



ELECTROMYOGRAPHY IN CLINICAL OCCUPATIONAL HEALTH: INTEGRATIVE REVIEW

A ELETROMIOGRAFIA NA CLÍNICA DA SAÚDE DO TRABALHADOR: REVISÃO INTEGRATIVA

ELECTROMIOGRAFÍA CLÍNICA EN LA SALUD OCUPACIONAL: EXAMEN INTEGRADOR

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ABSTRACT

Objective: identifying the scientific knowledge produced concerning the usage of electromyography in the worker's health. **Method:** it consists of literature integrative review, which presents the following guiding question: What is the knowledge produced in the scientific literature regarding the use of electromyography in occupational health? in the database CINAHL and MEDLINE which 19 publications were selected and analyzed. **Results:** the studies highlight that the electromyography has been used with the purpose of evaluating the pattern of muscle activity during work activities, identifying overload, tension, fatigue, discomfort and muscle aches, as well as identify the efficacy of interventions aiming to reduce the muscled demands. **Conclusion:** the usage of this technique shows its importance in the nursing field in the investigation of musculoskeletal disorders, as electromyography was seen as quite efficient concerning the identification of muscle conditions of the workers. **Descriptors:** Occupational Health; Electromyography; Occupational Diseases.

RESUMO

Objetivo: identificar o conhecimento científico produzido a respeito da utilização da eletromiografia na saúde do trabalhador. **Método:** estudo descritivo, de revisão integrativa da literatura, tendo como questão de pesquisa << Qual o conhecimento produzido na literatura científica com relação à utilização da eletromiografia na saúde do trabalhador? >> A busca foi realizada nas bases de dados CINAHL e MEDLINE nas quais foram selecionadas e, em seguida, analisadas 19 publicações. **Resultados:** os estudos evidenciam que a eletromiografia vem sendo utilizada com a finalidade de avaliar o padrão de atividade muscular durante as atividades de trabalho, identificando-se sobrecarga, tensão, fadiga, desconforto e dores musculares, bem como identificar a eficácia de intervenções que visem à redução das exigências musculares. **Conclusão:** a utilização desta técnica mostra sua importância frente à atuação da enfermagem na investigação das afecções osteomusculares, visto que a eletromiografia mostrou-se bastante eficaz quanto à identificação das condições musculares dos trabalhadores. **Descritores:** Saúde do Trabalhador; Eletromiografia; Doenças Profissionais.

RESUMEN

Objetivo: identificar el conocimiento científico producido al respeto de la autorización de la electromiografía en la salud del trabajador. **Método:** se trata de una revisión integrativa de la literatura, que presenta la siguiente pregunta: ¿Cuál es el conocimiento que se produce en la literatura científica sobre el uso de la electromiografía en salud laboral? La búsqueda fue realizada en las bases de datos del CINAHL y MEDLINE, que fueron seleccionadas y analizadas 19 publicaciones. **Resultados:** los estudios evidencian que la electromiografía viene siendo utilizada con la finalidad de evaluar el padrón de actividad muscular durante las actividades de trabajo, se verificando sobrecarga, tensión, fatiga y dolores musculares, bien como identificar la eficacia de intervenciones que visen la reducción de las sobrecargas musculares. **Conclusión:** el uso de esta técnica muestra su importancia frente a la actuación de la enfermería en la investigación de las afecciones osteomusculares, visto que la electromiografía se mostró muy eficaz cuanto a identificar las condiciones musculares de los trabajadores. **Descriptores:** Salud Laboral; Electromiografía; Enfermedades Profesionales.

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INTRODUCTION

Electromyography is the study of muscle contraction by electrical signals emanating from the muscle, allowing interpretation of normal and pathological conditions.¹ Its implementation can be accomplished by surface electrodes, which pick up the electrical signal through the skin. This technique involves clinical applications and research, performs a non-intrusive and neuromuscular evaluation of easy application. It is used in the study cinesiologic and superficial muscles, neurophysiological and applied by various health professionals with different purposes, as in the analysis of muscular fatigue strength and resistance parameters,² muscles,³ identification of neuromuscular diseases.⁴

The use of this tool assists in therapeutic conduct to be adopted so the upswing,⁵ main responsibilities of Nursing: clinical assistance actions, administration/management activities, educational activities, coordination of occupational health services and health promotion activities at work.⁶

The clinical actions performed based on clinical history, physical examination and consist of the following steps: detailed medical history (history of current disease); research of respiratory, circulatory, digestive, urinary and neuromuscular; relevant behaviors and habits; personal history; family history; occupational history; detailed physical examination and complementary examinations.⁷

It should be noted that during the investigation of health condition, nurse's work should look for paintings suggestive of musculoskeletal injuries. Electromyography is displayed as a valuable investigative method being explored by professional nurses. Therefore, this study aims to identify the scientific literature knowledge that is being produced with the use of electromyography in the area of workers' health.

METHOD

Descriptive study of integrative literature review in order to compile studies, resulting in complete understanding of the stage of the knowledge produced from the use of electromyography. ⁸ the research issue was the knowledge produced < < in the scientific literature regarding the use of electromyography in workers' health? >>

For the development of the study were covered by the following steps:

- 1) Elaboration of the survey question, definition of descriptors and criteria for inclusion/exclusion of studies.
- 2) Search in the literature
- 3) Data collection
- 4) Critical analysis of studies
- 5) Discussion of results
- 6) Presentation of integrative review.

The bibliographical survey was done from the Association of workers' health "descriptors" and "electromyography" and adequacy to the previously established inclusion criteria: scientific articles; available online in its entirety; published in Portuguese, English, and Spanish; published by the year 2010; using surface electromyography. The databases for the selection of the studies were Cumulative Index of Nursing and Allied Health Literature (CINAHL) e Medical Literature Analysis and Retrieval System Online (MEDLINE).

The search occurred in March of 2011, resulting in 72 productions, of these, 59 in MEDLINE and CINAHL in 13. The inclusion criteria were selected from 19 studies, 17 in MEDLINE and CINAHL, of which two on the reading in its entirety.

The collection of information was held from a questionnaire built previously. A synthesis of the studies and analysis was performed according to the thematic Evaluation categories of muscular activity and evaluation of interventions.

RESULTS

The analysis of 19 studies selected showed that the articles were indexed to databases in the period from 1997 to 2009. With respect to the journal with the highest number of publications identified the Applied Ergonomics with seven productions, followed by Industrial Health with three productions, Ergonomics with two, Clinical Biomechanics also two productions. At the journals Gastrointestinal Endoscopy, American Industrial Hygiene Association Journal, International Archives of Occupational and Environmental Health, The Southeast Asian Journal of Tropical Medicine and Public Health e European Journal of Applied Physiology presented a production each.

The predominance was experimental studies (12 publications), and five other items not mentioned explicitly the delineation used. Figure 1 presents a summary of selected studies.

Author	Journal	Study type	Year	Area of practice
Nussbaumet al.	Ergonomics	-	2009	Industrial engineering
Carbooret al.	Ergonomics	Experimental	2000	Experimental Anatomy and physical therapy
Mirkaet al.	AppliedErgonomics	Experimental	2009	Ergonomics and industrial engineering
Holtermannet al.	European Journal of Applied Physiology	Randomized/Experimental	2008	Worker's health
Meyer RH, RadwinRG.	AppliedErgonomics	-	2007	-
Poosanthanasarnet al.	The Southeast Asian Journal of Tropical Medicine and Public Health	Experimental	2005	Environmental Sciences
Iwakiriet al.	Industrial Health	Experimental	2004	Health Industrial
Wahlstromet al.	International Archives of Occupational and Environmental Health	Descriptive/Exploratory	2003	Occupational medicine
Laursen B, Sogaard K, Sjoegaard G.	ClinicalBiomechanics	Experimental	2003	Occupational Medicine and health Physiology Publishes
Iwakiriet al.	Industrial Health	Experimental	2002	Industrial Health
Nussbaumet al.	American Industrial Hygiene Association Journal	Experimental	2001	Industrial engineering
Chan et al.	AppliedErgonomics	Exploratory	2000	Rehabilitation science
Granataet al.	ClinicalBiomechanics	Experimental	1999	Motion analysis
Hermanset al.	AppliedErgonomics	-	1999	Ergonomics
Udoet al.	Industrial Health	Experimental	1999	Public Health
Boden A, Oberg K.	AppliedErgonomics	Experimental	1998	Agricultural Engineering
Hagget al.	AppliedErgonomics	-	1997	Ergonomics
Graham et al.	AppliedErgonomics	Experimental	2009	Kinesiology
Shergillet al.	Gastrointestinal Endoscopy	-	2009	Medicine

Figure 1. Distribution of the study's author, journal, study type, year, and area of expertise of the authors. Rio Grande, RS, 2011.

◆ **Evaluation of muscle activity**

It was identified that electromyography has been used as a way to evaluate the biomechanical responses of upper extremities and trunk, identifying the patterns of muscular activity, most requested muscles, tension, and load and Musculoskeletal weakness. As well as in the identification of the factors in the working environment with risk potential for the occurrence of musculoskeletal injuries.

When considering muscle activity during tree pruning activity, the study found that there, was trade-offs depending on the muscle work height, the higher the elevation of the biceps, the greater muscle activation levels.⁹ Standard muscle activation differences were also evident in study with automotive assemblers. Noting that the radial extensor carpal muscle was activated statically, whereas the radial flexor Carpi developed a more dynamic pattern.¹⁰

The pattern of muscle activity of cleaning workers was also investigated, and in this activity, the muscles most requested were the deltoid, infraspinatus and trapezius.¹¹ Another study examined the muscular activity of the thumbs were placed, and from

electromyogram it was found that the clamp force and muscular forearm loads applied at work can pose risk of injury by overload at the elbow and wrist.¹²

Office workers who stay for longer periods in front of computers also have muscle tension and emotional stress. These conditions are associated with the physical burden committed during the tasks, primarily muscle overload trapezius muscle related requirements.¹³ The movements of the trunk and spine were also investigated, seeking the identification of muscular activity, levels of effort associated with repetitive movements and the use of equipment that reduce muscle requirements.¹⁴⁻⁵ And still, the factors of influence the variability in Biomechanics.¹⁵

In a study with nurses, electromyography investigated the effects of the use of adjustable beds on the spine and stress levels. It was found that the use of these beds might influence the attitudes adopted by workers providing reduction of muscle requirements.¹⁴

It should be noted the work of industrial Chargers who perform repetitive lifting activities. Research showed that the spinal load varied significantly from one task to

another, although both being identical. The kinetic and variability of load on the vertebral column have been influenced by factors in the workplace, and may be considered risk factors for back pain.¹⁵

It was spinal muscles fatigue on posture angle and discomfort in posture porch in hamstring muscles during the professional activity of farmers.¹⁶ During the industrial assembly work fatigue levels were also identified, in which the deltoid muscle showed greater susceptibility.¹⁷ Violin players are also affected by muscle fatigue, especially of the trapezius muscle.¹⁸

The posture adopted during work activities, as well as the furniture has impact on musculoskeletal conditions of the workers.¹⁹ Surveys of office workers surveyed the seated posture ratio for pressure in the posterior thigh and his relationship with the occurrence of Semicircular Lipoatrophy. High-pressure levels were identified in individuals with the disorder, which remained for long periods sitting and with little use of Chair lumbar support.¹⁹

The chairs were also evaluated, trying to identify the effects of a tilting seat. The results showed that the chairs have beneficial effect for the muscular activity of the region back, once the balance condition, in contrast to the fixed seat condition spurred the activity and reduced muscular pain.²⁰

To investigate the relationship between passive resistance in axial rotation and the trunk torsion angle of office workers and tractor drivers when seated, it was evidenced that the passive resistance increases as the angle of twist.²¹

◆ Evaluation of interventions

For the promotion of the health of workers, are adopted strategies that improve muscle performance and subsidies that promote the control of hazards in the work environments by reducing the damage and harms to health.

The use of electromyography was bound to assess the impact of ergonomics on the muscle demand during the work tasks. Two studies showed that the use of ground support equipment for the feet and legs, like pillows, is able to reduce the discomfort and muscle load of the lumbar region and lower limbs during dishwashing.²²⁻³

Another study in automotive assembly line identified the effectiveness present in an instrument to pick up objects, since their use significantly reduced the discomfort and the strength required in the lumbar region.²⁴

In the area of residential construction, the use of electromyography was employed for evaluating muscular conditions and risk of injury during the construction of houses. Soon, it became clear that a support system allows a proactive risk control, since these buildings have high levels of risk for repetitive strain Injuries and work-related musculoskeletal disorders (LER/DORT).²⁵

Electromyography analysis of multifidus and erector spine muscles found that deploying an ergonomics intervention program reduced muscular workloads and the discomfort of the lumbar region, an auto spare parts industry.²⁶

The training of biofeedback is a technique widely used to improve muscular conditions of individuals, consisting of neuromuscular reeducation system through voluntary control.²⁷ To analyze the effects of this training in the trapezius muscle in Office workers showed that, after training, there were no signs of pain or muscle discomfort.²⁸

DISCUSSION

The studies analyzed showed that the surface electromyography is being used in different scenarios. To show the work done with the use of the upper limbs and shoulders must be considered that the shoulder is to position the hand function in the environment. Muscles, bones, and ligaments provide stability when there is upper limb movement and when the shoulder is in static position.²⁹

In the case of upper limb and shoulder movement, studies indicate that the flexion and abduction positions provide a more intense muscular activity, and deltoid and trapezium muscles, have higher levels of activation in maintenance of the abduction movement.³⁰

The movements of flexion and shoulder abduction, for a long period, can cause disorders of the shoulder, as well as staying in irregular body posture for a long time and voltage or load on the upper limb. Musculoskeletal complaints of upper extremities were linked to the maintenance of postures, such as maintenance of the head in position. It was evident, in addition, that psychosocial factors such as stress, long journeys and unsatisfactory rest periods are associated with the occurrence of shoulder injuries.³¹

The results showed that the movement pattern, the posture adopted and muscular requirements employees during work activities can set up risk for pain and muscle

injuries.^{10,12} Corroborating research conducted with teachers, the high prevalence of musculoskeletal pain in the upper limbs, torso and limbs.³²

As for the lumbar spine and trunk movement, electromyography studies indicate that the hamstring muscles and spinal have been identified as the main responsible for the lumbar and pelvic rhythm in flexion and extension movements of trunk³³ are considered as risk factors for back pain static and work requiring physical effort, remain standing for a long time, the absence of postural variation transport weights and pull or push loads.³⁴

Pain in lumbar and cervical region affect workers of different professions such as construction, oil, petrochemical, areas of telephony, electricity, ports, agriculture, driving buses and trucks.⁷ Yet, research on low back pain in women in the textile industry, other profession affected by musculoskeletal diseases, showed that this type of the disease presents itself as a sort of conflict between something normal without importance and the pain felt, limiting, which brings suffering and anguish.³⁵

In addition to these professions, include nursing workers, which include muscle fatigue exacerbated or caused by work, mainly in the regions of the spine, lumbar spine, shoulders, and neck.³⁶ What shows the need to provide better working conditions, investing in ergonomic changes in the work environment. Another condition evidenced with the results is the occurrence of muscular fatigue among workers of different professions, being related to the emergence of musculoskeletal pain and discomfort. Surface Electromyography is widely used for this purpose, having practical importance in the evaluation and treatment of deficits associated with low back pain.³⁷

Evaluation of fatigue and endurance of the spines muscles is indispensable, as it has been reported that individuals with low back pain develop deficits in physical conditioning that influence the strength and function of trunk³⁷ study with dentists points that the working conditions of these professionals, provide the appearance of musculoskeletal pains.³⁸ And during their work activities more muscles are weak deltoids and, in sequence, the trapezes.³⁹ Results also show, that pain in the lumbar region is related to the permanence in sitting posture for long periods. When sitting the individual performs a curvature of the spine which increases the pressure on the intervertebral discs and stresses the ligaments which causes muscle soreness.⁴⁰

The positions adopted in the working environment are also influenced by chairs used. Accessories such as lumbar support and armrests to arms, as well as the slope and height of backrest and seat are ergonomic components that reduce the mechanical load on the column during the sitting position.⁴⁰

Postures, muscle fatigue, low proportion, and overload in osteomyoarticular lesions caused by structures prolonged sitting position are risk factors for the onset of pain and lumbar injury.⁴⁰ In this manner, a set of measures such as changes in furniture, exercises to increase muscle strength and proprioception and posture re-education are important interventions to reduce the impact of sitting on the musculoskeletal system.⁴⁰

The results revealed that the work activities predispose to repetitive stress injuries and work-related musculoskeletal disorders, such as: repetitiveness of movements, effort and strength required by the task, inappropriate postures, static muscle work, invariability of task, shocks and impacts, mechanical pressure, vibration, cold and organizational factors.⁷ Risk control strategies and improvement of working conditions are already being carried out, is showing poll workers during harvest of apples, which evaluated the effectiveness of an ergonomic harness designed to distribute the weight of the harvest on the upper back. The results were positive, since there was a reduction of adoption of inflected posture and discomfort in the shoulder region was reduced.⁴¹

In another scenario, displayed the effects of a forearm support bound to office desks when working on the computer. Electromyography analysis of trapezius muscles, multifidus, very long, right anterior deltoid, and extensor muscles of the forearm was evidenced that the use of the support increased the activity of the upper limbs and reduced tension in the lumbar region.⁴² Other device evaluated from electromyography data was a hand and a glove, used while workers outside screws using screwdrivers. Such an initiative promoted the region handle comfort and reducing the sensation of muscle strain.⁴³

In this context the muscular activity of welders has been parsed when using conventional welding equipment and an alternative system designed to reduce exposure and trunk flexion, which proved effective as their purpose.⁴⁴

The implementation of actions aimed at preventing muscle injuries considered the electromyography biofeedback technique as a therapeutic resource that enables the re-

education of the neuromuscular system. By means of this technique, it is possible to improve the recruitment of neuromotor, increase muscle strength due to the action of more motor units and reduce lag time.²⁷ Studies conducted with Office workers with musculoskeletal pain in shoulder and neck showed that four weeks of biofeedback training significantly reduced the intensity of pain and disability.⁴⁵

CONCLUSION

The analysis of scientific literature about the technique of electromyogram in the area of workers' health, permitted to have a broad vision of the diversity of purposes of its applicability in different work environments. We find that the knowledge about the applicability of electromyography is based on two axes: the evaluation of muscle activity during work activities and the effects of interventions, based also in muscular conditions presented by workers. The studies presented the evaluation of muscle activity in relation to conditions of overload, stress, fatigue, discomfort and muscle aches, related primarily to the type of movement, effort required by the task, repetitions and work posture.

As regards interventions found to ergonomics, favoring labor, or performing posture are favorable in reducing muscular requirements, preventing discomfort and muscle aches. It is necessary, that risk control strategies and improvement of working conditions be adopted. The creation of such equipment is essential to be carried out to investigate the deeds of its use for the improvement of work and its implications for the health of workers.

We highlight the relevance of studies that investigate the muscular conditions of workers and their relationship with the environment and labor process, since they are identified several risk factors contributing to musculoskeletal wear and appearance of diseases of occupational origin. Against this, shows the relevance of this study to nursing, as it reveals a valuable research method that helps both the identification of muscle skeletal injuries, such as on the conduct to be taken.

However, presents itself as a limitation of that study the absence of studies that show the use of electromyography by nursing work, since this type of approach is able to provide fundamental data of muscular conditions of workers helping the nurses in the clinic of occupational diseases.

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