

The effect of low-frequency electromagnetic field (ELF-EMF) on serum total antioxidant capacity (TAOC) and on total oxidant stress (TOS)

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Abstract

Background: This study was carried out on individuals who constantly use Blow/Hair- dryers in Hair-dressing saloons. We have investigated the possible effects of electromagnetic fields.

Method: In the study, 32 subjects selected randomly (mean age:24±6) were divided into two groups: Group 1 (n=16, 8 males and 8 females using Blow-dryers) as experimental group; and Group 2 (n=16, 8 males and 8 females never using Blow-dryers) as control group. Total Antioxidant Capacity (TAOC) mmol Trolox Eqv/L and Total Oxidant Stress (TOS) μmol H₂ O₂ Eqv/L levels of the sera taken from the subjects were measured by an autoanalyzer. Statistical analyses of the data obtained were performed by using SPSS 15.0 Windows Package Program.

Results: In the study, TAOC and TOS values measured for males and females in both groups were compared separately by taking the same-genders into consideration. TAOC levels for males in control group were measured as mean±std= 0.72±0.05, for males in experimental group as mean±std=0.49±0.07, p<0.0001. TOS levels for males in control group were found as mean±std=9.92±1.5, for males in experimental group as 6.77±1.5, p<0.001. TOS levels for females in control group were found as mean±std=0.58±0.08, for females in experimental group as mean±std=0.40±0.05, p<0.0001. In the study, it was seen that TAOC and TOS values of individuals who use constantly blow/hair dryers in hairdressing saloons and who are exposed to electromagnetic field varied significantly.

Conclusion: It is concluded that radiation plays a significant role in revealing these molecules that play a part in the etiopathogenesis of many diseases, and thus preventive measures should be strictly taken, and exposure time should be taken under control through a limitation in workers

Keywords: TAOC, TOS, extremely low –frequency electromagnetic field, Blow dryers

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Introduction

The limited number of published studies relationship between the oxidative status and Extremely low frequency electromagnetic fields (ELF-EMF). The body produces energy by burning carbohydrates and fat; in other words, oxidation must take place. These metabolic reactions normally result in the formation of free oxygen radicals, which play a role in the defense against foreign substances and infectious agents¹. The body maintains a balance between the various pre-oxidative factors that affect the system and the antioxidant system created to counteract these. When antioxidant defenses are weakened, body cells and tissues become more prone to develop dysfunction and/or disease. Then, the maintenance of adequate antioxidant levels, but not overdosage, is essential to prevent or even manage a great number of disease conditions². Extremely low frequency electromagnetic fields originated from many sources such as high voltage transmission lines, household electric wiring and appliances etc have increased due to the high demand for electrical energy. When excessive oxidative stress occurs, the body responds to restore harmony balance. “With increase of EMF producing equipments and environmental exposure, public concern about the side effect of EMF on biological systems and risk to human health has been also increased”³.

The aim of this study to investigate the oxidative status of the persons who constantly use Blow/Hair-dryers in Hair-dressing saloons.

Materials and Methods

In this study, 32 subjects selected randomly (mean age:24±6) were divided into two groups: Group 1 (n=16, 8 males and 8 females using Blow-dryers) as experimental group; and Group 2 (n=16, 8 males and 8 females never using Blow-dryers) as control group. Individuals were excluded from the study; smokers, if findings showed congenital anomalies, chromosomal anomalies, metabolic disease, and systemic disease or any other disease that would cause free radicals to form. The subjects were told not to eat, drink, or take any antioxidant medicine for 3 hours before the blood samples were collected. Blood samples were withdrawn into heparinized tubes from a cubital vein and then stored immediately in ice. Plasma was separated from cells by centrifugation at 3000 rpm for 10 min. The plasma samples were stored at -80°C until analysis. Total Antioxidant Capacity (TAOC) mmol Trolox Eqv/L and Total Oxidant Stress (TOS) $\mu\text{mol H}_2\text{O}_2$ Eqv/L levels of the sera taken from the subjects were measured by an autoanalyzer.^{4,5} The details of the study were explained, and all the participants provided informed consent. The study protocol was approved by the local ethics committee.

Statistical analysis

Statistical analysis of the data obtained were analyzed using SPSS for Windows version 15.0 (Chicago, IL, USA). The values are expressed as the mean \pm SD the control group and the experimental group separately. Qualitative variables were assessed using the student t test. The differences between groups were analyzed using the Mann-Whitney U test. $p < 0.05$ was accepted as significant.

Result

In this study, TAOC and TOS values measured for males and females in both groups were compared separately by taking the same-genders into consideration. TAOC levels for males in control group were measured as mean±std= 0.72±0.05, for males in experimental group as mean ±std = 0.49±0.07, p<0.0001. TOS levels for males in control group were found as mean±std=9.92±1.5, for males in experimental group as 6.77±1.5, p<0.001. TOS levels for females in control group were found as mean±std=0.58±0.08, for females in experimental group as mean±std=0.40±0.05, p<0.0001. The results of comparison of TAOC and TOS parameters are presented in Figures 1 and 2.

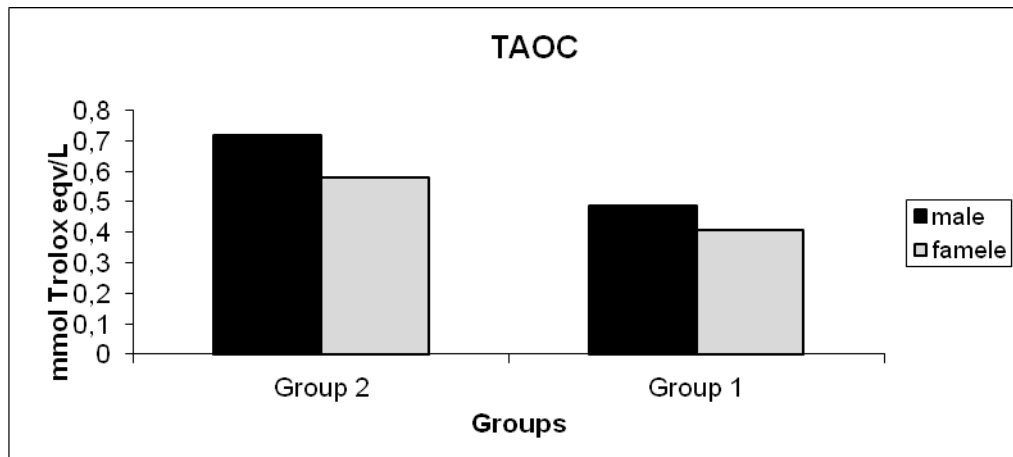


Figure 1. TAOC values (mean ± SD) for the two groups TAOC - total antioxidant capacity, Mann - Whitney U test

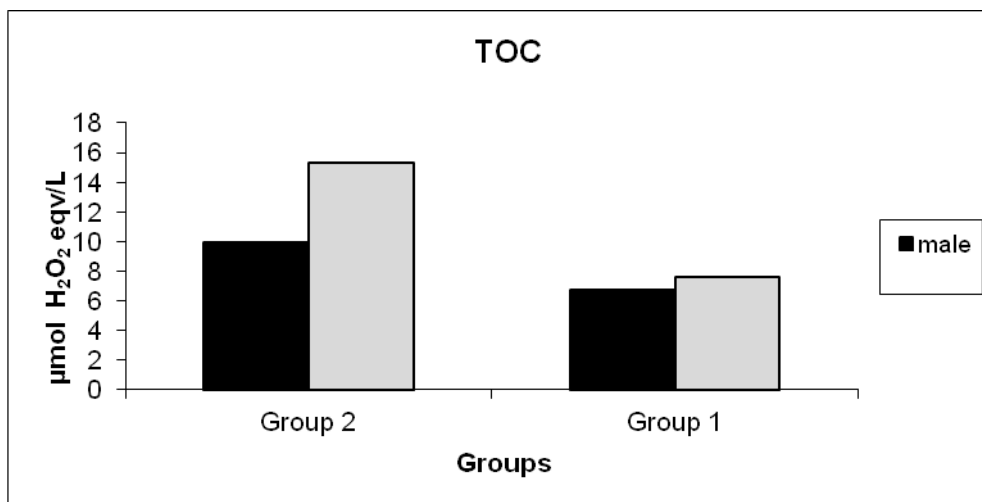


Figure 2. TOS values (mean ± SD) for the two groups TOS - total antioxidant status, Mann - Whitney U test

Discussion

In this study, it was seen that TAOC and TOS values of individuals who use constantly blow/hair dryers in hairdressing saloons and who are exposed to electromagnetic field varied significantly. It is concluded that radiation plays a significant role in revealing these molecules that play a part in

the etiopathogenesis of many diseases, and thus preventive measures should be strictly taken, and exposure time should be taken under control through a limitation in workers.

Effects of ELF MFs on oxidative reactions have been reported in a few studies and studied the responses of the land snails to 50 Hz MFs. Changes in activities of antioxidant enzymes were found following 10-day or 2-month exposures to MFs at 0.5 – 50 μ T⁷. It is difficult to evaluate the effects on organisms that are exposed to electromagnetic or magnetic fields. The main reason for this is the complex structure of biological systems⁸. Moreover, some researchers have recently linked the capacity of ELF-MF to activate immune relevant cell types to the free radical-based physiological changes detected following field exposure. In this context, very recently some of us have demonstrated that ELF-MF exposure causes significant changes in antioxidant capacity⁹. Another study, exposure of rats to ELF-MF (40 Hz, 7 mT, 60 min/day for 2 weeks) resulted in the decrease of plasma antioxidant capacity. Results indicate that effects of ELF-MF on antioxidant capacity of plasma depend on its working time¹⁰.

It was found a similar outcome in terms of declining of antioxidant capacity, Although some of the aspects of the work of Markkanen and Falcone are not resembled to ours. Duration of the applied energy is important as indicated in the study of Goraca. In our study, we found a significant reduction in levels of TAOS and TOS that can be used as an example for similar studies in the future. For that reason, we thought that it may be accepted as an important result.

There are several mechanisms changing the levels of molecules rolled in antioxidant systems. However, the effects of ELF-MF can be obtained like these studies.

Note: Magnetic field of Blow/Hair Dryers:⁶

3 cm distance (μ T) : 6 – 2000

30 cm distance (μ T) : 0.01 – 7

1 m distance (μ T) : 0.01 – 0.03

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