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INVESTIGATION OF RISK FACTORS OF LBP ASSOCIATED WITH THE MANUAL HANDLING OF CHECKED LUGGAGE AT ARACAJU AIRPORT

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Abstract:

The objective of this study was to investigate the risk factors for lumbago due to the manual handling of checked baggage at Aracaju Airport. The data were collected by means of systemic observation of the biomechanics used during the accomplishment of the tasks, being documented in physical means and recorded by means of photos and filming. The anthropometric data of the workers and the dimensions of the equipment that operated the checked baggage screening associated with the biomechanical data were submitted to the 3DSPP ™ Three-Dimensional Biomechanical Prediction of Static Effort model to quantify the biomechanical demands during the manual movement of Checked baggage. In addition, the NIOSH method was used to estimate the physical overload associated with the manual handling of checked baggage and to determine an ideal weight limit. Based on the data collected, it was possible to identify that the load handled by the workers is three times higher than recommended, emphasizing the existence of a high probability of injuries in the spine and the musculoskeletal system of the workers. It is expected that the risk factors for low back pain identified in this study will sensitize managers so that ergonomic propositions are implemented, aiming to promote the health of workers in the sector.

Keywords: Lombalgias, manual handling of luggage, luggage sorting, airport.

1. INTRODUSION

The globalization of the economy leads companies to search for techniques to achieve greater productivity and efficiency in their operations, since the accelerated interconnection between markets represents a challenge in the search for competitiveness in companies. Air transport is one of the main modes used in foreign trade. With the commercial aviation flexibility policy created in 1990, air transport became more competitive and efficient, becoming more popular and enabling access to a greater number of passengers (ZIMMERMANN & OLIVEIRA, 2012; ALMEIDA, MARIANO & REBELATTO, 2007) .

The increase in the use of air transport for commercial transactions, as well as passenger transport, raises an ergonomic issue with regard to cargo transport, since, in most Brazilian airports, some of the stages of the transport process Commercial orders and bags are carried out manually by operators. This type of activity results in physical effort and uncomfortable body positions, representing a major challenge for ergonomics in the quest to promote workers' occupational health.

Manual load transport refers to any transport in which the weight of the load is supported exclusively by a single worker, including lifting and placing the load (BRASIL, 2009). If performed through incorrect biomechanics, combined with hostile working environment conditions, the main consequences are low back pain and back pain. Low back pain can be defined as pain, muscle tension, stiffness located below the costal margin and above the lower gluteal fold, with or without pain in the legs. This damage to the spinal discs is a personal and economic problem, since the individual affected by this type of pathology suffers from pain that compromises their mobility, in addition to being one of the biggest causes of premature disability (OKIMOTO, TEIXEIRA & GONTIJO, 2011).

In this sense, the use of ergonomic solutions, such as the better adaptation of biomechanical variables, the rationalization of the frequency and intensity of actions and times, represent possibilities for reducing ergonomic risk (ORMELEZ & ULBRICHT, 2010). Therefore, the objective of this study was to investigate the risk factors for low back pain resulting from the manual handling of checked baggage at Aracaju Airport, based on the application of the Three-Dimensional Biomechanical Model for Static Effort Prediction (3DSSPP™) and the NIOSH method, proposed by the National Institute for Occupational Safety and Health (NIOSH).

2. METHODOLOGY

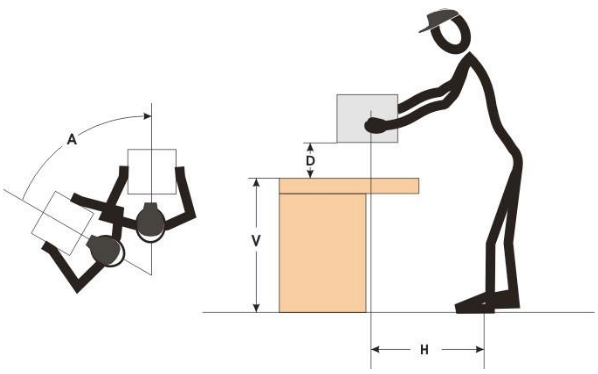
This cross-sectional study was carried out in the checked baggage screening sector at Aracaju – Santa Maria Airport, located in the south zone of the capital of Sergipe, which was founded in 1952 and incorporated into the Brazilian Airport Infrastructure Company (INFRAERO/SE) in 1975. This airport complex has more than 1,000 (one thousand) employees to meet an average monthly demand of 115 thousand passengers and 20 regular daily flights carried out by four airlines.

Data were collected in two stages in the first half of December. The first stage consisted of a pre-scheduled interview with the representative of the outsourced company responsible for processing checked baggage and with the representative of INFRAERO/SE. At this stage, it was possible to learn about the airport's physical facilities, the checked baggage screening process and the organization of the work. In the second stage, anthropometric, sociodemographic data and dimensions of the equipment used in the baggage screening process were collected, in addition to systemic observation of the biomechanics used by workers during the execution of the task. These data were documented in physical form and recorded through photos and filming.

The anthropometric data and the dimensions of the elements that allow the operationalization of the work, associated with the biomechanical data were subjected to analysis of the Three-Dimensional Biomechanical Model for Static Effort Prediction (3DSSPP™), proposed by the Center for Ergonomics at the University of Michigan, to quantify the biomechanical requests during manual handling of checked baggage. Subsequently, the NIOSH method was used to estimate the physical burden associated with manually handling checked baggage and determine a limit of ideal weight, so that a certain percentage of the population of workers in this sector can perform the task without a high risk of developing low back pain.

This method is based on a multiplicative model that provides a weight expressed as a coefficient that serves to reduce the load constant of six standardized variables of a given task. The coefficients are established based on the value of each variable found in the specific task, called the standard survey location. In the standard lifting location, the vertical distance from the load handle to the ground (V) must measure 75 cm, the horizontal distance from the handle to the midpoint between the ankles (H) must measure 25 cm and the vertical displacement of the load (D) must measure 25 cm (WATERS, 1993; NIOSH, 1994). Therefore, any deviation from this reference results in a situation far from ideal load lifting conditions. The representation of these variables can be seen in Figure 1

Figure 1 – Standard survey location



Based on these coefficients, the Recommended Weight Limit (LPR) was calculated for the screening task, that is, the weight of the load that approximately all healthy workers could carry for a period of up to 8 hours per day, without increasing the risk of develop low back pain related to this task (WATERS, 1993; NIOSH, 1994). The LRP was obtained through Equation 1.

$$LPR = 23 \times FDH \times FAV \times FDVP \times FFL \times FRLT \times FQPC \quad (1)$$

Where: value 23 corresponds to the ideal limit weight, that is, that which can be handled without exposing the worker to the risk of low back pain; FDH is the horizontal distance factor from the handle to the midpoint between the ankles, given by (25/H); FAV is the vertical height factor of the hands in relation to the ground at the beginning of the lift, given by (1 – (0.0038 x [V – 75])), for heights above 75 cm and (1 – (– 0.003 x [V – 75])), for heights up to 75 cm); FDVP is the vertical distance factor traveled from the origin to the destination, given by (0.82 + (4.5/D); FFL is the lifting frequency factor; FRLT is the lateral rotation factor of the body, given by (1 – (0.0032 x A); FQPC is the load handling quality factor.

From the LPR, the Lift Index (IL) was calculated, given by dividing the actual load lifted by the LPR. According to Waters (1993), when the IL value is in the range of 0 to 1, the chance of the worker developing low back pain will be minimal, while values between 1.1 and 2.9 increase the risk. A value equal to or greater than 3.0 indicates a high probability of injuries to the worker's spine and musculo-ligamentous system.

3. RESULTS AND DISCUSSION

3.1 General characteristics of the subjects

The study included 16 male subjects, who work in the handling of checked baggage on an 8-hour working day, with a 2-hour lunch break. There are no workers with special needs in this population. Workers are of average age 35 ± 4 years old, average height of 1.70 ± 0.03 m and average weight of 72 ± 6 kg. The length of service ranges from one year to six months to eight years.

Regarding the Body Mass Index (BMI) values, it was observed that

14 (87.5%) of the 16 workers have a BMI lower than 25, that is, they are within the limits recommended by the World Health Organization (WHO). Only 2 (12.5%) workers had BMI values greater than 25 (25.8 and 26.1), indicating that these workers are predisposed to obesity. This low incidence of obesity among these workers can be explained by the task requiring heavy muscular work dynamics.

3.2 Operationalization of checked baggage screening

At Aracaju Airport, screening checked baggage is an essential service and requires a large workforce. This process, unlike international airports, is carried out by a third-party company, which serves all airlines.

The screening process is carried out through a combination of automated and manual processes. The automated baggage sorting system collects the baggage delivered at the check-in counter, the properly labeled baggage goes through a conveyor belt that is shared by the airlines, then passes through the beam security checkpoint -x, and continues to be deposited on a conveyor belt. There are four conveyor belts at the airport, with each conveyor belt collecting baggage checked in by airline, with the help of a computerized tag reading system. Checked baggage deposited on the conveyor belt continues to the airport forecourt, where each piece of baggage is manually loaded onto the board-style transport cart. The manual transfer process of checked baggage can be seen in Figure 1.

Figure 1 – Operation of transferring checked baggage to the cart

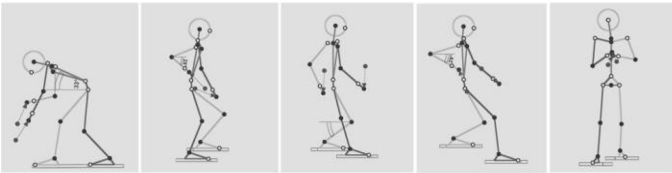
Source: Field research (2015)

This process is carried out by three employees on each conveyor belt, which is 26 cm high. According to the outsourced company, some luggage exceeds the 25 kg limit stipulated by airlines. During fieldwork, an average of the baggage checked in at the boarding counter was taken, which demonstrated that workers would sort baggage with an average weight of 28 kg (274.6 N), with a minimum weight of 12 kg. and a maximum of 34 kg.

3.3 Biomechanical analysis of checked baggage handling

In Figure 2, the biomechanical demands of the worker to perform the baggage handling task can be observed. In this analysis, it can be seen that the worker flexes the trunk at an angle of 33° degrees, tensing the muscles of the neck and spine. Both arms remained extended and, shortly afterwards, the worker flexed his right elbow and both knees to pick up the luggage with a rough claw-like grip. This flexion caused compression in the L4-L5 disc in the order of 3394 N. Then, the operator rotated the body at an angle of 90° degrees, flexed the legs and the right arm, at the same time, keeping his arm extended holding the base of the luggage on most of the route. When the worker positioned himself in front of the cart, his legs were extended and his two arms were flexed to deposit the luggage on the transport cart, which is 120 cm long, 60 cm wide, 53 cm high and has a load capacity of 2000 kg. During this journey, the compression in the L4-L5 disc varied between 2625 and 2893 N, these values being justified by the fact that the worker brings the luggage closer to the body.

Figure 2 – Biomechanical requests during manual handling of checked baggage.



Source: Three-Dimensional Biomechanical Model for Static Effort Prediction (3DSSPP™)

According to Merino (1996), compression in the L4-L5 and L5-S1 disc of the spine cannot be greater than 3400 N, as the vertebral disc, when subjected to a force above this order, causes micro trauma to the disc, causing the worker to experience intense pain and be unable to work. The compression forces experienced by workers in this sector in comparison to the thresholds recommended in the literature (ideal condition) show that intradiscal compression in L4-L5 and L5-S1 during luggage handling are below the stipulated limit, however, measures ergonomics must be implemented in order to increasingly reduce this compression.

In corroboration, the result of the NIOSH method suggests a drastic reduction in the handled weight to just over 9 kg (LPR of 9.33 kg and an IL of 3.0). The values found for LPR and IL indicate an unsafe working condition, where there is a high probability of injuries to the worker's spine and musculoligamentous system, as they are handling a load three times greater than recommended.

In Table 1 it is possible to view the task variables that most contributed to the inadequate LPR and IL values..

Table 1 – Standard survey location variable

23 kg	FDH	FAV	FDVP	FFL	FRLT	FQPC	LPR
23 kg	**1,00**	**0,81**	**0,98**	**0,80**	**0,71**	**0,90**	**9,33 kg**

Source: Prepared by the authors (2015)

These findings are corroborated by studies on working conditions at airports carried out in recent decades, which discuss the need for modifications to maintain the health and productivity of workers, and emphasize that the manual handling of checked baggage has been identified as an operation of high risk for more than 20 years, but little has been done to resolve the issue to date (STÅLHAMMAR et al., 1986; YOOPAT et al., 2002; TAPLEY & RILEY, 2005; RUCKERT et al., 2007).

Regarding recommendations, it is possible to suggest the implementation of an automated sorting system, using conveyor belts adapted to the dimensions of the aircraft's luggage compartment. It is also suggested to use a vacuum elevator to quickly handle loading and unloading baggage. This vacuum handling system has been widely used in most international airports, due to its flexibility and ability to handle a wide variety of baggage in terms of dimensions, shape and weight. Its principle is to secure luggage from any side, lift it and deposit it in the established location. In this way, it potentially increases productivity and, at the same time, minimizes the risk of low back pain.

If there is no possibility of implementing automated systems, it is recommended that existing equipment be adapted to the anthropometric measurements of workers. The height of the treadmill must be 75 cm high, not 26 cm, as this requires the worker to use an awkward posture and, consequently, intradiscal compression at L4-L5 and L5-S1. In relation to manual movement, it is recommended to adopt bent knees, semi-erect spine, and keeping luggage close to the body, avoiding, above all, body rotation. Therefore, several studies relate the reduction in the body-load distance as a factor reducing overload on the spine (WATERS, 1993; NIOSH, 1994).

4. CONCLUSIONS

The objective of this study was to investigate the risk factors for low back pain resulting from the manual handling of checked baggage at Aracaju Airport, based on the application of the Three-Dimensional Biomechanical Model for Static Effort Prediction (3DSSPP™) and NIOSH.

The previously considered hypothesis that the weight of luggage was not recommended for individual manual transport according to the NIOSH method was confirmed, since the calculation carried out reached a maximum value of 9.33 kg, while the luggage is on average 28kg. It is concluded that to perform this task, the worker handles a load that is 66.68% higher than recommended, causing a physical overload on the workers' spine and musculo-ligamentous system. Due to the handling of luggage weighing more than recommended, compression was observed in the vertebral disc at L4-L5 in the order of 3394N, a value very close to the limit recommended in the literature.

In general, it is expected that the risk factors for low back pain identified in this study will sensitize managers so that ergonomic propositions regarding workplace reconfigurations and exploration of auxiliary devices for handling luggage are implemented quickly, aiming to promote the health of workers in the checked baggage screening sector.

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