Effects of shiftwork on superoxide dismutase activity (SOD) in Military Police Oficers

Efeitos da troca de turnos sobre a atividade da superóxido dismutase (SOD) em Policiais Militares

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Resumo

Objetivo: O objetivo deste estudo foi avaliar a atividade da superóxido dismutase (SOD) em policiais militares de um município brasileiro. **Métodos:** foi desenvolvido um estudo epidemiológico descritivo transversal com indivíduos do 2° batalhão da Polícia Militar em Mato Grosso, Amazônia Legal, Brasil. Dois questionários validados foram utilizados para caracterizar a população estudada e os problemas de sono, sendo o estresse avaliado segundo o inventário de sintomas de estresse de Lipp (LSSI). Foi coletado o sangue e determinada a concentração sérica da CuZn-SOD(E.C.1.15.1.1). **Resultados:** entre os policiais que trocam de turno, um terço tiveram redução da atividade da SOD. Entretanto, a redução da atividade da SOD foi maior nos policiais que não trocavam de turno (42%). **Conclusões:** a troca de turnos pode favorecer os fagócitos na re-síntese de SOD que é um biomarcador da explosão respiratória componente essencial na defesa frente a patógenos microbianos. A troca de turno teve efeitos positivos diminuindo o fardo do estresse oxidativo.

Palavras chave: superóxido dismutase, estresse, troca de turno, sono, policial militar

Abstract

Objectives: this study aimed to assess the Superoxide dismutase (SOD) activity among police officers from a Brazilian city. **Methods:** It was performed a descriptive cross-sectional epidemiological study covering subjects from the 2nd Military Police battalion in Mato Grosso, Legal Amazon, Brazil. Two validated questionnaires were used to charactherize the studied population and sleeping disorders, and stress was evaluated by the Inventory of Stress Symptoms for Adults by Lipp (LSSI). In 54 police officers blood were collected and serum CuZn-

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SOD(E.C.1.15.1.1) levels were determined. **Results:** Among military officers who shiftwork, one third had impaired SOD activity. However, the impaired SOD activity was higher among police officers who did not shiftwork (42%). **Conclusions:** Shifwork can give phagocytes a chance to resynthesize SOD which is a biomarker of the respiratory burst activity which is an essential key against microbial pathogens. Shiftwork had positive effects decreasing the burden of oxidative stress.

Key words: superoxide dismutase, stress, shiftwork, sleep, military

Introduction

Stress includes a set of organic reactions associated with physical, psychic, neuroendocrine, cardiovascular, immune and renal changes affecting the homeostasis as proposed by Hans Selye.[1] Stress is considered a public health problem that raises costs for the individual, employer, and society.

Proposed by Selye in 1936, the general adaptation syndrome has three basic stages: alarm reaction, resistance, and exhaustion.[2,3]

Alarm phase is the initial conscious or unconscious reaction to a stressor characterized by physiologic changes to counteract the stressor. The sympathetic nervous stimulation results in substantial release cathecolamins, adrenocorticotrophin, cortisol, and antidiuretic hormone, leading to increased heart rate, blood pressure, sodium and water retention due to the stimulation of renin-angiotensin-aldosterone system. Then, during alarme phase people have headaches, abnormal blood pressure, irritability, insomnia, and tachycardia.[4]

As an adaptation to the stressful situations, resistance phase is a compensation response to the alarm stage. The adaptation phase could be chronicized causing fear, nervousness, hair loss, changes in appetite and social isolation.[4].

Unable adjustment to a chronic stressor causes exhaustion which compromise homeostasis and is characterized by the onset of heart disease, gastrointestinal disorders, and depression. In some cases it may lead to shock, multiple organ failure, and subsequently death.[4]

Lipp has characterized a fourth stage of stress, between the resistance and exhaustion phases, being called near-exhaustion. This phase occurs when the individual becomes unable to adapt or resist to a stressor, leading to the beginning of disease pathogenesis.[5,6]

Occupational stress can discharge organism energy affecting productivity and satisfaction at the workplace.[3,4,7] Stressful working has been associated with physical and mental fatigue, cognitive losses, high blood pressure, cardiovascular disorders, behavioral problems, alcohol and drug addiction, and psychosomatic symptoms.[1,3,4]

Military Police workers should face conflicts, tensions, violence, poor health care support, society criticism and other factors that usually result in job insatisfaction and occupational distress.[1,4,8,9] Shiftwork is another factor that disturbs police life resulting in a chronobiological disruption associated with disorders, immunological impairment, and sleep quality problems.[10,11]

Superoxide dismutase is a biomarker of respiratory burst activity which is an essential key for killing pathogenic bacteria, fungi, and protozoa.[12-14] In order to metabolize superoxide free radicals (O_2^-) anions avoiding its excessive amounts the SOD enzyme converts superoxide anions to hydrogen peroxide (H_2O_2)[11].

Many studies with animal models of both acute and chronic stress have been showed impaired SOD levels among stressed animals.[15-19].

Then, the aim of this study was to evaluate the SOD activity and stress symptoms among police officers who shiftwork or not.

Subjects and Methods

This study was an observational, descriptive, and prospective investigation regarding SOD levels in military policemen and women who shift work or not.

The study population consisted of 54 military police officers from the 2nd Military Police Battalion of the State of Mato Grosso (2nd Battalion / MT), Barra do Garças, Brazil. This population of police officers was characterized by male predominance (81%), with aging ranging from 22 and 44 years old (mean of 30 years), e.g., this is a relatively young population with 6 to 10 years of service time, and 51% had incomplete college level. According to the Stress Symptoms Inventory for Adults (LSSI) 52% of the sample was not stressed, but 48% of participants had clear stress symptoms. 70% of police women were found in some stage of stress and 43% the policemen had also been stressed as previously published.[6,14]

Data were collected in the second battalion, on previously scheduled days during the second semester of 2010.

Determination of CuZn-SOD concentration (CuZn-SODdE.C.1.15.1.1)

Police officers (54) were randomly assigned in order to measure the serum SOD activity. SOD was measured in during service entry and after service exit. The CuZn-SOD enzyme concentration was determined using the nitroblue tetrazolium test (NBT; Sigma, St Louis, USA) and read at 560 nm with the spectrophotometer.[20] A 0.5 mL volume of serum samples was placed in test tubes, and 0.5 mL of standard hydroalcoholic solutions (1:1 v/v) were prepared in other tubes. Both samples of sera and the standard solutions were added to 0.5 mL of chloroform-ethanol solution (1:1 ratio) followed by 0.5 mL of a

reactive mixture of NBT and diaminoethanetetraacetic acid at a 1:1.5 ratio (v/v). After 2.0 mL of carbonate buffer plus hydroxylamine were added, pH increased to 10.2.24 The tubes remained at room temperature for 15 minutes and underwent spectrophotometrical reading. The reactive mixture reached zero values (for 3.5 mL). The SOD was calculated by the following relationship: SOD= (Ab standard_Ab sample/Ab standard) X 100 = % reduction of NBT/CuZn-SOD. The results were expressed in international units of CuZn-SOD.

Statistical analysis was performed using analysis of variance (ANOVA), and the nonparametric test Mann-Whitney for comparing two independent samples, and nonparametric Kruskal-Wallis test for comparing three or more independent samples by BioStat2.0® software.

Following the Brazilian Ethical resolution No.196/10/1996, the study design was submitted and approved by the Research Ethics Commitee of the "Júlio Müller University Hospital" from the Federal University of Mato Grosso (protocol nº 601/CEP-HUJM/09).

Results

Comparing the SOD values during job service entry and exit, the enzyme activity was strongly impaired among police with administrative working but not among those directly working in street operations (Figure 1).

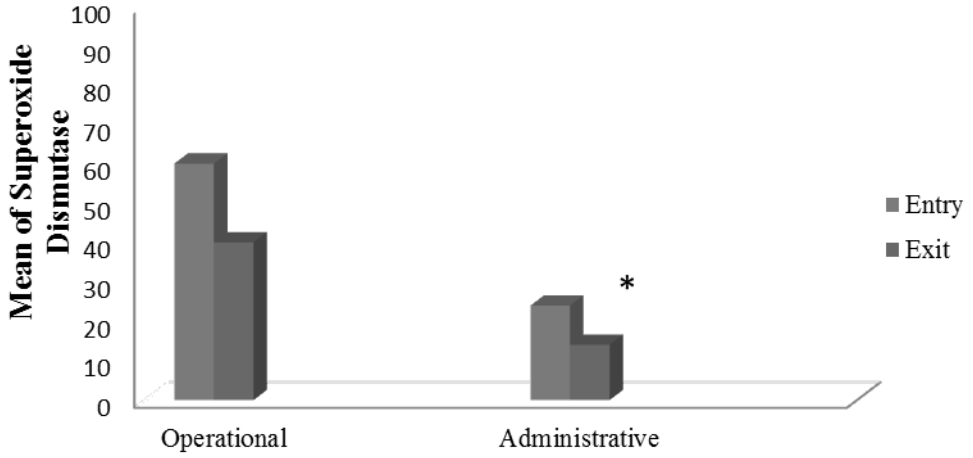

Figure 1. Superoxide dismutase mean values in Military Police officers (n-54) at entry and exit from working according to type of function.

* p=0,0048 in the exit according to service function

SOD levels were lower among police workers who did not shifwork compared with that did (33% and 42%, respectively).

Discussion

Recent insights into the molecular mechanisms of myocardial infarction revealed that lower SOD levels were closely associated with increased risk of myocardial injury[21,22]. In fact, decreased SOD levels have been associated with hypertension, kidney damage, myocardial ischemic injury, pancreatic damage, and stroke[23-30]. On contrary, SOD overexpression rescue cell death in vital organs (brain, kidney, heart) decreasing diseases' risk and its complications[20-23,30].

This study is the first report regarding decreasing SOD activity among police officers. Police working is a chronic stressful job. So, impairment of SOD activity could be a plausible finding. Unexpectedly, police workers who shiftwork experienced a lesser SOD decay compared with who did not shiftwork.

Maintainance of adequate SOD levels is important to avoid infections which are typical among in diabetic and chronic granulomatous disease patients[13,31], and in cardiovascular and brain protection after ischemic injury[12].

Our results could be plausible considering data from a Switzerland and Norwegian police staff studies which reported inadequate working schedules, lack of chief and organizational support, and bad working conditions as the major risk factors for both stress and psychiatric disorders[32,33].

Although this study confirmed that both operational work and shifwork had less impact on SOD levels, this study was limited by small sample size, absence of an adequate control group, its transversal design, and the absence of similar studies on the subject for adequate comparisons.

Conclusions

Police women suffered from more stress than policemen. Women officers had predominantly the exhaustion stage of stress. Since lacking of hobbies and leisure-time activities were strongly associated with stress among police officers in France[34], further studies are necessary to address the potential benefit of preventive strategies as stated by Cooper[35], and more research is also relevant to evaluate the value of lifestyle factors such as physical activity, adequate nutrition and body composition, avoidance of smoking and alcoholic beverages, and availability of leisure-time activities on the stress symptoms of police officers during shiftwork. This can explain why police officers who shiftwork had a lower impairment of SOD levels than those who did not.

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