

Musculoskeletal Risk Related to Housework

Risco Osteomuscular Relacionado ao Trabalho Doméstico

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ABSTRACT

The Musculoskeletal Diseases related to work have been discussed for years in Brazil, but still are causes of health problems throughout life and the quotidian of many workers. In the case of those who work in the domestic sector, these houseworkers have no access to adequate security measures within their work environment and lack supervision and official control about this condition. In addition, the occupational diseases related to domestic work remain neglected. In order to identify risk factors for development of these diseases, were noticed the daily activities of a domestic worker for a full day in her workday. The most common risks were constituted by inadequate postures, repeatability of movements with spinal flexion, prolonged standing positions, bad organization of the activities and of the work environment and lack of adequate guidance to the worker on such problems. It was concluded for the need of creation and routine application of protocols and standardized guidelines to minimize the occurrence of musculoskeletal diseases related to the domestic work and to the risk of accidents, and to establish care practices and social policies that make possible to qualify the physical, mental and labor condition of those who live and occupy as domestic workers.

Keywords: Health Education, Curriculum, Health Professional Training.

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RESUMO

As Doenças Osteomusculares Relacionadas ao Trabalho têm sido discutidas há anos no Brasil, mas, ainda são causas de problemas de saúde ao longo da vida e do cotidiano de muitos trabalhadores. De acordo com a literatura, os profissionais do lar não têm acesso a medidas de segurança adequadas dentro do seu ambiente de trabalho e faltam fiscalização e controle oficial sobre essa condição. Além disso, as doenças ocupacionais relacionadas ao trabalho doméstico continuam negligenciadas. Com o objetivo de identificar fatores de risco para o desenvolvimento dessas doenças, observaram-se atividades cotidianas de uma trabalhadora doméstica durante um dia completo de sua jornada de trabalho. Os riscos mais comuns constituíram-se por posturas inadequadas, repetitividade de movimentos com flexão da coluna, tempo prolongado em posição ortostática, má organização das atividades e do ambiente de trabalho e falta de orientação adequada à trabalhadora sobre tais problemas. Concluiu-se pela necessidade da criação e da aplicação rotineira de protocolos e diretrizes padronizados para minimizar a ocorrência de doenças osteomusculares relacionadas ao trabalho doméstico e o risco de acidentes, bem como estabelecer práticas assistenciais e políticas sociais que oportunizem qualificar a condição física, mental e trabalhista de quem vive e se ocupa como empregada do lar.

Palavras-chave: Doença osteomuscular relacionada ao trabalho, Trabalho doméstico, Saúde e segurança no trabalho doméstico.

INTRODUCTION

Work-related Musculoskeletal Disorders (WMSDs) refer to a group of neuromiotendinous disorders resulting from injury or dysfunction induced by work activities. According to the Ministry of Health, the WMSDs are manifested by a chronic pain accompanied or not by objective changes that can affect muscles, tendons and peripheral nerves, especially in areas such as the neck, shoulder girdle, lower limbs and spine.¹ In addition to pain, these disorders can produce numbness or feeling of heaviness or fatigue.²

The WMSDs can also, by their nature and symptomatology, trigger a state of stress that is able to result in muscle tension which further worsens the pain or functional difficulty.³

This particular group of problems has been recognized in Brazil for about 30 years, especially from their clinical findings in banking who worked as typists. Later it came to be described also in supermarket cashiers, workers in industrial assembly lines, packers, among others. It is currently among the most common causes of work-related diseases reported to the National Institute of Social Security (INSS).⁴

A problem that arises in this environment is the fact that a significant portion of health professionals is not sufficiently attentive to WMSDs under the individual care and do not adequately address the environment and working conditions of the people they serve. This favors the occurrence of underdiagnosis, underreporting, little effective treatment and preventive negligence.^{5,6}

As WMSDs are chronic conditions often manifested by subjective symptoms without identification of corresponding organ damage, many of the workers affected by them wander, without success, through the health services seeking improvement in their symptoms and returning to the same generation working conditions of their problem. Thus, these workers experience progressive clinic worsening, socioeconomic losses by reduced working capacity and relationship conflicts, becoming stigmatized. In this condition, they lose self-esteem, become insecure and feel frustrated and helpless. That is, they also start to suffer emotionally.^{7,8}

Still relating to WMSDs and their impact, there are several studies related to several specific occupational branches; however, there are very few studies in relation to domestic work. Moreover, it is likely that the epidemiological underreporting on the health of housemaids is significantly higher than what happens in relation to other categories, since most of those who work in the domestic sector operate informally.⁹

On the other hand, the domestic work is still an activity predominantly performed by women. Be as professional that receives income of this branch; or as a worker who, although working in another branch, assumes most or almost all of the care tasks of your own home.¹⁰ As these workers act mainly in an informal way, as already mentioned, they do not have social security or health protection in the workplace.¹¹

However, these professionals are at high risk for developing occupational health problems, especially diseases of the

musculoskeletal system. The domestic work involves great physical effort and requires the use of different equipment that involves postures and managements that can have various effects on the musculoskeletal system.¹²

In addition, there is a higher frequency of mood disorders, difficulty in concentrating and psychosomatic manifestations in housemaids than in other occupational categories. Similarly, non-fatal accident in the workplace is 7.3% more frequent among housemaids.⁹ The most cited accidents are the accidents from falls, the twists of the lower limbs, cuts the skin and burns.¹¹

The housemaids commonly have problems related to work overload, lack of fixed time for the close of the workday and the lack of time to rest or eat properly. Certainly, this situation has historical reasons at the origin of domestic work as a slave activity, so that the home professional occupation seems to keep still some unique identity that affects the treatment that is given to worker of this area.⁶

The main working tools of the workers that act in the domestic cleaning sector are their own bodies that wear out by the use as any other tool.¹³ In this sense, backaches or leg pain and swelling in the lower limbs are common complaints among housemaids.¹¹

Adding to what has been exposed, 22% of users of the Unified Health System (SUS) are housemaids. In this way, the concern for the occurrence of WMSDs in this category of workers is very relevant.⁹

Given the biomedical and social importance of WMSDs among the housemaids and the current lack of attention on this issue, we decided to observe the labor activity of a housemaid during a full workday, in order to describe risk factors for developing WMSDs in this type of occupation and propose triggers for a reflection on the subject.

MATERIAL AND METHODS

Through a case study approved by the Human Research Ethics Committee and consented freely by subjects (the mistress of the house and her housemaid), we observed, filmed and photographed a home generalist worker in her environment and her natural working condition during a full working. This housemaid was legally registered as a maid.

Then we applied the Corlett and Manenica diagram in order to raise the physical discomfort complaints of the housemaid. This diagram consists of a human body design seen from behind, divided into numbered segments that indicate the neck, cervical region, upper back, middle back, lower back, hips, shoulders, arms, elbows, forearms, hands, thighs and legs.¹⁰

The painful areas are marked on the diagram according to the name and corresponding number. For each body region highlighted in the drawing there is a degree ranging from 1 to 5 indicating, respectively, the absence of pain or discomfort to intolerable pain or discomfort in the segment considered. The very person who feels discomfort is who marks the painful area in the design and classifies according to the intensity with which realizes the symptom.¹⁰

We organized the data for analysis in the same chronological sequence in which they were collected; i.e., in the same sequence in which the observed working day flowed, which included house general organization activities, floor cleaning, kitchen cleaning and laundry services. The Corlett and Manenica diagram, which was filled by the observed

housemaid itself, was the last data incorporated in the analysis.

We made the description of the observed, filmed and photographed data under critical look and based on the references of Clinic and Preventive Physical Therapy presented by Couto and Iida.^{10,13} These authors interpreted each identified item as a risk for the development of WMSDs in the light literature in the areas of Ergonomics, of Biomechanics, of Occupational Health and of Preventive Physical Therapy.

RESULTS

The general organization of the house consisted of storing toys, clothes and shoes; getting the garbage; making the beds; tidying and cleaning wardrobes and mirrors (FIGURE 1). Several of these tasks were performed simultaneously. All tasks were held upright without breaks, with the repetitive use of the spine, knees and ankles bending or twisting.

To clean the floor, the housemaid had to sweep, scrub and dry floors. This activity required the worker to move continuously with the spine in at-bent twist due to short cable squeegees and brooms (figure 2). The housemaid also had to carry heavy buckets by excessive physical and postural exertion, manifested by imbalance of the march, lever burden on the higher members and the spine as well as airflow limitation by sharp contraction of the chest muscles in order to sustain weight in his arms. In addition, the buckets had unstable handles that required great flexor effort of fingers and wrist to hold them while carrying water. The housemaid wore a slipper that did not guarantee security or stability for the march, increasing the need for efforts on ankles and feet.

To put the clothes in the washing machine, the housemaid lowered and raised herself several subsequent times through repetitive movements of ante-bending and twisting of the spine with some weight in her arms and fingers flexed against resistance to return to the standing position (figure 3). This problem could be minimized by placing the bucket in a position above the ground (on a bank, for example).

The activity of ironing was sometimes done using a bed as the ironing table. As the bed was low, the housemaid



Figure 1. House organization.



Figure 2. Floor Cleaning.



Figure 3. Laundry service.

remained with sustained spine in flexion for about half an hour while doing this service. The correct use of a table to iron would certainly minimize this spine overload.

The kitchen cleaning demanded activities as washing, drying and storing dishes. We observed that the most used utensils in the kitchen, such as cutlery, plates and cups were stored at lower places of the cabinets, requiring repeated movements of flexion-extension of the spine (figure 4).



Figure 4. Kitchen Cleaning.

DISCUSSION

The findings described allowed highlight the following risk factors for WMSDs in domestic work: continuous dynamic muscle movement in the limbs under overload; repetitive or continuous movements, some under overload in ante-bending and twisting of the spine; improper handling of loads requiring effort or vicious attitude of the spine, knees and ankles; improper postures and tools with risk of accidents and diffuse myotendinous overload; and lack of housemaid's awareness about the importance of minimizing situations of occupational risk.

With respect to each of these factors, the dynamic muscle movement causes the muscles to contract and relax several times, acting as a blood pump in which the contraction expels the blood with metabolic waste and the relaxation allows the replacement of renovated blood with nutrients and oxygen. However, as the muscles contract subsequent times long, its accumulated metabolic consumption exceeds the replacement so that functional ability of the muscle decreases by metabolic exhaustion, which can manifest in symptoms of weakness, fatigue, pain or subjective muscle discomfort.¹⁰

The observed housemaid, while organizing the house, moved by several continuous hours and without resting intervals, mobilizing many mioarticulares groups simultaneously or alternately in activities that required frequent posture changes, but all the time standing. In this case, even in a dynamic activity, the standing posture determining static strain on the muscles that may contribute to the occurrence of pain in the lower limbs. In fact, this was a complaint by the observed person, as described by Corlett and Manenica diagram showed in figure 5.

Furthermore, the standing posture impedes the venous return and thus elevates the blood hydrostatic pressure in the veins of the lower extremities, causing accumulation of liquids with swelling and pain in this region.¹⁴

The repetitive or continuous movements, some under overload in ante-bending and twisting of the spine, may be related to the back pain complaint, as described by her through the Corlett and Manenica diagram.

The explanation for this may come from the fact that the human spine is a segmented and complex osteoarticular system that has supporting, balance, posture and movement

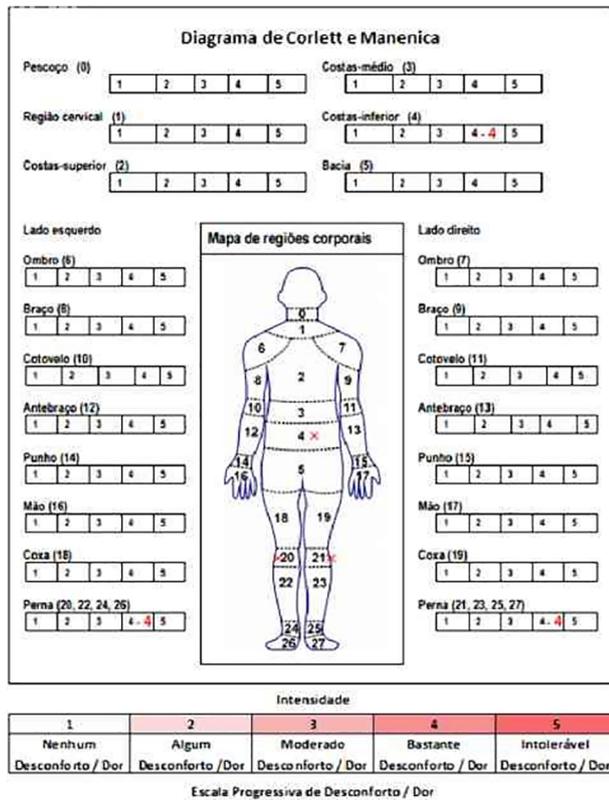


Figura 5. Diagram of Corlett and Manenica Filled by the Domestic Worker of the Study.

functions. The spine is made up of 33 vertebrae separated from each other by intervertebral discs. Twenty-four are movable so as to allow movements of rotation, lateral bending, flexion and extension.¹⁵ However, the spine can suffer induced anatomical-functional degeneration or aggravated by dynamic or postural overload, muscle contractures and trauma.¹⁶

Such overloads often trigger chronic pain in the neck, back or lumbar with mechanical origin due to overuse or overload of their structures. This injury is known as Cumulative Trauma Disorders or Repetitive Strain Injury.^{8,17}

The constant bending or twisting of the spine under overload required by housework, has the effect of shifting the center of corporal gravity during labor activity that, sustained for a long time, leads to supraphysiological wear of the intervertebral discs. At the same time, this kinectpostura defect overloads functionally miotendíneo paraspinal structures so that the erector muscles of the spine comes to bear the weight of the trunk and posterior ligaments are stretched, causing pain conditions in dorsal-lumbar region.¹⁸

In this regard, in 1997 Cimino already commented on work activities that require antiergonômics postures or movements as cause or factor of worsening of spine disorders.¹⁸

In the observed case, in addition to excessive frequency with which the housemaid flexed and extended the spine during their work activities, sometimes these movements were associated with weight lifting causing the column to be used as a lever, after which she referred fatigue and lumbar discomfort.

The load lifted at a certain distance from the body requires muscle strength greater than that would be needed to lift it vertically, significantly increasing the pressure on the

intervertebral disk, creating greater stress on the spine and most distensivo effort on the paraspinal muscles.¹⁹ The loads lifting must always be performed with the column in vertical position, using the muscles of the legs which are more resistant. The spine is able to sustain axial or vertical direction forces, but is extremely weak to forces acting perpendicularly to its longitudinal axis.²⁰

This physiologic aspect can be explained by the fact that the intervertebral disc is constituted by a thick outer ring, formed by fibrocartilage, called the fibrous ring and pulposus nucleus consists of central gelatinous material. The collagen fibers in the ring form angles of approximately 30° to each other and are fundamental in the disc mechanics. Depending on the load applied to the rings, there may be disruption of this collagen microstructure. The nuclei of young healthy discs consist of approximately 90% of water and the remainder by collagens, proteoglycans, and osmotically active ions. The high water content of the nucleus protects them against compressions.

Mechanically, the rings act as springs that join the vertebral bodies to the nucleus. During flexion and extension of the spine, the vertebral bodies compress one side of the intervertebral ring and distend simultaneously the opposite side.²¹ At physiological levels, this movement contributes to proper blood supply to the disk and determines the transtisular water exchange necessary to adapt the pressure on the spine. This adaptation is what causes the intervertebral discs act as load shock applied axially on the column.^{21, 22}

Thus, when a disk is compressed, it fits losing water and absorbing sodium and potassium until its internal electrolyte concentration is sufficient to prevent any further loss of water. When this osmotic equilibrium is reached, the disc internal pressure becomes equal to the external pressure, which corresponds to the disk adaptive threshold. A continuous overload for a period of several hours results in reduced blood perfusion of the disk and an additional loss of intradiscal fluid beyond its adaptive capacity and can lead to degeneration or disc shifts that ultimately can cause a disc protrusion with neurologic compression and their clinical and functional repercussions.^{21, 22}

Returning to the lumbar discomfort complaint filed by the observed housemaid, we observed that this postural discomfort by itself is an indicator of anti-ergonomic use of motor structures of this body region. Associated with repetitive and stents movements that employ excessive force, it favors the passing of anatomical and functional capacity tissue and can cause damage to musculoskeletal and osteoarticular structures involved in the operation of the spine.²³

In this case, the bending associated with weight lifting practiced in function of the working activity can be an important cause of lumbar embarrassments and symptomatic and functionally limiting spinal injuries and their connections. Incidentally, this is the most common cause of recurrent work absences.²³

As the incorrect handling of loads, the use of inappropriate tools can also affect the spine structures, since they can lead to maintenance anti-ergonomic postures as it was observed.

For the maintenance of posture and efforts in anterior flexion of the spine, the muscles and the dorsolumbar ligaments need to remain in continuous contraction, causing increased pressure on the intervertebral discs and strain on

the paraspinal ligaments, with consequent onset of neck and back pain.²⁴

Ergonomically it is ideal that the cables brooms and squeegees are in the height of the shoulder line of those who will use them so that the hands can hold them in a height above the line of the elbows. This posture keeps the spine straight, avoiding overloading its structures.²⁵

Regarding the task of ironing, it requires a static posture of the lower limbs and spine, with repetitive adduction-abduction movement of the shoulder and flexion-extension of the fingers. To protect the column from a position in flexure and consequent overload paravertebral myotendinous, it is important that the height of the bench is adjusted to move according to the working height, should be located 18 cm below the elbow flexed to 90°. When passing the clothing on a very low bed, the observed housemaid was exposed to the development of important new health problems on your spine in addition to those already seen in other activities that she played.

According to the literature, the main causes of work-related diseases are associated with inadequate work activities to the human body, which mainly involve issues related to the pace of activities, repetitive movements, overload muscle, absence of breaks and the use of inadequate equipment.^{26, 27} All this was present in the work of the housemaid observed in this study.

In this case, intermittent breaks and systematic switch-over between activities are important for continuous overload relief on specific muscle groups while also bring benefit to the mental activity of management of the own activity.^{28, 29}

In this regard, it is known that work breaks allow relief to the most claimed muscles for labor activity and mental rest by providing moments of lower concentration; therefore the work breaks are essential to prevent musculoskeletal pain and mental fatigue.^{28, 29}

To avoid accidents and WMSDs, the adequacy of clothing and work tools to the task being performed and the worker's body functional structure is as important as taking care of the posture and movements. In this sense, the World Health Organization (WHO) warns of the importance of preventing musculoskeletal disorders through proper management of the work environment, the correct setting of the equipment and its use, and the organization of instruments and work method. This warning includes diagnosis and precise approach of environmental, labor and medical problems related to WMSDs as strategies for the benefit of the worker and the actual result of the work.³⁰

Another noted aspect, not ergonomic, but with impact on this sphere, was the lack of planning and organization of work of the housemaid of this study. The tasks were performed without any organizational criteria, without any order, and all the time by improvisations. This favored she quantitatively performed movements beyond the necessary and qualitatively inadequate to body health without moments of breaks or compensatory postural alternations. Also off the ergonomic level, but related to occupational health, we observed several situations of risk for accidents involving burns, falls or sprains.

In this sense, it is important that health professionals pay attention to the need to detect and take care of situations of occupational origin of triggering health problems of people.³² Among these professionals, the physiotherapist can help with corrective techniques and postural orientation in

work activities as well as providing training on load handling and opportunities for continuing education on prevention and treatment of WMSDs.³⁰

In the case of the observed worker, we noted the need for information provision and guidance on their unhealthy working conditions, on alternative possibilities to this condition linked to the use of her own body as a tool, on proper management of the process and the work environment, and on correct adjustment and use of equipment.

FINAL CONSIDERATIONS

This study approach to focus the WRMD in home workers, but allowed to expand slightly in the direction of occupational accidents and reflect on social policy issues related to the profession of a maid. Exceeded the goal and the possibility offered by the methodology also addressing biological accidents that home workers are potentially exposed.

Regarding WMSDs, as risk factors in observed domestic work, the repetitiveness of ante-flexion and spine twist and dynamic work in long standing position of the lower limbs stood out. These factors might be related to the symptoms of pain and discomfort manifested by the housemaid.

Then we observed the weight lifting in an anti-ergonomic way, the inappropriate use of inadequate tools and equipment to the task in which they were used, resulting in mioartrotendineous supraphysiological postures and overload, the lack of planned activities, disorganized environment adding risk of accidents, no use of appropriate protective clothing or equipment and lack of awareness of working on all these issues. This lack of awareness prevented the housemaid applies protective measures to her own health, to her well-being and to her productivity, what reduced the efficiency of their movements and postures over the conduct of her work activity process.

In addition to these objective questions and despite the limitation of this study to allow generalizations because of the epistemological nature of the method, it was possible to reflect on domestic work as an activity that seems to dispense with any technical or scientific support for its implementation, as if it depended only on a set of instinctive actions destined for a result in which the process to achieve does not need to be considered.

In this way, the body of the housemaid becomes to be used as any other non-human tool and therefore exposed to the same type and wear process; as a device that requires no maintenance and that is consumed over time and use.

However, the housemaids are human workers who, being neglected, suffer physically and mentally without this being recognized, even burdening the Health System and the Social Security System with their problems preventable by relatively simple measures proposed by the ergonomics, by the physical therapy, by the occupational medicine and by several other areas of applied knowledge.

Are mood disorders and WMSD, manifested by anxiety, sadness, frustration, as well as everyday pain, injuries, disorders and derivatives mioarticulares disabilities of mental alienation, lack of information as the application moves, appropriate body postures and use correct tools and other equipment, factors that are absent in the work activities of a domestic worker.

In this environment, the establishment of political and social measures and technical actions that enable to properly care the work and the housemaid is needed, among which it is possible to propose monitoring and continuing education programs for housewives (mistresses) and her housemaids about the occurrence of WMSDs and other occupational diseases, and the creation and standardization of protocols and guidelines for the management and enforcement of domestic labor activities focusing on worker health.

In terms of individual care, it is important that housemaids carry out their activities under proper guidance as to the movements, to the posture, to the use of tools, clothing and equipment, as well as to the safety in the workplace. It is necessary that the housemaids alternate between the various activities throughout the working day to avoid continuous and vicious use of one specific muscle group and have regular periodic rest breaks throughout the day. These measures should aim at the whole body and mind set of the worker. However, in the case of WMSDs, it is important to emphasize the need and the importance of preserving the spine and lower limbs because these are the areas that are most heavily burdened by domestic labor activity.

As health professionals, it is important that they remain attentive to so common occupational problems in housemaids through an expanded and comprehensive care centered on the person provided by a multidisciplinary team, which should participate, too, the housewife and her housemaid.

REFERENCES

1. Brasil. Ministério da Saúde. Departamento de Ações Estratégicas, Área Técnica de Saúde do Trabalhador. Diagnóstico, tratamento, reabilitação, prevenção e fisiopatologia das LER/DORT: Ministério da Saúde. Brasília; 2001.
2. Kuorinka I, Forcier L. Les Lésions Attribuibles au Travail Repetitif: Ouvrage de Référence Sur Les Lésions Musculo-esqueletiques Liés au Travail. Quebec: MultiMondes; 1995.
3. Moon SD. A Psychosocial View of Cumulative Trauma Disorders: Implications for Occupational Health and Prevention. In: Moon SD, Sauter SL. Beyond Biomechanics Psychosocial Aspects of Musculoskeletal Disorders in Office Work. London: Taylor & Francis; 1996. p. 109-43.
4. Brasil. Núcleo de Referência em Doenças Ocupacionais de Previdência Social. Relatório Anual. Belo Horizonte; 1993.
5. Sales EC, Santana VS. Depressive and Anxiety Symptoms among Housemaids. American Journals of Industrial Medicine; 2003, 44: 685-91.
6. Pereira BP. De Escravas a Empregadas Domésticas – A Dimensão Social e o “lugar” das Mulheres Negras no Pós-Abolição. [Internet] Pontifícia Universidade Católica de São Paulo. PucSP. Disponível em: Disponível em http://www.snh2011.anpuh.org/resources/anais/14/1308183602_ARQUIVO_ArtigoANPUH-Bergman.pdf
7. Mendes AP, Bertoline SMMG, Santos LA. Análise Ergonômica em Ambiente Doméstico. Rev Educ Fis. 2006; 17(1): 1-10.
8. Hall SJ. Biomecânica Básica. 5ª Ed. São Paulo: Manole; 2009. p. 229.
9. Bertoncelo D. Importância da Intervenção Preventiva da Fisioterapia na Readequação Ergonômica e Análise Biomecânica de um Posto de Trabalho. Rev Fisioter Mov. Out; 1996/ Mar; 1999; Vol.12 (2): 89-96.
10. Couto HA. Doenças Osteomusculares Relacionadas com o Trabalho: Coluna e Membros Inferiores. In: Mendes R. Patologia do Trabalho. 2ª Ed. São Paulo, Rio de Janeiro, Ribeirão Preto, Belo Horizonte: Atheneu; 2007.
11. Bandeira L, Batista AS. Preconceito e Discriminação como Expressões de Violência. Rev Estud Feministas. 2002; 10(1): 119-20.
12. Silveira AM. Saúde do Trabalhador. Belo Horizonte. Editora Copmed; 2009. p. 96.
13. Iida I. Ergonomia Projeto e Produção. 8ª Edição. São Paulo: Edgard Blucher Ltda; 2002.
14. Grandjean E. Adaptando o Trabalho ao Homem. Manual de Ergonomia. 4ª Edição. Tradução: João Pedro Steim. Porto Alegre: Artes Médicas; 1998.
15. Hamill J, Knutzen KM. Bases Biomecânicas do Movimento Humano. São Paulo: Manole, 1999.
16. Whiting WC, Zerniche RF. Biomecânica da Lesão Musculoesquelética. Tradução: Giuseppe Taranto. Rio de Janeiro: Guanabara Koogton; 2001.
17. Amatuzei MM, Hernandez AJ, Albuquerque RF. Lesões Meniscoligamentares do Joelho. In: Herbert S, Xavier R. Ortopedia e Traumatologia: Princípios e Práticas. Porto Alegre: Artemed, 2003. p. 1306-21.
18. Cimino R. Organização do Trabalho, Planejamento e Produtividade: Planejar para Construir. [Internet] Editora Pini; 1997. Cap. IV. Disponível em: www.engenhariacompartilhada.com.br/secoes.aspx?capitulo-122
19. Iida I. Ergonomia Projeto e Produção. 2ª Ed. São Paulo: Edgard Blucher Ltda; 2005
20. Hall SJ. Biomecânica Básica. 5ª Ed. São Paulo: Manole; 2009. p. 229.
21. Quintanilha, A. Coluna Vertebral: Segredos e Mistérios da Dor. Porto Alegre: Age; 2002.
22. Dul J, Weerdmeester B. Ergonomia Prática. 2ª Edição. Tradução Itiro Iida. São Paulo: Edgard Blucher; 2004.
23. Pontes BR. Avaliação de Desempenho: Nova Abordagem. 9ª Ed. São Paulo: LTr; 2005.
24. Ergotriade. Varrendo com Ergonomia: O tamanho ideal do cabo da vassoura, 2015. [Internet] Disponível em: www.ergotriade.com.br
25. Guérin F, Laille A, Daniellou F, Duraffourg J, Kerguelen A. Compreender o Trabalho para Transformá-lo: a Prática da Ergonomia. São Paulo: Edgar Blucher, 2001.
26. Settimi MM. Lesões por Esforços Repetitivos – LER. Caderno de Saúde. Instituto Nacional de Saúde no trabalho da CUT. São Paulo; 2001.
27. Codo W, Almeida MCGG. LER: Lesões por Esforços Repetitivos. 4ª Ed. Rio de Janeiro: Editora Vozes; 1995.
28. Mendes AM, Abrahão JL. A Influência da Organização do Trabalho nas Vivências de Prazer – Sofrimentos do Trabalhador: Uma Abordagem Psicodinâmica. Rev Psicol. 1996, 26(2): 179-84.
29. Miyamoto ST, Salmaso C, Mehanna A, Batistella AE, Grego ML. Fisioterapia Preventiva Atuando na ergonomia e no Estresse no trabalho. Rev Fisioter. Univ. São Paulo; 1999, 6(1): 83-91.