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EFFECT OF HEAD LICE INFESTATION AS ECTOPARASITES ON OXIDATIVE STRESS STATUS IN PRIMARY SCHOOL PUPILS AT LAYLAN CAMP FOR DISPLACED PEOPLE

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Abstract

The head lice infestation which is caused by *Pediculus humanus capitis* is one of the most important public health problems at children worldwide. The infestation stimulates the immunity system defending against the infection. The immune system generates toxic oxidants. If these oxidants are not sufficiently counteracted by the antioxidant system then a state of oxidative stress can occur. This study aims is to assess the oxidative stress status in the infested pupils of primary schools with pediculosis. 60 blood samples from both sexes (males and females) were collected from students at Laylan Camp for Displaced Primary School for girls and boys. The results of the current study indicate that there is a significant increase ($P<0.01$) in the concentration of Malondialdehyde MDA in the serum of pupils with head lice compared to control samples. However, a significant differences ($P<0.01$) were represented by a decrease in the activity of Glutathione(GSH),Catalase(CAT) and Superoxide dismutase (SOD) in the serum of the infested pupils compared with the control group of healthy pupils. The results also never indicate the role of gender and age in the infested and healthy group in influencing the levels of studied oxidative stress variables. Increased oxidative stress has a harmful effect and may play a role in the pathogenesis of several diseases.

Key words: Pediculosis, Oxidative stress, Malondialdehyde, Glutathione, Superoxide dismutase, Catalase.

Introduction

Lice are a wide rank, an external parasite of the human and, a vector to many diseases by nourishing on human blood. All types of lice belong to the order Phthiraptera, and are the only parasitic group amongst the exopterygote insects. Head lice got the attention of the public health around the world. Also, it affects individuals from different social and economic backgrounds of all ages, especially schoolchildren, individuals, refugees and, poor residents (Meister and Ochsendorf, 2016 ; Nazari *et al.*, 2016). For head, lice feed on the human blood, so the severe chronic injury among school students may lead to anemia, which is reflected in fatigue and drowsiness in the class, lack of educational performance and, cognitive function. Infested children may also be disturbed by sleep disorders during the night because of the severe itching (Gratz and WHO, 1997; Nordin *et al.*, 2006). In addition to the investigation in the lice in a psychological stance, social activity abuse of school and imbalance in the performance of young people (Al Bashtawy and Hasna, 2012). The most important areas of all kinds especially primary schools and displacement camps play an important role and a proliferation of headset in the direct propaganda and the lack of requirements of the healthy aspects (Nazari and Azizi, 2014). Several studies have reported that the human and animals infected with parasites undergo oxidative stress (Stocker *et al.*, 1985; Upcroft and Upcroft, 2001), as well as the antioxidant defense mechanism that exists between parasites and the animal host (Ueland *et al.*, 1986). In human allergic inflammatory diseases, such as helminthic infections, the associated influx of eosinophil's has been implicated as a primary source of tissue damage through their potent reactive oxygen metabolites production Petreccia *et al.*, 1987). This study aims at evaluating the oxidative stress status in the pediculosis-infested pupils in primary school at Laylan camp for displaced people.

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Materials and Methods

During the period of the study, hair and scalp were visual inspection to determine infestation of the head lice. 60 blood samples was taken from pupils, 30 blood samples infested with head lice, and 30 blood samples belong to non-infested pupils were considered as a control sample. Thirty of them were males and 30 were females. Their ages ranged from 6-18 years. The samples were collected from pupils at Laylan Camp for displaced people in the primary school for girls and the primary school for boys. 3 ml of blood samples were obtained from the vein of each pupil, and the blood was placed in test tubes free of anticoagulant for the purpose of separating blood and obtaining the serum by using a centrifuge at 3000 r / min for ten minutes after that the serum was pulled by micropipettes and put in small tubes and stored at - 20 ° C until use.

Oxidative Stress Markers

MDA and GSH levels, as well as CAT and SOD enzymes activities, were analyzed in the blood serum spectrophotometrically according to the methods of (Moron *et al.*,1979; Goth,1991; Rao and Ormrod, 1998 and.Fridovich, 1998). Respectively

Results

A. The Influence of Head Lice Infestation on GSH, CAT, SOD and MDA

The results (table 1) show a significant decrease in the level of antioxidant variables GSH, CAT, and SOD in the serum of the head lice infested pupils as compared with the results of the control or healthy group. The same table shows that the concentration of MDA *i.e.* the end result of lipid peroxidation significantly increased in the serum of pupils infested with head lice as compared with the results of healthy pupils group.

B. The Effect of Head Lice Infestation on GSH, CAT, SOD and MDA in Respect to Gender

The results of the current study as shown (Table 2) indicate that there were no significant differences in the level of GSH, CAT, SOD, and MDA between males and females infested with head lice. As a comparison between males and females infested with head lice and those healthy males and females, the results show a significant difference (P-Value = 0.0006, 0.001, 0.0004, 0.0007) respectively.

C. The Effect of Head Lice Infestation on GSH, CAT, SOD, and MDA in Respect to Age

The results (Table 3) show that there were no significant differences in the concentration of GSH, CAT, SOD, and MDA among the ages 8 -10, 11-13 and 14 -16 years in the infested groups. However, there were significant differences at the level of (P-Value= 0.0004, 0.020, 0.0003, 0.0006) respectively, as compared with the values of GSH, CAT, SOD, and MDA for the same age groups between the infested and the healthy groups.

Discussion

Oxidative stress is one of the potential biochemical mechanisms involved in the pathogenesis of several diseases. Normal cell functions and integrity of cell structures may be broken via considerable reactivity of reactive oxygen species (ROS). The organism has enzymatic and non-enzymatic antioxidant mechanisms that work as scavengers against ROS. Reduced glutathione is considered the main component of the thiol group and the basic cellular scavenger of free radicals.

Therefore, a decrease of glutathione in a group infested with head lice may reflect with the exhaustion of the reserve of non-enzymatic antioxidants. On the other hand, glutathione plays a prominent role in the defensive antioxidant system, and in catalytic regulatory of protein interactions, electron transport, and maintaining the correct synthesis of proteins (Madhikarmi and Murthy, 2011). Previous researches indicated that infestation with external parasites might lead to iron-deficiency anemia in humans and animals together (Burke, 2011; Hau and Muhi-lddin,2014;and Madhes *et al.*, 2019).

As the researcher Speare *et al.*(2006) conducted a study to measure the volume of blood taken from the stomach of head lice, they concluded that severe infestation with head lice can contribute to iron-deficiency anemia. Also related diseases in an individual, including anemia, can ultimately lead to a decrease in the total reduced glutathione (Gadjeva *et al.*, 2005;Tolentino and Friedman, 2007).This is what the results of our current

Table (1): Shows the Influence of Head Lice Infestation on GSH, CAT, SOD and MDA

Groups	No.	M ± SD µmol\l			
		GSH	CAT	SOD	MDA
Infested groups	30	0.3636± 0.029	1.115± 0.192	2.361± 0.150	1.488± 0.124
Healthy groups	30	0.4139± 0.027	1.287± 0.150	2.620± 0.211	1.246± 0.0764
P-Value		0.0004	0.0001	0.0003	0.0004

Table 2: Shows Effect of Head Lice Infestation on GSH, CAT, SOD, and MDA in Respect to Gender

Groups	No	M ± SD µmol\l			
		GSH	CAT	SOD	MDA
Infested males	15	0.36093 ± 0.02809[b]	1.0887 ±0.1169[c]	2.362 ± 0.1462[b]	1.4433 ±0.1595[b]
Infested females	15	0.36620 ± 0.03219[b]	1.1407 ± 0.2477[c]	2.359 ±0.1588[b]	1.5320 ±0.0469[a]
Non-infested males	15	0.40513 ±0.02635[a]	1.2420 ± 0.1740[b]	2.590 ± 0.2291[a]	1.2407 ± 0.0485[c]
Non-infested females	15	0.42273 ± 0.02568[a]	1.3313 ± 0.1085[a]	2.649 ± 0.1937[a]	1.2520 ± 0.0983[c]

Table 3: The Effect of Head Lice Infestation on GSH, CAT, SOD, and MDA in Respect to Age

Groups	age (year)	No.	M ± SD µmol / L			
			GSH	CAT	SOD	MDA
Infested	8-10	9	0.37033±0.02138[b]	1.097±0.1406[b]	2.452 ± 0.1722[b]	1.544 ± 0.0490[a]
	11-13	17	0.36641±0.02885[b]	1.135±0.2342[b]	2.330 ± 0.1366[b]	1.462 ± 0.1388[a]
	14-16	4	0.33620±0.0412[b]	1.065 ± 0.0705[b]	2.285 ± 0.0300[b]	1.467 ± 0.1603[a]
Non-infested	8-10	11	0.41064±0.03006[a]	1.290 ± 0.1733[a]	2.567 ± 0.2191[a]	1.247 ±0.1092[b]
	11-13	16	0.41375±0.02781[a]	1.281 ± 0.1505[a]	2.655 ± 0.2012[a]	1.246 ± 0.0561[b]
	14-16	3	0.42700±0.00200[a]	1.303 ±0.0577[a]	2.6230 ± 0.273[a]	1.240 ± 0.0361[b]

study showed from the decrease in reduced glutathione in school children with head lice as compared to healthy people. Anemia leads to many symptoms in school pupils including fatigue, sleep in class, poor educational performance and ill cognitive function.

The child may also experience sleep disturbance at night due to severe itching (Nordin *et al.*, 2006). Moreover, and according to a number of studies, the free radicals in host cells with external parasites depend on the nutritional status of the host, the degree or severity of parasitic infections and the extent of their devastating effect on tissues (Bickers and Athar, 2006; Abd Ellah, 2013). Because the percentage of severe injuries among the study samples is low in different ages, the study did not show significant differences in the concentration of glutathione in the patients according to gender and age.

Numerous studies have indicated the presence of oxidative stress in human and animals infected with parasites, as well as the presence of an antioxidant defense mechanism between parasites and mammals hosts. In allergic inflammatory diseases which caused by helminthes infections, the spread of eosinophil's associated with this inflammation can be the main source of tissue damage, and possibly through their metabolic products from strong reactive oxygen species (Petreccia *et al.*, 1987; Corrigan and Kay, 1991; Upcroft and Upcroft, 2001). Cells contain a variety of antioxidant systems that play a major role in protecting against reactive oxygen species (Halliwell, 1991).

Antioxidant systems consist of antioxidant enzymes such as SOD, CAT, CATH-PX etc., proteins such as GSH-glutathione, protein-binding proteins for minerals such as ceruloplasmin and albumin, as well as vitamins such as Vitamin E (alpha-tocopherol, ascorbic acid and flavonoids) (Halliwell, 1994). Antioxidants may act directly by scavenging the free radicals and maintaining the activity of antioxidant enzymes or inhibiting the activity of oxidizing enzymes (Boczon, 1986; Derda *et al.*, 2004; Abd Ellah, 2010). Lipid peroxidation, of which MDA is one of its main metabolic products, is regarded as one of the best indicators of the level of reactive oxygen species (ROS) that causes systemic biological damage (Popova and Popov, 2002).

The antioxidant system contains a cellular protective measure against the oxidative stress of cells and organs and tissue damage caused by the parasite invasion (Chuenkova *et al.*, 1989; Das *et al.*, 1996 and Dede *et al.*, 2002). It also plays a role in protecting Phagocytic leukocytes against their products and reactive oxygen radicals.

The results of our current study showed an imbalance in the oxidative stress status, which was represented by increasing in the results of MDA and by decreasing in the activity of the studied antioxidant enzymes. Studying the relationship between external parasites namely head lice on the indicators of oxidative stress in humans is very rare but the existence of significant differences in the studied indicators related to the parameters of oxidative stress, especially in school children, who are in the stages of growth and early vital formation of the most critical body, which represents a source of concern if it is taken into consideration that most of the modern diseases such as diabetes, cardiovascular diseases, cancer etc. which are closely related to oxidative stress. Moreover,

the emergence of these significant differences regarding the variables of oxidative stress between the infested group and the control healthy group may be basically attributed to the influence of head lice infestation on the scale of oxidative stress at these children which may stimulate the immune system in the body to perform its defensive role.

The emergence of oxidative stress is a very expensive cost in activating the immune system of the organism (Costantini and Møller, 2009; Dowling and Simmons, 2009).The generation of oxidizing substances may occur during the immune response through several methods: Firstly, they are released by immune cells whose toxic cellular effects used to kill the pathogen, as immune cells can generate reactive oxygen species that the pesticides kill all kinds of invasive organisms from bacteria and viruses as well as parasites (Halliwell and Gutteridge,). Secondly, oxidizers are a secondary product of oxygen consumption (Finkel and Holbrook, 2000). And the increase of metabolic activity during the immune response (Van de Crommenacker *et al.*, 2010). Moreover, they may contribute to the generation of additional toxic oxidants. Thirdly, parasites themselves can also be directly responsible for releasing oxidation by breaking down the products of their own metabolic processes (Francis *et al.*, 1997). Therefore, parasitic infection and what can cause to the host of a number of immune, histological, blood and biochemical changes which can contribute to the high concentration of MDA and the low level of antioxidants.

Therefore, infections of the organism with endoparasites or ectoparasites are associated with excessive release of free radicals, which may because the decrease in nutrients that the body benefits from for the synthesis of antioxidants, as well as the destruction of cells produced by the activity of the parasites, as free radicals are involved in diseases of most parasitic infections associated with lipid peroxidation, which cause an imbalance in the oxidative balance - antioxidants, thereby exposing the organism to infection with many diseases (Stocker *et al.*, 1985).

Conclusions

External infection with head lice has a direct or indirect impact on levels of oxidative stress, where a decrease in the levels of antioxidants such as glutathione, catalase and superoxide dismutase was observed. On the other hand, there was an increase in the level of concentration of malondialdehyde which is the indicator of oxidative stress which involved in the pathogenesis of several diseases.

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Conflict of interest

The Authors declare that there is no conflict.

References

Abd Ellah, M. R. (2010). Involvement of free radicals in animal diseases. *Comp Clin Path*. **19(6)**, 615-619.

Abd Ellah, M. R. (2013). Involvement of free radicals in parasitic infestations. *J. Appl. Anim. Res*, **41(1)**, 69-76.

Al Bashtawy, M. and F. Hasna (2012). *Pediculosis capitis* among primary-school children in Mafraq Governorate, Jordan.

Bickers, D. R. and M. Athar (2006). Oxidative stress in the pathogenesis of skin disease. *J. Invest. Dermatol.*, **126(12)**, 2565-2575.

Boczon, K., E. Hadas, E. Wandurska-Nowak and M. Derda (1996). A stimulation of antioxidants in muscles of *Trichinella spiralis* infected rats. *Acta Parasitol.*, **3(41)**.

Burke, S. and P. Mir (2011). Pediculosis causing iron deficiency anaemia in schoolchildren. *Arch. Dis. Child.*, **96(10)**, 989-989.

Chuenkova, M.V., N.N. Sukhareva, Y.Y. Sergacheva, T.L. Sokhanenkova, F.F. Soprunov and L.G. Grinberg (1989). The effect of vitamin E on the lipid composition in mouse erythrocytes and in *Plasmodium berghei*. *Med. Parazitol.* **4**: 13-15.

Corrigan, C. J. and A. B. Kay (1992). T cells and eosinophils in the pathogenesis of asthma. *Immunol. Today*, **13(12)**, 501-507.

Costantini, D. and A. P. Møller (2009). Does immune response cause oxidative stress in birds? A meta-analysis. Comparative Biochemistry and Physiology Part A*: Molecular & Integrative Physiology*, **153(3)**, 339-344.

Das, B. S., D. I. Thurnham and D. B. Das (1996). Plasma alpha-tocopherol, retinol, and carotenoids in children with falciparum malaria. *Am. J. Clin. Nutr.*, **64(1)**, 94-100.

Dede, S., Y. Deger, T. Kahraman, S. Deger, M. Alkan and M. Cemek (2002). Oxidation products of nitric oxide and the concentrations of antioxidant vitamins in parasitized goats. *Acta Vet. Brno*, **71(3)**, 341-345.

Derda, M., E. Wandurska-Nowak and E. Hadas (2004). Changes in the level of antioxidants in the blood from mice infected with *Trichinella spiralis. Parasitol. Res.*, **93(3)**, 207-210.

Dowling, D. K. and L. W. Simmons (2009). Reactive oxygen species as universal constraints in life-history

evolution. *Proceedings of the Royal Society B: Biol Sci*, **276(1663)**, 1737-1745.

Finkel, T. and N. J. Holbrook (2000). Oxidants, oxidative stress and the biology of ageing. *Nature*, **408(6809)**, 239.

Francis, S. E., D. J. Sullivan Jr. and A. D. E. Goldberg (1997). Hemoglobin metabolism in the malaria parasite *Plasmodium falciparum*. *Annu. Rev. Microbiol.*, **51(1)**, 97-123.

Fridovich, I. (1998). Oxygen toxicity: a radical explanation. J. Exp. Biol. **201**:1203-1209.

Gadjeva, V., D. Kuchukova and R. Georgieva (2005). Vitamin combinations reduce oxidative stress and improve antioxidant status in patients with iron deficiency anemia. *Comp Clin Path*, **14(2)**, 99-104.

Goth, L. (1991). A simple method for determination of serum catalase activity and revision of reference range. *Clin. Chim. Acta*, **196(2-3)**, 143-151.

Gratz, N. G. and World Health Organization. (1997). Human lice: Their prevalence, control and resistance to insecticides: A review 1985-1997 (No. WHO/CTD/WHOPES/97.8). Geneva: World Health Organization.

Halliwell, B. (1991). Reactive oxygen species in living systems: source, biochemistry, and role in human disease. *Am. J. Med.*, **91(3)**, S14-S22.

Halliwell, B. (1994). Free radicals, antioxidants, and human disease: curiosity, cause, or consequence?. *Lancet (British edition)*, **344(8924)**, 721-724.

Halliwell, B. and J. M. C. Gutteridge (1999). Free radicals in biology and medicine: Oxford University Press. *Inc, New York*.

Hau, V. and N. Muhi-Iddin (2014). A ghost covered in lice: a case of severe blood loss with long-standing heavy *Pediculosis capitis* infestation. Case Reports, *BMJ*, bcr206623.

Madhes, E., U. Dimri, Y. Ajith, S. Shanmuganathan, P. Sivasankar, R. Karthikeyan, A.K. Choudhary and K. Kavitha (2019). Vitamin E Ameliorates the Mineralo-Oxidative Stress of Sucking Lice Infestation in Indian Water Buffalo. *Int.J.Curr.Microbiol.App.Science*, **8(7)**: 1538-1548.

Madhikarmi, N.L. and K.R.S. Murthy (2011). Effect of iron deficiency anemia on lipid peroxidation and antioxidant systems. *Nepal Med Coll J*, **7(4)**:34-43.

Meister, L. and F. Ochsendorf (2016). Head lice. Deutsches Ärzteblatt International.*Dtsch Arztebl Int.* **113**: 763–772.

Moron, M. S., J. W. Depierre and B. Mannervik (1979). Levels of glutathione, glutathione reductase and glutathione S-transferase activities in rat lung and liver. *Biochim.Biophys. Acta*. **582(1)**, 67-78.

Nazari, M., R. Goudarztalejerdi and M. Anvari Payman (2016). *Pediculus capitis* among primary and middle school children in Asadabad, Iran: An epidemiological study. *Asian Pac J Trop Biomed*. **6(4)**: 367–70.

Nazari, M. and A. Azizi (2014) Epidemiological pattern of scabies and its social determinant factors in west of Iran. Health; **6(15)**: 1972-1977.

Nordin, R. B., W. A. Che, N. A. Ibrahim and L. Naing (2006). Prevalence and associated factors of head lice infestation among primary schoolchildren in Kelantan, Malaysia. Southeast *Asian J Trop Med Public Health*, **37(3)**, 536.

Petreccia, D. C., W. M. Nauseef and R. A. Clark (1987). Respiratory burst of normal human eosinophils. *J. Leukoc. Biol.*, **41(4)**, 283-288.

Popova, M. P. and C. S. Popov (2002). Damage to subcellular structures evoked by lipid peroxidation. *Z. Naturforsch., C, J. Biosci.* **57(3-4)**, 361-365.

Rao MV, B. Hale and D.P. Ormrod (1998). Amelioration of Ozone induced oxidative damage in wheat plants grown under high carbon dioxide. Role of antioxidant enzymes. *Plant Physiol.***109**: 421-432.

Speare, R., D. V. Canyon and W. Melrose (2006). Quantification of blood intake of the head louse: *Pediculus humanus capitis*. *Int. J. Dermatol*. **45**:543-546.

Stocker, R., N.H. Hunt, G.D. Buffinton, M.J. Weidemann, P.H. Lewis- Hughes and I.A. Clark (1985). Oxidative stress and protective mechanisms in erythrocytes in relation to Plasmodium vinckei load. *Proc. Natl. Acad. Sci.*USA **82**:548-551.

Tolentino, K. and J. F. Friedman (2007). An update on anemia in less developed countries. *Am. J. Trop. Med. Hyg.*, **77(1)**, 44-51.

Ueland, P.M., M.A. Mansoor, A.B. Guttormsen, F. Muller, P. Aukrust, H. Refsum and A.M. Svardal (1996). Reduced, oxidized and protein-bound forms of homocysteine and other aminothiols in plasma comprise the redox thiol status a possible element of the extracellular antioxidant defense system. *J. Nutr.***126**:1281S-1284S.

Upcroft, P. and J. A. Upcroft (2001). Drug targets and mechanisms of resistance in the anaerobic protozoa. *Clin Microbiol Rev*, **14(1)**, 150-164.

Van de Crommenacker, J., N. P. Horrocks, M. A. Versteegh, J. Komdeur, B. I. Tieleman and K. D. Matson (2010). Effects of immune supplementation and immune challenge on oxidative status and physiology in a model bird: implications for ecologists. *Indian J. Exp. Biol.* **213(20)**, 3527-3535.