



WORK LOAD AND MUSCLE FATIGUE: INTEGRATIVE REVIEW

CARGA DE TRABALHO E FADIGA MUSCULAR: REVISÃO INTEGRATIVA

CARGA DE TRABAJO Y FATIGA MUSCULAR: REVISIÓN INTEGRATIVA

Lenira Wanderley Almeida¹, Maria Lúcia do Carmo Cruz Robazzi², Regina Maria dos Santos³, Laís de Miranda Crispim Costa⁴, Marcia Teles de Oliveira Gouveia⁵

ABSTRACT

Objective: to analyze the scientific production on workload and its relationship to muscular fatigue. **Method:** integrative review, with the purpose of answering the question << what is published about workload and muscular fatigue? >> Searches were made in the databases LILACS, COCRHANE and PubMed/MEDLINE, in addition to the virtual library SciELO, using descriptors *work load and muscle fatigue*. 22 articles were selected that composed the sample of the study, which were statistically treated and then categorized. **Results:** studies were found about the risks of workload, the variation of lactic acid in muscle fatigue, occasion in which lactic acid is often changed, and articles that analyzed the effects of the workload in subjects with repetitive stress injuries or work-related musculoskeletal disorders. **Conclusion:** it was identified relationship between work load and muscle fatigue showing changes in the metabolism of lactic acid. The articles found showed interest in the topic. **Descriptors:** workload; Muscle Fatigue; Publications.

RESUMO

Objetivo: analisar a produção científica sobre carga de trabalho e sua relação com a fadiga muscular. **Método:** revisão integrativa, com o propósito de responder a questão << O que existe publicado sobre carga de trabalho e fadiga muscular? >> As buscas foram feitas nas bases de dados LILACS, COCRHANE e PubMed/MEDLINE, além da biblioteca *virtual SciELO*, utilizando-se os descritores *carga de trabalho e fadiga muscular*. Foram selecionados 22 artigos que compuseram a amostra do estudo, os quais foram tratados estatisticamente e depois categorizados. **Resultados:** foram encontrados estudos sobre os riscos da sobrecarga de trabalho, a variação do ácido láctico em situação de fadiga muscular, ocasião em que o ácido láctico está frequentemente alterado, e artigos que analisaram os efeitos da carga de trabalho em sujeitos já com lesões por esforço repetitivo ou que apresentam doenças osteomusculares relacionadas ao trabalho. **Conclusão:** identificou-se relação entre carga de trabalho e fadiga muscular evidenciando alterações no metabolismo do ácido láctico. Os artigos encontrados evidenciaram interesse pelo tema. **Descritores:** Carga de Trabalho; Fadiga Muscular; Publicações.

RESUMEN

Objetivo: analizar la producción científica sobre carga de trabajo y su relación con la fatiga muscular. **Método:** revisión integrativa, con el propósito de responder a la pregunta << Lo que existe publicado sobre carga de trabajo y fatiga muscular? >> Las búsquedas fueron hechas en las bases de datos LILACS, COCRHANE y PubMed/MEDLINE, además de la biblioteca *virtual SciELO*, utilizándose los descriptors *carga de trabajo y fatiga muscular*. Fueron seleccionados 22 artículos que compusieron la muestra del estudio, los cuales fueron tratados estadísticamente y después categorizados. **Resultados:** fueron encontrados estudios sobre los riesgos de la sobrecarga de trabajo, la variación del ácido láctico en situaciones de fatiga muscular, ocasión en que el ácido láctico está frecuentemente alterado, y artículos que analizaron los efectos de la carga de trabajo en sujetos ya con lesiones por esfuerzo repetitivo o que presentan enfermedades osteomusculares relacionadas al trabajo. **Conclusión:** se identificó relación entre carga de trabajo y fatiga muscular evidenciando alteraciones en el metabolismo del ácido láctico. Los artículos encontrados evidenciaron interés por el tema. **Descriptor:** Carga de Trabajo; Fatiga Muscular; Publicaciones.

¹Sanitarist Nurse, Phd student, Interunidades Program, Nursing School of Ribeirão Preto/USP. Professor, Nursing and Pharmacy School, Federal University of Alagoas/ESENFAR/UFAL. Maceió (AL), Brazil. E-mail: lenirawanderley@gmail.com; ²Occupational Nurse, Titular Professor, Department of Nursing General and Specialized, Nursing School of Ribeirão Preto /USP. Ribeirão Preto (SP), Brazil. E-mail: avrmccr@eerp.usp.br; ³Nurse, Phd Professor in Nursing, Coordinator of the Postgraduate Program in Nursing (Master degree), Nursing and Pharmacy School, Federal University of Alagoas/ESENFAR/UFAL. Maceió (AL), Brazil. E-mail: relpesantos@gmail.com; ⁴Occupational Nurse, Master degree student, Postgraduate Program in Nursing, Nursing and Pharmacy School, Federal University of Alagoas/ESENFAR/UFAL. Maceió (AL), Brazil. E-mail: laismcc@gmail.com; ⁵Nurse, Phd student, Nursing School of Ribeirão Preto /USP. Professor, Nursing Graduation Course, Federal University of Piauí. Piauí (PI), Brazil. E-mail: marcia06@gmail.com

INTRODUCTION

The production of literature on the effects of work on the worker, although significant, yet gives security in determining biological markers identifiers for purposes of overwork on the metabolism, making the clinical determination of the workload supported by the employee. However, the current dynamics of the work come to add the efforts spent on specific function, the exercise of supplementary activities, maximizing the utilization of labor effort.¹

The excessive burden of work brings losses to the worker², as well as the diversity of functions associated with duplicated journeys that cause stress, affect the performance of the activity, going so far as to cause shortages, clearances or even reduction in the level of commitment of the worker with the work to be performed. However, these losses to workers' health are more reported by them than evidenced by measurable biological signal emission, in addition to the complaint or noticeable before the disease appears.³

In nursing is known that the recognition is long and exhausting their workday and, when associated to multiple jobs links, especially if in precarious working conditions and wages, coupled with the pursuit of the activity of management of the home, very quickly makes the professional express symptoms of fatigue, often reaching exhaust states.²⁻⁵

The hospital nursing worker process when the worker unfit that acts in these institutions, can bring harm to their physical and mental integrity, by providing the typical work accidents (ATTs) and/or wear of varied natures to that group, with significant personal, social and economic implications.²

Absenteeism rates are high and of licenses for health treatment^{4,5}, including nursing, in which they report situations of overwork as double shifts, large number of patients to be met, insufficient workers, indicating the existence of relationship between overwork and physical signs of exhaustion, although has not yet given a parameter as insurance of that relationship.

In this sense it is important to study the evidence of relationship between overwork and metabolic changes realized so that they can add arguments to the thesis that it is possible to find a blood marker that works as a factor of alert in order to determine the time at which the worker must decrease his rate of work.

Considering the lactic acid is also produced as a function of the muscle work and that he, when accumulated, produces muscle fatigue⁶,

for this integrative review established the following guiding question: what's in the scientific production about the workload and muscle fatigue that can contribute to the understanding of the relationship between overwork and blood level change of lactic acid? It is important to answer such a question because it is essential to relate these findings to nursing activity, often described as category, for his work and appears to be susceptible to fatigue.

To answer the question raised, the study had as general objective << to analyze the scientific production on work load and muscle fatigue >> and as specific objectives << to identify the existence of relationship between workload and the change of blood lactic acid level and seek theoretical subsidies to see if lactic acid can be regarded as biological marker of excessive workload>>. The results of this study will help to subsidize other investigations aimed at determination of markers of overwork caused by extensive journeys, including among the nursing professionals.

METHOD

Integrative review, type of study necessary and meaningful for contributing to the construction of the object of study, in order to guide and measure in the literature review, establishing parameters for defining goals and even lighten the methodological choices of other studies, especially the theses and dissertations.

The integrative review follows its own methodology⁷⁻⁸ that, in this study, has been observed in full. Initially, it was developed the stage of determination of the object of research. For this, the theme journey and overwork, topic of interest of the authors, was extensively read, getting to the definition of the guiding question, which made it possible to find descriptors deemed appropriate, fulfilling the third step: the establishment of descriptors. In this study, the guiding question was: what's published on work load and muscle fatigue?

After this, a decision was started to the search in databases: MEDLINE (International Literature in Health Sciences/Medical Literature Analysis and Retrieval System Online), LILACS (Latin American literature and Caribbean Center on health sciences), PUBMED (U.S. National Library of Medicine), COCHRANE and in virtual library SciELO (Scientific Electronic Library Online).

The descriptors were adopted *work load and muscle fatigue*. The descriptor *nursing* was disregarded because it referred to a great

number of articles outside the focus study. To give the search sequence, three inclusion criteria were adopted, namely: are fully available for *online* access, being they quantitative or qualitative; have been published in the last ten years and are written in Portuguese, English or Spanish.

The search resulted in 510 publications, with several of them repeated in more than one database. First, were read all titles. Then there was a precise reading of all summaries. Lastly, the articles more approached the study objectives were read in full. After completion of all steps, 22 were selected publications that met the requirements proposed to constitute the sample of study, being 19 articles, two integrative reviews and a systematic review.

For the collection of data in publications that were included in this review, an instrument was elaborated contemplating

independent variables sample characterization: year, database, and periodical title, as well as the dependent variable which was the contribution of the article to clarify the central theme. A summary table was built for presentation of data and for later discussion, using statistical resources still as simple frequency and accumulated. Frames and tables gave visibility to data.

RESULTS

The data were divided into two blocs, being the first characterization of the sample and the analysis concerning the second dependent variable. On the characterization of the sample, it was deemed important to verify the distribution over the last ten years, mainly because it is undeniable the need to make public the advances that science is achieving.

Table 1. Distribution of the publication on work load and muscle fatigue according to the year, in the period from 2002 to 2011.Maceió, 2012.

Períod	n	%
2003 - 2005	5	22,7
2006 - 2008	6	27,3
2009 and more	11	50
Total	22	100

The data in Table 1 show that 50% of the publications were produced in the period of 2009 to 2011 and 22.7% in the period from 2003 to 2005. Whereas the year 2002 was included in the search period, it is important to register that that year was not found scientific production in this theme; it is observed that, from 2003 to 2011, the number of articles grew.

In relation to databases in the period from 2002 to 2011, the Latin American literature and Caribbean Center on health sciences-LILACS-54.6% were originated from the

selected productions, while the COCHRANE Library housed 4.6% of the sample. The library SciELO and PUBMED also provided articles, which highlights the dissemination of research conducted worldwide. The existence of studies on the question of this survey spanning bases so broad as to PUBMED and the COCHRANE makes it clear that the search for clinical signs of overwork is a concern shared by the scientific community.

To synthesize the first group of data, Figure 1 shows all the characteristics of selected articles:

Ano	Journal	Title	Authors
2003	Rev Bras Ciência e Movimento.	Metabolic basis of acute muscular fatigue.	Santos MG; Dezan VH; Sarraf TA.
2004	Rev Bras Med Esporte.	Study of the correlation between the speed of motor reaction and blood lactate, in different times of fight in Judo.	Lima EV; Tortoza C; Rosa LCL; Lopes-Martins RAB.
2005	Revista de Enfermagem da UERJ.	Occupational risks of nurses in a municipal health center.	Farias SNP; Zeitoune RCG.
2005	Rev Bras Med Esporte.	Effects of acute supplementation of arginine-aspartate in acute muscular fatigue in trained volunteers.	Sales RP; et al.
2005	Rev. de Salud Pública - Universidad Nacional de Colombia.	Physical load and maximum working time acceptable in a supermarket workers in Cali, Colombia.	Ariza LE; Hidrovo AJ.
2006	Journal of Applied Physiology.	Effects of arterial oxygen content on peripheral locomotor muscle fatigue.	Amann M; et al.
2007	Revista Gaúcha de Enfermagem.	Workloads between the communitarian agents of health.	Trindade LL; et al.
2008	Bioscience Journal.	Metabolic and neural Bases of fatigue during exercise.	Moreira PVS; Teodoro BG; Magalhães-Neto AM.
2008	Rev. de Administração em Saúde.	Influence of working environment on performance and wear of professional health care team.	Sessa RM; et al.
2008	The Journal of Physiology.	Locomotor muscle fatigue modifies central motor drive in healthy humans and imposes a limitation to exercise performance.	Amann M; Dempsey JA.
2008	La Biblioteca Cochrane Plus.	Advice on manual material handling and supporting devices for the prevention and treatment of low back pain in workers.	Martimo KP; et al.
2009	Journal of Physiological Anthropology.	Relationships between force and muscle oxygenation kinetics during sustained static gripping using a progressive workload.	Demura S; Nakada M.
2009	Revista Fisioterapia e Pesquisa.	Evaluation of lactic acid in patients with hemiparesis cerebrovascular post-accident after electrical stimulation for muscle strengthening.	Corrêa FI; et al.
2009	Revista Fisioterapia Brasil.	The organisation of work and risks to ler/dort: a case study of the mount in the industry sector.	Bernardes JM; Renner JS.
2009	Motriz. Revista de Educação Física - UNESP.	Effect of speed race on electromyographic and metabolic variables.	Fraga CHW; Silva SRD; Gonçalves M.
2010	Caderno de Saúde Pública.	Self-assessment of health and working conditions among workers of primary health care centers in Brazil.	Garcia LP; Höfelmann DA; Facchini LA.
2010	Revista Latino-Americana de Enfermagem.	Psychosocial aspects of work and musculoskeletal disorder in nursing workers.	Magnago TSBS; at al.
2010	Revista Electrónica Salud Mental, Alcohol y Drogas - Redalyc.	Psychic loads of work and workers wear from the nursing teaching hospital of Paraná, Brazil.	Secco IAO; Robazzi MLCC; Souza FEA; Shimizu DS.
2010	Journal of Applied Physiology.	Mechanisms of aerobic performance impairment with heat stress and dehydration.	Cheuvront SN; et al.
2011	Revista Gaúcha de Enfermagem.	Workloads and working conditions of Nursing: integrative review.	Schmoeller R; et al.
2011	Fisioterapia em Movimento.	Workload analysis of systems analysts and musculoskeletal disorders.	Guimarães BM; et al.
2011	Ciência & Saúde Coletiva - Redalyc.	Factors determining the workload in a basic health unit	Silva NR.

Figura 1. Algumas características das publicações sobre carga de trabalho e fadiga muscular que compuseram a amostra do estudo. Maceió, 2012. (n=22)

The data indicate that the selected items are apportioned to the understanding of the relationship between workload and physiological signs of overwork, making it justifiable to conduct research that cast lights on the ability to determine a biological marker capable of alerting when the worker is overstepping his bounds of physical exertion. The studies address the problem from different angles,

provided clarification on the physiological processes of response to workload until the evidence of the result of the work of occupational categories subject to various disorders generators work.

The results can be better visualized if analyzed from the distribution of this scientific production, according to the descriptors defined as exposes the Table 2:

Table 2. Distribution of selected publication on work load and muscle fatigue, according to the data base and adopted descriptors. Maceió, 2011

Database/vvr tual Library Descriptors	Overwork		Muscle Fatigue		Workload AND Muscle Fatigue		Total	
	f	%	f	%	f	%	f	%
SciELO	1	12,5	2	22,2	-	-	3	13,6
Lillacs	7	87,5	7	77,8	-	-	14	63,5
Pubmed/Medline	-	-	-	-	4	80,0	4	18,3
Cochrane	-	-	-	-	1	20,0	1	4,6
Total	8	100,0	9	100,0	5	100,0	22	100,0

Most publications (87.5%) selected from the *workload* descriptor was found in the LILACS, as well as most of the articles that have addressed the descriptor "muscular fatigue" (77.8%). An article with the descriptor workload was found simultaneously in LILACS and SciELO and decided, for the purposes of analysis, include it in the LILACS, since it showed the database which brought together the largest number of contributions.

Articles found on PUBMED and COCHRANE were characteristic of the two descriptors defined approach, showing that the five publications obtained in these bases treated directly if relations seeks to establish between work load and muscle fatigue. The analysis of its contributions brings evidence that the workload, especially when associated with the volume and intensity of effort, triggers the release

of substances such as lactic acid, can be measured by laboratory testing.

To analyze the data on the dependent variable, second block of data in this review, the articles were read thoroughly and highlighted according to the contributions that offered to strengthen the possibility of establishing a biological marker for overwork, in case the blood lactic acid level.

The readings and reflections emerged statements which enabled agglutinate the contributions so that a read first pointed the evidence contained in the material studied. The statements can be seen in Figure 2, in which they are cited in many publications each of the statements appeared. To facilitate the monitoring of the discussion, every statement was treated as a category a priori. Thus, the number of times that appears is not equivalent to the number of selected articles.

Statement/Contribution	N.º de articles which is described
1- Metabolic processes of fatigue or determinants of change of lactic acid	12
2- Variation of Lactic Acid in or after muscular fatigue situation	7
3- Evaluation of physiological load of work or professional workload analysis	11
4- Analysis of risks arising from work overload	9
5- Workload analysis of patients with musculoskeletal disorders	3
Total	42

Figura 2. Contributions of articles for the study. Maceió, 2011.

The majority of contributions (12) were on the understanding of the metabolic processes of fatigue or of the determinants of changes of lactic acid. This is significant because it refers directly to the possibility of establishing relations between fatigue and alteration of this acid. It was identified the existence of 11 articles dealing with physiological work load ratings or directly on analysis of the workload of certain professions.

It is important to register that nine contributed publications discussing the risks arising from work overload, while seven evaluated the variation of lactic acid in muscle fatigue, or shortly after the subject had been submitted to a state of muscular fatigue, demonstrating that the measure of the lactic acid in these situations is often changed. Three articles were ahead and contributed with results of analyses of the effects of the workload in subjects already

suffering from repetitive strain injuries or work-related musculoskeletal diseases present.

DISCUSSION

The data analysis presented brings in first line notice that the researchers' interest by the issue of the effect of the work on the worker has been growing over the past ten years, although in very different contexts. Most published studies addressed the work of athletes submitted to exercise controlled, evidencing that muscles subjected to effort (muscular work) emit physiological signs to be measured by the presence of certain substances in the blood. One of them is the lactic acid.

The scientific community's concern with the relationship between working time and overwork is reflected in the existence of publications housed in databases of worldwide

like PUBMED and the COCHRANE library. In this review, articles were found in the four databases searched, with most LILACS (54.6%), which can be seen as a significant sign of two aspects, the first relates to the efforts of Latin America and the Caribbean to find answers to the problems faced in overcoming social inequalities, marked by precarious working conditions, prolonged journeys both in the production of goods and services production. Two publications were found to deepen that analysis to argue that workers subjected to mental work overload and pressure develops physical disturbance and stress.⁹⁻¹⁰

The search for the recognition of technological advances in the control of the effect of physical effort to boost sports *performance* justifies the appearance of many articles in databases, because the interest in showing the other countries in Latin America there are also investments in the area's evidence, including the volume of production found in LILACS, demonstrating the commitment and the meticulous work of ibero-American scientific community and the Caribbean.

The predominant language in articles selected were the Portuguese, though they have been also found documents in the English language, which ratifies the efforts of researchers to publish the results of their research internationally, whereas this is the accepted language in PUBMED and COCHRANE databases exclusively. The SciELO and LILACS accept articles in Portuguese and Spanish.

These publications suggest possibilities for advances in the eyes of researchers of worker's health, discuss both the risks inherent to workloads as their consequences and ways of perception by workers about the effects of these loads in industry and services sectors, including the health. In this phase of development of science, are to seek methods and protocols are able to assess metabolic changes that occur in conditions of muscle fatigue.

In relation to contributions of articles for the understanding of the issue, it was evident that the first of these, on the descriptor *workload*, many authors have endeavored to clarify its concept. In summary, it was concluded that the workload refers to the volume, quantity and intensity of work, including taking into account the relationship of the team and its form of organization, i.e. both what is executed as the conditions and staff sizing have relevance in the process. So, to ensure health and safety at work, we need to understand what the maximum load of

physical work that can be supported during the daily labor activity.^{1,811-2}

It is emphasized that there is a physical and mental dimension in this workload, the first associates the physical effort in carrying out labor activities, in which the quality and the amount of effort spent by the employee expresses the physical load of the workday. Mental overloads already refer to the need for concentration, reasoning, decision-making and memory.^{9,11}

Furthermore, a study shows that worker process factors that interact among themselves trigger changes in bio-psychics processes of the body of the worker, classified as "loads of materiality" external (physical loads, mechanical, biological and chemical) and internal (physiological and mental loads) to that body, even if are established through them.²

Seeking the relationship of the workload with the labor of nursing, a study of the nursing staff of a basic health Unit (BHU), where were identified the physical and mechanical loads to which they are subjected on a daily basis, concluded that one of the physiologic and most frequently encountered neuro-psychics, underscore the arterial hypertension, changes in sleep-wake rhythm in attention and memory as well as the manifestations of anxiety, distrust, inquietude, insecurity, pessimism and depression.¹³

Understanding these consequences of nursing work is important not only to relate the workload with the interferences in the interpersonal relationship of the team, forms of organization and environmental conditions, but mainly brings out the worldwide interest about this issue regarding the reflection on the quality of care provided and the new forms of work that category management.⁸

These workloads, particularly when high, commit to obstruction of blood volume, increased blood pressure, heart rate and pain sensation and therefore the muscle fatigue. That's because it's a consensus among multiple authors that the repercussions of overwork in the human body is on the musculoskeletal system that, through the release of chemical substances by the body in the bloodstream, can trigger a muscle strain or increase it, when existing. Thus, it is clear that muscle metabolism disorders, stress and other factors affect the sense of worker's effort, in which fatigue after exercises with accumulation of maximum amounts of lactic acid.^{9,14-16}

With this evidence, even if there is "a high correlation between the increase in lactate ion concentration and the decline of strength

and performance during high-intensity exercise, the increase of this ion has little or no role in the fatigue process.^{17: 85} This inverse correlation between lactate and peak tetanic tension is dependent on the high correlation between lactate and the ion H^+ free, being H^+ responsible for this fatigue. Lactate has, then, two targets: "a final product of anaerobic glycolysis, or an important metabolic intermediate of aerobic Glycolysis."^{17: 85}

On this aspect, a survey conducted at the *University of Wisconsin Medical School*, Madison's city-United States of America, with the goal of determining the concentration of lactate in the blood of athletes before and after exercise corroborates with this understanding, because it concludes that, despite the changes of arterial oxygen cause significant changes in metabolism, the amount of peripheral fatigue measured before and after activities have been identical.¹⁸

Taking as reference the fatigue occurs after activities with accumulation of acid, another article, whose main objective was to verify the time needed to rest to avoid the onset of muscle fatigue in hemiparetic individuals due to cerebrovascular accident (AVE), through the determination of lactic acid, concluded that the tool used (electrical stimulation) was not effective in detection and measurement of muscular fatigue, since no statistically significant difference was recorded in the value of this marker before and after therapy.¹⁶ Still, blood lactate increase may lead to decreased performance, due to acidosis caused by the accumulation of H^+ which was dissociated from lactic acid, therefore decreasing the pH. This state is associated with a reduction of the power produced by Glycolysis inhibition by inhibiting the enzyme PHOSPHOFRUCTOKINASE generates energy supply disruption, causing fatigue.^{1.19}

After all this exposed, studies still argue that the detection of blood lactic acid is a standard procedure for estimating the intensity of physical exercise or as a criterion of maximum exhaust, this is because the scientific knowledge has proven that high intensity activities, the major routes of supply of adenosine triphosphate (ATP) are the breakdown of Creatine phosphate and the degradation of muscle glycogen into lactic acid. This reduction of muscle glycogen content is related to the onset of fatigue, demonstrated by the change of lactic acid rate.^{6, 16,20}

With this review, it was possible to identify as a contribution for the descriptor concept *muscle fatigue*. That fatigue has

multifactorial etiology and can be conceptualized as an inability of the muscle to keep certain power or sustain a level of performance during a physical activity. Therefore, it deserves to be prevented or treated to no end by generating work-related musculoskeletal diseases - DORT-compromising functionality and the ability of reproduction of the labor/employee force.^{6, 17.21}

It should be noted that there are individual differences in activities that require physical exertion before reaching the peak of the feeling of muscular fatigue.^{14.22} although many data showing the crucial role that fatigue on exercise performance, due to its inhibitory influence on the central motor^{18 .23} drive, there are still shortages of studies that suggest the ideal time to detect it and what would be the best marker to your measurement.

We must differentiate central peripheral fatigue fatigue. The first takes place in one or more levels of nerve structures that interfere in the activity, causing physical changes since the central nervous system through the recruitment of axons engines. The second is due to a failure or limitation of one or more processes of motor neurons, peripheral nerves, neuromuscular connections and muscle fibers. Thus, "a muscle can perform contractions at high power with high concentrations of lactate, since the pH stay close to 7.0".^{6: 9} However, since muscle pH is less than 7.0, there is a decreased muscle power, relating to the etiology of peripheral fatigue with an intracellular accumulation of protons.⁶

Muscle fatigue can be induced by repetitive movements in the musculoskeletal system has no time required for recovery. When these conditions are worsening, there is the risk of developing diseases such as repetitive strain injuries (RSI), especially when other risk factors co-exist as high temperatures and realization of overtime.²¹ Today, musculoskeletal disorders pose a serious problem that affects workers' health, including in the area of public health, and its major risk factors are: Organization of work, environmental factors and possible overloads of muscle groups in certain movements. About the latter, include excessive force, the repetitiveness and postures.¹⁰

Thus, the adaptability of workers to the workplace must take into account the location, the nature of the work, the Organization, the method, the availability of auxiliary tools and instruments, as well as other physical factors such as lighting and

temperature in order to prevent diseases of the musculoskeletal system, with emphasis on backaches.²²

In General, can be taken as another contribution the fact some articles also address, in addition to physical overload, emotional wear and tear suffered by the worker, which can be influenced by a physical environment inappropriate, excessive, or stiffness of bureaucratic standards, lack of communication, lack of support, insecurity, bad weather in the interpersonal relationship of the team and ethical conflicts, among other factors.^{24,25}

This latest contribution brings out the aspect of the work of nurse who has relationship with the choice of the object of this research "relationship between workload and muscular fatigue", although refer to more subjective aspect of the matter. Even if there have been found many publications focusing on the subject in question have not yet been filled all the gaps of knowledge, possibly because it comes to ascertain the subjective points of the worker, with all intervening factors such as fear of losing their jobs, need for security, power games between competitive groups and many other nuances, which becomes important a production of scientific knowledge that anchor or deny these assumptions.

Anyway, it's up to the professional set his limit and the maximum ability to perform certain tasks in order to reduce your mental wear and the feeling of exhaustion. The problem is that, typically, he realizes his limit after overtake him.²⁶ Thus, it is justified to continue producing knowledge in this line until it can define, via clinical research, whether or not it is possible to define biological markers for overwork.

CONCLUSION

By holding this integrative review studies about the risks of work overload were found, on the variation of lactic acid in muscle fatigue, time is often changed, and articles that analyzed the effects of the workload in subjects already suffering from repetitive stress injuries or work-related musculoskeletal disorders. The articles analyzed presented evidence that there is relationship between workload, production of lactic acid and muscle fatigue, demonstrated that the higher the workload, the greater the effort, producing more lactic acid and generating muscle fatigue.

The areas of occupational health and sports performance are highlighted in the current situation, whereas there is a growing volume

of scientific publications. For this reason, the integrative review is a necessary exploration to establish evidence to support and justify further research, giving security to the researcher and reliability in the choice of the most appropriate methods.

The results presented, although they have pointed to links between work load and muscle fatigue, not even all the knowledge gaps in the area on the agenda, given the complexity of the relationships between work and worker, whose subjectivity has not yet been sufficiently explored in relation to its interference in the worker's fatigue, justifying the continuation of research on the subject. Indeed, it is concluded that there is a need to carry out studies aimed at identifying biological markers able to detect the limit the workload which the employee supports, before fatigue is established. The impossibility to relate directly the evidence reached in this study with nursing workers is a limitation which raises the realization of other studies related to the topic and supported in clinical research.

REFERENCES

1. Ariza LE, Idrovo AJ. Carga física y tiempo máximo de trabajo aceptable en trabajadores de un Supermercado en Cali, Colombia. Rev de Salud Pública. [Internet]. 2005 [cited 2005 Junio 6];7(2):145-56. Available from: <http://www.scielo.org/pdf/rsap/v7n2/v7n2a03.pdf>
2. Secco IAO, Robazzi MLCC, Souza FEA de, Shimizu DS. Cargas psíquicas de trabalho e desgaste dos trabalhadores de enfermagem de hospital de ensino do Paraná, Brasil. SMAD, Rev. Eletrônica Saúde Mental Álcool Drog [Internet]. 2010 [cited 2012 Nov 12];6(1):1-17. Available from: http://www.revistasusp.sibi.usp.br/scielo.php?script=sci_arttext&pid=S1806-69762010000100016&lng=pt
3. Portela LF, Rotenberg L, Waissmann W. Self-Reported Health and Sleep Complaints Among Nursing Personnel Working Under 12 h Night and Day Shifts. Chronobiol Int. 2004; 21(6):859-70.
4. Giomo DB, Freitas FCT, Alves LA, Robazzi MLCC. Acidentes de Trabalho, Riscos Ocupacionais e Absenteísmo entre trabalhadores de enfermagem hospitalar. Rev enferm UERJ [Internet]. 2009 Jan/Mar;17(1):24-9. Available from: <http://files.bvs.br/upload/S/0104-3552/2009/v17n1/a004.pdf>
5. Barboza DB, Soler ZASG. Afastamentos do trabalho na enfermagem: ocorrências com

trabalhadores de um hospital de ensino. Rev Latino-Am Enfermagem [Internet]. 2003 Mar [cited 2012 Nov 12];11(2):177-83. Available from:

http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-11692003000200006&lng=pt.
<http://dx.doi.org/10.1590/S0104-11692003000200006>

6. Santos MG, Dezan VH, Sarraf TA. Bases metabólicas da fadiga muscular aguda. Rev bras ciênc Mov. 2003 Jan; 11(1):7-12.

7. Pompeo DA, Rossi LA, Galvão CM. Revisão integrativa: etapa inicial do processo de validação de diagnóstico de enfermagem. Acta Paul Enferm [Internet]. 2009 Mar [cited 2012 Nov 12];22(4):434-8. Available from: <http://www.scielo.br/pdf/ape/v22n4/a14v22n4.pdf>

8. Schmoeller R, Trindade LL, Neis MB, Gelbcke FL, Pires DEP. Cargas de trabalho e condições de trabalho da enfermagem: revisão integrativa. Rev Gaúcha Enferm [Internet]. 2011 Jun Mar [cited 2012 Nov 12];32(2):[about 5 screens]. Available from: <http://www.scielo.br/pdf/rgenf/v32n2/a22v3n2.pdf>

9. Guimarães BA, Martins LB, Azevedo LS, Andrade MA. Análise da carga do trabalho de analistas de sistemas e dos distúrbios osteomusculares. Fisioter Mov Curitiba [Internet]. 2011 Jan/Mar Mar [cited 2012 Nov 12];24(1):115-24. Available from: <http://www.scielo.br/pdf/fm/v24n1/v24n1a13.pdf>

10. Magnago TSBS, Lisboa MTL, Griep RH, Kirchhof ALC, Guido LA. Aspectos psicossociais do trabalho e distúrbio musculoesquelético em trabalhadores de enfermagem. Rev. Latino-Am. Enfermagem [Internet]. 2010 June [cited 2012 Nov 12];18(3):429-35. Available from:

http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-11692010000300019&lng=en.
<http://dx.doi.org/10.1590/S0104-11692010000300019>

11. Silva, NR. Fatores determinantes de carga de trabalho em uma Unidade de Saúde. Ciência & Saúde Coletiva. 2011 Jan/Ago;16(8):3393-402.

12. Trindade LL, Gonzales RMB, Beck CLC, Lautert L. Carga de trabalho entre os agentes comunitários de saúde. Rev Gaúcha Enferm [Internet]. 2007 Dec Mar [cited 2012 Nov 12];28(4):473-9. Available from: <http://www.lume.ufrgs.br/bitstream/handle/10183/23586/000628516.pdf?sequence=1>

13. Farias SNP, Zeitoune RCG. Risco no trabalho de enfermagem em um Centro

Municipal de Saúde. R Enferm UERJ [Internet]. 2005 Mar [cited 2012 Nov 12];13(2):167-74. Available from: <http://www.facenf.uerj.br/v13n2/v13n2a04.pdf>

14. Demura S, Nakada M. Relationships between force and muscle oxygenation kinetics during sustained static gripping using a progressive workload. J Physiol Anthropol [Internet]. 2009 Mar [cited 2012 Nov 12];28(3):109-14. Available from: https://www.jstage.jst.go.jp/article/jpa2/28/3/28_3_109/_pdf

15. Cheuvront S N, Kenefick RW, Montain SJ, Sawka MN. Mechanisms of aerobic performance impairment with heat stress and dehydration. J Appl Physiol [Internet]. 2010 Mar [cited 2012 Nov 12];109:1989-95. Available from: <http://www.jappp.org/content/109/6/1989.full.pdf+html>

16. Corrêa FI, Corrêa JCF, Tassarolo AA, Melo AS, Sampaio LMM, Costa MS, et al. Avaliação do ácido láctico em indivíduos com hemiparesia pós-acidente vascular encefálico após estimulação elétrica para fortalecimento muscular. Fisioterapia e pesquisa [Internet]. 2009 Abri/Jun Mar [cited 2012 Nov 12];16(2):178-82. Available from: <http://www.revistasusp.sibi.usp.br/pdf/fpusp/v16n2/15.pdf>

17. Moreira PVS, Teodoro BZ, Magalhães Neto AM. Bases neurais e metabólicas da fadiga durante o exercício. Biosci. J [Internet]. 2008 Jan/Mar Mar [cited 2012 Nov 12];24(1):81-90. Available from: <http://www.seer.ufu.br/index.php/bioscienc/ejournal/article/view/6730/4441>

18. Amann M, Dempsey JA. Locomotor muscle fatigue modifies central motor drive in healthy humans and imposes a limitation to exercise performance. J Physiol [Internet]. 2008 Mar [cited 2012 Nov 12]; 586(1):161-73. Available from: <http://onlinelibrary.wiley.com/doi/10.1113/jphysiol.2007.141838/pdf>

19. Lima EV, Tortoza C, Rosa LCL, Lopes-Martins RAB. Estudo da correlação entre a velocidade de reação motora e o lactato sanguíneo, em diferentes tempos de luta no judô. Rev Bras Med Esporte [Internet]. 2004 Sept/Oct Mar [cited 2012 Nov 12];10(5):339-43. Available from: <http://www.scielo.br/pdf/rbme/v10n5/v10n5a01.pdf>

20. Sales RP, Miné CEC, Franco AD, Rodrigues EL, Pelógia NCC, Silva RS, et al. Efeitos da suplementação aguda de aspartato de arginina na fadiga muscular em voluntários treinados. Rev Bras Med Esporte [Internet]. 2005

Nov/Dec [cited 2012 Nov 12];11(6):347-51.
Available from:
<http://www.scielo.br/pdf/%0D/rbme/v11n6/a08v11n6.pdf>

21. Bernardes JN, Renner JS. Fatores de risco para LER/DORT no setor de montagem de uma indústria de calçados. *Fisioter. Bras.* 2009 maio-jun;10(3): 181-7.

22. Martimo KP, Verbeek JH, Karppinen J, Furlan AD, Kuijer PPFM, Viikari-Juntura E, et al. Manual material handling advice and assistive devices for preventing and treating back pain in workers. *Cochrane Database of Systematic Reviews* 2007, Issue 3. Art. No.: CD005958. DOI: 10.1002/14651858.CD005958.pub2.

23. Amann M, Romer LM, Pegelow DF, Jacques AJ, Hess CJ, Dempsey JA. Effects of arterial oxygen content on peripheral locomotormuscle fatigue. *J Appl Physiol* [Internet]. 2006 Feb Mar [cited 2012 Nov 12];101:119-27. Available from: <http://www.jappp.org/content/101/1/119.full.pdf+html>

24. Sessa RM, Kioroglo OS, Varallo SM, Bruscatto WL. Influência do ambiente laboral no desempenho e desgaste profissional da equipe de saúde. *RAS* [Internet]. 2008 Abr/Jun Mar [cited 2012 Nov 12];10(39):51-60. Available from: <http://www.cqh.org.br/files/ARTIGO39.pdf>

25. Garcia LP, Höfelmann DA, Facchini LA. Self-rated health and working conditions among workers from primary health care centers in Brazil. *Cad. Saúde Pública* [Internet]. 2010 May [cited 2012 Nov 12];26(5):971-80. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-311X2010000500019&lng=en

26. Martins CC, Valente GSC. A interferência do estresse na saúde ocupacional do enfermeiro que atua em emergência hospitalar. *J Nurs UFPE on line.* 2010 Apr/June Mar [cited 2012 Nov 12];4(2):533-8. Available from: <http://www.revista.ufpe.br/revistaenfermagem/index.php/revista/article/view/697>

Submission: 2012/03/16

Accepted: 2013/08/25

Publishing: 2013/12/15

Corresponding Address

Lenira Maria Wanderley Santos de Almeida
Edf. Copacabana
Rua Hamilton de Barros Soutinho, 307, Ap. 201
Bairro Jatiúca
CEP: 57035-690 – Maceió (AL), Brazil