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A RESEARCH PERSPECTIVE CONCERNING WORK RELATED
EARLY WEAR

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Abstract

This paper presents some results of a longitudinal study concerning the survey of a group of employees in the power field, in order to identify the possible work related wear phenomena and specific occupational risks. Aims: establishing a system of exposure indicators and biological response to the identified occupational risks and a long term monitoring procedure of the physical and psychophysical capacities and health state; settling measures to maintain the safety and health at work as well as the working capacity all along the working life. The study involved a multidimensional methodology, starting from the premise of the human operator situation in a complex work system whose parts are interconnected and, thus, the influence of work on the health state should be holistically analyzed. The study emphasized the occupational risk factors which can contribute, together with the extra-occupational and individual factors, to the etiological-pathogenesis of the investigated personnel' possible illnesses and the necessary measures in the OSH organisation policy. We consider the study as useful for the researchers and experts in occupational health and safety field.

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1. Introduction

The biological factors involved in the aging/wear process are complex and multifactorial (Green, 2003; Moraru, Babut, Cioca, 2014). The aging/wear represents overall physiological and psychological processes that modify the structure and functions of the human organism after adulthood. It represents the resultant of the intricate effects between genetic factors (“intrinsic” wear) and environmental factors operating on the organism during its lifetime. It is a slow and progressive process which should be separated from the effects of diseases. The aging/wear is defined by some anatomic, physiological, psychological and pathological characteristics lying in: modifications in the nervous system, muscular system, respiratory apparatus, cardiovascular apparatus, digestive and renal apparatus, bone system, epidermis, visual and hearing analyzers, immunity system and also psychological effects consisting in diminution of the performances related to some psychophysiological and mental capacities (Carter *et al*, 2004; Charnes, 2008; McEwen, 2002; Najjar, Scuteri & Lakatta, 2005). Inside OSH field, aging / wear can be considered from three points of view: chronological (age related); physiological and psychological (Toma, 2004). As life duration and the number of adult persons increased during the last century, the perspective of an aging workforce became very important (Green, 2003; Walters, 1998) the idea of social and individual utility/use of work activity for this category of persons has drawn the attention of scientific community as follows: on one hand, the problem of the aging employees’ role played in the productive work and services of the society; on the other hand, the question of the eventual influence of work on individual’s physiological wear process raised for consideration and if positive, under what conditions the work activity intervenes as an aging/wear precocious producing factor. However, the uppermost idea in the scientific area should be that the aging employees are not a group of population to be globally retired, but useful employees for the specific work and realizing a better life standard of all society members (Ilmarinen, 2001). The decrease in performance is influenced by many factors and that is why it is difficult to determine the age/precocious wear effect in this decrease (Harper & Marcus, 2006). The following issues should be studied now: the noxious occupational factors which could directly determine precocious aging; the noxious occupational factors which directly determine an accelerate aging rhythm and the declining of general health state through occupational or work – related diseases; sanogenic, prophylactic and therapeutic measures, coming from both occupational pathology and geriatric pathology, to prevent and control the precocious wear phenomenon.

2. Problem Statement

The precocious detection of some signs and symptoms of the reversible physical and mental diseases, reduction of work capacity, the occurrence of defective and risky work behaviours, which can emphasize the existence of a possible early wear risk of staff, together with the identification and supervision of occupational risks, are considered to be especially important within the framework of the pursuits on occupational safety and health.

3. Research Questions

This paper presents some partial results of a longitudinal study concerning the survey of a group of employees in the power field, in order to identify the possible work related wear phenomena and the specific occupational risks. The study questioned on the possibility of decreasing the capacities involved by work task performance, also if there are any symptoms concerning the health state (physical or mental) that can be correlated with occupational risks.

4. Purpose of the Study

The main objectives of the study were: determining a system of exposure indicators and biological response to the identified occupational risks and risk factors; establishing a long term monitoring procedure of the physical and psychophysical capacities and the health state of the personnel; settling some measures to monitor the health state, maintain the safety and health at work, optimal usage of the human resources in order to preserve the health state and working capacity all along the working life.

5. Research Methods

5.1. Data collection and measures

The study involved a complex ergonomic methodology, taking into account the premise of the human operator situation in a complex work system whose parts are interconnected and, as consequently, the influence of work on health state should be analyzed during a holistic approach. Using specific ergonomic methods and techniques, the study achieved the following issues: the work analysis for electricians working at high altitude and in installations under power; the analysis of work conditions; the analysis of specific work risks; the assessment of some physical and physiological capacities; the analysis of mental and physical health status.

Work analysis was performed using observations, documents study, monitoring the workday, interviews with employees, questionnaires.

Some psychophysiological investigations included: measuring the somato-metric indexes (corporal mass index), articular mobility indexes for the scapula – humeral, humeral – ulna, knee and dorsal – lumbar vertebral column articulations; measuring the segmental force indexes for palmar, scapula – humeral and lumbar flexor muscles and calculating the global index reported to the subject weight; Astrand test for assessing aerobic physical effort; cardiovascular functional tests (Teslenko, Crampton, Harvard and Ruffier); exploring some visual functions: binocular visual acuity (with and without present optical correction), simultaneous vision (binocular superposition and fusion), phoria and relief vision, post-obliteration adjustment function, chromatic vision.

There were also studied: the psychophysiological capacities – attention, perception (using Digital Tachistoscop) and the general personality traits (using personality inventories: e.g. Freiburg Personality Inventory); the neuropsychic load (through the work task indicators and the subjective assessment indicators of individual workload: TLX – NASA); the analysis of the physical and mental health state and the psychological stress level (through questionnaires, medical documents analysis etc.).

The values of the assessed capacities were referred to the normal average values for the corresponding age. The investigations were repeated after 6 months in order to detect eventual modifications. The indicators will be monitorized for a period of three years on the same group of participants from the investigated personnel categories through two annual assessments, in winter and summer, in order to precociously identify the eventual wear phenomena.

5.2. Population

The investigated group included 40 subjects, average age of 40,8 years. The total work seniority: 22,1 years and the present workplace seniority (with specific occupational exposure) – 16,3 years. From the total of 40 participants, 20 subjects are electricians working at high altitude electric lines and 20 subjects – electricians working in high power stations.

6. Findings

(1). Work analysis and the assessment of work conditions showed:

The activity of the electricians working at high altitude electric lines consists in revision, maintenance and repair work on the ground, on the power poles and in high power stations. The difficulty and risk levels of work carried out is amplified by: the power installations oldness, working in close vicinity of high power installations and in the presence of electromagnetic fields, the high physical load together with unfavorable meteorological conditions, irregular land and reduced number of staff. The activity of the electricians working in high power stations consists in: supervising and controlling the installations functioning, executing maneuvers and functional tests, liquidation of the damages in critical situations. The activity is organized in permanent work shift, mobile work shift for remote controlled stations and home confine. The alternant work shifts are positively perceived by the personnel.

The activity of the maintenance – repairing staff (electricians working at high altitude electric lines) is mainly developed outside, meaning exposure to unfavorable meteorological conditions: high or low temperatures, drought of air, rain, wind. Indoors, where the preparing activities are made, problems of discomfort microclimate can occur, such as inappropriate lightning.

The activity of the electricians working in high power stations is mainly developed indoors, inside the power stations and also in the outdoor station or during transport to the remote control stations. The working conditions are satisfactory, but they still need improving, as for the ergonomics of the workplace.

The conditions of the workplace and work station when working at height, revision and repair of technical equipment: long distances (involving operators' stretching out of the usual work area), too high or too low work plan, work plan demanding different handling levels, edges of work place elements or work equipments pressing on the muscles and tendons, unstable supporting points for feet, work places not allowing safe / comfortable manual handling.

The work analysis for the investigated personnel emphasized the exposure to a sum of accident and occupational sickness risk factors. The accident risks are mechanical, electrical, chemical and thermal and resulted from the use / operation and characteristics of the energetic equipment and installations, from the used working tools and instruments, the means of conveyance etc. The personnel is exposed to specific work environment sickness risk factors due to the work carried out inside and especially outside

such as: high / low temperatures, significant variations of the temperature, humidity and air flows speed; bad weather; insufficient lightning levels and lack of lightning uniformity; presence of gases, vapors and toxic aerosols; presence of electric and magnetic fields with effects in acute or chronic pathology, a specific symptomatology and specific reply indicators of the human organism.

The investigated electricians' activity involved the presence of ergonomic risks: a). the risk factors are especially related to the high physical work load, manual handling and transport, difficult maneuvers in awkward positions needing extreme articular angle movements, environmental work conditions, imposed work rhythm in urgent situations, eventual maintaining of an awkward or unstable position in carrying out the work task, using hands or body as a press to sustain different objects while carrying out work task. The characteristic issue for the physical load / ergonomic risks is working at high altitude power lines and covering difficult directions on foot, under possible extreme climatic conditions; b). the operative personnel' activity in the power stations is predominantly sedentary, with long static postural load, accentuated by the lack of the ergonomic layouts and outdoor activities involving average physical load under unfavorable climatic conditions, with eventual urgent requirements in interventions.

(2). The assessment of some physical and physiological capacities emphasized: the corporal mass index corresponds to the obesity for 14 subjects (35% of the participants); decreases of articular mobility in scapula – humeral articulation (32,5%) and knee articulation (57,5%); low level of force of palmary flexor muscles (77,5%) and of global force index referred to the subject weight (90%). Astrand test showed 70% of subjects with adequate effort capacity. Teslenko test showed good and very good cardiovascular capacity for 80% of subjects. Crampton test indicated good and very good index for 55% of subjects. Physical aptitude index (Harvard) and Ruffier index showed satisfactory to average physical status. The visual tests indicated the need for optical corrections for 43,9% of subjects.

(3). The assessment of the psychosocial risk factors emphasized the following occupational demands involving high work load and high physical and /or mental demands: the average level of some work tasks difficulty; the work rhythm and work breaks regime are not considered to be risk factors; temporal demands coming from hurrying in completing the activity – average level; the work load due to different occupational behaviours – high risk level; work precision in carrying out the different tasks – high level; repetitive nature of some operations – frequent (high level of risk) for electricians working in power stations; the need for communication and cooperation with different categories of persons – high level; work responsibility related to the risk of producing errors with important consequences – high level of risk; mental demands – over average level.

(4). The analysis/ assessment of the psychophysiological and mental capacities showed that: between 80 and 82.35% of subjects present over average levels of sensorial – perceptive and cognitive capacities; between 64.7 and 88.23% of subjects present over average levels of psychomotor capacities. There should be emphasized the better results for the hearing stimuli reaction time in comparison with visual stimuli reaction time.

The existence of the occupational risk and over-stress factors is considered to be a risk for the health state and it is reflected in the personnel morbidity. There is a clear “dominance” of the cardiovascular diseases and high frequency of the musculoskeletal disorders in the general pathology. Moreover, a high incidence of obesity, arterial hypertension and diabetes can be noticed. The morbidity for the electricians working in power stations is dominated by cardiovascular diseases (22,2%) –

increasing tendency with aging, and the locomotory apparatus diseases (15,7%) – the same level for all age groups, followed by Central Nervous System / sense organs diseases (13%), digestive diseases (12,9%) and respiratory diseases (12,6%). The electricians working at electric lines present the following morbidity situation: the first place is hold by respiratory diseases (24,1%), followed by locomotory diseases (21,9%), cardiovascular diseases (15,5%), digestive diseases (14,6%), Central Nervous System / sense organs diseases (especially refraction vices) (11,1% of subjects).

In the experimental investigations, some of the subjects accuse obesity, arterial hypertension, musculoskeletal disorders, visual disorders (glaucoma), vibration disorder, neurosensorial hypoacusis and diabetes, especially for the over 55 year old age group. As for job seniority, the cardiovascular disorders are highest rated for the subjects with 20 years and over seniority. This situation called for eventual occupational risk factors together with extra-occupational and individual factors due to lifestyle.

With regard to mental health, 100% of the subjects in the group of electricians working at electric lines and 93.75% of the subjects in the group of electricians working in power stations are within normal limits – comfort state and mental health, with the absence of eventual significant psychopathological symptoms, meaning mental well being and health state. The stress levels are between low and average, being related to occupational demands (such as mental and temporal demands and high responsibilities etc.) and moderated by control possibilities and work satisfaction general level. The work load level is between average (for routine situations) and high and very high (for high difficulty and responsibility interventions).

7. Conclusion

The specific risks of the investigated activities could have specific effects for every type of risk or multiple lesions whenever the cumulative action of many risks is present. The work accidents have as main impact – the impact on employee's body, affecting more or less the motor and sensorial, even cognitive performances. However, there is no work accident without psychical consequences together with the physical ones; the somatic impact is always doubled by psychical impact. The ergonomic risk factors are pertinent as well as occupational biological exposure indicators and are reflected in the health state, especially in the presence of musculoskeletal disorders.

By correlating the health state's situation and the analysis of the work demands addressed to the human organism due to work conditions, it could be stated that the occupational risk / stress factors together with other extra-occupational and individual factors could intervene in the etio-pathogenesis of some diseases of the investigated personnel.

From health state's perspective, the study emphasized that the present personnel is work function and workplace compatible. The subjects with chronic diseases and the ones with recent diagnostics were considered "conditionally able" and "temporary able", and mandatory specialized treatments and periodical supervision were mentioned.

The investigations of physical and physiological functions and capacities showed the present levels of performances, as the reference level in the future supervision of the studied electricians' performances. The results of every assessment were referred to the general population norms. Even if some indicators presented low levels, there should be noticed the good physical effort capacity of the

personnel and their adjustment to the work task demands. These aspects are in compliance with the results of periodical medical examinations.

The assessment of psychophysiological and mental capacities showed over average levels for the majority of the studied subjects and the constant levels of the sensorial – perceptive and cognitive demands in the different stages of the study. Cases of ascendant evolution tendency – improvement of the capacities – were also noticed.

For an optimal development of the activities, without risky behaviours with serious material and human consequences, the different personnel categories should present adequate levels of the occupational capacities (skills, general personality traits, professional training and experience) corresponding to the complexity and the levels of the work demands specific to both normal and abnormal (incident or damage) work situations. Moreover, the personnel should be permanently able to mobilize their capacities (eventually at maximum level) and cope with changeable effort, from under – load to over – load.

The study allowed to obtain preliminary data that are to be considered as reference data for the actual situation of the morbidity and the levels of different functions and capacities of the investigated personnel. In the following two years, the longitudinal supervision of the health state, the levels of different physical, physiological and mental functions and capacities, the general personality traits, will emphasize the relationships between the work (under all aspects) and the health state, offer the possibility for a more judicious assessment referred to the occupational exposure to accident and sickness risk factors and allow the precocious detection of the reversible disease / decreases. Even if the personnel health state (and the general population one as well) raise many problems to be solved, the achieved steps in optimizing the personnel health state supervision and the progresses obtained in OSH field should continue the same ascendant evolutive way. The supervision of the personnel health state should be correlated with the specific occupational risk factors and legislation requirements. This aim cannot be achieved without really knowing and understanding the actual workplaces, functions, demands, work conditions and the organism reply to all these work demands.

Completing the research includes also proposal for improving the working conditions and ergonomics of the workplaces.

The study could not benefit, as starting point, of epidemiological and demographical data related to the investigated population of employees (due to the inexistence of a centralized statistics). Therefore, the study intended that its results to be starting data for a longitudinal monitorization of this population.

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