



Survey of Airline Baggage Handlers Suggests Methods to Prevent Back Injuries

A recent opinion survey of 156 baggage handlers explored the causes and prevention of back injuries in their occupation. Most of the participants, employed by 10 airlines and two ground-handling companies, said that manual handling and stacking of baggage within the baggage compartments of narrow-body aircraft pose the highest risk of back injury.

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Geoff Dell

Protocol Safety Management

Advances in ergonomics (human engineering) continually improve the flight decks and cabins of transport-category aircraft, but some researchers believe that improvements should be made in areas below the cabin floors to help prevent back injuries among baggage handlers.

This article summarizes the opinions of 156 baggage handlers from 10 airlines and two ground handling companies worldwide on tasks associated with back-injury risk, identifies elements of the baggage-handling system and equipment that are believed to present significant manual-handling problems, and suggests appropriate solutions. *Manual handling* refers to physical baggage movement in general, including tasks such as loading, moving baggage within a compartment, stacking, unloading and transferring. *Stacking* refers to placing bags on top of one another to fill the baggage compartment as bags are loaded into the aircraft. The injury risks during stacking have been studied because manual lifting of bags to various heights is required, sometimes to the height of the baggage handler's head.

Baggage handlers from the following organizations were interviewed: Aerolíneas Argentinas, Argentina; Austral Líneas Aéreas, Argentina; Delta Air Lines, Germany; Delta Air Lines, U.S.; Lufthansa German Airlines, Germany; Northwest Airlines, U.S.; Midwest Express Airlines, U.S.; Qantas Airways,



Australia; Scandinavian Airlines System, Sweden; Service Master, U.S.; and CLT Aviation, U.S.

The study selected participants randomly at each organization, and the interviewers used the following set of questions:

- How long have you worked as a baggage handler?
- What are your age and gender?
- Have you personally experienced a back injury?
- How often have you experienced back pain?
- Are baggage handlers in your organization required to lift bags or cargo items that weigh more than 70 pounds (32 kilograms)? (This industry standard defines the weight of a piece of passenger baggage for the purpose of charging excess-baggage fees.)
- From a list of five baggage-handler workplace locations, which do you consider the most likely and the least likely to cause back injuries?
- From a list of 12 manual-handling tasks routinely performed by baggage handlers, which five tasks do you consider the most likely to cause back injuries?

- What back-injury-control measures have been adopted by your company?
- What measures do you believe would be necessary to reduce back injuries among baggage handlers?

From 1992 to 1994, 25 percent of compensation claims filed by workers in Victoria, Australia, recorded back injuries as the most serious ailment suffered by the claimants.¹ In 1996, Workcover New South Wales in Australia reported that back injuries were 30 percent of all the state's workplace injuries in the period from 1993 to 1995.²

Studies have been documenting the workplace back-injury problem for more than 10 years. In 1987, the Workers Compensation Board of Ontario, Canada, said that back injuries accounted for 27 percent of all lost-time compensation claims.³ A 1993 study of Swedish male workers with back ailments⁴ and a 1986 study of nurses in England⁵ suggested that 80 percent of workers experience lower-back ailments during their working life.

In 1994, 20 percent of all injuries and illnesses in U.S. workplaces were back injuries, and these injuries cost more than US\$20 billion, said a report by the U.S. National Institute of Occupational Safety and Health (NIOSH).⁶

For nearly 20 years, back-injury problems among airline baggage handlers⁷ have been a subject of academic research. The International Air Transport Executive of the National Safety Council of America (ARTEX) was among the earliest investigators of baggage-handler back injuries. In a 1981 report, ARTEX said that 340 baggage-handler back injuries had occurred among 10 airlines in 1977.⁸ ARTEX also said that loading or unloading of narrow-body aircraft⁹ was involved in 85 percent of the injuries.

A 1997 study¹⁰ found that back injuries to baggage handlers at 15 airlines and one ground-handling company cost an average of \$21 million per year during the period from 1992 to 1994, that 8.5 percent of baggage handlers suffered back injuries each year and that the average annual lost-time back-injury¹¹ frequency rate (LTFR) during the period was 41.5 (per million hours worked). Airline-safety professionals surveyed in this study also rated loading and unloading of narrow-body aircraft as the greatest back-injury causation risk.

Of the 156 baggage handlers surveyed in this study, 148 were male and eight were female. The participants had baggage-handling experience ranging from six months to 32 years, with an average of 10.6 years of experience. The ages of participants ranged from 17 years to 62 years, with an average age of 36 years.

In the study, 110 (70 percent) of these baggage handlers believed that the "narrow-body-aircraft baggage compartment" was the workplace location likely to cause the most back injuries (Table 1). Significantly lower percentages

Table 1
Baggage-handler Opinions on Locations Likely to Cause the Most Back Injuries

Workplace Location	Number	Percent
Inside narrow-body-aircraft baggage compartments	110	(70)
Baggage check-in areas	13	(8)
Outside the aircraft on the tarmac	11	(7)
Baggage-sorting rooms	9	(6)
Inside wide-body-aircraft bulk holds	9	(6)
No response	4	(3)
Total	156	100

Source: Geoff Dell

of participants believed that other workplace locations were likely to cause the most back injuries. "Baggage check-in" was the second-most-common response to this question (13 participants), followed by "outside the aircraft on the tarmac" (11 participants), "baggage sorting rooms" (nine participants) and "inside wide-body-aircraft bulk holds" (nine participants).

The bulk hold is the rearmost baggage-and-cargo compartment in a wide-body aircraft, accessed by a separate door in the rear fuselage. Baggage handlers transfer baggage and cargo into the bulk hold using a mobile-belt-loader vehicle, a method similar to loading a narrow-body-aircraft baggage compartment. Baggage handlers stack bags manually inside bulk holds. In some wide-body aircraft, the floor-to-ceiling heights in the rear of the bulk hold (the area immediately forward of the aft bulkhead) are significantly lower than the floor-to-ceiling heights in the baggage compartments of narrow-body aircraft.

Concerning heavy baggage, 139 of these baggage handlers (89 percent) said that they were required to lift pieces of baggage that weighed more than 70 pounds, and 141 participants (90 percent) said that they believed that pieces of baggage heavier than 70 pounds created a significant injury risk.

Table 2, page 3 shows the baggage handlers' responses to questions about which manual-handling tasks are likely to cause back injuries.

Two baggage-handling tasks related to narrow-body aircraft — pushing bags from doorways into baggage compartments of narrow-body aircraft and stacking bags inside baggage compartments of narrow-body aircraft — were believed by the most participants (136 participants and 135 participants, respectively) to be likely to cause back injuries. Baggage handlers believed that "transferring bags from baggage trailers directly into the aircraft" was the task next most likely to cause back injuries (131 participants), followed by "pushing and pulling loaded trailers" (129 participants).

Table 2
Baggage-handler Opinions* on Manual-handling Tasks Likely to Cause Back Injuries

Manual-handling Task	Back-injury Likelihood					
	Likely	Percent	Unlikely	Percent	No Response	Percent
Pushing bags from doorways into baggage compartments of narrow-body aircraft	136	(87)	18	(12)	2	(1)
Stacking bags inside baggage compartments of narrow-body aircraft	135	(87)	16	(10)	5	(3)
Transferring bags from trailers directly into aircraft	131	(84)	21	(13)	4	(3)
Pushing and pulling loaded trailers	129	(83)	25	(16)	2	(1)
Pushing containers inside wide-body aircraft (with loading systems out of service)	118	(76)	27	(17)	11	(7)
Stacking baggage inside wide-body-aircraft bulk holds	113	(73)	30	(19)	13	(8)
Loading bags onto trailers in baggage rooms	107	(69)	47	(30)	2	(1)
Loading containers in baggage rooms	104	(67)	42	(27)	10	(6)
Transferring bags from trailers to mobile belts	103	(66)	49	(31)	4	(3)
Unloading containers in baggage rooms	101	(65)	44	(28)	11	(7)
Unloading trailers in baggage rooms	93	(60)	61	(39)	2	(1)
Lifting baggage on and off conveyors	69	(44)	83	(53)	4	(3)

* A total of 156 baggage handlers participated in this opinion survey.

Source: Geoff Dell

“Pushing containers inside wide-body aircraft when the mechanical-loading systems are unserviceable [out of service]” was believed to be likely to cause back injuries by 118 participants (76 percent). “Stacking baggage inside wide-body-aircraft bulk holds” was considered to be a back-injury risk by 113 of the baggage handlers (73 percent).

Eighty-three of the baggage handlers (53 percent) believed that lifting baggage on and off conveyors was the only manual-handling task that did not present a risk of back injuries.

Seventy-two of the participants (46 percent) said that they had experienced a back injury while handling baggage (Table 3). Of those, 40 baggage handlers (56 percent) said that their back injuries reduced their ability to work, and 43 baggage handlers (60 percent) said that the injury had recurred at least once since the first injury.

In response to the question “How often do you experience back pain when handling baggage?” 110 baggage handlers

(71 percent) said that they had experienced back pain more than once. Twenty-seven participants (17 percent) said that they had back pain daily, 24 participants (15 percent) said that they had back pain weekly, 18 participants (12 percent) said that they had back pain monthly, and 41 participants (26 percent) said that they seldom had back pain.

When questioned about the design of baggage-sorting rooms, 88 participants (56 percent) said that they believed that efficient design of baggage-sorting rooms made their job easier. The survey found that the heights of conveyor belts were considered adequate by 82 baggage handlers (52 percent).

Fifty-three baggage handlers (34 percent) said that their airlines have stacking systems installed in narrow-body aircraft. Of those participants, 47 (89 percent) said that the system made baggage handling easier and reduced their exposure to back injuries. All 53 of these baggage handlers said that they preferred loading aircraft fitted with stacking systems to loading aircraft without stacking systems.

Table 3
Baggage-handler Opinions* on Personal Back-injury Experience at Work

Question	Yes	Percent	No	Percent	No Response	Percent	Total
Have you personally experienced a back injury while handling baggage?	72	(46)	84	(54)	0	(0)	156
Has the back injury reduced your ability to handle baggage?	40	(56)	32	(44)	0	(0)	72
Has the injury recurred since the first injury?	43	(60)	29	(40)	0	(0)	72

* A total of 156 baggage handlers participated in this opinion survey.

Note: Percentages may not total 100 because of rounding.

Source: Geoff Dell

Table 4 shows the baggage handlers' responses concerning possible engineering-redesign solutions to the back-injury problem.

The development of in-plane baggage-stacking and cargo-stacking systems was the engineering-redesign solution recommended by the largest number of participants. A total of 122 baggage handlers (78 percent) said that this is a viable method of reducing the risk of back injury in aircraft loading. The redesign of baggage-handling systems to reduce back-injury risk was supported by 111 baggage handlers (71 percent). Although most participants supported all engineering-redesign solutions, 93 participants (60 percent) supported the provision of mechanical-assistance devices for lifting baggage, 89 participants (57 percent) supported the introduction of robotics to eliminate manual baggage handling and 78 participants (50 percent) supported aircraft baggage-compartment redesign.

Table 5 shows details of the baggage handlers' opinions about possible administrative and procedural solutions to prevent back injuries.

The most highly ranked procedural intervention — and the most-often-recommended solution in the survey — was introducing tags marked HEAVY to alert baggage handlers to the possible increased injury risk presented by the labeled pieces. The survey showed that 140 (90 percent) supported this intervention and 138 participants (88 percent) supported "baggage-handler training" as a potential solution. "Improve maintenance of baggage-handling equipment" received 121 positive responses (78 percent) as a preferred solution. "Introduce warm-up exercises" received 98 positive responses (63 percent), and "improve the quality of supervision" received 67 positive responses (43 percent).

Because some of the airlines and baggage-handling companies required or permitted the use of back-support belts

Table 4
Baggage-handler Opinions* on Engineering-redesign Strategies to Prevent Back Injury

Strategies	Yes	Percent	No	Percent	No Response	Percent
Develop in-plane baggage-stacking and cargo-stacking systems	122	(78)	27	(17)	7	(4)
Redesign baggage-handling systems to reduce back-injury risk	111	(71)	41	(26)	4	(3)
Provide mechanical-assistance devices for lifting baggage	93	(60)	49	(31)	14	(9)
Introduce robotics to eliminate manual baggage handling	89	(57)	60	(38)	7	(4)
Redesign aircraft baggage compartments	78	(50)	69	(44)	9	(6)

* A total of 156 baggage handlers participated in this opinion survey.
Note: Percentages may not total 100 because of rounding.

Source: Geoff Dell

Table 5
Baggage-handler Opinions* on Procedural and Administrative Strategies to Prevent Back Injuries

Strategies	Yes	Percent	No	Percent	No Response	Percent
Place tags marked HEAVY on heavy bags to alert handlers	140	(90)	3	(2)	13	(8)
Improve baggage-handler training	138	(88)	14	(9)	4	(3)
Improve maintenance of baggage-handling equipment	121	(78)	27	(17)	8	(5)
Improve baggage-acceptance and cargo-acceptance procedures	120	(77)	23	(15)	13	(8)
Improve staff scheduling to meet work demand	119	(76)	31	(20)	6	(4)
Educate the public concerning baggage-handler back-injury risk	118	(76)	26	(17)	12	(8)
Enforce a lower baggage-weight limit	114	(73)	28	(18)	14	(9)
Slow down the baggage-handling process	104	(67)	48	(31)	4	(3)
Require passengers to repack heavy bags to reduce weight	101	(65)	42	(27)	13	(8)
Introduce back-support belts	100	(64)	47	(30)	9	(6)
Introduce warm-up exercises	98	(63)	52	(33)	6	(4)
Improve the quality of supervision	67	(43)	82	(53)	7	(4)

* A total of 156 baggage handlers participated in this opinion survey.
Note: Percentages may not total 100 because of rounding.

Source: Geoff Dell

in the past, the interviewers asked participants a number of questions about the use of back-support belts. Table 6 shows the responses.

Sixty-three of the participants (40 percent) said that they had worn back-support belts, and 10 of these baggage handlers (6 percent) said that they had suffered a back injury while wearing a back-support belt. Ninety-three of the baggage handlers (60 percent) believed that back-support belts improve the wearer's ability to perform baggage-handling tasks. Ninety-four participants (60 percent) believed that back-support belts help prevent lost-time back injuries, and 86 participants (55 percent) believed that back supports should be worn for all lifting tasks. Thirteen of the baggage handlers (8 percent) believed that wearing back-support belts would make lifting-technique training unnecessary.

Table 7 shows that the majority of baggage handlers supported the use of lifting-technique training to reduce the risks of back

injury in baggage-handling tasks. In the survey, 145 of the participants (93 percent) said that training should include techniques for lifting with restricted postures in confined spaces. The responses of 129 participants (83 percent) said that back-care training would help prevent lost-time back injuries, and 125 participants (80 percent) believed that training would enhance baggage handlers' ability to perform handling tasks.

Several researchers have said that the ergonomic design of narrow-body-aircraft cargo compartments has placed significant limitations on baggage-handler working postures and has increased the risk of injury.¹² Baggage compartments in narrow-body aircraft such as the Boeing 737, McDonnell Douglas DC-9, British Aerospace BAe 146 and Fokker 100 provide space for stacking baggage and cargo, but there are no machines available to assist with stacking baggage inside narrow-body aircraft. As a result, manual baggage handling — typically using a restricted working posture — has been

Table 6
Baggage-handler Opinions* on Back-support Belts

Question	Yes	Percent	No	Percent	No Response	Percent
Have you personally worn a back-support belt to help prevent back injuries?	63	(40)	90	(58)	3	(2)
Have you experienced a back injury while wearing a back-support belt?	10	(6)	123	(79)	23	(15)
Do back-support belts improve the wearer's ability to perform baggage-handling tasks?	93	(60)	52	(33)	11	(7)
Do back-support belts help prevent lost-time back injuries?	94	(60)	52	(33)	10	(6)
Should back-support belts be worn for all lifting tasks?	86	(55)	60	(38)	10	(6)
Do back-support belts make lifting-technique training unnecessary?	13	(8)	133	(85)	10	(6)
If you wear a back-support belt at work, must you wear it when lifting at home?	66	(42)	79	(51)	10	(6)

* A total of 156 baggage handlers participated in this opinion survey.
Note: Percentages may not total 100 because of rounding.
Source: Geoff Dell

Table 7
Baggage-handler Opinions* on Lifting-technique Training to Prevent Back Injuries

Question	Yes	Percent	No	Percent	No Response	Percent
Should training include techniques for lifting with restricted postures in confined spaces?	145	(93)	9	(6)	2	(1)
Will back-care training help prevent lost-time back injuries?	129	(83)	25	(16)	2	(1)
Does back-care training improve baggage handlers' ability to perform handling tasks?	125	(80)	30	(19)	1	(1)
Should warm-up exercises be part of baggage handlers' daily routine?	106	(68)	48	(31)	2	(1)
Does lifting-technique training (back straight, knees bent) benefit baggage handlers?	104	(67)	48	(31)	4	(3)

* A total of 156 baggage handlers participated in this opinion survey.
Note: Percentages may not total 100 because of rounding.
Source: Geoff Dell

Action Urged to Prevent Baggage-handler Back Injuries

Since the early 1980s, several organizations have shown interest in preventing back injuries among airline baggage handlers. Airports, baggage-sorting systems and ground-equipment designs are all linked and dependent on aircraft-system design. Aircraft manufacturers will be the key for long-term design solutions to the risk of back injuries among baggage handlers.

Nevertheless, some short-term solutions should be implemented quickly based on the consensus of researchers and current technology. Airlines that already have retrofitted semiautomated baggage-handling systems in narrow-body aircraft should share their experience and data with other airlines in the interest of back-injury prevention. Air-transport-industry associations should play a leading role in setting global standards that account for the known problems in manually handling airline baggage. An industry-wide solution should be developed based on the consensus position about heavy baggage, for example. Reducing the weight of individual pieces of baggage handled by baggage handlers may be the only effective method to reduce exposure to this back-injury risk. A related solution is for all airlines to label baggage and cargo with accurate weights and alert labels. This would permit baggage handlers to prepare for each lift and to assess the injury risks of handling each item.

Past reliance on designing airport systems for the dimensions of the physically "average" baggage handler should be replaced by solutions that provide ergonomic advantages for all system users. Baggage-handling-system design has focused on solutions to the volumetric problems of baggage transfer and sorting. Relatively few ergonomic principles — with the exception of integration of average height and reach distances — have been applied.

Ground equipment and aircraft-loading systems not only should be provided, but these systems also should be maintained to a high standard. When equipment is out of service, the risk of injury to baggage handlers increases significantly because people manually handle loads that should be moved by machines. For injury prevention within the current work environment, there also is a need to provide better lifting-technique training for baggage handlers, and to improve serviceability (time in service) of baggage-handling systems and related equipment.

Although back-support belts are low on the hierarchy of hazard controls, the current lack of clearly effective injury-prevention measures suggests that all control measures should be considered. The hierarchy theory suggests that personal protective equipment, such as back-support belts, is the least effective injury-prevention measure compared to engineering solutions and other workplace-intervention solutions. (See Victorian Department of Labor. *Hazard Control*. Melbourne, Australia: Labor Share Program, Victorian Department of Labor, 1990.) Back-support belts should be evaluated using sound scientific methods to demonstrate whether or not the belts are an effective injury-prevention tool for baggage handlers.

Development and enforcement of occupational health and safety regulations, using the latest data, also should be improved. If engineering solutions cannot be found for the manual-handling tasks associated with passenger baggage and cargo, occupational health and safety regulations should require airlines to find other methods. ♦

— Geoff Dell

the only option available to load and unload narrow-body aircraft. Baggage handlers presently use mechanical-assistance devices in baggage-sorting rooms of a few airports.

A majority of the 156 baggage handlers surveyed in this study — 135 participants (87 percent) — also said that stacking baggage inside narrow-body aircraft was one of the tasks most likely to cause back injuries.

The ergonomic problems of narrow-body-aircraft baggage compartments have been identified and quantified relatively recently. Nevertheless, some workplace-safety researchers believe that aircraft-design processes should take into account the incidence and the cost of injuries to baggage handlers. These researchers have said that baggage-handling solutions should receive increased attention among airline-specified performance criteria such as range, payload, fuel economy and overall operating cost.

One researcher, for example, said, "There will have to be airline-industry consensus before the aircraft manufacturers will carry out design changes to their aircraft."¹³

Forty-four percent of the baggage handlers said that engineering redesign of baggage compartments would be a potential method to prevent back injuries. This response may reflect an assumption by these baggage handlers that changes in aircraft baggage-compartment designs are unlikely to occur.

Some airlines have retrofitted semiautomated loading systems in the baggage compartments of current models of narrow-body aircraft. These loading systems provide a movable wall that can be positioned near the baggage-compartment door. The movable wall typically enables baggage handlers to stack all bags adjacent to the doorway. Each time a stack of bags adjacent to the doorway reaches the ceiling, the baggage handler mechanically moves the stack farther into the baggage compartment. The stack-and-move operation continues until the movable wall meets the inner bulkhead and the compartment is full. Such systems eliminate the need for baggage handlers to move bags manually along the length of the cargo compartment. Nevertheless, these systems require baggage handlers to stack bags in the baggage compartment.

Although not yet in wide use, these types of automated systems have been installed by some airlines, and their contribution to safety has been encouraging. A 1995 study, for example, found a 25 percent reduction in baggage-handler sick-leave rates.¹⁴ This study also estimated cost savings of \$2 million during the first three years of operation of 17 B-737 aircraft with one type of loading system.

There has been a consensus among some studies that the weight of passenger baggage has been a major injury-causation factor.¹⁵ Ninety percent of the participants in a 1997 survey said that heavy passenger baggage is a significant injury risk.¹⁶ Weight reduction of individual baggage has been

required by occupational health and safety legislation in Victoria, Australia, to reduce worker exposure to injuries.¹⁷

Airlines that have introduced baggage-weight restrictions based on occupational health and safety recommendations — such as Qantas, Ansett Australia and Air New Zealand — have had mixed results, said the 1997 study.¹⁸ Because there has not been widespread adoption of baggage-weight restrictions among all airlines, the airlines that introduce weight restrictions have a competitive disadvantage. Passengers who are permitted to check heavy baggage on one airline react negatively if asked by another airline to repack baggage to reduce the weight of each piece.

The survey found that approximately half of the participants had used back-support belts. Many of the baggage handlers in this group, however, said that back-support belts were part of the overall solution.

Research on the use of back-support belts as injury-prevention devices has provided mixed conclusions about the effectiveness of the belts. In 1995, two researchers said, “The impact of back belts on the prevention of back injuries due to manual material handling remains unclear. ... There is no clear evidence that back belts reduce the incidence or severity of back injuries.”¹⁹ Some studies said that the data do not show that back-support belts have been effective in injury prevention.²⁰

NIOSH said in 1994 that many earlier studies of back-support belts did not follow accepted scientific methods, and therefore cannot be used either to support or to refute claims about the effectiveness of back-support belts in injury reduction.²¹ More recent studies based on comparisons of back-injury rates have not provided conclusive evidence for the effectiveness of back-support belts, NIOSH said in 1997.²² The institute therefore does not recommend the use of back-support belts to prevent injuries among workers who never have been injured (NIOSH has not evaluated the use of back-support belts as a medical treatment during rehabilitation from injury). The consensus of researchers has been that more scientifically rigorous research should be conducted to determine the effectiveness of back-support belts in airline baggage handling.♦

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