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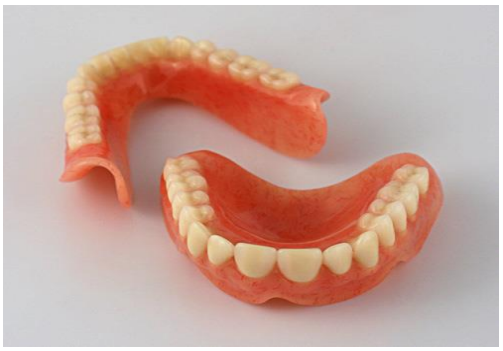
Research Paper



Clinical and Immunological Evaluation of FarGALS Efficacy during the Process of Adaptation in Patients with Removable Plate Prosthesis Depending on Age.

Nigmatullaevich AA.
J. Life Sci. Biomed., 7(4): 37-41, 2017;
pii:S225199391700007-7

Abstract
Patient adaptation to complete removable plate prosthetics (different types) is one of the acute problems for dental specialists. In addition, some factors including the negative impact of prosthetics on the condition of prosthetic bed, the function of the salivary glands, immunological reactivity, microbiological diversity of oral cavity and insufficient quality of prosthetics manufacture and design features, contribute to the problem. This study aimed to evaluate FarGALS efficacy during the process of adaptation in patients with removable plate prosthesis depending on age. Patients were divided into two control and treatment groups consisted of 3 internal patient groups. Control group included 19, 43 and 37 patients (1^{st}-3^{rd}, respectively) was treated with the traditional method. Treatment group included 23, 52 and 45 patients (1^{st}-3^{rd}, respectively) was treated with FarGALS. Patients of this group after meal at bedtime performed the processing of removable plate prostheses and rinsing them 3-4 times during the day by diluting FarGALS with distilled water (1: 4). Antibacterial and anti-inflammatory properties of the drug FarGALS directed against the risk of pathogen attachment and appearance of inflammation in the oral cavity. Therefore, optimal conditions are created to stimulate the activity of neutrophilic leukocytes and macrophages, which leads to the destruction of pathogens of inflammatory surfaces, and intensive filling of the mucosal defects. In conclusion, FarGALS is safe and effective drug which can be used in patients with removable plate prosthesis.

Keywords: Plate Prosthetics, Inflammation, FarGALS
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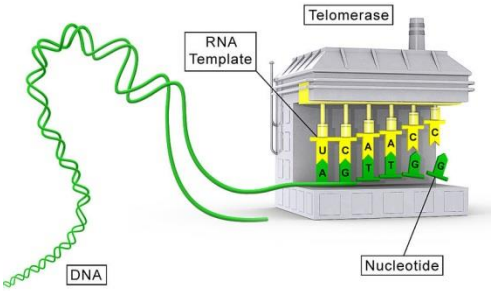
Review



A Review of the Effects of Electromagnetic Fields on Telomere-Dependent Life Span in Human and Experimental Animal Models.

Chekani Azar S.
J. Life Sci. Biomed., 7(4): 42-50, 2017;
pii:S225199391700008-7

Abstract
At current decade, electromagnetic fields (EMFs) and its beneficial or hazardous biological effects is subject of so many studies on human and animals. This paper reviews the effects of EMFs on telomere shortening throughout the life span of human and some animal models and also the importance of major antioxidants in reducing the damage caused by free radicals in the body under exposures. Some studies tried to show the role of oxidative stress in telomere shortening that inevitably directed biological experiments to the use of antioxidant vitamins for telomere stability. Based mainly on biological and epidemiological studies, *in vitro* experiments not only showed positive results with antioxidants, but *in vivo* studies are always getting attention, due to other biological factors that might influence the telomere shortening. Telomere length and telomerase activity assessed in animal cells, tissues and organs may determine telomere stability (off-again) and carcinogenesis (on-again) relationship and life span. In contrast to human, rodent telomeres are generally much longer and express telomerase in many tissues. The rapid death following reproduction observed in rodent especially mouse species is much different and so these model organisms are not a good representative of human aging mechanisms. However, the rat model might be more feasible than mice in studying the effect of oxidative stress and ageing. Animal models such as dogs, bird species, and cattle have been observed that does share more similarities in telomere and telomerase biology with humans, respectively. Although, investigations indicate that telomere length and telomerase activity can be a promising genetic biomarker for chronic oxidative stress caused by free radicals due to long-term exposure to environmental factors like EMFs as part of human daily lives, but there is a need for more research on the role of telomere shortening on inflammatory diseases progression, cancer and the various factors leading to cell senescence, such as heredity and other ageing.

Keywords: Human and Animal studies, Electromagnetic fields (EMFs), Mobile phone, Radiation, Health risk, Oxidative stress, Telomerase, Telomere shortening, Cancer, Ageing, Antioxidants
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Clinical and Immunological Evaluation of FarGALS Efficacy During the Process of Adaptation in Patients with Removable Plate Prosthesis Depending on Age

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ABSTRACT

Patient adaptation to complete removable plate prosthetics (different types) is one of the acute problems for dental specialists. In addition, some factors including the negative impact of prosthetics on the condition of prosthetic bed, the function of the salivary glands, immunological reactivity, microbiological diversity of oral cavity and insufficient quality of prosthetics manufacture and design features, contribute to the problem. This study aimed to evaluate FarGALS efficacy during the process of adaptation in patients with removable plate prosthesis depending on age. Patients were divided into two control and treatment groups consisted of 3 internal groups. Control group included 19, 43, and 37 (1st-3rd, respectively) was treated with the traditional method. Treatment group included 23, 52, and 45 (1st-3rd, respectively) was treated with FarGALS. Patients of this group after meal at bedtime performed the processing of removable plate prostheses and rinsing them 3-4 times during the day by diluting FarGALS with distilled water (1:4). Antibacterial and anti-inflammatory properties of the drug FarGALS directed against the risk of pathogen attachment and appearance of inflammation in the oral cavity. Therefore, optimal conditions are created to stimulate the activity of neutrophilic leukocytes and macrophages, which leads to the destruction of pathogens of inflammatory surfaces, and intensive filling of the mucosal defects. In conclusion, FarGALS is safe and effective drug which can be used in patients with removable plate prosthesis.

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Keywords
Plate Prosthetics, Inflammation, FarGALS

INTRODUCTION

In the current era, there is an urgent need for production of new effective drugs against pathogenic microorganisms resistant to current antibiotics and chemotherapeutic treatment [1]. In this regard, the high antimicrobial activity of a new biotechnological drug (FarGALS) against a wide spectrum of pathogenic microorganisms, suggests that it can be effective against the risk of pathogen attachment and appearance of inflammation in the oral cavity or in treatment of different diseases associated with this pathogen [1-3].

Adaptation to complete removable plate prosthetics is acute problem for dental specialists. The negative influence of prosthetics on the prosthetic bed of the oral cavity, the function of the salivary glands, immunological reactivity, microbiological diversity and insufficient quality of prosthetics contribute to the actuality of the problem. It is especially relevant to the elderly patients; at who, along with the complete loss of dental rows, the adaptive capabilities of the body, including the oral cavity, are sharply reduced and do not positively resist the negative effects associated with removable prosthesis [4-6].

Unreasonable and uncontrolled use of chemotherapy leads to the formation of strains with resistance to drugs. This can be avoided by using antiseptic drugs that have a broad antibacterial spectrum and do not induce microbial resistance [6-9]. Further application of the medicinal forms of antiseptics for topical application is undoubtedly a very promising direction, as it allows changing the nature of the effect on the humoral and cellular inflammation factors in the adaptation period while using complete removable plate prostheses [6, 7, 10].

The particular interest from the point of view of the use of new medicines forms for the use of complete removable plate prostheses lays in the influence of FarGALS on local immunity and bacteriological parameters of the oral cavity of elderly patients using complete removable plate prostheses and on the process of adaptation to them. The drug FarGALS is included in the pharmacotherapeutic group: antiseptic wound-healing agents.

MATERIAL AND METHODS

Patients were divided into two control and treatment groups. Control group consisted of 3 internal groups included 19 patients as 1st group, 43 as 2nd group, 37 as 3rd group, was treated with the traditional method. Treatment group consisted of 3 internal groups included 23 patients as 1st group, 52 as 2nd group, 45 as 3rd group, was treated with FarGALS. Patients of treatment group after meal at bedtime performed the processing of removable plate prostheses and rinsing them 3-4 times during the day by diluting FarGALS with distilled water (1: 4).

Patients of group 1 were from 40 to 59 year-old after the start of traditional therapy. Patients of 2nd group were from 60 to 74 year-old and patients of 3rd group were from 75 to 90 year-old. At the background of the treatment, immunological and microbiological studies were conducted in dynamics with admission, and data were collected on day 15, and day 30 of treatment.

Ethical approval

The review board and ethics committee approved the study protocol and informed consents were taken from all the participants.

RESULTS AND DISCUSSION

As has been shown in elderly patients with complete absence of teeth, at the seeking orthopedic care, there is a violation of local immunity in the form of deficiency of PhAN (Phagocyte Activity of Neutrophils), PhI (Phagocytose Index), lysozyme, secretory sIgA in the oral cavity, depending on the age aspect. In this connection, it is of interest to study the effectiveness of the current therapy of impaired local immunity in the process of adaptation to removable prostheses, depending on the method of treatment for these body indices. The results of the study are presented in Table 1.

Table 1. Level of content of local immunity parameters in mixed saliva in patients of the 1st group (from 40 to 59 years) with orthopedic treatment in dynamics.

Items	Indicators	Baselines	15 days after treatment	30 days after treatment
Control group	PhAN in %	52.8 ± 0.82	54.4 ± 2.8	46.6 ± 2.26 $^{*\ \#}$
	PhI	4.06 ± 0.82	4.12 ± 0.21	3.95 ± 0.17
	Lysozyme (mg/ml)	19.3 ± 0.46	28.8 ± 0.86 **	19.5 ± 0.62 $^{\#\#}$
	SIgA (µg/l)	199 ± 6.0	226 ± 8.3 *	188 ± 9.2 $^{\#}$
Treatment Group	PhAN in %	52.8 ± 0.82	60.4 ± 1.9 $^{**\ °}$	52.0 ± 1.24 $^{\#\#\ °}$
	PhI	4.06 ± 0.82	4.83 ± 0.19 $^{**\ °}$	4.28 ± 0.17 $^{\#\#}$
	Lysozyme (mg/ml)	19.3 ± 0.46	32.2 ± 0.90 $^{**\ °}$	20.4 ± 0.58 $^{\#\#}$
	SIgA (µg/l)	199 ± 6.0	302 ± 7.8 $^{**\ °°}$	205 ± 7.9 $^{\#\#}$

The reliability of differences from baseline (**: P<0.001 and *: P<0.05); Data from 15 days ($^{\#\#}$: P<0.001 and $^{\#}$: P<0.05); and control data ($^{°°}$: P<0.001 and $^{°}$: P<0.05). PhAN = Phagocyte Activity of Neutrophils; PhI = Phagocytose Index.

As can be seen from the data of Table 1, in patients of group 1 (from 40 to 59 years after the start of traditional therapy), in patients receiving treatment with removable prostheses and oral rinsing, there were insignificant positive shifts in PhAN, lysozyme and sIgA values in local immunity on the 15th day of the study and were respectively 54.9±1.1%; 22.7±0.83 mg/ml and 226 ± 8.3 µg/l. It can be seen that only the lysozyme and sIgA

values are significantly higher in comparison with the initial indices (P<0.001 and P<0.05), respectively. However, on day 30 of the study, the local immunity indices of the 1st group of patients examined were below the normative value.

A very different picture was observed in group 1 patients (from 40 to 59 years after initiation of therapy (local treatment by FarGALS) on the day 15. a significant increase was observed on the part of the phagocytic index of neutrophils: if in the given group, on admission, the PhAN was averaged 52.8±0,82%, in the process of treatment with FarGALS, this index averaged 60.4 ± 1.9% and the number of positive samples normalized, these values were significantly higher in relation to the parameters before treatment (P<0.001) and the control group (P<0.05). However, at the FN of neutrophils derived indicators have not changed significantly in the first group of patients throughout the study and the number of positive samples in 30 days was equal to 26.1%.

Application of FarGALS drug in the patients of the treatment group led to the activation performance of lysozyme and sIgA content in the saliva of patients. At the patients aged 40 to 59 years, baseline activity of lysozyme and sIgA were 19.0±0.46 mg/ml and 199±6.0 g/l, whereas after use of FarGALS preparation for rinsing the mouth lysozyme activity and sIgA increased sharply and correspondingly was 32.2±0.9 mg/ml and 302±7.5 µg/l, the differences were statistically significant compared to the initial values of the control groups (P<0.001), respectively. The normalized water permeability (NWP) indicators also normalized. After adaptation to removable dentures by 30th day, these indicators came close to the initial indicators.

At the patients from 60 years to 74, PhAN content and lysozyme before and after using traditional mouthwash increased after 15 days, respectively, was 48,5±0,78% and 51.9±1.1%; 17.3±0.53 and 22.7±0.83 mg/ml (P<0.05 and P<0.001), the differences are statistically significant (Table 2). NWP was 20.9% and 13.9% in the group. It revealed significant shifts reliable indicators from the FF and sIgA oral cavity after 15 days (P>0.05), respectively, and found significantly higher NWP (27.9% and 30.2%). in other words, after 15 days at 43/13patients local immunity of the oral cavity In the 2nd group after using the traditional mouth rinse is weakened.

Table 2. The level of local immunity in the mixed saliva of the patients of 2nd group (60 to 74 years) in orthopedic treatment in the dynamics

Items	Indicators	Baselines	15 days after treatment	30 days after treatment
Control group	PhAN in %	48.5 ± 0.78	51.9 ± 1.1*	45.2 ± 1.31$^{*\,\#\#}$
	PhI	3.68 ± 0.07	3.92 ± 0.12*	2.81 ± 0.17$^{**\,\#\#}$
	Lysozyme (mg/ml)	17.3 ± 0.53	22.7 ± 0.83**	15.6 ± 0.75$^{\#\#}$
	SIgA (µg/l)	180 ± 8.9	200 ± 5.8	167 ± 4.56$^{\#\#}$
Treatment Group	PhAN in %	48.5 ± 0.78	55.1 ± 1.2$^{**\,\circ}$	49.7 ± 1.9$^{\#}$
	PhI	3.68 ± 0.07	4.12 ± 0.13**	3.76 ± 0.09$^{\#\,\circ\circ}$
	Lysozyme (mg/ml)	17.3 ± 0.53	25.7 ± 0.88$^{**\,\circ}$	19.6 ± 0.57$^{\#\#\#\,\circ\circ}$
	SIgA (µg/l)	180 ± 8.9	238 ± 4.5$^{**\,\circ\circ}$	192 ± 5.6$^{\#\#\,\circ\circ}$

The reliability of differences from baseline (**: P<0.001 and *: P<0.05); Data from 15 days (##: P<0.001 and #: P<0.05); and control data (°: P<0.001 and °: P<0.05). PhAN = Phagocyte Activity of Neutrophils; PhI = Phagocytose Index.

As shown by the results of studies in table 2, after 30 days of continuous use of complete removable dentures, despite the fact that patients regularly rinsed the mouth and dentures with conventional rinse oral fluid, a significant decrease in the level sIgA- 12.1%, reduced lysozyme activity - 11.7%, PhAN - 15.8%, and the FF of 21.7% in saliva are reported compared with the control data.

At patients of the treatment groups by rinsing oral cavity and processing complete dentures with "FarGALS" positive local immunity changes are marked. After 15 days after the professional oral hygiene and the processing of dentures with "FarGALS" the level of local immunity (PhAN, the FF, lysozyme and sIgA) in all patients was increased. And correspondingly, the average indices for the group was 55.1±1.1%; 4.12±0.13; 25.7±0,88mg/ml and 238±4,5 mkg/l, the differences are statistically significant (P<0.001), respectively, with the baseline level. And the number of positive probes was only for the PhAN and PhI indicators 11.6%. With other words 88.4% of the surveyed subjects normalized. We also note that on the 15th day of the study, the local immunity indices (PhAN, PhI, lysozyme and sIgA) in patients within the 2-group (from 60 to 74 years) were significantly higher in comparison with the indices of patients in group 1 (P<0.05, P<0.05, P<0.001 and P<0.001), respectively. On the 30th day, these indicators decreased and were within the initial values. Indices of local immunity (PhAN, PhI, lysozyme and sIgA) in patients of senile age (from 75 to 90 years) with orthopedic treatment in dynamics are given in Table 3.

Table 3. Level of content of local immunity parameters in mixed saliva in patients of 3rd group (from 75 to 90 years) with orthopedic treatment in dynamics.

Items	Indicators	Baselines	15 days after treatment	30 days after treatment
Control group	PhAN in %	45.5 ± 0.90	47.1 ± 1.21	41.0 ± 1.85$^{*\cdot}$
	PhI	3.23 ± 0.1	3.61 ± 0.13 *	2.75 ± 0.18$^{*\,\#\#}$
	Lysozyme (mg/ml)	16.6 ± 0.53	20.3 ± 0.39 **	14.5 ± 0.78$^{*\,\#\#}$
	SIgA (µg/l)	169 ± 3.2	185 ± 8.3	156 ± 4.2$^{\#}$
Treatment Group	PhAN in %	45.5 ± 0.90	51.9 ± 1.51 $^{**\circ}$	46.1 ± 1.41$^{\#\#\,\circ}$
	PhI	3.23 ± 0.1	3.94 ± 0.12 $^{**\circ}$	3.76 ± 0.17$^{\infty}$
	Lysozyme (mg/ml)	16.6 ± 0.53	21.7 ± 0.52 $^{**\circ}$	17.5 ± 0.81$^{\#\#\,\circ}$
	SIgA (µg/l)	169 ± 3.2	196 ± 5.2 *	167 ± 4.7$^{\#\#}$

The reliability of differences from baseline (**: P<0.001 and *: P<0.05); Data from 15 days ($^{\#\#}$: P<0.001 and $^{\#}$: P<0.05); and control data ($^{\infty}$: P<0.001 and $^{\circ}$: P<0.05). PhAN = Phagocyte Activity of Neutrophils; PhI = Phagocytose Index.

As can be seen from the data given in Table 3 in patients of group 3 (from 75 to 90 years), after traditional therapy (with the processing of removable prostheses and rinsing the oral cavity) on the side of local immunity, the heterogeneous responses of PhAN, lysozyme and sIgA were observed on the 15th day of the study . It can be seen from the table that in all patients only the indices of PhI and lysozyme increased insignificantly. And accordingly, the average indices for the group were 3.23±0.1 and 16.6±0.53 mg/ml and above 3.61±0.13 and 20.3±0.39 mg / ml, the differences are statistically significant in comparison with initial indices (P<0.05 and P<0.001). The normalized water permeability (NWP) decreased by 54.8% and 32.9 to 35.4%. From the side indicators PhAN and sIgA on the 15 day study significant positive changes in comparison Baseline not detected (P>0.05), respectively. In the course of traditional treatment on the 30th day of the study, the local immunity indices significantly decreased in comparison with the baseline and control group parameters (P<0.001) and a sharp increase in NWP to (48.8, 57.3 and 46.3%), respectively were observed. Apparently, with the aging of the organism and the insufficiency of individual links of nonspecific immunity and the weakness of the controlling parts of the immune system in patients of senile age, a sharp decrease in the response of local immunity to the inflammatory process of the oral cavity occurred after removal of removable prostheses.

In patients of senile age, the main treatment groups when treating the oral cavity and rinsing complete removable dentures with FarGALS, a positive shift of changes in local immunity is noted 15 days after orthopedic treatment. The level of local immunity (PhAN, PhI, lysozyme and sIgA) in all patients significantly increased (P<0.001), respectively, compared with baseline. Moreover, the number of positive probes also decreased and amounted to an average of the group (26.6, 35.6, 24.4%). In other words, in 2/3 of the patients after the treatment, local immunity parameters were restored. After adaptation to removable dentures by 30th day, these indicators approached the initial values.

Thus, when studying the dynamics of the values (PhAN, PhI, lysozyme and sIgA) of these indices, it was shown that in patients in the treatment group, after the use of the FarGALS drug in orthopedic practice, there was a significant increase, in contrast to the comparison group, local immunity in all examined groups, which suggested a positive effect of FarGALS on local immunity. Despite extremely unfavorable conditions for the functioning of the tissues of the prosthetic bed, the use of FarGALS resulted in positive effects, that led to the preservation of the initial level of local immunity and the clinical effect after the application of prostheses. Whereas with traditional orthopedic treatment, this indicator significantly worsened after the application of prostheses, with further aggravation of this negative effect over time. It should be noted that the most pronounced differences between the patients of the observation and comparison groups were noted in the early period, that is, up to 15 days of treatment. An increase in the local immunity index indicates the activation of nonspecific immune defense of the oral cavity in patients of the treatment group. The increase in PhAN and FF indicates a response to pathogenic microorganisms, which are noted in patients with complete absence of teeth. PhAN and FF in the observed patients of the treatment group, were decreased by 30th day, which indicates the relief of inflammation.

CONCLUSION

In our opinion, antibacterial and anti-inflammatory properties of the drug FarGALS directed against the risk of pathogen attachment and appearance of inflammation in the oral cavity. As a result, optimal conditions are created to stimulate the activity of neutrophilic leukocytes and macrophages, which leads to the destruction of pathogens of inflammatory surfaces, intensive filling of the mucosal defect. The absence of an irritant effect on the mucous retains its integrity. The intact mucosa, especially the tissues of the prosthetic bed, is an important source of the epithelial layer covering erosion: the microenvironment activates a sufficient number of viable cells that activate healing, thereby guaranteeing the preservation of the oral microbiocenosis.

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Competing interests

The author declares that they have no competing interests.

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A Review of the Effects of Electromagnetic Fields on Telomere-Dependent Life Span in Human and Experimental Animal Models

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ABSTRACT

At current decade, electromagnetic fields (EMFs) and its beneficial or hazardous biological effects is subject of so many studies on human and animals. This paper reviews the effects of EMFs on telomere shortening throughout the life span of human and some animal models and also the importance of major antioxidants in reducing the damage caused by free radicals in the body under exposures. Some studies tried to show the role of oxidative stress in telomere shortening that inevitably directed biological experiments to the use of antioxidant vitamins for telomere stability. Based mainly on biological and epidemiological studies, *in vitro* experiments not only showed positive results with antioxidants, but *in vivo* studies are always getting attention, due to other biological factors that might influence the telomere shortening. Telomere length and telomerase activity assessed in animal cells, tissues and organs may determine telomere stability (off-again) and carcinogenesis (on-again) relationship and life span. In contrast to human, rodent telomeres are generally much longer and express telomerase in many tissues. The rapid death following reproduction observed in rodent especially mouse species is much different and so these model organisms are not a good representative of human aging mechanisms. However, the rat model might be more feasible than mice in studying the effect of oxidative stress and ageing. Animal models such as dogs, bird species, and cattle have been observed that does share more similarities in telomere and telomerase biology with humans, respectively. Although, investigations indicate that telomere length and telomerase activity can be a promising genetic biomarker for chronic oxidative stress caused by free radicals due to long-term exposure to environmental factors like EMFs as part of human daily lives, but there is a need for more research on the role of telomere shortening on inflammatory diseases progression, cancer and the various factors leading to cell senescence, such as heredity and other ageing.

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Telomere shortening,
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Antioxidants

INTRODUCTION

Currently people live in an invisible but dangerous ocean of electromagnetic radiation. We believe that cellphones are unhealthy at any speed or we need to be aware of the adverse health effects of environmental factors so that we can have the choice of taking precautions against the exposures. There are critical following questions: What is the evidence that wireless and EMF radiations is dangerous and is disturbing biology and impacting our genetic material and DNA, our present functioning as well as potentially jeopardizing the health of future

generations? What mechanisms can explain the beneficial or hazardous biological effects and links to various conditions? How are the effects of EMFs on telomere shortening, telomerase activity and aging or life span? What is the importance of natural antioxidants, i.e., vitamins A, E and C in reducing the damage caused by free radicals in the body under exposures? Learn why use of time, distance and shielding in radiation protection is important and essential to preserve optimal functioning and fertility, while legal technological efforts are currently pursued to assure safer communications technologies. Hence, to response the questions, findings in this review can provide a better understanding of the subject matter and issues involved.

In this review, special attention is paid to the effects of environmental factors like EMFs on telomere attrition of human and some animal models and also the importance of natural antioxidants in reducing the damage caused by free radicals in the body under exposures.

Detrimental effects of EMF on human and experimental animals

Nowadays, people are under exposure of various types of non-ionizing electromagnetic fields (EMF) that has increased due to wireless or the mobile handset and base station antennas. This new invisible environmental factor can affect gender, tissue density of the body, life span. The exposure levels to electromagnetic fields can penetrate the body and act on all the organs and tissues, altering the cell membrane potential and the distribution of ions and dipoles and therefore influencing the biochemical processes in the cell [1]. It has been reported that waves from the electromagnetic fields of cellular phones, can produce energy distribution and temperature in living tissues [2, 3]. In the long-term, these extremely low frequencies (ELFs) that are the International Telecommunication Union (ITU) designation for electromagnetic radiation (radio waves) with 3 to 30 Hz frequencies, and 100,000 to 10,000 kilometers wavelengths, respectively, cause some variations in the structure and biochemical properties of tissues [4, 5].

At current decade, EMFs and its hazardous or beneficial biological effects is subject of so many researches on human and animal models. In 2004-2005 some significant experiments has been conducted on the effects of EMFs on the nervous and endocrine systems [3, 5-7]. The results suggested that temperature is an important factor in the regulation of the release of endocrine hormones. For example, the activity of thyroid hormones increased under cold temperature and thyroid-stimulating hormone (TSH) secretion from the pituitary, and the release of T3 and T4 from the thyroid increased by acute psychological stress [8]. On the one hand, heat temperature is one of the wide varieties of factors which cause oxidative stress *in-vivo*.

It has been reported that EMFs and MFs cause an increase in lipolysis and glycogenolysis in adipose tissue of rodent model and also an increase in hormones such as thyroxin, glucagon and cortisol of particular interest as a stress indicator secreted by the adrenal glands [7, 10, 11]. Based on human studies of Radon et al. [12] it has been reported that exposure to EMF increased serum cortisol [12]. Vangelova et al. [13] reported significant high levels of stress hormones such as cortisol levels of physiotherapists and nurses due to long-term EMF exposure. The elevated levels of cortisol as a number one of public health enemy, have been known for years that interfere with lower immune function, bone density and learning and memory, increase weight gain, cholesterol, blood pressure, heart disease etc. However, the number of investigations on the negative long/short-term effects of EMFs on endocrine glands are still limited [9].

According to the studies about of biological effects of EMF emitted from cellular phones (GSM: 900MHz) on laboratory animals, it is reported that 900 MHz EMF make to change the rate of some endocrine hormones in the rats [9] and hamsters [14], also, It makes oxidative stress in the rats and rabbits [14, 15]. Lotfi and Shahryar [13] had showed that EMFs emitted by cellular phone can change serum testosterone and lipid concentrations in exposed male hamsters. Some of the related studies with different frequencies of EMF and magnetic fields (MF) showed that Magnetic fields (MFs) and EMFs may cause decrease in total cholesterol and triglyceride of plasma in human and laboratory animals [16-20]. Also, these effects were more significant in longer time period in exposure to MF and EMF [17, 19]. Although there have been many studies in the case of biological effects of EMF with different frequency and time periods, unfortunately it hasn't been studied any possible direct effects of cellular phone EMF (GSM: 900 MHz) on plasma lipids rate such as cholesterol and triglyceride.

Evidences of the hazardous effect of cellular phones on male fertility are still equivocal as studies have revealed a wide spectrum of possible of testicular damage [21]. Shahryar et al. [14] had reported exposure to cellular phones EMF can elevate sex hormone (testosterone) in male hamsters and also can changes secondary sex ratio [22]. It seems that the effects of mobile phones and EMF on progesterone and stress hormone such as cortisol and especially on telomere shortening and life span were not clearly studied in rodent, while more studies were performed on birds or other animal models. Exposure to EMF was studied in poultry at pre-incubation [23], during-

incubation [24, 25] or post-incubation [26]. It has been well documented that when conditions were optimal, chick embryos developed normally and hatched in approximately 21 d [17], but hatchery factors includes turning, vital gas exchange, temperature, humidity and other environmental factors [28] have been shown to affect embryo growth.

The environmental factors that are critical to the development of the embryo occur during the incubation and hatching processes and any alterations in these processes influences the metabolism and growth of embryos with possible consequent at post-hatch life and affect finishing outcome via changes in the efficiency of nutrient metabolism and utilization [29-30]. At current decade, researchers have done focused on other environmental factors in hatching process such as light color [29], electric fields [30] and electromagnetic fields (EMF) [24, 25].

During rearing period, regardless to hazardous effects of fields, EMFs could apply as anti-coccidiosis agent [31]. During incubation, embryonic exposure to EMFs had detrimental effects on embryo development and hatching results [25, 32]. Along with negative effect of EMFs on development, various studies had reported significant [33] or not significant [34] effects of EMFs (50-60 Hz) on organ weight in mammalian models. It seems that late stage exposure to EMF caused slow proliferation and morphogenesis in liver [35]. As regards internal organs, in mammalian model, Erpek et al. [34] had reported that liver weight didn't have significant change in exposure to 50 Hz, 6 mT for two months, 2 h daily. In hatchery experiments, Shafey et al. [30] reported lower proportions of liver plus heart plus gizzard in chicks exposed to electric fields when compared with those of the control birds.

Telomerase activity, Telomere shortening and aging

Telomerase is a ribonucleoprotein that is an enzyme which adds DNA sequence repeats ("TTAGGG" in all vertebrates) to the 3' end of DNA strands in the telomere regions, which are found at the ends of eukaryotic chromosomes. This region of repeated nucleotide called telomeres contains noncoding DNA and hinders the loss of important DNA from chromosome ends. As a result, every time the chromosome is copied only 100–200 nucleotides are lost, which causes no damage to the organism's DNA. Telomerase is a reverse transcriptase that carries its own RNA molecule, which is used as a template when it elongates telomeres, which are shortened after each replication cycle. Under normal circumstances, telomerase become shorter and shorter with each cycle of cell division. A sufficiently short telomere is believed to signal the cells to stop dividing. In the case of eukaryotic organisms, telomerases are composed of an accumulation of repeated defined nucleotide sequences (repeats), which for example contain the sequence TTAGGG in humans.

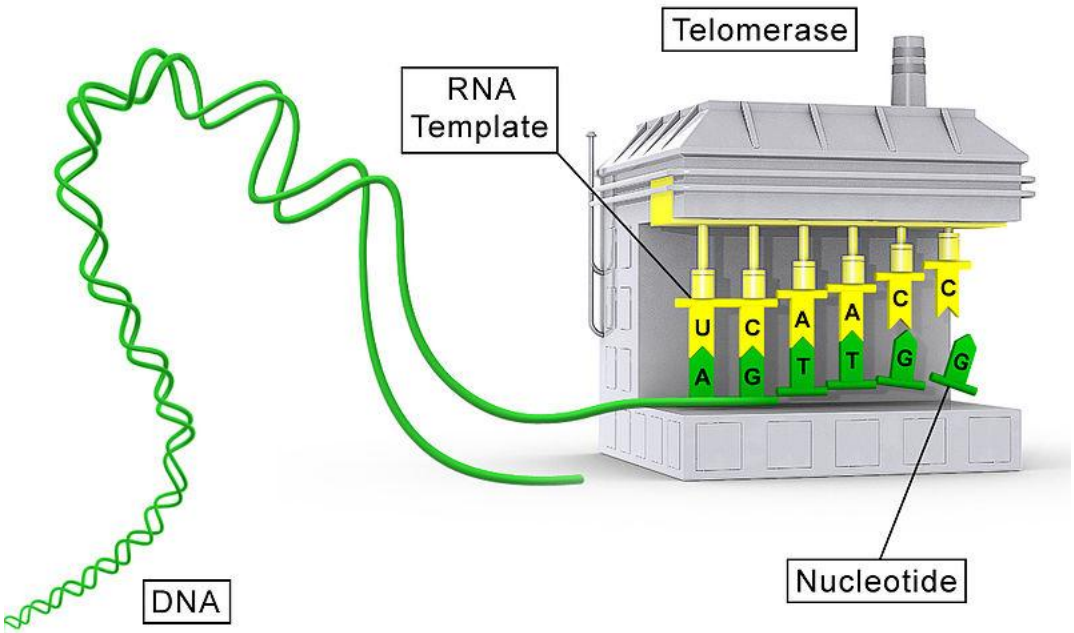

Figure 1. An illustration of a telomerase molecule. RNA-directed DNA polymerase. A conceptual diagram showing the protein component of telomerase (TERT) in grey and the RNA component (TR) in yellow [Author = Sierra Sciences, LLC (uploaded from intranet, February 19, 2009); Permission = Sierra Sciences has released this diagram under the Creative Commons]

Telomerase activity is expressed in most human tumor tissues but not in normal tissues except those of the germline (testes/ovaries). Stem cells of renewing tissues express very low levels of telomerase. Telomerase activity is occasionally detected in tissues adjacent to tumors possibly reflecting the presence of occult micrometastases.

It has been suggested that telomerase is responsible for the unchecked growth of human cancer cells. Unlike normal cells, in cancer cells telomerase appears to grant the cell immortality by maintaining telomere length so that the cell never receives a signal to stop dividing. The telomerase enzyme is an ideal target for chemotherapy because this enzyme is active in about 90 percent of human tumors, but inactive in most normal cells.

By contrast to stem cells and germ-line cells, telomeres in somatic cells shorten with each cell division leading to cellular senescence (ageing). The enzyme telomerase (cellular reverse transcriptase) is involved in telomere stability by synthesizing a new copy of the repeat by using its RNA template. Bodnar et al. [36] forced expression of telomerase in normal human cells by transfection of retinal pigment epithelial cells and foreskin fibroblasts with a vector encoding the human telomerase enzyme. Remarkably, these cells exhibited elongated telomeres, "divided vigorously", and proliferated at least 20 doublings beyond their normal life-span; in contrast, the control cells showed shortening of telomeres and senescence [36]. Thus, in typical somatic cells, human telomeres normally undergo shortening at each cell division, and when several kilobases of telomeric DNA is gone, cell division halts and senescence manifests.

Regulation of telomerase activity is an area of intense investigation, but its exact mechanisms are not yet elucidated. The contribution to telomere loss by oxidative DNA damage senescence cells were found to contain 30% more oxidative modified guanine in their DNA. Since oxidative modifications and shortening by reactive oxygen species (ROS) leads to aging of the somatic cells, it is expected that antioxidants and reactive free radical scavengers may play a preventive role and possess anti-ageing properties. Additional evidence for the role of ROS in telomere shortening was associated with chronic oxidative stress and inflammation.

Various models (animal types) have been developed and applied to investigate the relationship between telomere length and oxidative stress. And future studies should investigate the genetic determinants of telomere shortening and stability and to assess the effects of environmental factors that increase oxidative stress and chronic inflammation.

Antioxidant: Vitamins E and C

It has been recognized since the 1940s that vitamin E (α-tocopherol) is a powerful lipophilic antioxidant that is absolutely vital for the maintenance of mammalian spermatogenesis [37]. It is present in particularly high amounts in Sertoli cells and pachytene spermatocytes and to a lesser extent round spermatids [38].

Vitamin C (ascorbic acid) also contributes to the support of spermatogenesis at least in part through its capacity to reduce α-tocopherol and maintain this antioxidant in an active state. Vitamin C is itself maintained in a reduced state by a GSH-dependent dehydroascorbate reductase, which is abundant in the testes [39]. Deficiencies of vitamins C or E leads to a state of oxidative stress in the testes that disrupts both spermatogenesis and the production of testosterone [37].

Conversely, ascorbate administration to normal animals stimulates both sperm production and testosterone secretion [40]. This vitamin also counteracts the testicular oxidative stress induced by exposure to pro-oxidants such as arsenic, Bioaccumulation of polychlorinated biphenyl (PCBs) (Arochlor 1254), cadmium, endosulfan and alcohol [41-45]. Furthermore, endogenous ascorbate levels decrease dramatically when oxidative stress is induced in the testes by, for example, chronic exposure to lead, chromium, cadmium or aflatoxin [46-48]. Vitamin E has also been shown to suppress lipid peroxidation in testicular microsomes and mitochondria [49, 50] and to reverse the detrimental effects of oxidative stress on testicular function mediated by exposure to such factors as ozone, iron overload, intensive exercise or exposure to aflatoxin, polychlorinated biphenyls (PCBs), cyclophosphamide and formaldehyde [41, 45, 46, 51-55]. Furthermore testicular vitamin E levels have also been shown to fall significantly when oxidative stress is induced by exposure to pro-oxidant stimuli such as chromium [47]. Therefore, antioxidant nutrient supplementation especially vitamins E, C and A, selenium, zinc and chromium can be used to attenuate the negative effects of environmental factors as stress agents.

DISCUSSION

The role of oxidative stress in telomere shortening

These results and the role of oxidative stress in telomere shortening, inevitably directed biological experiments to the use of antioxidant vitamins in the prevention of telomere shortening [56]. Some studies supported this

suggestion. It was found that age-dependent telomere shortening in human vascular endothelial cells, *in vitro*, could be slowed down by an ascorbic acid derivative (ascorbate-2-O-phosphate). It led to an extension of the cellular life span and prevented cell-size enlargement (cellular indication of senescence) [57]. The same treatment of human embryonic cells with ascorbic acid phosphoric ester magnesium salt decreased the level of oxidative stress, prevented telomere attrition and extended the replicative life span of cells [58]. Another study *in vitro* by Yudoh et al. [59] chondrocyte senescence (risk for cartilage degeneration) has been used. These cells, chondrocytes, cultured in the presence of the oxidant H2O2 showed that oxidative stress induced telomere shortening and replicative senescence, but in the presence of ascorbate-2-O-phosphate the shortening was reduced [59].

Although *in vitro* experiments showed positive results with antioxidants, *in vivo* experiments are considered more important because other biological factor might influence the telomere shortening. Male and female rats were used for these types of experiments. Several oxidative stress markers were studied and the results showed that female rats exhibited longer telomeres than male rats. Expression levels of certain antioxidant enzymes, such as the mitochondrial antioxidant manganese superoxide dismutase (MnSOD), glutathione peroxidase (GPx) and glutathione reductase (GRx), in the renal cortex and medulla were found to be higher in female than in male rats. The explanation is that female rats have higher levels of estrogens, which enhance gene expression of MnSOD. The decreased antioxidant levels may be partially responsible for the age-related kidney telomere shortening [60, 61].

Proliferating fibroblasts exposed to buthionine sulfoximine, which depletes the antioxidant enzyme reduced glutathione (GSH, reduced Glutathione is a linear tripeptide, the molecule has a sulfhydryl (SH) group on the cysteinyl portion, which accounts for its strong electron-donating character), decreased telomerase activity, whereas repletion of cells with glutathione increased telomerase activity in a dose-dependent manner [62].

Italian researcher La Torre et al. in 1997 [63] found that the death of some cell lines was due to the sum of molecular damages caused by free radicals, and the subsequent loss of telomeric DNA. So short of the siRNA inhibition in cancer cells, what interventions can be affected for the health aspects? [64]. We have all heard of free radicals damage and on the contrary, health benefits of antioxidants. Science has progressed to the point that availability of antioxidants will allow the body to eliminate and or decrease the damage caused by free radicals (oxidative stress). Anti-oxidants are substances that are generally ingested and provide electrons to bind with dangerous free radicals and neutralize them in order for the body to dispose of them.

Different parts of the body are protected by different antioxidants. Structures containing lipids (fats) are mainly protected by the fat soluble vitamins A and E, whereas the water-soluble vitamin C helps us against free radicals in the blood, body fluids and within cells. If there was a method by which countless negatively charged ions could be delivered into your body (most of us aren't getting it from our cooked processed food diets anymore) would it not be totally beneficial. In the recent past, everyone was scrambling to find powerful anti-oxidants. The cause of aging, along with most of humanity's diseases, has been determined to be due, in large part, to actions of free radicals on our body.

We need to know which events speed up the pace of telomere shortening late in life although it can be associated with the cell's ability to withstand oxidative damage [65]. Meanwhile, the observed reduction in telomerase activity likely contributes to the acceleration in telomere erosion [67]. Therefore by the more antioxidants present in the body the less damage that occurs to the chromosome [68-71]. Telomere length is also directly related to life span and incidence of disease [72].

Which animal models have more similarities in telomere and telomerase biology with humans?

In contrast to human, rodent telomeres are generally much longer and express telomerase in many tissues. Telomere shortening is broadly studied in mice, especially in telomerase knockout mice [73, 74]. However, it is only after 4-6 generations that telomere shortening becomes a critical issue in these mice, indicating mechanisms of carcinogenesis and ageing [75]. The rapid death following reproduction observed in rodent especially mouse species is much different and so these model organisms are not a good representative of human aging mechanisms, however, scientists noticed that rat telomeres do not have to be modulated to detect shortening, so the rat model might be more feasible than mice in studying the effect of oxidative stress and ageing. Telomere length assessed in Wistar rats in the kidney, liver, lung and brain may determine life span (longevity). It was found that male rats have shortened life span compared to females [76, 77]. Telomere length has been investigated in dogs, cats, bird species, horses, and cattle as animal models for applicability of the research to human telomere and telomerase activity. These animals have been observed that does share more similarities in telomere and telomerase biology with humans [78-90].

CONCLUSION

People should be aware of the biological hazard and adverse health effects of EMFs as life stress. These studies have shown that electromagnetic fields as part of human daily lives can speed up the shortening of our protective telomeres and the ageing process because of chronic oxidative stress caused by free radicals, and people who rely on supplements and have a diet rich in major natural antioxidants or a good mixture of fruit and vegetables with high in antioxidants to help reduce the effects of these waves will live longer and healthier than those who don't.

However, although there is a long way to be able to assess the effects of environmental factors in life span, there is a need for more research on genetic determinants of telomere stability and other intrinsic and extrinsic factors leading to cell senescence and also the role of telomere shortening on inflammatory diseases progression, cancer and the various factors, such as heredity and other ageing.

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Competing interests

The authors declare that they have no competing interests.

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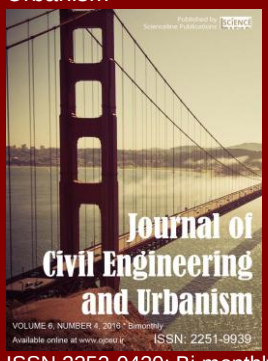

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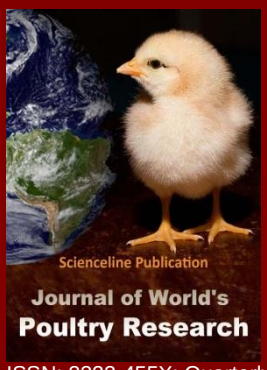

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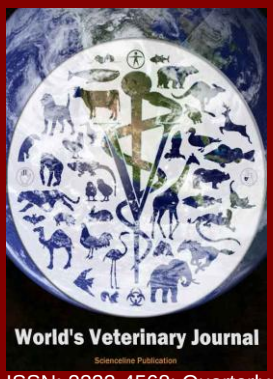

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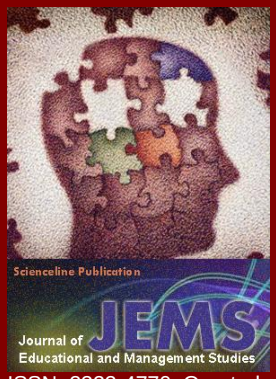

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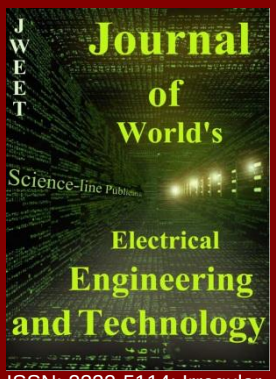

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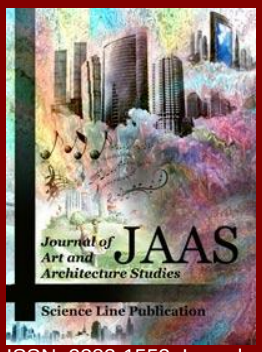

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