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Baggage handling in an airplane cargo hold: An ergonomic intervention study

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Abstract

Incidence rates of lost time back and shoulder injuries in the airline industry are some of the highest in all of private industry. Commonly, risk factors associated with such injuries include overexertion, repetitive lifting, and awkward postures. These factors are found in combination in the airline baggage handler job. Twelve male subjects performed a simulated baggage handling task in a kneeling posture under a low ceiling, to test the effects on spinal loading, muscle activity, and trunk motion of (1) providing baggage weight information on the routing tag, and (2) an alternative method for handling and stowing bags. Providing weight information did not alter the biomechanical characteristics of the handling exertions in these subjects. However, it was shown to reduce cumulative spinal loading if used to organize stowing of baggage. The alternative stowing method, tipping bags and storing them on their short sides (like books on a shelf), was found to reduce spinal loads and trunk muscle activity.

Relevance to industry

Airline baggage handler injuries cost millions of dollars, annually. Two low-cost administrative means of changing their working conditions were explored, and showed promise, in terms of reducing biomechanical loads on the baggage handlers when performing some of their most strenuous activities.

Keywords: Airline baggage handler; Manual materials handling; Kneeling; Spinal load; Intervention study; Administrative control

1. Introduction

The airline industry in the US has some of the highest rates of work-related lost time injuries in all of private industry. The overall incidence rate is 3.5 times the rate for private industry as a whole; rates of back and shoulder injuries are four and five times the respective rates for private industry as a whole. A comparison of 2002 US Bureau of Labor Statistics (BLS) incidence rates in various sectors of private industry in the USA is provided in Table 1 (BLS, 2002). "Air transportation, scheduled" (airline passenger service) had the second highest rate of lost time back injuries, among the hundreds of industries listed by the BLS. The incidence rate of back pain injury for "air transportation, scheduled" exceeded that of coal mining and nursing and personal care facilities, and almost all other industries for which the BLS maintains statistics.

Musculoskeletal back pain and disorder has been linked to work involving lifting and forceful movements (Bernard, 1997). Shoulder musculoskeletal disorders (MSDs) have been associated with work postures and repetitive work (Bernard, 1997), and more specifically with lifting with one or two hands (10 kg), lifting at or above shoulder level (9 kg), and pushing/pulling (32 kg); working with hands above shoulder and monotonous work, and any other body part pain (Harkness et al., 2003).

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Table 1
2002 BLS lost time work injury incidence rates, per 10,000 full time employees, for various industry sectors and some specific industries (BLS, 2002)

	Overall (R5)	Event/exposure: overexertion (any body part) (R8)		Nature of injury: back pain, hurt back only (R5)	Part of body affected (any event) (R6)	
		Total	Lifting		Back	Shoulder
Private industry	162.6	43.1	23.6	5.3	39.1	9.5
Agricultural production	217.9	33.7	17.3	9.7	40.5	13.6
Mining	198.8	53.6	19.8	1.9	43.3	10.0
Coal mining	463.2	156.3	57.7	6.6	116.2	22.3
Construction	276.8	57.2	30.3	9.3	58.6	13.3
Manufacturing	174.5	42.9	22.2	3.8	34.7	11.6
Services	133.8	41.2	20.8	0.8	37.2	7.7
Health services: nursing and personal care facilities	411.3	203.5	91.2	25.9	152.5	31.3
Transportation and public utilities	270.6	74.2	37.3	10.3	68.4	19.9
Trucking terminal facilities	515.4	225.2	119.3	—	177.3[a]	63.0
Transportation by air	520.4	200.4	107.9	33.9	142.8	41.0
Air transportation, scheduled	**576.9**	**227.6**	**122.5**	**39.4**	**161.6**[b]	**47.7**

Specific BLS reference (R) tables are noted in parentheses in each column heading.
Bold signifies the industry subgroup in which airline baggage handling job is included.
[a]Industry with highest rate of injuries to backs.
[b]Industry with second highest rate of injuries to backs.

One airline industry job that requires repetitive manual handling of heavy materials is that of airline baggage handler. Dell's surveys of airline safety professionals and baggage handlers revealed that one in 12 baggage handlers suffers a back injury each year (Dell, 1997, 1998). On average, in the time period 1992–1994, baggage handler back injuries cost each of the surveyed companies $1.25 million annually. Both sampled groups identified working inside narrow-body aircraft as the top work location likely to cause back injuries. The top two tasks identified by both groups as most likely to cause injury were "pushing baggage from the doorway into the baggage compartment of narrow body aircraft" and "stacking baggage inside the baggage compartment of narrow body aircraft".

Narrow-body aircraft include airplanes such as the Boeing B737 and Fokker F100. Ceiling height for the Boeing 737 cargo hold is 112 cm, which forces baggage handlers to work in squat, stooped, kneeling, or seated postures and often handle luggage at or above shoulder level. On average, a piece of luggage weighs 15 kg (de Looze et al., 2001); however, baggage handlers are typically required to handle bags weighing more than 32 kg (the notional industry weight limit) (Dell, 1997). This load exceeds the National Institute for Occupational Safety and Health (NIOSH) lifting equation limit for working in *optimum* working postures and conditions (Waters et al., 1993).

Stålhammara et al. (1986) performed a laboratory simulation of baggage handling in a DC-9 (100 cm ceiling height) to study effects of different working postures. Participants were professional aircraft loaders. Bags weighed 9–19 kg. Based on their biomechanical assessment, no one posture was better or worse across all of their measures. There was somewhat of a tradeoff between muscle activities, in that postures with higher erector spinae activity tended to have somewhat lower trapezius activity and vice versa. Additionally, luggage-handling times were significantly shorter (by 10%) when kneeling than when sitting or squatting.

When adverse work conditions exist, engineering and/or administrative means of changing the conditions should be explored. One engineering solution that is being used in over 2500 narrow-body aircraft at this point is the Sliding Carpet System (Telair). The system still requires manual handling and stacking of baggage, but it eliminates much of the manual movement of baggage along the length of the plane. Johansen (1995), cited in Dell (1997), reported reductions in sick rates, damage to luggage and luggage compartment lining, and numbers of baggage handlers required to load a plane, as well as $2 million in savings in the first 3 years of operation of 17 B737s with the systems. The baggage handlers surveyed by Dell were also favorably inclined toward "in-plane" baggage systems (Dell, 1998).

The baggage handlers also identified a number of administrative solutions that might be useful. At the top of the list was adding warning tags to heavy bags and improving baggage handling training. Dell (1997) also examined the option of enforcing the weight limit, but unless this was adopted by all countries and airlines