

Association of bodily discomfort with occupational risk factors in poultry slaughterhouse workers

Adriana Seára Tirloni ^a, Diogo Cunha dos Reis ^{a,b}, Eliane Ramos ^b & Antônio Renato Pereira Moro ^{a,b}

^aTechnological Center, Federal University at Santa Catarina, SC, Brazil. adri@tirloni.com.br

^bBiomechanic's Laboratory, CDS, Federal University at Santa Catarina, SC, Brazil. diogo.biomecanica@gmail.com

Received: January 25th, de 2017. Received in revised form: June 9th, 2017. Accepted: June 27th, 2017

Abstract

Brazil is classified as the second largest world chicken meat producer and leading exporter. This study aimed at analyzing the characteristics of bodily discomfort in poultry slaughterhouse workers, and its associations with the occupational risk factors. The study included 312 workers, 207 females and 105 males. A body map for evaluating discomfort and an interview regarding organizational issues and criteria of the OCRA method were used. Descriptive statistics and Chi-square test ($p \leq 0.05$) were used. It was found that 85.9% of respondents performed repetitive tasks, 98.1% took rest breaks, 44.6% performed job rotation (2-7 tasks), 40.4% used tools and 62.5% felt cold. Additionally, 71.2% felt discomfort in at least one body region and the body regions most frequently cited were shoulders (50.3%) and arms (34.3%). There was association between body discomfort and individuals' sex ($p < 0.001$), task characteristics (repetitive and non-repetitive) ($p = 0.001$), use of tools ($p = 0.008$) and perception of cold ($p < 0.001$).

Keywords: bodily discomfort; poultry slaughterhouse; repetitive tasks; ergonomics; musculoskeletal disorders.

Asociación entre las incomodidades corporales y los factores de riesgo laboral en trabajadores de mataderos de aves

Resumen

Brazil es el segundo mayor productor de aves del mundo y líder en exportación. Este trabajo tiene el objetivo de investigar las causas de las incomodidades corporales y los factores de riesgo laboral entre los trabajadores de mataderos de aves. El estudio abarcó 312 trabajadores, 207 mujeres y 105 hombres. Se utilizó el mapa del cuerpo humano para evaluar las incomodidades corporales, una entrevista sobre temas organizacionales y el método OCRA. Se aplicó estadística descriptiva Chi-cuadrado ($p \leq 0,05$). Los resultados apuntaron que 85.9% hacían tareas repetitivas, 98,1% efectuaban pausas, 44,6% realizaban rotación de tareas (2-7 tareas), 40,4% usaban herramientas y 62,5% sintieron frío. Además, 71,2% sintieron incomodidad en alguna parte de su cuerpo. Las más mencionadas fueron hombros (50,3%) y brazos (34,3%). Incluso, se identificó relación entre incomodidad corporal y sexo ($p < 0,001$), características de la tarea (repetitiva y no repetitiva) ($p = 0,001$), uso de herramientas ($p = 0,008$) y percepción de frío ($p < 0,001$).

Palabras clave: incomodidades corporales; matadero de aves; tareas repetitivas; ergonomía; trastornos musculoesqueléticos.

1. Introduction

According to the United States Department of Agriculture, in October 2015, Brazil has become the second largest producer of broiler meat in the world, overtaking China, and remaining as leader in exportation of this type of meat [1].

Many poultry processing jobs are physically demanding and involve factors that increase the risk of developing a Musculoskeletal Disorders (MSDs) [2]. Reenen et al. [3] found that the peak and cumulative discomfort could predict future musculoskeletal pain in the neck (relative risk - RR 2.56 and RR 2.35) and right or left shoulder (RR 1.91 and 1.90; RR 2.45 and 1.64, respectively).

How to cite: Tirloni, A.S., Reis, D.C., Ramos, E. and Moro, A.R.P., Association of bodily discomfort with occupational risk factors in poultry slaughterhouse workers. DYNA, 84(202), pp. 49-54, September, 2017.

The Ergonomics-related risk factors that may lead to the development of MSDs in poultry processing facilities include: repetition, forceful exertion, awkward and static postures, vibration, and cold temperatures [2]. Tirloni et al. [4] found that the majority of the workers of a poultry slaughterhouse in Brazil reported some kind of bodily discomfort (67.2%). According to Tirloni et al. [4] and Reis et al. [5], workers of poultry slaughterhouse perceived more body discomfort in the shoulders (62.6%; 45.0%, respectively) and neck (46.2%; 29.0%, respectively).

The OCRA Checklist method (Occupational Repetitive Actions) was developed to analyze the workers exposure to risk factors of developing upper limb work-related musculoskeletal disorders (UL-WMSDs) [6]. For such, the method evaluates the main collective risk factors (frequency of actions, awkward postures and movements of the upper limbs, excessive use of force, 'stereotypy' or lack of postural variation, inadequate recovery periods) based on their respective duration, and additional factors, such as mechanical, environmental, and organizational factors. Reis et al. [7] applied the method OCRA in a poultry slaughterhouse, and found that 77% of the activities performed by employees were classified as moderate risk, predisposing the workers to developing UL-WMSDs with greater risk of incidence (between 10.8 and 21.5%) for the right side of the body.

Tirloni et al. [4] using the method OCRA found that 87.6% of workers in the poultry slaughterhouse performed repetitive tasks, 86.2% took rest breaks, 82.8% performed job rotation (2-7 tasks), 54.1% felt cold and 61% used tools. However, there was association only between body discomfort and perception of cold ($p=0.035$).

Therefore, the aim of this study was to analyze the perception of body discomfort in poultry slaughterhouse workers and its associations with the individuals' sex, length of time working at the company, task characteristics (repetitive and non-repetitive), performance of rest breaks and job rotation, use of tools, perception of cold and ambient temperature.

2. Materials and methods

The study was conducted in a poultry slaughterhouse in the South of Brazil, with 3,500 workers approximately, distributed in two shifts. The sectors were classified according to the type of ambient temperature: artificially cold (cutting and shipping) (271 workers) and natural (scalding) (41 workers). The daily working time was 8h and 48 min, with 45 min of breaks for meals, 16 min for physiological needs, 8 min of worksite physical exercise, and 25 min for snacks (coffee).

In Brazil, artificially cold environments are those with temperatures lower than 10°C, 12°C or 15°C, according to the climatic zone of the company's location [8]. The company surveyed was located in a bland mesothermal climate zone (artificially cold environment - average temperature between 10 and 15°C). The environment temperature in the artificially cold sectors ranged from 8 to 12°C.

2.1. Participants

The sample was randomly selected. The company provided a list of all the names of the workers, selecting the

fifth employee down the list followed by the tenth name found in the list and so on. The workers were invited to participate in the study, signed the consent form, and followed to a private room to be interviewed. All participants agreed to be part of this study. The study was approved by the Ethics Committee in Research with Human Beings in Brazil, according to the Declaration of Helsinki.

The study included 312 workers, 207 females and 105 males with a mean age of 33.6 years (range 19 to 52 years) and 36.0 years (range 18 to 54 years), respectively. They were employed for 10.2 ± 8.1 years, at least five months and at the most 35 years, with the majority being right-handed (97.1%).

2.2. Instruments

The human body map for the discomfort assessment was used as a measuring instrument [9]. This instrument was adapted by the authors in order to include the following bodily regions: elbow, wrist, hands, knees and feet/ankles. Each worker should report and/or show the body region where pain/discomfort was perceived. Questions regarding data to identify workers, work organization (presence of job rotation, rest breaks and use of tools) and perception of cold were also used. The tools utilized by the workers were classified in two ways: knife/knife-sharpener and other tools: bowl, stamp and pen, fork, bucket, steel spatula, keys, scissors, thermometer, hammer and cleaner.

For the analysis of repetitiveness, the workers were videotaped for five minutes while performing their activities using the criterion of the OCRA method [10] for classification. Repetitive tasks are characterized as cycles (regardless of the duration) with upper limb movements, or repetition of the same work gesture for the majority of the time (over half of the total time) [11]. In order to classify the pauses performed by the workers as poorly distributed during the workday, the following OCRA criteria were considered: the pause could not be performed before the main meal and in the last hour of the workday, and maintaining a proportion of 5:1 between working time and recovery time [10].

2.3. Statistical analysis

Descriptive statistics was used, as well as the Chi-square test, in order to verify the relationship between variables with a significance level of $p \leq 0.05$.

3. Results

Among the 312 workers interviewed, 71.2% reported bodily discomfort in at least one body region among the 14 regions mentioned, and felt most discomfort in the right side of the body ($p < 0.001$). The body regions most frequently cited were: shoulders (50.3%), arms (34.3%), wrists (23.4%), hands (21.8%) and lower back (20.5%), as shown in Table 1.

From 222 workers who felt discomfort, 17.1% classified it as very mild / mild, 50.0% as moderate and 32.9% as very strong / strong. The three symptoms most often reported were pain (82.7%), fatigue (42.3%) and tingling (42.7%). According to 61.7% of workers, the feeling of discomfort

Table 1.
Discomfort regions reported by workers. Values equivalent to percentages according to sex (♂=105, ♀=207).

| Regions | Bodily discomfort (%) | | | | |
|-------------|-----------------------|------|------|------|-------|
| | Right | Left | ♂ | ♀ | Total |
| Neck | 9.9 | 9.3 | 5.7 | 14.5 | 11.5 |
| Shoulders | 46.5 | 38.8 | 35.2 | 58.0 | 50.3 |
| Upper back | 13.8 | 9.6 | 13.3 | 15.5 | 14.7 |
| Lower back | 19.9 | 16.0 | 19.0 | 21.3 | 20.5 |
| Arm | 30.1 | 25.0 | 21.0 | 41.1 | 34.3 |
| Elbows | 14.7 | 10.9 | 9.5 | 20.8 | 17.0 |
| Forearms | 11.2 | 9.6 | 2.9 | 18.4 | 13.1 |
| Wrists | 19.9 | 16.0 | 11.4 | 29.5 | 23.4 |
| Hands | 19.6 | 17.0 | 11.4 | 27.1 | 21.8 |
| Hips | 0.6 | 0.6 | 0.0 | 1.4 | 1.0 |
| Thighs | 0.3 | 0.6 | 1.0 | 1.0 | 1.0 |
| Knees | 2.9 | 2.2 | 3.8 | 2.9 | 3.2 |
| Legs | 7.4 | 7.7 | 5.7 | 9.2 | 8.0 |
| Feet/ankles | 1.6 | 1.9 | 3.8 | 1.0 | 1.9 |
| Total | 93.7 | 84.2 | 55.2 | 79.2 | 71.2 |

Source: The authors.

was felt for over a year. The majority of the workers noticed increased discomfort during work (83.3%), attributing the feeling to the workplace (97.3%).

Among workers who felt discomfort, 64.0% perceived reduction in discomfort due to the rest breaks, 40.1% on weekends, 27.5% at night, 20.7% decreased during the rotation of tasks and/or breaks and 36.0% of workers mentioned that the discomfort did not decrease in any of the questioned situations. More than half of the workers (61.3%) were taking medications in order to be able to work, 63.0% did so on their own and only 8.0% reported having received a medical prescription by the company, with analgesics being the most widely used (50.5%) after anti-inflammatory drugs (19.4%).

Regarding to length of time of working in the company, 34.6% worked in the company for less than 5 years, 27.2% between 5 and 10 years and 38.1% more than 10 years. The majority of workers performed systematically repetitive work (85.9%). Nearly all of the workers (98.1%) took rest breaks (excluding meal breaks) lasting 08 minutes, with an incidence of 1-5 times day, however, most workers took three daily breaks (68.9%). Also found that 60.6% took at least one poorly distributed rest break during the workday (Table 2).

Job rotation was done by 44.6%, and these rotations consist of 2-7 tasks, and most of them (38.1%) performed two tasks during the workday. In this study, the contents of the tasks of each employee were not investigated. Approximately half of the workers interviewed (40.4%) used hand tools and 88.9% of those used knife and knife-sharpener frequently, and 65.6% of them felt discomfort.

In relation to the perception of environmental conditions, it was found that most workers felt cold during the workday (62.5%), and 45.5% felt heat (often and sometimes). Among those who felt hot, 74.5% worked in sectors with natural ambient temperature.

Some workers felt both heat and cold during work (22.8%). The body regions in which the workers felt the coldest were: feet (56.2%), hands (42.8%), whole body (11.3%), back (6.7%), the legs (5.7%) and the trunk (5.7%). It is noteworthy that 86.9% of workers performed their tasks in artificially cold environments.

Table 2.
Association between perception of body discomfort and different occupational variables.

| Variables | Perception of body discomfort | | | | | | p |
|--|-------------------------------|------|--------|------|-------|------|---------|
| | Present | | Absent | | Total | | |
| Individuals' | n | % | n | % | n | % | |
| sex | | | | | | | |
| Female | 164 | 73.9 | 43 | 47.8 | 207 | 66.3 | <0.001* |
| Male | 58 | 26.1 | 47 | 52.2 | 105 | 33.7 | |
| Length of time working at the company | | | | | | | |
| < 5 years | 77 | 34.7 | 31 | 34.4 | 108 | 34.6 | 0.119 |
| 5.1 to 10 years | 67 | 30.2 | 18 | 20.0 | 85 | 27.2 | |
| > 10 years | 78 | 35.1 | 41 | 45.6 | 119 | 38.1 | |
| Task characteristics | | | | | | | |
| Repetitive | 200 | 90.1 | 68 | 75.6 | 44 | 14.1 | 0.001* |
| Non-repetitive | 22 | 9.9 | 22 | 24.4 | 268 | 85.9 | |
| Rest breaks | | | | | | | |
| Good distributed | 87 | 39.2 | 36 | 40.0 | 123 | 39.4 | 0.894 |
| Poorly distributed | 135 | 60.8 | 54 | 60.0 | 188 | 60.6 | |
| Job rotation | | | | | | | |
| Yes | 95 | 42.8 | 44 | 48.9 | 139 | 44.6 | 0.326 |
| Not | 127 | 57.2 | 46 | 51.1 | 173 | 55.4 | |
| Use of tools | | | | | | | |
| Yes | 100 | 45.0 | 26 | 28.9 | 126 | 40.4 | 0.008* |
| Not | 122 | 55.0 | 64 | 71.1 | 186 | 59.6 | |
| Perception of cold | | | | | | | |
| Yes | 153 | 68.9 | 42 | 46.1 | 195 | 62.5 | <0.001* |
| Not | 69 | 31.1 | 48 | 53.9 | 117 | 37.5 | |
| Ambient temperature | | | | | | | |
| Natural temperature | 25 | 61.0 | 16 | 39.0 | 41 | 13.1 | 0.089 |
| Artificially cold | 197 | 72.7 | 74 | 27.3 | 271 | 86.9 | |
| environment | | | | | | | |
| Total | 222 | 71.2 | 90 | 28.8 | 312 | 100 | |

Test Chi-square *p≤0.05; % related to bodily discomfort; Use of tools – It's knife and knife-sharpener.

Source: The authors.

There was no association between body discomfort and length of time working at the company, performance of rest breaks, job rotation and ambient temperature; however, there was association with individuals' sex, task characteristics (repetitive and non-repetitive), use of tools and perception of cold (Table 2). The results presented in Table 2 indicate that females felt more discomfort than males, and the presence of discomfort was independent of length of time working in the poultry slaughterhouse; the discomfort occurred mainly with workers who performed repetitive tasks, used tools (knife and knife-sharpener) and felt cold. There was no significant difference between the proportion of workers who felt discomfort with those who did not, in relation to the length of time working at the company, rest breaks, job rotation and ambient temperature (natural or artificially cold sectors).

4. Discussion

Tirloni et al. [4] evaluated 290 workers of a poultry slaughterhouse in Brazil and found that the majority of the workers reported some kind of bodily discomfort as well (67.2%). Tirloni et al. [4] and Reis et al. [7] also corroborate with these results, reporting the shoulder region as the most affected in poultry slaughterhouse workers, 62.6% and 45%,

respectively. The same studies found that the neck (46.2% and 29%, respectively) was the second most affected region with discomfort, unlike the present study where the arms (34.3%) were the second most affected.

Bot et al. [12] obtained data from the second Dutch national survey of general practice (391,294 patients at the start of the survey), the results showed that the most commonly reported complaint was neck symptoms (incidence 23.1 per 1000 person-years), followed by shoulder symptoms (incidence 19.0 per 1000 person-years).

The most bodily discomfort complaints were for the right side of the body, which can be justified by the study of Reis et al. [7]. The authors found that the risk of developing UL-WMSDs in the analyzed activities was also higher for the right side of the body. In the present study, the females workers perceived more discomfort than males ($p < 0.001$), however, in the study of Tirloni et al. [4], there was no association between the discomfort and the individuals' sex ($p = 0.136$). In another study with 1,721 workers in Minas Gerais, Brazil, the prevalence of upper-limb musculoskeletal pain was 24.1% among females and 11.0% among males [13]. Females workers who had high domestic workloads, and performed tasks under high strain showed high prevalence of musculoskeletal pain. For females and males workers, a high prevalence of upper-limb pain was reported by those who performed highly physically demanding tasks, and those exposed to poor environmental conditions [13].

In the present study as well as in Tirloni et al. [4] there was no association between body discomfort and length of time working in the company. According to OSHA [2], jobs and tasks that have multiple risk factors have a higher probability of causing MSDs, and poultry processing may lead to the development of MSDs due ergonomics-related risk factors: repetition, forceful exertion, awkward and static posture, vibration, and cold temperatures allied to these risk factors. In poultry slaughterhouse, the risk factors are varied and high; however, the results of our study suggest that working time at the company and the ambient temperature where the activities are realized were indifferent to cause bodily discomfort.

The risk of MSD injury depends on the frequency in which the task is performed, the level of effort required, the duration of the task, as well as other factors [3]. Reis et al. [7] when analyzing 22 tasks performed in a poultry slaughterhouse, considering the five risk categories by the proposed OCRA method, found that 9% were considered high risk, 77% moderate risk and 14% were within a low risk, suggesting that the majority of the slaughterhouse workers were vulnerable to ergonomic hazards due to repetitive movements. Reis et al. [14] using the same method, analyzed 26 work activities and found that 8% were considered high risk, 81% represented moderate risk and 11% were within a low risk. The results of these studies suggest that workers are predisposed to a greater probability of developing UL-WMSDs.

According to Sundstrup et al. [15], there are predominant highly repeatable movements of the upper limbs in poultry slaughterhouses. Several studies used the OCRA method and presented findings classifying the work in the poultry slaughterhouse as repetitive [4,7,11,14] where most of the

activities presented a high risk [11,16,17].

OSHA [2] recommends that the employer should allow pauses in order to provide for recovery of fatigued muscles. The Brazilian Regulatory Standard 36 (NR-36) [18] establishes the minimum requirements for evaluation, control and monitoring risks in activities performed at meat processing industries cites.

The NR-36 advises that for workers who perform activities directly in the production process, which requires repetitiveness and/or static or dynamic neck muscles overload, shoulders, back and upper and lower limbs, distributed psychophysiological breaks should be provided. In contrast, in our study, there was no association between body discomfort and pause performance.

The breaks should be distributed in a manner to avoid the first hour of work, in close proximity with meal breaks or within the last hour of work [18]. In our study, both employees who felt uncomfortable as those do not felt, took rest breaks, good or poorly distributed ($p = 0.894$), similar to the Tirloni et al. [4] ($p = 0.746$).

Studies should be conducted by analyzing in more detail the variables that can interfere in the effectiveness of breaks such as the location where the breaks are performed. NR-36 [18] recommends rest break areas located away from the workstation, with thermal and acoustic comfort, and with banks or chairs and drinking water available. The same norm cites that the break cannot be accompanied by an increase in the individual's rate of production after returning to work, and the pauses cannot be accumulated. Therefore, compliance with this standard requires the monitoring of rest breaks by both employers and employees.

One administrative solution used effectively by poultry processors to reduce the duration and frequency of exposure to risk factors, is the use of a rotation schedule to address high-risk tasks, and design a job rotation schedule in which workers rotate between jobs that use different muscle groups [2]. In the study of Tirloni et al. [4], there was no association between body discomfort and job rotation ($p = 0.385$), similar to the present study. According OSHA [2], job rotation may alleviate physical fatigue and stress to a particular set of muscles and tendons, however, the review study of Leider et al. [19] found that there is inconsistent evidence for recommending job rotation as a strategy for preventing musculoskeletal complaints.

The NR-36 recommends that the abattoir's employer must implement job rotations in the daily journey that provides at least one of the following requirements: alternation of working positions, the muscle groups with activities without requiring repeatability and environmental exposure to noise, humidity, heat, cold, more comfortable; reduction of postural requirements such as elevations, pushups/extreme extensions of body segments, excessive radial/ulnar deviation of the wrist, among others; reducing or minimizing the most frequent static and dynamic forces; reduction of loading, handling and lifting loads and weights and repetitiveness [18].

In slaughterhouses, the rotation is also indicated between tasks with cadence set by machines, treadmills, overhead conveyor with other tasks where the worker can freely determine their pace of work; in activities where workers'

hands are completely wet and it is not possible to use gloves, due to the probability of generating additional risks, rotation to other tasks is advised [18]. Therefore, more detailed and controlled studies about job rotation are required; in order to monitor the actual task performed by employees, as well as analysis those tasks should be performed.

In the present study, the use of knife was associated with bodily discomfort, the workers who did not use knife felt less body discomfort, on the other hand, the study by Tirloni et al. [4] did not find association between these variables ($p=0.303$). The tools should promote the adoption of appropriate postures and movements, ease of use and comfort, in order to not require the worker to use excessive force, pressure, hold, flexion, extension or twisting of the body segments [18]. The NR-36 recommends that the tools should be specific and appropriate for each type of activity, light and efficient.

The handgrip strength can be a predictor of compression syndromes of the upper limbs, since compression of the peripheral nerves of the UL contributes to loss of grip strength [20]. The employers should train employees on knife-sharpening, maintenance schedules and good cutting techniques, whereas as using dull knives result in workers having to apply more force than necessary to accomplish the task [2].

The NR-36 states as preventive actions: sharpening and suitability of tools and equipment; training and orientation of workers, on admission and routinely; as well as the existence of a regular maintenance schedule [18]. More studies on the use of tools in slaughterhouses should be conducted with analysis of the process of sharpening the knives, the use of knife-sharpener, and exchange of knives during the workday and yearly, as well as evaluation of grip strength of those who perform manual tasks during the workday.

In relation to perception of cold, according OSHA [2], use of force in combination with cold temperatures increase the potential of develop MSDs. Corroborating with this study, Tirloni et al. [4] found that the bodily discomfort was associated with the perception of cold of poultry slaughterhouse workers ($p=0.035$).

Many of the operations in poultry processing occur with a chilled product or in a cold environment [2]. Ramos et al. [21] used an infrared camera and found that workers who used knife had the contralateral hand (non-dominant) significantly colder, and this may be due to the handling of refrigerated products. One administrative solution used effectively by poultry processors to reduce the duration and frequency of exposure to risk factors is to minimize exposure to cold [2].

For workers who carry out their activities in artificially cold environments the NR-36 recommends that companies make available system for heating hands near the toilets or rest break areas provide personal protective equipment; provide a rest break after an hour and forty minutes of continuous work, and performance rotation with activity alternating changing environmental exposure, obeying the hygienic and sanitary aspects [18].

4.1. Limitations of the study

The research was performed in only one poultry slaughterhouse, making it impossible to generalize the

results. It was not possible to control and detail some variables, such as the content of the tasks performed by each employee, and monitoring the rest breaks during the workday to check for compliance.

5. Conclusions

In conclusion, the majority of the workers felt bodily discomfort, the right side of the body was the most affected, the regions with the biggest complaints were the shoulders and arms and the symptoms most often cited by workers were pain, fatigue and tingling. Most workers who felt bodily discomfort were taking medication on their own, in which, the analgesic was the most commonly used medication; these workers performed systematically repetitive work, took rest breaks and felt cold; on the other hand, the minority of the employees performed rotation, and used hand tools. The body regions that most workers felt cold were hands and feet.

Body discomfort was associated with individuals' sex, in which was more prevalent in females than in males; also associated with the performance of repetitive tasks, the use of hand tools (knives/knives-sharpener) and the perception of cold by the workers. Lastly, it was found that workers felt bodily discomfort regardless of the length of time working in the poultry slaughterhouse, of the distribution of breaks and performance of job rotation.

The results of this study point to the need for preventive actions in poultry slaughterhouse such as the organization of work (adjust the rhythm of production, the number of employees, and the individual's psychophysiological capacity; conducting rotations containing repetitive tasks and not repetitive, with and without the use of hand tools and in different environments - natural and artificially cold). Also suggests that there is a need to control the sharpening process and replacement of knives, provide training on sharpening of knives, supply gloves, socks and boots with increased thermal insulation and quality.

Finally, the sector of occupational safety and health administration in the poultry abattoirs should enhance and intensify the prevention programs of WSMDs, mainly among females, since they appear to be the most affected with bodily discomfort. The health care systems offered to workers in abattoirs should be improved by providing more accurate diagnoses, recommending an appropriate treatment and advice workers on the risk of abusive ingestion of medicines without prescription.

References

- [1] United States Department of Agriculture. Livestock and Poultry: World markets and trade. [online]. [Accessed: October of 2016]. 2015, Available at: <http://usda.mannlib.cornell.edu/usda/fas/livestock-poultry-ma/2010s/2015/livestock-poultry-ma-10-09-2015.pdf>
- [2] OSHA. Occupational Safety and Health Administration. Prevention of musculoskeletal injuries in poultry processing, [online]. [Accessed: 30 of September of 2016]. 2013. Available at: <https://www.osha.gov/Publications/OSHA3213.pdf>
- [3] Hamberg-van Reenen, H.H., van der Beek, A.J., Blatter, B.M., van der Grintenc, M.P., van Mechelen, W. and Bongers, P.M., Does musculoskeletal discomfort at work predict future musculoskeletal

- pain? *Ergonomics*, 51(5), pp. 637-648, 2008. DOI: 10.1080/00140130701743433
- [4] Tirloni, A.S., Reis, D.C., Santos, J.B., Reis, P.F., Barbosa, A. and Moro, A.R.P., Body discomfort in poultry slaughterhouse workers, *Work* (Reading, MA), 41, pp. 2420-2425, 2012. DOI: 10.3233/WOR-2012-0651-2420
- [5] Reis, P.F. and Moro, A.R.P., Preventing Rsi/Wruld: use of esthesiometry to assess hand tactile sensitivity of slaughterhouse workers. *Work* (Reading, MA), 41, pp. 2556-2562, 2012. DOI: 10.3233/WOR-2012-0498-2556
- [6] Colombini, D. and Occhipinti, E., Preventing upper limb work-related musculoskeletal disorders (UL-WMSDs): New approaches in job (re)design and current trends in standardization, *Applied Ergonomics*, 37(4), pp. 441-50, 2006. DOI: 10.1016/j.apergo.2006.04.008
- [7] Reis, D.C., Moro, A.R.P., Ramos, E. and Reis, P.F., Upper limbs exposure to biomechanical overload: Occupational risk assessment in a poultry slaughterhouse, in: Goonetilleke, R. and Karwowski, W., (Org.). *Advances in Physical Ergonomics and Human Factors*. 7ed. Florida: Springer, 489. pp. 275-282. 2016. DOI: 10.1007/978-3-319-41694-6_28
- [8] IBGE. Instituto Brasileiro de Geografia e Estatística. Mapa clima do Brasil. [online]. [accessed: 20 of October of 2016]. Available at: ftp://geofp.ibge.gov.br/informacoes_ambientais/climatologia/mapas/brasil/clima.pdf
- [9] Eklund, J.A.E. and Corlett, E.N., Experimental and biomechanical analysis of seating, in: Corlett, N., Wilson, J. and Manenica, I., (eds). *The Ergonomics of Working Postures*. London: Taylor and Francis Ltd, pp. 319-330. 1986.
- [10] Colombini, D., Occhipinti, E. e Fanti, M., Método OCRA para análise e a prevenção do risco por movimentos repetitivos: Manual para a avaliação e a gestão do risco. São Paulo: LTr, 2008.
- [11] Colombini, D. and Occhipinti, E., Risultati della valutazione del rischio e del danno in gruppi di lavoratori esposti, in diversi comparti lavorativi, a movimenti e sforzi ripetuti degli arti superiori. *La Medicina del Lavoro*, 95, pp. 233-246, 2004.
- [12] Bot S.D., van der Waal J.M., Terwee C.B., van der Windt D.A., Schellevis F.G., Bouter L.M. and Bekker, J., Incidence and prevalence of complaints of the neck and upper extremity in general practice. *Annals of the Rheumatic Diseases*, 64(1), pp. 118-23, 2005. DOI: 10.1136/ard.2003.019349.
- [13] Barbosa, R.E.C., Assunção, A.Á. and Araújo, T.M., Musculoskeletal pain among healthcare workers: An exploratory study on gender differences. *American Journal of Industrial Medicine*, 56, pp. 1201-1212, 2013. DOI: 10.1002/ajim.22215
- [14] Reis, D.C., Ramos, E., Reis, P.F., Hembecker, P.K., Gontijo, L.A. and Moro, A.R.P., Assessment of risk factors of upper-limb musculoskeletal disorders in poultry slaughterhouse. *Procedia Manufacturing*, 3, pp. 4309-4314, 2015. DOI:10.1016/j.promfg.2015.07.423
- [15] Sundstrup, E., Markus D., Jakobsen, M.D., Jay, K., Brandt, M. and Andersen, L.L., High intensity physical exercise and pain in the neck and upper limb among slaughterhouse workers: Cross-sectional study. *BioMed Research International*, pp.1-5, 2014. DOI: 10.1155/2014/218546
- [16] Mohammadi, G., Risk factors for the prevalence of the upper limb and neck work-related musculoskeletal disorders among poultry slaughter workers. *Journal Musculoskeletal Research*, 15(1), pp. 1-8, 2012. DOI: 10.1142/S0218957712500054
- [17] Reis, D.C., Reis, P.F. and Moro, A.R.P., Assessment of risk factors of musculoskeletal disorders in poultry slaughterhouse. In: Azevedo, P. et al. (Org.). *Proceedings book of the international symposium on occupational safety and hygiene - SHO2015*. led. Guimarães - Portugal: Sociedade Portuguesa de Segurança e Higiene Ocupacionais, pp. 294-296, 2015:1. DOI: 10.1016/j.promfg.2015.07.423
- [18] Ministério do Trabalho. Norma Regulamentadora NR 36 - Segurança e saúde no trabalho em empresas de abate e processamento de carnes e derivados. Portaria MTE nº 555, de 18 de abril de 2013, Brasil. [online]. [Accessed: 5 of October of 2016]. Available at: http://trabalho.gov.br/legislacao/normasregulamentadoras/nr_36.pdf
- [19] Leider, P.C., Boschman, J.S., Frings-Dresen, M.H. and Van der Molen, H.F., Effects of job rotation on musculoskeletal complaints and related work exposures: A systematic literature review. *Ergonomics*, 58, pp.18-32, 2014. DOI: 10.1080/00140139.2014.961566.
- [20] Reis, P.F., Moro, A.R.P., Reis, D.C. and Ramos, E., Repetitive working in slaughterhouses: The esthesiometry use of the hand as a proposal for assessing levels of RSI compression syndromes of the upper limbs, in: Goonetilleke, R., Karwowski, W., (Org.). *Advances in Physical Ergonomics and Human Factors*. 1ed. Orlando: Springer, 489, pp. 125-133. 2016. DOI: 10.1007/978-3-319-41694-6_13
- [21] Ramos, E., Reis, D.C., Tirloni, A.S. and Moro, A.R.P., Thermographic analysis of the hands of poultry slaughterhouse workers exposed to artificially cold environment. *Procedia Manufacturing*, 3, pp. 4252-4259, 2015. DOI: 10.1016/j.promfg.2015.07.408

A.S. Tirloni, is a postdoctoral researcher (Ergonomics) at the Federal University of Santa Catarina (Brazil). She received her PhD in Production Engineering in 2013 from the Federal University of Santa Catarina, Florianópolis, Brazil. She is an Ergonomist by the Brazilian Association of Ergonomics (ABERGO); she is also a professor of ergonomics and safety at work and currently research about ergonomics, occupational biomechanics, body posture, body discomfort, school furniture and slaughterhouse. ORCID: 0000-0003-0844-3351

D. Cunha dos Reis, is a postdoctoral researcher (Ergonomics) at the Federal University of Santa Catarina (Brazil). PhD. degree in Biodynamics of Human Movement from Federal University of Santa Catarina obtained in 2014. Main research interest includes ergonomics, occupational biomechanics, sports biomechanics and Parkinson's disease. ORCID: 0000-0002-0325-8360

E. Ramos, holds a MSc. in Biodynamics of Human Movement. Currently, she works as an associate instructor for the physical therapist assistant program at Southwestern Community College in Sylva, North Carolina, and is a physical therapy clinician at Macon Valley Nursing and Rehabilitation Center. She has published research in ergonomics, Parkinson's disease and biomechanics of the human body. ORCID: 0000-0001-6098-5700

A.R.P. Moro, is PhD. Associate professor at the Federal University of Santa Catarina (UFSC), teaching the graduate programs in Production Engineering (Ergonomics area) and Physical Education (Biodynamics of Human Movement area). He is the founding Partner of the Brazilian Society of Biomechanics (SBB) and Senior Ergonomist by the Brazilian Association of Ergonomics (ABERGO). He coordinates the Biomechanics Laboratory of UFSC. In his curriculum the most frequent terms in the contextualization of technical and scientific production area are ergonomics, biomechanics, body posture, anthropometry, occupational biomechanics, cinemetry, occupational diseases, lower back pain, school, school furniture, work gymnastics, quality of life and sports. ORCID: 0000-0002-1796-8830