuries result from an excess of energy absorbed by the body, it is not surprising that descending stairs and ladders result in five times as many injuries as ascending. Improving balance may be an underestimated prevention tool since it not only affects many different causes but also plays a role in avoiding or reducing severity of injuries once the cause such as ice has been encountered.

Command	# of Mishaps	% of Mishaps	% of USAF Population
AFMC	35	23%	5%
AETC	23	15%	16%
ACC	21	14%	20%
AMC	21	21%	11%
USAFE	16	11%	6%
SPACECOM	13	9%	4%
PACAF	10	7%	7%
AFSOC	1	1%	2%

As expected, AFMC's more industrialized mission produced a disproportionate share of these mishaps, a rate over 4 times higher than the rest of the AF. AMC's rate was twice as high as the overall AF. ACC's mishaps were disproportionately low.

Key to the following table

	<15% of STF injuries are associated with this causal factor
	15% - 29% of STF injuries are associated with this causal factor
	30% - 49% of STF injuries are associated with this causal factor
	> 50% of STF injuries are associated with this causal factor

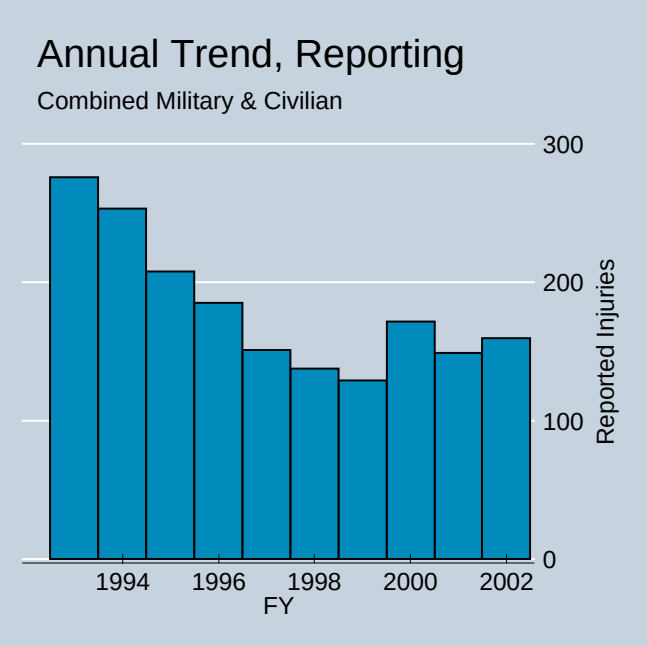
Stairs, Ladders and Platforms (2,045 lost workday injuries)

AF Military and Civilian

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Slipped- wax, metal, rung, or unspecified	- Slipped off rung of ladder - Descending stairs and slipped *Excludes:* Ice, water, descending stairs or ladder unspecified	407 (20%)	- Remove or replace slick surfaces
Tripped on, stepped on object, stumbled	- Caught heel on step and fell - Stepped on cable on stairs	267 (13%)	- Remove objects from stairs -
Lost balance	- Lost balance on stairs and fell - Lost balance and fell off ladder - *Excludes:* Structural failure	218 (11%)	- Balance training
Missed step	- Missed top step and fell - Missed rung and fell	187 (9%)	- Observe foot placement
Collapsed, gave way/shifted/tilted	- Fell when handrail came loose - Fell when ladder tipped over -*Includes:* Structural failure and overreaching	171 (8%)	- Replace wooden ladders - Ensure stability of ladders - Inspect prior to use - Avoid overreaching
Carrying object	- Carrying box of books down stairs - Moving dresser down stairs	150 (7%)	- Use elevator, buddy, dolly - Ensure balance is unimpaired, view is unobstructed
Water/fluid/rain	- Descending wet stairs and fell - Slipped on hydraulic oil and fell	125 (6%)	- Stair hygiene
Running/hurrying/jumping	- Jumped down flight of stairs - Hurrying down ladder and fell - Fell while running down stairs	109 (5%)	- Promote policy of slowing down on stairs
Ice/snow	- Slipped and fell on icy asphalt - Slipped and fell on icy stairs	81 (4%)	- Clearing of snow from stairs, steps
Descending ladder or stairs- unspecified	- Fell while descending ladder - Descending stairs, fell through window	74 (3%)	- Ensure stability of ladders - Inspect prior to use
Stand-safety rail or hole	- Fell through hole in work stand - Safety rail swung out and worker fell off	43 (2%)	- Completely cover holes - Inspect stands before use

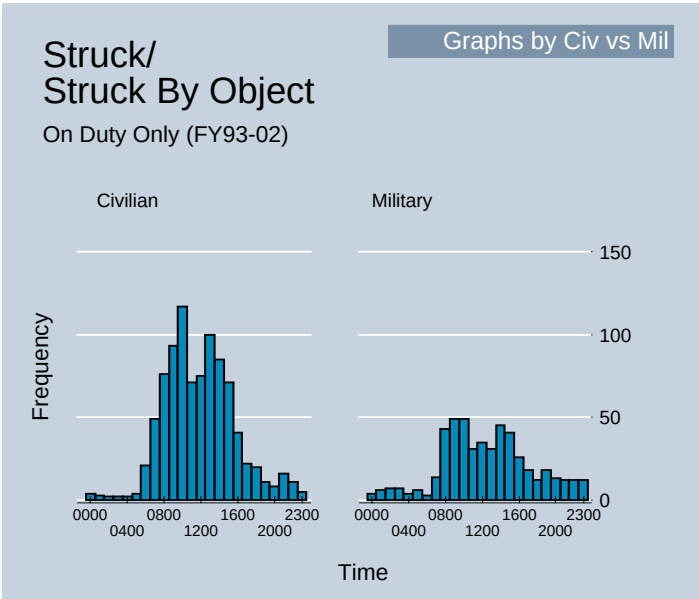
Struck/Struck by object	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	6	9	4
Total lost workdays	7	9	4
Severity*	1	8	1

Note: Rankings for top 12 injury-producing activities only
** Combination of % fracture/concussions/dislocations + median LWD*



Struck/Struck by Object accounted for a total of 1,821 reported mishaps and 10,804 lost workdays for FY92-02. The overall number of mishaps (on/off-duty combined) are almost evenly distributed between civilian and military personnel (Civ = 942, Mil = 879). The chart at the left shows that from FY93 to FY99 there was a steady decline in 'struck/struck by' mishaps and the past three FYs have seen a slight increase and plateau of these injuries.

Examples of mishaps in this category include a person striking their head on the underside of an aircraft or a person's hand being struck by a closing door. This category includes being struck by falling objects, but excludes persons being struck by objects that they dropped on themselves or were dropped on them by others (separate category: *dropped object*). Also, this category does not include being struck by a motor vehicle or "struck/struck by" mishaps involving the use of hand tools (separate category: *using hand tools*).



The chart at the left shows civilian/military 'on-duty' mishaps in this category by time of day. There are noticeable peaks before and after the lunch period (0900-1000 and 1300-1400) for both civilian

and military. These peaks are not necessarily unexpected and correspond to the highest worker availability and productivity times. Civilian on-duty mishap numbers (n=942) are just about double the military on-duty numbers (n=506). On-duty "struck/struck by" mishaps occured in the expected age groups in both the civilian and military populations. The majority of the civilian workforce is in the 35+ year old age group and the majority of the military 'hands-on' workforce is in the 17-24 year old group. This military age group equates roughly to the E1-E4 military ranks.

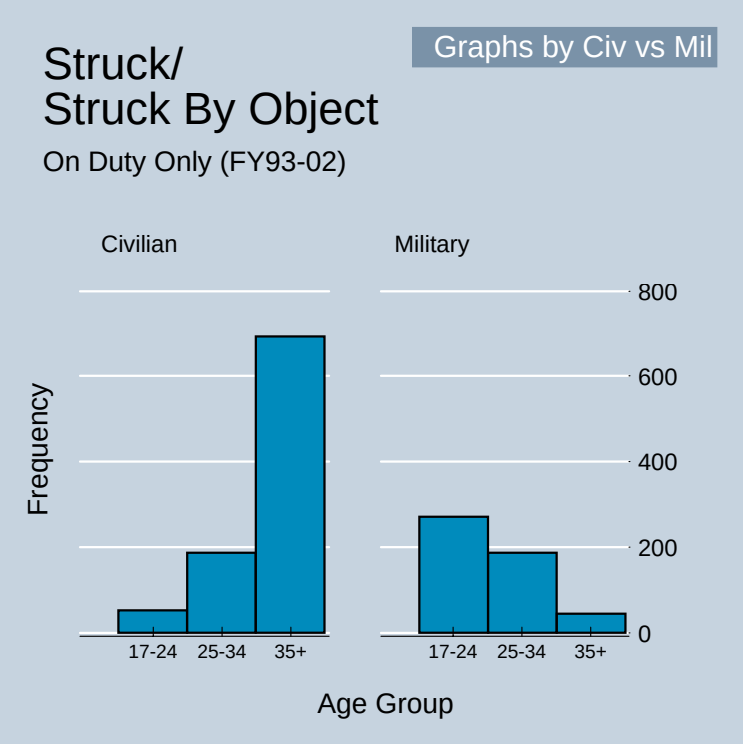


Table 1 is a break out of on-duty civilian and military struck/struck by mishaps. Although only the top three civilian and military functional areas listed in the table below, these career fields comprise about 73% of all on-duty struck/struck by mishaps. Finger and head injuries dominate the list as the primary and secondary body parts injured in these mishaps.

Table 1.
Top 3 civilian and military on-duty functional areas and associated *body parts* and *physical objects* for "*Struck/Struck By*" mishaps.

	Top 3 Functional Areas *(Career Fields)*	Top 3 Body Parts Injured *(in struck/struck by mishap)*			Top 3 Physical Objects *(that persons "struck" or were "struck by")*		
Civilian	Aircraft Maintenance (n=339)	Finger (20%)	Head (18%)	Foot (8%)	Aircraft (15%)	Maint. Stand (6%)	Aircraft Radar (4%)
	Services/MWR (n=246)	Finger (16%)	Head (13%)	Knee (10%)	Other Person (13%)	Door (9%)	Cart (7%)
	Civil Engineering (n=152)	Finger (26%)	Head (11%)	Knee (8%)	Door (7%)	Pipe/Conduit (5%)	Fire Truck (4%)
Military	Aircraft Maintenance (n=219)	Head (26%)	Finger (24%)	Eye (10%)	Aircraft (15%)	Aircraft Part (5%)	Aircraft Radar (4%)
	Civil Engineering (n=75)	Finger (26%)	Leg (9%)	Eye (8%)	Bench-Type Shears/Door/Air Conditioner/ Cinder or Concrete Block/Truck Tailgate* (4%)		
	Transportation (n=34)	Finger (29%)	Hand (21%)	Head (15%)	Forklift (12%)	Tire/Wheels (9%)	Truck/Crane/ Fire Truck* (6%)

*Indicates tie among listed objects

Looking at only on-duty head injuries where the head struck an aircraft or aircraft component (n=99) we found that 40 of these injuries occurred inside a hangar or maintenance facility. Wearing a hardhat/safety helmet in this non-FOD (Foreign Object Damage) environment could have saved 98 lost workdays over the past ten years. If FOD was not a consideration on the flight line, wearing a hardhat/safety helmet could have saved an additional 148 lost workdays over the past ten years.

Table 2. Average, Median and Range of Lost Work Days

		Average LWD	Median LWD	Range
Civilian	**On-Duty**	6.2	3	1 – 107 days
Military	**On-Duty**	5.7	2	1 – 180 days
	Off-Duty	5.6	2	1 – 78 days

Off-duty Summary

The two tables below (Table 3 and Table 4) breakout the activities, injured body parts and physical objects associated with military **off-duty** "struck/struck by" mishaps (n=373). Current activity categories listed in the tables are broad and mostly incidental, but they help convey the general off-duty activities people are engaging in when these mishaps occur. It is interesting to note that most of the off-duty struck/struck by injuries are associated with other people, auto/truck doors or vehicle maintenance.

Table 3.
Predominant body part injuries associated with Top 10 Military Off-Duty "*Struck/Struck By*" Activities

		Body part injury profile		
Rank[+]	**Activity**	**Leading**	**Secondary**	**Tertiary**
1	**Handling** (n= 48)	Eye (38%)	Finger (23%)	Arm (8%)
2	**Horseplay** (n= 37)	Eye (18%)	Toe (16%)	Head/Leg/Jaw (8%*)
3	**Walking** (n= 35)	Toe (54%)	Head (9%*)	Knee (9%*)
4	**Standing** (n= 27)	Head (30%)	Knee (11%)	Finger/Eye/Toe/Hand (7%*)
5	**Closing/Opening** (n= 26)	Finger (50%)	Toe (15%)	Hand (12%)
6	**Entering/Exiting** (n= 24)	Finger (38%)	Head (17%)	Hand/Foot (13%*)
7	**Maintenance** (n= 19)	Hand (32%)	Finger (26%)	Toe/Arm (11%*)
8	**Running** (n= 13)	Toe (46%)	Head (15%)	***
9	**Reaching/Stretching** (n= 12)	Finger (33%)	Hand (25%)	Eye/Face (17%*)
10	**Carrying** (n= 9)	Finger (33%)	Hand (22%*)	Knee (22%*)

[+]Rank based on number of mishaps
*Indicates tie among listed body parts
***Indicates 1 or less mishaps reported

Table 4.
Predominant physical objects associated with Top 10 Military Off-Duty "*Struck/Struck By*" Activities

		Object-involved profile		
Rank[+]	**Activity**	**Leading**	**Secondary**	**Tertiary**
1	**Handling** (n= 48)	Misc. Object (15%)	Another Person (10%)	Private Vehicle (8%)
2	**Horseplay** (n= 37)	Another Person (68%)	***	***
3	**Walking** (n= 35)	Door (23%)	Table (14%)	Fixture/Sofa/Chair (6%*)
4	**Standing** (n= 27)	Another Person (22%)	Door (15%)	Bathroom Fixture (11%)
5	**Closing/Opening** (n= 26)	Door (46%)	Auto/Truck Door (19%)	Overhead Door (12%)
6	**Entering/Exiting** (n= 24)	Door (42%)	Auto/Truck Door (25%)	***
7	**Maintenance** (n= 19)	Auto/Truck Component (32%)	Private Vehicle (16%*)	Auto/Truck Engine (16%*)
8	**Running** (n= 13)	Stairs (15%)	***	***
9	**Reaching/Stretching** (n= 12)	Another Person (25%)	Door (17%)	***
10	**Carrying** (n= 9)	Bed/Cot/Bunk/Mattress (22%)	***	***

[+]Rank based on number of mishaps
*Indicates tie among objects listed
***Indicates 1 or less mishaps reported

Key to the following table

	<15% of injuries are inflicted on this body part
	15% - 29% of injuries are inflicted on this body part
	30% - 49% of injuries are inflicted on this body part
	> 50% of injuries are inflicted on this body part

Struck/Struck by object (1,821 lost workday injuries)

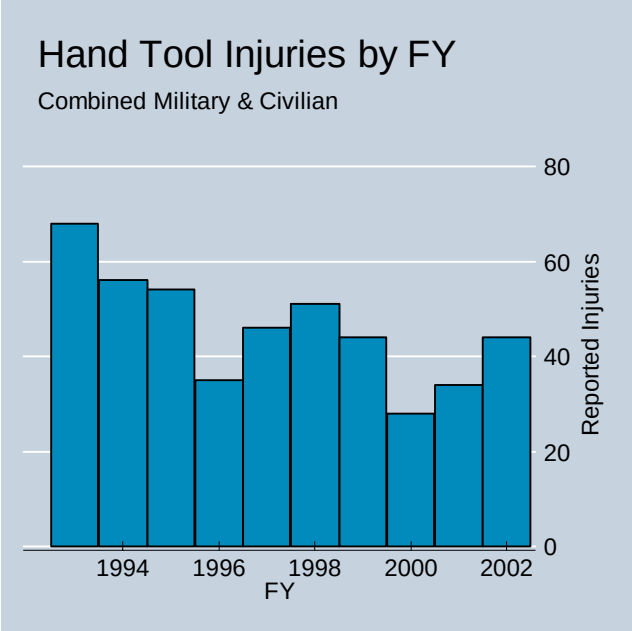
AF Military/Civilian Employees (On and Off-Duty combined)

Body Part Injured	Example(s)	Inj (% of total)	Prevention
Finger/Hand	- Closed door on hand/fingers - Lowering bin and crushed fingers - Crushed hand between tow bar and vehicle - Pushing bed frame and pinched fingers between wall and frame	527 (29%)	- Improve situational awareness of where fingers and hands are at all times - Review and reinforce basic "pinch point" avoidance
Head	- Striking head on aircraft fuselage, antenna or engine cowling - Ceiling tile fell and struck worker on the head - Struck head on door frame while exiting vehicle - Struck head on wall locker while play wrestling	269 (15%)	- Mandate hard hats around aircraft (when not potential FOD) especially in hangars and maintenance facilities - Increase situational awareness when working on or around aircraft/flight line

Body Part Injured	Example(s)	Injuries reported (% of total)	Prevention
Eye	- Struck in eye by debris from drill, hammer, saw, etc… - Poked in eye by finger - Struck in eye by flying rock while mowing lawn or using grass trimmer - Struck in eye by elbow while play wrestling	137 (8%)	- Use eye protection at appropriate times both on and off-duty
Knee	- Struck knee on open desk drawer - Opened car door into knee - Struck on knee by falling dinner plates - Struck on knee by military working dog	109 (6%)	- Improve situational awareness - Improve office/industrial area hygiene
Foot	- Struck on foot by rolling tool cart, maintenance stand or hand truck - Crushed foot between outrigger & frame of backhoe - Hit on foot by furniture while loading it into truck	106 (6%)	- Use steel toed safety shoes to eliminate or minimize injury to toes and feet.

Using Hand Tools	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	-	-	8
Total lost workdays	-	-	9
Severity*	-	-	7

Note: Rankings for top 12 injury-producing activities only
** Combination of % fracture/concussions/dislocations + median LWD*



Hand tool injuries are currently on a 3-year increasing trend, but still rank in the top ten only for civilian injuries. However, this low number of reports belie the importance of this injury source. The low reporting is probably due to the relatively low severity of these injuries, which do not require lost duty time and therefore no reporting. These reports should be used for their relative importance in conveying prevention information rather than their absolute magnitude. The 460 reported injuries were split evenly between the military (52%) and the civilian workforce (48%) with 313 (68%) on-duty and 365 (79%) on-base, thus this area has high potential for mishap prevention efforts.

The range of different body parts affected by hand tool injuries is unusually small, with finger, hand, back and eye accounting for a full 75% of all injuries. Using gloves and eye protection would have prevented 80% of the saw-related injuries. The correlations between types of injuries occurring with the body part and the tool are consistent and logical. The majority of lacerations match up with fingers and hands and are caused by knifes. Strain injuries match up with backs, and are caused most frequently by wrenches. Even more interesting is the correlation between age and type of injury. Although lacerations show no age differential, bruises, fractures and particularly strains rise dramatically with age (data not shown).

Except for strains, personal protective equipment could make dramatic reductions in all these injuries while eye protection would virtually eliminate eye injuries. Surprisingly,

25% of screwdriver injuries were to the eye, emphasizing the use of eye protection during the use of any tool. A full 25% of injuries were caused by the wrench slipping off the bolt or nut. Therefore, increased attention needs to be placed on using the right-sized wrench and using a pulling motion (i.e., rotating the wrench toward the body) rather than pushing the wrench (i.e., away from the body). Exertion injuries could be reduced by using the proper tool, proper positioning, and preparation of the task, such as using penetrating oil.

A number of electrical incidents occurred with all metal tools--particularly screwdrivers. Although obvious, attention still needs to be placed on ensuring electrical systems are not hot. At a minimum, insulated tools should be used for electrical work. This also highlights the fact that screwdrivers are used with many things other than screws--using the proper tool would prevent many injuries. Overuse injuries are common off-duty since the worker is not conditioned to the task and wants to finish the task during one period, such as a day off.

Command	# of Mishaps	% of Mishaps	% of USAF Population
AFMC	56	30%	5%
ACC	47	25%	20%
AETC	33	18%	16%
AMC	17	9%	11%
USAFE	11	6%	6%
PACAF	9	5%	7%
SPACE	9	5%	4%
AFSOC	3	2%	2%

As expected due to the level of industrial activity, AFMC experienced a disproportionate number of these injuries--six times as many. ACC experienced significantly fewer than expected in their population.

Key to following table

	<15% of injuries are associated with this tool
	15% - 29% of injuries are associated with this tool
	30% - 49% of injuries are associated with this tool
	> 50% of injuries are associated with this tool

Using Hand Tools (460 lost workday injuries)

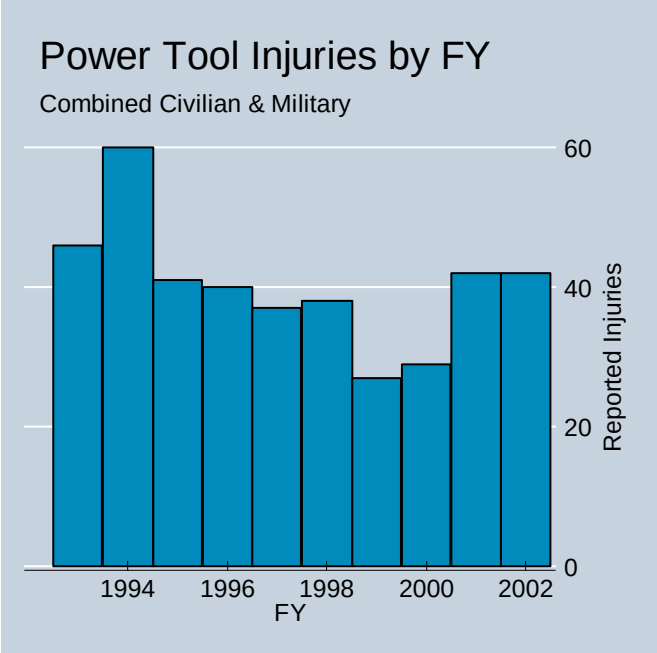
Military and Civilian *(Part I tables presented only the civilian portion of these injuries)*

Specific Tool	Example(s)	Injuries reported (% of total)	Prevention
Knife or sharp implement	- Cutting plastic sheet with utility knife - Using knife to filet fish	152 (33%)	- Cutting away from body - Using hand protection - Keep hands and body clear of knife stroke
Wrench or ratchet	- Using pipe wrench--strained arm - Struck in face by ratchet wrench	110 (24%)	- Correct size wrench - Use penetrating oil - Pull rather than push

Specific Tool	Example(s)	Injuries reported (% of total)	Prevention
Hammer (Includes sledge)	- Striking hammer, sliver entered eye - Using sledgehammer and struck thumb	49 (11%)	- Eye protection - Hand protection
Miscellaneous	- Using scribe and punctured hand - Using hand grinder, object in eye	29 (6%)	- Eye protection - Avoid overuse
Screwdriver	- Screwdriver made contact with grounded switch- causing burns - Screwdriver slipped and struck eye	21 (5%)	- Ensure electrical systems are not hot - Eye protection
Shovel	- Digging in manhole, strained groin - Shoveling mortar--strained back *Includes*: all tools with handles	19 (4%)	- Avoid overreaching and overexertion
Axe or hatchet	- Chopping wood and struck foot - Splitting logs and strained back	19 (4%)	- Proper positioning of log and feet - Eye protection
Saw	- Cut fingers while sawing tree - Struck in head when sawing branches	10 (2%)	- Wear hard hat - Eye protection - Wear gloves

Using Power Tools	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	-	-	10
Total lost workdays	-	-	10
Severity*	-	-	6

Note: Rankings for top 12 injury-producing activities only
** Combination of % fracture/concussions/dislocations + median LWD*



Power tool and equipment injuries are currently on a 2-year plateau, which exceeds the numbers seen since 1995, but still rank in the top ten only for civilian injuries. The range of different body parts affected by power tool injuries is unusually small, with finger, hand, back and eye accounting for a full 70%, and eyes alone 45% of all injuries. Of the 402 injuries reported, the military accounted for 222 (55%), while civilians accounted for the remaining 180 (45%). These injuries have a high potential for prevention since 73% occurred on-base (61% on-duty). However, many of these high energy injuries will not be prevented using the same precautions as with hand tools. Although eye protection should yield the same results, the extra protection of a face shield is needed to prevent those particles traveling at a greater speed from going underneath or around safety goggles. Hand protection may in some cases actually create a risk (being pulled into the tool) without providing the necessary protection.

Although safety procedures such as proper lighting, eliminating clutter and not wearing jewelry are important, 90% of all saw related injuries are still caused by contact with the saw blade. Hence the need to use innovative equipment protection such as the SawStop® technology as soon as it is available. SawStop® technology stops a blade in 5 milliseconds and can be used on practically any type of woodworking equipment (table, circular, band). In the interim, all efforts to keep hands away from the blade (push sticks, etc.) must be made. The single greatest cause of lawnmower injuries is running over the foot--and those *all* occurred when pulling the mower backwards. Mower injuries also occurred when placing the foot or hand near the mower when the

blade is still turning. Grinder injuries are very specific with 93% of these mishaps injuring the eye and hand. However, almost all of the workers with eye injuries from the grinder and drill were wearing safety glasses--so this is not adequate protection. A face shield is also necessary. Although gloves should be worn, small objects should never be held by hand--always secure with pliers. Injuries from meat slicers are very unique in that every worker was on-duty, on-base and civilian. They are also completely preventable with proper use of the guard and wearing a cut-resistant glove on the right hand.

Command	# Mishaps	% of Mishaps	% of USAF Population
AFMC	112	28%	5%
ACC	97	24%	20%
AMC	46	11%	11%
AETC	39	10%	16%
PACAF	30	7%	7%
USAFE	20	5%	6%
SPACE	14	3%	4%
AFSOC	8	2%	2%

These injuries were not distributed evenly among the major commands. AFMC experienced nearly 6 times more injuries than expected from their census, likely due to the more industrial nature of their mission. ACC was also somewhat higher than expected while AETC experienced far fewer mishaps than expected.

Key to following table

	<15% of injuries are associated with this tool
	15% - 29% of injuries are associated with this tool
	30% - 49% of injuries are associated with this tool
	> 50% of injuries are associated with this tool

Using Power Tools (402 lost workday injuries)

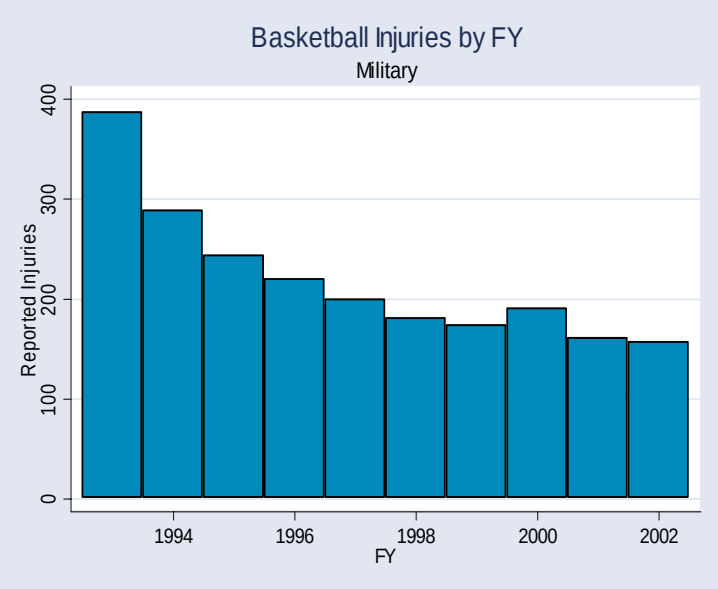
Military and Civilian *(Part I tables presented only the civilian portion of these injuries)*

Specific Tool	Example(s)	Injuries reported (% of total)	Prevention
Saw--table, circular, band	-Cutting wood--hand contacted blade - Wood slipped and blade cut thumb	137 (34%)	- SawStop technology - Separate hand from blade
Mower	-Tripped and pulled mower backward over foot - Slipped and pulled mower over foot	34 (8%)	- Mow forward, not backward - Foot protection
Drill	- Drilling and shavings entered eye - Lacerated fingers while using drill	37 (9%)	- Add face shield to protection - Don't hold object in hand
Grinder	- Wheel shattered, debris entered eye - Grinder wheel contacted finger	28 (7%)	- Add face shield to protection - Use pliers for object - Keep tool rest adjusted
Chain saw	- Saw kicked back and cut leg - Using 25 lb saw and strained back	17 (4%)	- Use kickback precautions - Position legs away from saw path
Slicer, meat, etc.	- Hand slipped from meat and cut - Was distracted and cut hand	14 (3%)	- Always use guard - Use cut-resistant glove

SPORTS AND RECREATIONAL INJURIES

Basketball	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	4	2	N/A
Total lost workdays	6	4	N/A
Severity*	7	6	N/A

Note: Rankings for top 12 injury-producing activities only
** Combination of % fracture/concussions/dislocations + median LWD*



Basketball is the leading producer of injuries in the sports and recreation subcategory during this period. Although decreasing in total number and incidence rate in the first half of the 1990's, reductions have slowed since 1998 when personnel losses also slowed. With speed and height so integral to the game, prevention of basketball injuries is challenging. However, the emerging popularity of balance training provides one potential prevention tool for the jumping injuries--the predominant category. This idea is reinforced by the fact that 68% of basketball injuries were lower leg injuries, with 35% affecting the ankle. In addition, the importance of warming-up rather than stretching prior to the game is an idea that is not widely recognized and can potentially reduce many leg injuries in this and every sport in which running is involved. Although eye injuries comprised only 2.5% of the injuries, eye protection could prevent the vast majority of those.

Distribution of basketball injuries and population by major command, FY02 (military only)

Command	# of Mishaps	% of Mishaps	% of USAF Population
AETC	36	23%	16%
AMC	28	18%	11%
ACC	26	17%	20%
PACAF	19	12%	7%
SPACECOM	16	10%	4%
USAFE	13	8%	6%
AFMC	11	7%	5%
AFSOC	4	3%	2%

AETC, AMC, PACAF, and SPACECOM each reported numbers of basketball injuries in FY02 higher than expected based on population size. These generally younger commands "own" more remote bases with limited recreational off-duty opportunities than other commands.

Key to following chart

	<15% of basketball injuries are associated with this activity
	15% - 29% of basketball injuries are associated with this activity
	30% - 49% of basketball injuries are associated with this activity
	> 50% of basketball injuries are associated with this activity

Basketball (2,204 lost workday injuries)

AF Active Duty

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Jumped, landed awkwardly, on side of foot	- Jumped for rebound, rolled ankle - After lay-up, landed on side of foot - *Excludes*: Landed on other players foot	578 (26%)	- Physical conditioning including balance training - Ankle/knee braces for susceptible players (e.g., previous ankle/knee injury)
Jumped, landed on player's foot	- Jumped, landed on defenders foot - Came down on foot when rebounding - *Excludes*: Jumping, did not land on player's foot	370 (17%)	- Largely uncontrollable given the nature of the game
Struck by another player (push, kick)	- Struck by player in eye - Elbowed by player in nose - *Excludes*: collision, struck by ball	100 (11%)	- Eye guards, mouth guards
Collision	- Collided with another player - Ran into from behind - *Excludes*: undercut, struck by	221 10%)	- Reduce exposure to non-refereed games - Realize this isn't the NBA Finals
Running, pivoting, cutting	- Pivoted quickly and injured foot - Stopped quickly and strained knee - *Excludes*: collision, jumping, fall	145 (7%)	- Shift emphasis from stretching to warming up prior to play
Injured Achilles	- Ruptured Achilles tendon - Tore Achilles tendon - *Excludes:* other tendons	162 (7%)	- Conditioning, shift emphasis from stretching to warming up prior to play
Fell, unspecified	- Slipped and fell - Fell and landed on wrist - *Excludes*: Collision, struck by	139 (6%)	- Implement training to improve balance; dry floors
Twist ankle, unspecified	- Twisted and sprained ankle - Twisted and sprained knee - *Excludes:* Jumped, landed on foot	44 (2%)	- Physical conditioning to include balance training

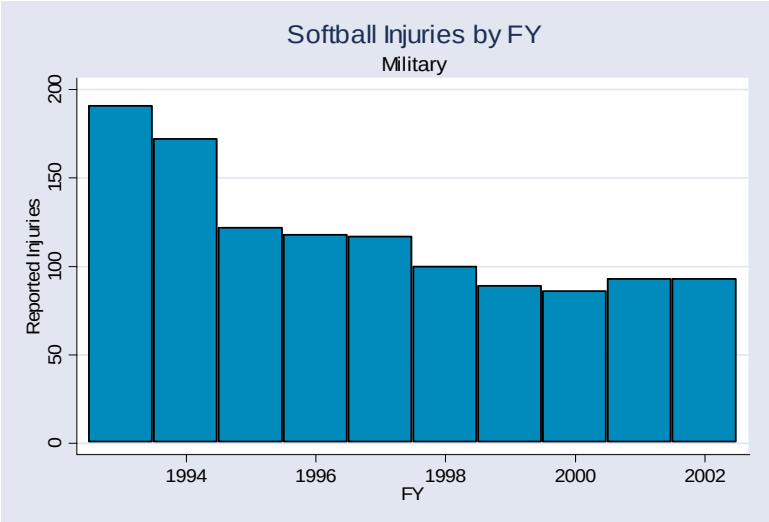
Softball	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	8	4	N/A
Total lost workdays	8	6	N/A
Severity*	2	1	N/A

Note: Rankings for top 12 injury-producing activities only

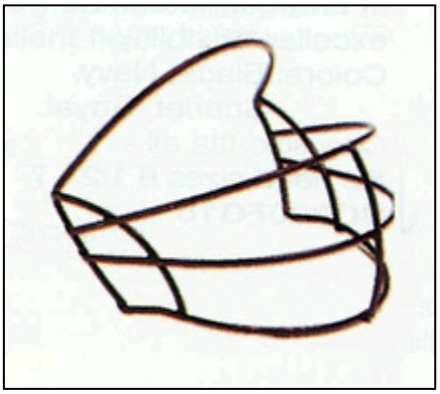
**Combination of % fractures/concussions/dislocations + median LWD*

Softball is second only to basketball in producing LWD injuries in the sports and recreation subcategory. Although decreasing in total number and incidence rate for much of the last decade, a plateau was reached in 1999.

Only three causes (sliding, hit by ball, and collision) represent 60% of the injuries. Although proven prevention equipment (breakaway bases) and rule options (restricting sliding) exist, sliding remains the number one cause of injury in softball. Furthermore, sliding injuries have increased 84% since 1998. This suggests that--among other possibilities--worn and expensive breakaway bases may frequently be replaced with less expensive stationary bases.



The use of breakaway bases at some AFBs may explain why the USAF proportion of softball injuries due to sliding is lower than their civilian counterparts (70%). Breakaway bases deserve wider implementation. Two-thirds of the players injured when hit by a ball were hit somewhere on the head. Helmets equipped with face guards (see below) would completely eliminate this injury if worn throughout the game. In contrast to baseball, protection from the ball is most important when *not* batting. Reduced Injury Factor balls could reduce hit by ball injuries of other anatomic sites by reducing the velocity of the ball, and the resulting energy of impact. The emerging popularity of balance training provides one potential prevention tool for injuries in several categories. Finally, the importance of warming-up rather than stretching prior to the game is an idea that is not widely recognized and can potentially reduce many leg injuries in this and every sport in which running is involved.



Face guard which can be snapped into a helmet

Distribution of softball injuries and population by major command, FY02 (military only)			
Command	**# of Mishaps**	**% of Mishaps**	**% of USAF Population**
ACC	28	30%	20%
AMC	15	16%	11%
AETC	14	15%	16%
AFMC	12	13%	5%
SPACECOM	8	9%	4%
PACAF	7	8%	7%
USAFE	6	6%	6%
AFSOC	1	1%	2%

ACC, AMC, AFMC, and SPACECOM each reported a disproportionately high number of softball-related injuries in FY02. The remainder reported numbers in line with their census (AF at-large not shown in the table at left). Approximately 75% of these injuries occurred in 4 commands.

Key to following chart

	<15% of softball injuries are associated with this activity
	15% - 29% of softball injuries are associated with this activity
	30% - 49% of softball injuries are associated with this activity
	> 50% of softball injuries are associated with this activity

Softball (1,181 lost workday injuries)

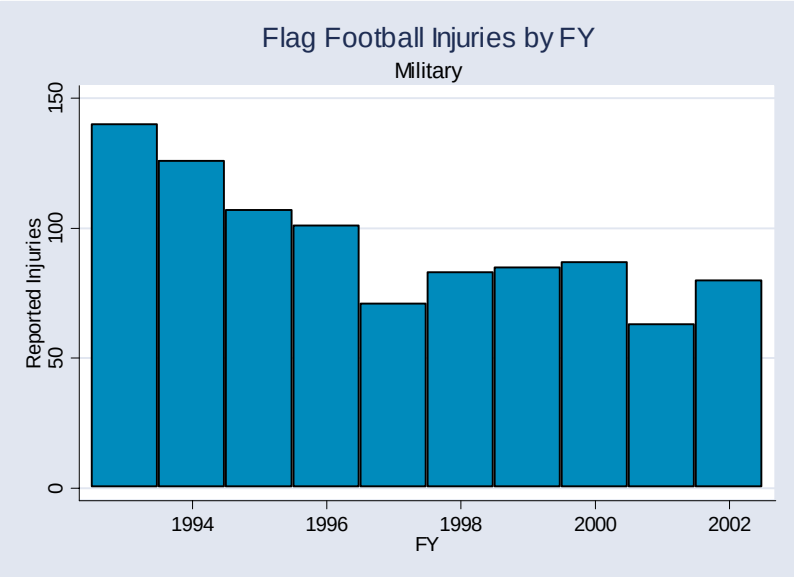
AF Active Duty

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Sliding	- Slid into second, fractured ankle - Slid into 3rd face first - *Excludes*: Stepping on-base, running between bases	272 (23%)	- Breakaway bases - Ban sliding - Restrict headfirst sliding
Hit by Ball	- Struck on jaw by ball - Hit in left eye by ball - *Excludes*: Stepped on ball	236 (20%)	- Helmet wear on-bases - Reduced Injury Factor balls

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Collision with Player	- Collided with another player - Run over by another player - *Excludes*: Sliding, running	187 (16%)	-Training to "call balls" to warn off other fielders - Recognize this isn't supposed to be a contact sport!
Running	- Running and knee buckled under - Tore Achilles tendon - *Excludes*: Sliding, collision, falling	126 (11%)	-Shift emphasis from stretching to warming up prior to play - Pre-season conditioning
Fall- unspecified	- Running and fell - Fell and landed on elbow - *Excludes*: Sliding, running without fall	81 (7%)	- Improved fields - Training to improve balance
Stepped on-base, Bat, Ball	- Tripped over base - Stepped on-base - *Excludes*: Sliding, falling	57 (5%)	- Recessed bases
Diving or Jumping	- Dove for ball and dislocated elbow - Jumped and twisted back - *Excludes*: Sliding	52 (4%)	- Recognize this isn't the Majors! - Training to improve balance
Swinging bat	- Swung bat and strained back - Swung bat and twisted knee - *Excludes:* stepped on bat	34 (3%)	- Conditioning - Pre-game warm-up

Flag Football	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	9	8	N/A
Total lost workdays	10	8	N/A
Severity*	4	5	N/A

Note: Rankings for top 12 injury-producing activities only
** Combination of % fracture/concussions/dislocations + median LWD*



Flag football is the third leading producer of injuries in the sports and recreation subcategory, behind basketball and softball. Although decreasing in total number and incidence rate in the first half of the 1990's, an undulating plateau was reached in 1997. Since the Air Force personnel strength has not changed significantly over the past few years, the report-based trend also represents the trend in the incidence rate of these injuries. Despite the fact that "flag" football is intended to reduce contact and therefore promote safety, a full 42% of injuries are due to contact. Effort should be made in developing and enforcing rules to minimize contact. In addition, the emerging popularity of balance training provides a potential prevention tool for the jumping, and STF injuries. Finally, the importance of warming-up rather than stretching prior to the game is an idea that is not widely recognized and can potentially reduce many leg injuries in this and every sport in which running is involved.

ACC, PACAF, AFMC, and SPACECOM reported proportionately more of these injuries than did the other commands based on population size (see table below). We suspect that players' age is related to injuries in this category, and we note here that the most youthful command, AETC, has reported "their fair share" of these injuries. Given the previous analysis on injury severity (Part I, pages 36-37), people 40 and older should seriously reconsider their participation in flag football.

Distribution of flag football injuries and population by major command, FY02 (military only)			
Command	**# of Mishaps**	**% of Mishaps**	**% of USAF Population**
ACC	24	30%	20%
PACAF	13	16%	7%
AETC	12	15%	16%
AFMC	9	11%	5%
SPACECOM	9	11%	4%
AMC	8	10%	11%
USAFE	4	5%	6%
AFSOC	1	1%	2%

Key to following table

	<15% of football injuries are associated with this activity
	15% - 29% of football injuries are associated with this activity
	30% - 49% of football injuries are associated with this activity
	> 50% of football injuries are associated with this activity

Flag Football (944 lost workday injuries)

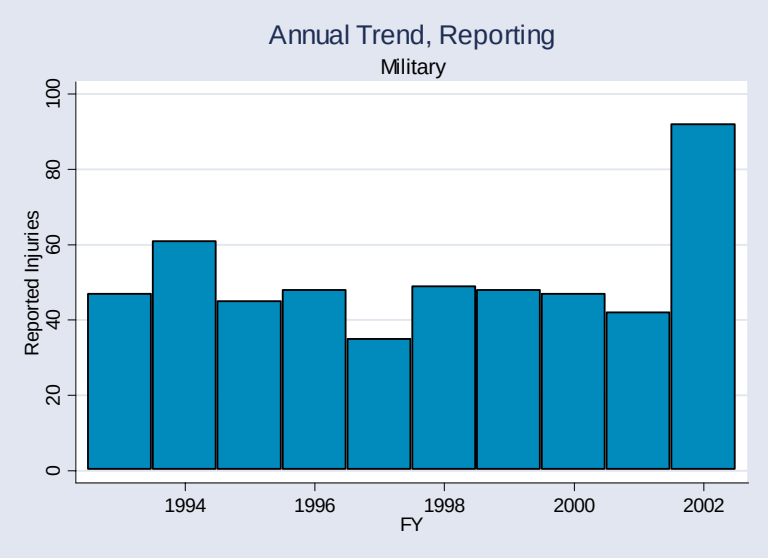
AF Active Duty

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Collision with another player	- Tackled, fractured ankle - Kicked in ankle by player	393 (42%)	- Implement and enforce rules to minimize contact, i.e., no tackling
Slip, Trip, Fall	- Fell while running - *Excludes*: tripping over player or object, bad field, ball	129 (14%)	- Training to improve balance
Running	- Heard pop while running - Knee gave out while running - *Excludes*: collision while running	100 (11%)	- Shift emphasis from stretching to warming up prior to play - Pre-season conditioning
Plant foot, cut, change direction	- Knee popped while changing directions - Cut sharply to receive ball - *Excludes*: running unspecified	66 (7%)	- Brace previously injured or weak knees and ankles - Wear shorter cleats
Jumped (leg injury)	- Jumped to deflect a pass - Jumped to catch a ball - *Excludes*: hit by ball	57 (6%)	- Training to improve balance
Grabbing the flag	- Jammed thumb while grabbing flag - Caught finger on pocket	43 (5%)	- Enforce no pocket rule - Better flag system
Uneven surface, hole, mud	- Stepped in a hole while running - Tripped on a dirt pile - *Excludes*: fall unspecified	36 (4%)	- Improve playing field - Cancel/postpone games if field is too sloppy
Stepped on ball, hit by ball	- Stepped on ball, sprained ankle - Hit on hand by ball	26 (3%)	

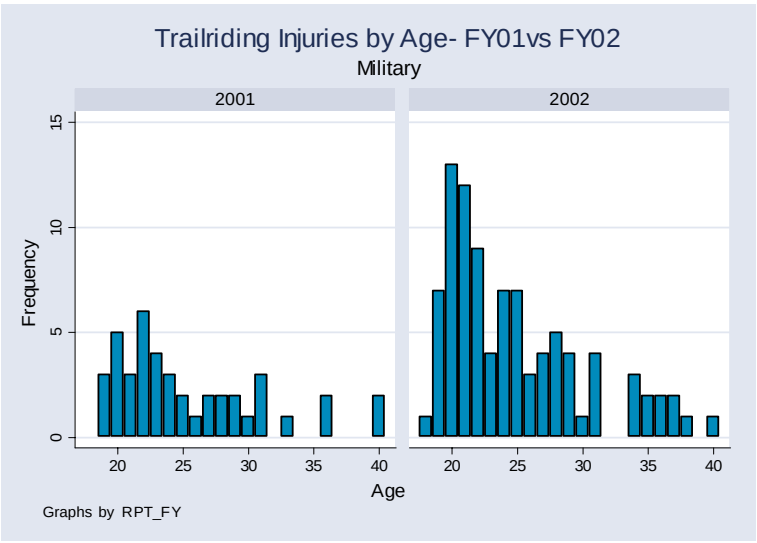
Trail riding--dirt bikes, ATVs	Overall ranking	Military ranking	Civilian ranking
Lost workday injuries (events)	11	10	N/A
Total lost workdays	9	7	N/A
Severity*	1	1	N/A

Note: Rankings for top 12 injury-producing activities only

**Combination of % fractures/concussions/dislocations + median LWD*



Trail riding is the seventh overall producer of military total LWD, fifth in average LWD. These mishaps occurred almost exclusively off-base and off-duty. There were no mishaps reported of this type in AF civilians. Remarkably, in FY02, trail riding mishaps more than doubled the previous five-year average. In FY 02 external causes which increased several fold included slick surfaces, avoidance, uneven surfaces, and jumping, which had the largest numeric increase.



The 20-24 age group represents 25% of the total USAF population, yet accounted for a full 50% of the trail riding mishaps in FY02. Most age groups increased numerically, while the age group percentages remained fairly consistent. This means that the highest risk ages hardly changed from FY01 to FY02, only the magnitude of the trail riding injury risk changed--more than doubling in most age groups.

The number of trail-riding mishaps and injuries more than doubled in FY02, however the severity decreased given that the sum of lost duty days increased only slightly.

External cause	Mishaps		Lost Days	
	FY01	FY02	FY01	FY02
Loss of control	21	16	403	97
Jumping	10	26	175	281
Rut, uneven surface	4	13	85	118
Collision with object	3	8	16	78
Avoidance	2	8	24	59
Slick surface	1	8	41	46
Over edge	1	4	9	75
Miscellaneous	0	9	0	86
USAF Total	42	92	753	840

All external causes increased with the exception of loss of control. Intentional (and obviously unsuccessful) jumping showed the largest increase from FY01. Many of these external causes (e.g., slick, rutted, uneven surfaces) in tandem with the age factor shown above suggest poor individual-level risk assessment.

Distribution of trail riding injuries and population by command, FY02

Command	# of Mishaps	% of Mishaps	% of USAF Population
ACC	37	40%	20%
PACAF	18	20%	7%
AMC	14	15%	11%
SPACECOM	9	10%	4%
AETC	7	8%	16%
AFMC	3	3%	5%
AFSOC	2	2%	2%
USAFE	1	1%	6%

The four leading commands in numbers of trail riding mishaps were also overrepresented population-wise in FY02. ACC and PACAF together had twice the number of trail riding injuries than what was expected based on their personnel strength. These two commands accounted for 60% of the mishaps, while representing only 27% of the USAF population. AETC's disproportionate contribution was in the opposite (and desired) direction, possibly due to the influences of being in a training environment, for both the students and cadre.

We chose to contrast FY01 to FY02 above, as FY02's surge in reported mishaps called for a detailed analysis. While we conveniently used FY01, any of the previous seven years would have produced remarkably similar results. So, FY01 is a good representation of "the norm". The detailed external cause analysis below is based on the complete 10 years of data.

Key to following table

	<15% of trail riding injuries are associated with this factor
	15% - 29% of trail riding injuries are associated with this factor
	30% - 49% of trail riding injuries are associated with this factor
	> 50% of trail riding injuries are associated with this factor

Trail riding--dirt bike/ATV
514 lost workday injuries

AF Active Duty

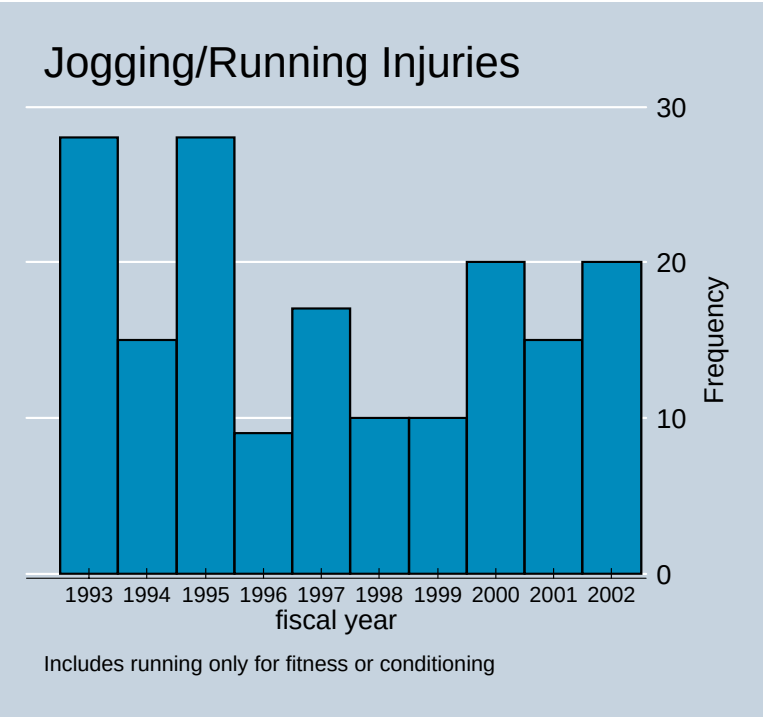
Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Loss of Control (Reason may be unspecified)	- "Lost control, laid down" - "Lost control and was thrown off" - *Excludes*: Loss of control during jump, due to collision, or due to abnormal surface such as mud	144 (28%)	- Reduce speed - Vehicle and terrain familiarization - Avoid extreme stunts
Intentional jumping	- "Overshot jump, tumbled and rolled" - "Went over jump, landed on ankle" - *Excludes*: unexpected bumps or drop-offs	103 (20%)	- Don't imitate *Jackass* - Know limitations - Gradually increase degree of difficulty
Rut, pothole, depression, bump, uneven surface	- "Hit a rut, was ejected" - "Struck bump and was thrown off" - *Excludes*: mud, sand, gravel; large rocks;	65 (13%)	- Reduce speed - Terrain familiarization - Drive 4-wheel, not 3-wheel
Collision with object	- "Struck guardrail and was ejected" - "Dirt bike hit log" - *Excludes*: Collision with vehicle	43 (8%)	- Reduce speed - Terrain familiarization
Mud, ice, sand, gravel, slick surface	- "Hit deep sand and fell off" - "Lost control on ice" - *Excludes*: Large rocks	32 (6%)	- Reduce speed - Terrain familiarization
Avoidance	- "Veered to avoid tree" - "Swerved to miss deer" - *Excludes*: Unspecified loss of control	27 (5%)	- Reduce speed - Reduce speed at night or with reduced visibility
Thrown or fall off	- "Thrown over handlebars" - "Flipped over handlebars" - *Excludes*: Falls due to surface, large rock, jump or collision	21 (4%)	- Reduce speed - Vehicle and terrain familiarization
Collision with vehicle	- "Two ATVs collided head-on" - "ATV 2 turned into ATV 1" - *Excludes:* Collision with objects	20 (4%)	- Maintain safe distance from other riders - Reduce speed when approaching other riders
Drop off, cliff, overhang	- "Drove off into ravine" - "Rode off 30 ft drop-off" - *Excludes*: intentional jumps	16 (4%)	- Trail familiarization - Reduce speed - Don't imitate *Jackass*

SPECIAL INTEREST TOPICS

This section provides details on types of injuries that--even though of relatively low frequency--are unique to military life (e.g., running injuries) or have serious long-term functional implications (e.g. eye injuries). Many are caused by the likewise unique exposures that come with military service. These injuries may have been less likely to have occurred if not for military service or serving as a civilian AF employee.

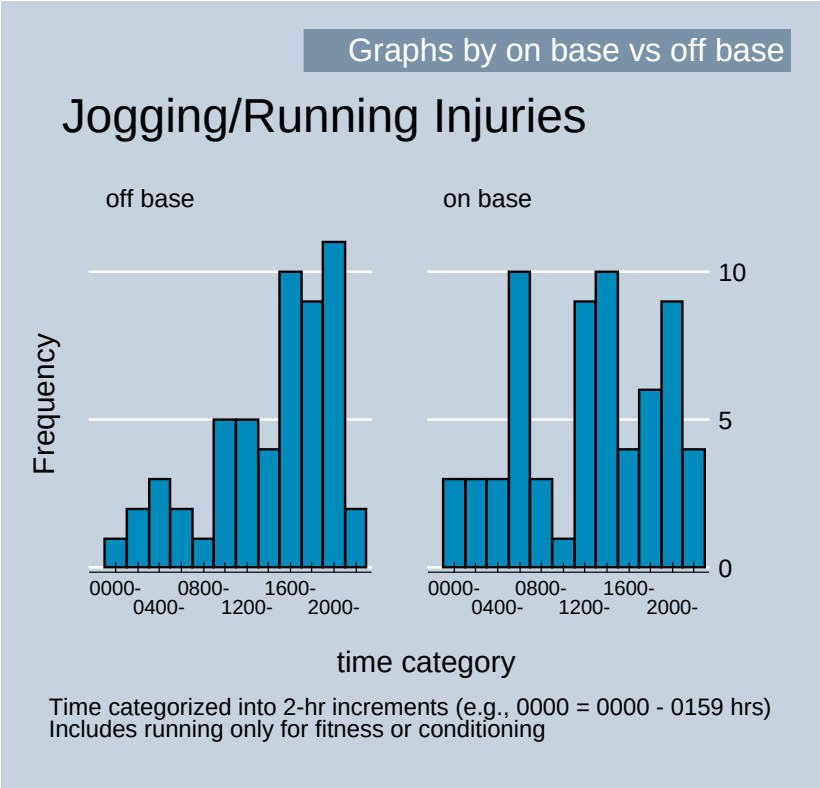
Running Injuries

Many airmen run for physical and aerobic conditioning. In the future, many more will do so for the same purposes given the AF's latest revision to the physical fitness testing regimen that is based in part on run times vs. the oxygen demand estimates ($VO_{2\ max}$ in cycle ergometry) previously used. The potential for increases in running associated injuries is high given the additional miles of exposure that will inevitably accrue as airmen alter their training regimen towards the revised testing parameters. The causal information on past injuries reported here can provide valuable information that can be used by both commanders and individuals to prevent running injuries.

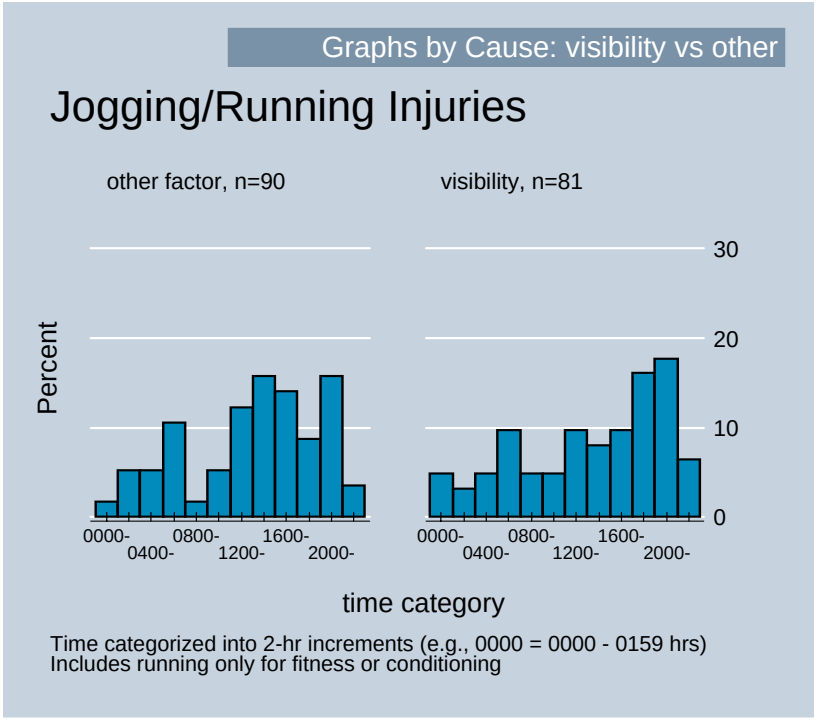


A total of 171 jogging or running injuries were reported during the 10 year period in which the injured person lost at least one duty day. The frequency of these reports over the most recent three years has increased compared to the mid-1990s although no clear generalized trend is evident. SEPR will continue to track these injuries in response to expected changes in individuals' physical fitness regimen. No doubt this is the tip of the iceberg of all running injuries, but the causes

associated with most of these more serious injuries are likely the same as those of lesser severity.



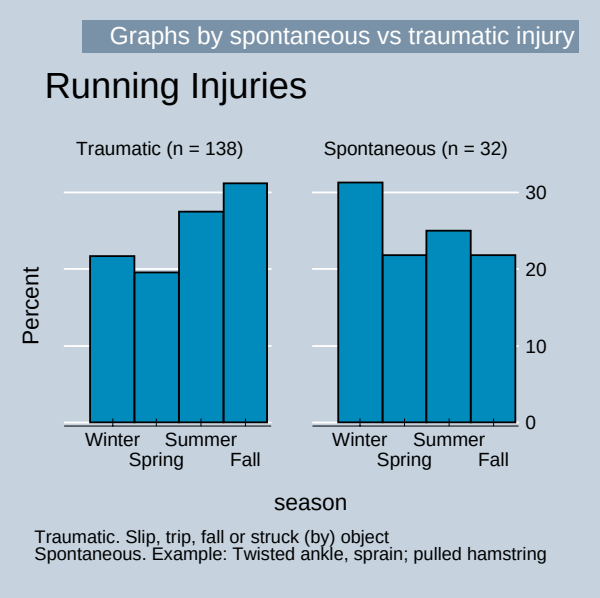
Out of the 171 injuries, 92 (54%) occurred on-base. The distribution of these injuries by time of day followed different on vs. off-base patterns. Off-base injuries surged between 1600 and 2100 hours with the highest peak in the late evening/ nighttime (2000-2100) hours when visibility is likely reduced. Also of interest are the 3 on-base peaks at the 0600-0759 period, during the lunchtime and early afternoon hours, and--as in the off-base distribution--the 2-hour spike starting at 2000 hours.



Of the 171 running injuries, 81 (47%) are suspected to have been related to visibility: either the runner didn't see a specific hazard (e.g., a pothole or a curb) or a vehicle operator didn't see the runner. Out of those 81 injuries, the time of day was reported for 62 of these injuries. Of those 62, 33 (53%) occurred after 1800 hours and before 0600 hours when lighting may have been low. In the 57 "other factor" injuries with reported time of

day, 23 (40%) occurred in low-light periods. So, while low lighting was apparently a contributing factor in visibility-related mishaps, lightning was not the only factor. Runners should choose the environment or terrain with the safest degree of visibility (to see *and* to be seen).

The seasonal distribution of running injuries differs by the type of injury sustained. Traumatic injuries--those due to slips, trips, falls, or being struck by (or striking) an object--occur most frequently in the summer (June-August) and fall (September-November). Spontaneous "non-falling" injuries such as muscle sprains and turning an ankle (without stepping in a hole or being pushed) occur most often in the winter (December-February). The summer months may invite runners to environments and surfaces that aren't necessarily safe to run in or on. The colder winter months, on the other hand, make warming up harder, resulting in more muscle pulls. The winter months also produced all of the traumatic wet/icy surface related STF injuries. Non-traumatic injuries also showed a small spike in the summer months which could be related to inadequate hydration leading to electrolyte imbalances, subsequently leading to muscular injuries.



The specific external cause of running injuries differed by whether the mishap was the result of a slip, trip, or fall (STF) or was the result of some other means of energy

Comparison of external causes of running injuries: Slips, trips, & falls (STF) vs. non-STF

Slips/Trips/Fall Injuries (n = 84)			Non-STF Injuries (n = 87)		
Cause/Surface	**Injuries**	**%**	**Cause/Surface**	**Injuries**	**%**
Icy/wet surface	21	25%	Self-induced trauma†	31	36%
Unexplained *	20	24%	Curb/sidewalk	12	14%
Uneven surface/sand	11	13%	Uneven surface/animal hole	10	11%
Rocky/gravel surface	9	11%	Pothole	9	10%
Grass surface	8	10%	Struck object (e.g., log)	9	10%
Curb/sidewalk	5	6%	Rocky/gravel surface	7	8%
Animal interference	4	5%	Struck by vehicle	6	7%
Other identified causes	6	7%	Animal interference	3	3%

** No apparent cause of traction/balance loss aside from the injured person, typically "stumbling"*
† For instance, muscle pulls apparently caused only by the action of running; includes 1 instance of hyponatremia, an electrolyte imbalance brought on by excessive water intake

transfer (e.g., getting struck by a PMV, hard impacts with the ground, or excessive musculoskeletal loading). STF injuries were largely the result of either a slick surface or the individuals' unexplained loss of balance due to stumbling and where the running surface itself was not noted to be a contributing factor. Non-STF running injuries were dominated by "self-induced" or spontaneous trauma in which the person typically pulled a muscle or otherwise injured themselves without some external force or safety hazard coming into play. Hard contact with curbs and sidewalks, running on uneven surfaces that sometimes included animal holes, stepping in potholes, and striking fixed objects while running represented 71% of the non-STF injuries. Six airmen were hit by motor vehicles. Animals (dogs actually) were a causal factor in 7 (4%) of the 171 total running injuries, either tripping the runner or directly injuring the runner through physical contact. None of the injuries resulted from an animal bite.

The most frequent body part injured during running was the ankle. Over two-thirds of these were sprains. Legs were the next-most frequent injured body part, but fractures were instead the predominant type of injury. The high proportion of fractures in leg injuries was responsible for the extremely high (13 days) median total lost duty days which ranged as high as 42 days. Other fractured sites did not result in as many lost duty days, as the non-leg fractures showed a median of 6 lost duty days. Overall, fractures accounted for 68 (40%) of the 171 running injuries, second only to sprains and strains with 79 injuries (46%)--data not shown.

Injury frequency by body part injured & primary types of injury

Body part/ *type of injury*	**Freq**	**Percent***	**Median lost days**	**Min - Max lost days**
Ankle	72	42%	2	1 - 17
Sprain	*49*	*68%*		
Fracture	*21*	*29%*		
Leg	23	14%	13	2 - 42
Fracture	*15*	*65%*		
Sprain/strain	*4*	*17%*		
Knee	15	9%	2	1 - 11
Sprain/strain	*11*	*73%*		
Foot	12	7%	2	1 - 13
Fracture	*8*	*67%*		
Sprain/strain	*3*	*25%*		
Back	8	5%	2	1 - 35
Sprain/strain	*6*	*75%*		
Other	40	29%	2	1 - 32
Fracture	*23*	*58%*		
Sprain/strain	*13*	*32%*		

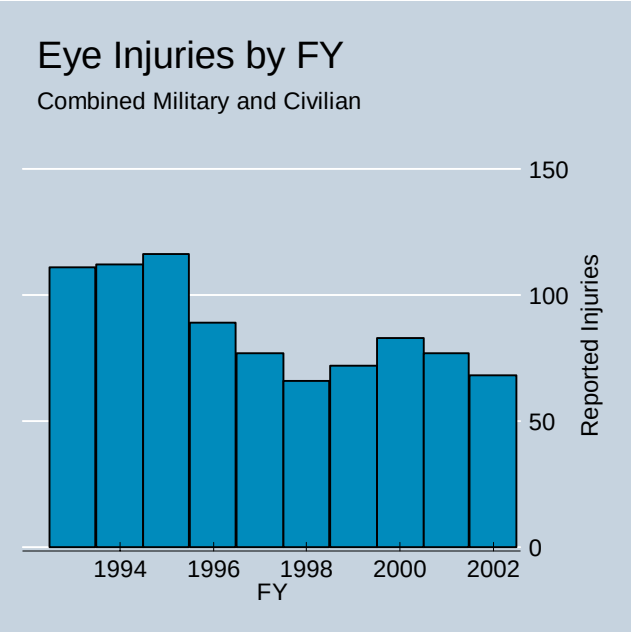
* *Type of injury* percentages based on the total # of category-specific body site injuries

Prevention of running injuries

- Slow and gradual increase in running speed, distance, and frequency
- Running no more than 3 times per week
- Running no more than 30 minutes per session
- Never running in formation
- Never running in anything but running shoes (i.e., not cross-trainers or basketball shoes)
- Wear properly sized and fitted running shoes (including the correct shoe specification or insert for stability, motion control [i.e., pronation] or for impact absorption [i.e., rigid foot])*
- Replacing pre-session stretching with warm-up and cool-down periods
- Strength and flexibility training for lower extremities
- Select appropriate (safe) running surfaces with sufficient lighting and line of sight to see hazards (e.g., motor vehicles, potholes, animal holes, slick surfaces, etc) and to be seen

* Note: Many sources exist for fitting and sizing information. Besides consulting with the USAF Health and Wellness Centers' exercise physiologists, unit leaders and individuals may find good information in the library or on the internet. One useful U.S. Army website is *http://www.benning.army.mil/usapfs/Training/ShoeSelection.htm*. Another useful website for both shoe selection and injury prevention tips is *http://www.runnersworld.com/home* which is particularly suited for competitive runners but is also useful for those who run exclusively for fitness. Note: Listing a website does not indicate that the Air Force endorses any products that may be purchased via these sites.

Eye Injuries



Eye injuries decreased during the mid-90s, but have been on a fluctuating plateau for the last 5 years. These injuries were investigated as a special topic since they are potentially serious, disabling injuries. Although severe injuries such as punctures do occur, the vast majority of injuries are abrasions, lacerations, bruises, foreign objects, and burns--all usually less severe than a puncture--lowering the average lost days (3.6 days per injury) below that of the average injury in this study.

A review of subcategories showed that eye injuries are clustered in three areas, aircraft maintenance, civil engineering, and off-duty activities. This may be the most important finding of this analysis. Specific activities leading to the injury showed great variation, with few common threads. This variation was extensive under two of the top three activities, struck and struck by, and handling, with almost no repeat circumstances found. However, aircraft cleaning dominated the cleaning category. This activity is ripe for innovative solutions, such as an automatic wash bay, since extensive eye protection is already utilized in these areas. Also, it was alarming to see racquetball still causing injuries on-base despite mandatory requirement for protective eyewear. However, there were no such incidents reported in 2002. The other sports causing eye injuries, basketball and softball, are covered in other areas of this report. Since the exact activity leading up to the injury is so inconsistent and unpredictable, universal precautions for protective eyewear become is relevant and important.

Functional Area	# Injuries	% of total
Off-duty	398	46%
Aircraft Maintenance	229	26%
Civil Engineering	101	12%
Services	39	4%
Transportation	20	2%

Eye injuries were evenly distributed throughout the year, with only December having fewer cases, probably due to vacation time during the holiday season. The time of day distribution showed a bell-shaped curve that started in the morning with the beginning of the duty day, peaked at 1400 hours, and slowly decreased to a minimum at 2300 hours. The reason for the peak at 1400 is unexplained. Just over half (473, 54%) of the eye injuries were on-duty, but a greater percentage occurred on-base (648, 74%). Two-thirds were accounted for by military, which is almost identical to the AF overall lost workday injury breakdown. Injuries were evenly distributed between the three age groups (17-24, 25-30, 40+).

Command	# Mishaps	% of Mishaps	% of USAF Population
ACC	209	24%	20%
AFMC	202	23%	5%
AMC	103	12%	11%
AETC	90	10%	16%
PACAF	73	8%	7%
USAFE	66	8%	6%
SPACECOM	30	3%	4%
AFSOC	16	2%	2%

AFMC was the only command which was significantly overrepresented for their population, probably due to the large industrial base in the command. As with other injury types, eye injuries are probably underrepresented in this report, with many more injuries occurring that do not involve lost duty time. Therefore, although eye injuries are not a major cause of lost duty time in the USAF, prevention gains can be realized in this area by improving eye protection in selected sports, and in the industrial setting, specifically in aircraft maintenance and civil engineering.

Key to the following table

	<15% of eye injuries are associated with this mechanism
	15% - 29% of eye injuries are associated with this mechanism
	30% - 49% of eye injuries are associated with this mechanism
	> 50% of eye injuries are associated with this mechanism

Eye Injuries (871 lost workday injuries)

AF Military and Civilian

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Struck or Struck by	- Struck in eye by metal strap - Struck in eye by branch - Excludes: Debris/discharge from power tools/equip entering eye	137 (16%)	- Eye protection
Handling	- Liquid content splashed in eye - Pouring acids in beaker, splashed eye	69 (8%)	- Eye protection

Activity/Factor	Example(s)	Injuries reported (% of total)	Prevention
Cleaning	- Soap entered eye while cleaning aircraft - Cleaning stove, splashed eyes	65 (7%)	- Automatic aircraft washing, no personnel contact necessary
Basketball	- Received a finger to the eye	58 (7%)	- Eye protection
Hand tool	- Screwdriver slipped, punctured eye	51 (6%)	- Eye protection
Power tool	- Worker using grinder at bench; expended metal particles entered eye from underneath safety glasses	42 (5%)	- Eye protection; wear goggles or face shields if operating grinder to avoid particles coming into eye from underneath safety glasses
Maintenance	- Solvent entered eye during engine maintenance	31 (4%)	- Eye protection
Softball	- Runner hit in eye by thrown ball	29 (3%)	- Eye protection - RIF balls
Racquetball	- Ball came off back wall, hit player in eye	27 (3%)	- Eye protection
Operating	- Worker operating push mower; debris from discharge entered eye	23 (3%)	- Eye protection

APPENDIX A

TEN COUNTERMEASURES FOR INJURY PREVENTION & CONTROL

With examples

1. **Prevent the creation of the hazard in the first place**
   Ban 3-wheelers, restrict types of ammunition

2. **Reduce the amount of energy aggregated**
   Reduce flammability of flight suits, pills per container, water temp

3. **Prevent the release of an already existing hazard**
   Increase automation, handrails, improve brakes

4. **Alter the rate or spatial distribution of the hazard from its source**
   Seatbelts, blister pack, child restraints

5. **Separate the host and the hazard in time or space**
   Bike paths, remove trees, hurricane evacuation, ejection seat

6. **Separate the host and the hazard by material barriers**
   Bike helmets, pool fences, noise abatement

7. **Modify basic relevant qualities of the hazard**
   Non-skid floors, breakaway bases and poles, energy-absorbing surfaces

8. **Improve the resistance of the host to damage from the hazard**
   Fluoridation, physical conditioning, building codes

9. **Rapid detection**
   Smoke detectors, roadside hones, early warning systems

10. **Repair the damage**
    EMS, treatment and rehab, self-care training

Consider cost, feasibility, convenience, and acceptability

Reference: Haddon W Jr. *J Trauma*. 1973 Apr;13(4):321-31

APPENDIX B

HADDON MATRIX

Applied with example: Interventions to reduce wartime motor vehicle crash-related injuries
(adapted from Bell NS, Amoroso PJ, Baker SP, Senier L. *Injury Control Part II: Strategies for Prevention*. Technical Note RN 00-4 (DTIC # A372985) Military Performance Division, US Army Research Institute of Environmental Medicine, January 1999)

Phase	Factors		
	Human (host)	**Equipment (vector or vehicle)**	**Environment**
Pre-event	Fatigue; familiarity with terrain and vehicle; driving experience; personality; speed; smoking; cell phone usage; drug/alcohol use	ABS brakes; vehicle condition (e.g., lights, brakes); center of gravity (pertains to rollover potential); tire traction and speed rating	Terrain; weather; visibility; enemy position; reconnaissance accuracy; command enforcement of training & drug/alcohol abuse prevention; speed limit
Event	Use of safety belt; speed	Air bags; helmets; energy-absorbing steering column; structural integrity (roll bars, side bars)	Obstacle-free road; vehicle following distance
Post-event	Knowledge of self-aid/buddy care (first aid); general state of health; age; smoking history; alcohol or drug use; prior history of injury	Fire retardant interior/gas tank; first aid gear on board; fire extinguisher	Open terrain for rapid evacuation; command support of MEDEVAC; planning for triage; distance to aid station; training of field medical staff

APPENDIX C

INTRODUCING UNIVERSAL PRECAUTIONS TO THE INDUSTRIAL WORKPLACE

The field of medicine was introduced to the concept of "universal precautions" out of necessity due to the emergence of infectious agents such as HIV and Hepatitis B which are transmissible to both the patient and the medical care provider. The idea had further justification as additional agents continued to be discovered, such as Hepatitis D, raising the concern of how to protect against agents which were unknown. Both the mishap/circumstance and the source of infection were unforeseeable, or unpredictable. With the stakes so high in the face of incomplete knowledge, protection was needed for every person and with every medical procedure.

The industrial workplace is reaching a similar point in time. The escalating costs of medical care and the highly competitive nature of the marketplace combine to make workplace injuries increasingly unacceptable. Add in the increasing demands for troops to be ready for duty in a high-ops tempo environment, and it's easy to understand the rationale for a SECDEF goal to dramatically reduce the DoD injury rate.

The field of medicine itself did not immediately respond to the call for universal precautions due to numerous objections such as the time and cost of complying along with the loss of sensitivity and dexterity in procedures. In time, all of the cost-based objections were resolved through many avenues such as engineering and mass production. Medical personnel at some point realized that the need for protection was absolute--and the path was inevitable. The paradigm shift occurred over time, and the concept of universal precautions is now completely embraced by the medical profession.

This paradigm change may be even more painful in the industrial world. One of the most persistent objections in the medical world to additional safeguards has been that the vast majority of providers, patients and procedures will not benefit from universal precautions. However, that is a basic principle of public health: that the entire population must pay a small cost, for which there is no personal return, to gain much for the individuals who will be helped. Seat belts usage may only represent an additional cost and hassle for the vast majority of the millions of drivers, yet the belts

save many of those drivers' lives (albeit a relatively small number) every day--in mishaps that cannot be predicted.

During this analysis, we determined that 25% of injuries involving a screwdriver injured the eye. Certainly the vast majority of individuals using a screwdriver do not currently use eye protection since the risk of an eye injury seems remote. Indeed, the vast majority will not benefit from doing so! However, these mishaps, just as with motor vehicle crashes, cannot be predicted, and therefore will not be prevented until eye protection is used by all workers.

The introduction of universal precautions into the workplace is not completely foreign. The concept is already in place in many isolated locations where protection, such as hard hats, is mandatory. However, there are more precautions which seem ready for implementation, such as eye protection. The more complete implementation of universal precautions into industrial settings will be slow, painful and expensive--but is inevitable. The time has come for DoD to lead the way in beginning this process.