EFFECTS OF EXPOSURE TO METAL FUMES ON THE REPRODUCTIVE HEALTH OF MALE WELDERS

By

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Abstract

Introduction: Welding fumes are made up of a variety of metal oxides, fumes, and gases, and many of these metals have been linked to diverse fertility issues. **Aim of Work:** To determine the blood levels of metals among welders and to investigate their impact on male reproductive health. **Materials and Methods:** The study included 142 male employees in a stainless steel manufacturing facility, wherein 71 welding workers serve as a vulnerable group and 71 administrative persons served as the control group. All participants underwent a thorough medical history, a detailed reproductive questionnaire, including an erectile function test using the international index of erectile function (IIEF-5), and a full clinical examination. An atomic absorption spectrophotometer was used to determine blood lead (Pb), serum aluminum (Al), manganese (Mn), and zinc (Zn) levels. Follicle-stimulating hormone (FSH), luteinizing hormone (LH), testosterone, and superoxide dismutase (SOD) levels were evaluated using an enzyme-linked immunosorbent assay. **Results:** The exposed group had a lower IIEF-5 score, lower libido, and a higher blood Al, Pb, and Mn compared to the control group. Welders had higher levels of reproductive hormones (FSH and LH) and lower levels of testosterone and antioxidant enzyme SOD compared to controls. A positive correlation was detected between the level of Al, Pb, Mn, FSH, LH, age, and duration of employment among the exposed group, but a negative correlation between Al, Pb, Mn, testosterone, SOD levels, and IIEF-5. **Conclusion and Recommendations:** Welders' metal levels affect reproductive hormones and lead to oxidative stress alterations, both of which could impair male reproductive health. To reduce exposure to welding fumes, it is strongly advised to regularly wear high-quality personal protective equipment, particularly masks and gloves.

Keywords: Welding fumes, Metals, Reproductive health and Superoxide dismutase.

Introduction

Welders work include; melt, cut, and fuse metals using a flame or an electric arc. Heat, radiation (ultraviolet, visible, and infrared), noise, fumes, gases, and electricity are all risks that could endanger the welder's health (Sajedifar et al., 2018). Welding fumes contain a complex of metal particles, such as lead (Pb), manganese (Mn), zinc (Zn), aluminum (Al), and other metals that can cause major harm to the body (Cezar-Vaz et al., 2015).

Studies revealed that male welding workers have poor fertility, with lower sperm quality, lower fecundity, and altered levels of reproductive hormones, compared to non-exposed persons (Ellingsen et al., 2007). Other studies have shown minimal evidence of a relationship between welding fumes and fertility (Jensen et al., 2006).

Male infertility is caused by a variety of reasons, one of which is metal fume exposure, which has been linked to reproductive problems in welders (Kumar et al., 2003). Both direct and indirect toxicity due to oxidative stress and inflammation have been hypothesized as potential mechanisms behind the impaired reproductive function in males since both routes may interfere with testicular function (Lan and Yang, 2012).

Welders' exposure to metal fumes was linked to the development of oxidative stress (Prabhu et al., 2020). An abnormal buildup of reactive oxygen species (ROS) causes oxidative stress. Increased oxidant generation, main antioxidant defense depletion as antioxidant enzymes (superoxide dismutase [SOD], catalase [CAT], and glutathione peroxidase [GPX]), and welders' failure to overcome the large variety of enzymes are of the most important pathogenetic routes underlying male infertility (Perelomov et al., 2016).

Male sexual hormones play a significant role in sperm generation and multiplication. luteinizing hormone (LH), Follicle-stimulating hormone (FSH), and testosterone concentrations are regarded as responsive fertility indicators. FSH stimulates interstitial cells, producing testosterone (Bo et al., 2015). LH activates spermatogonial tubes and increases spermatozoa production in conjunction with testosterone (Sinclair, 2000). Endocrine balance and communication to the testicles may be disrupted by metals, ROS, and inflammatory regulators, indicating spermatogenesis impairment (Skovmand et al., 2020).

The neuro-endocrine and reproductive systems are among the many that are impacted by chronic exposure to even very low amounts of Pb. According to Nkomo et al. (2018), Pb exposure causes subclinical testicular injury and the production of reactive oxygen species, both of which are thought to affect spermatogenesis and sperm function, leading to male infertility (Balachandar et al., 2020)

Aluminum accumulates in the endocrine glands, it can induce male reproductive issues, such as testicular failures by producing oxidative stress in the testes, insufficient androgenic hormone, and diminished androgen receptor functioning, it interferes with the reproductive hormones, LH, FSH, and testosterone (Sun et al., 2018).

Cumulative Al in the testis damages Leydig cells, thereby dropping testosterone level, which in turn increases LH level through a negative regulatory function of the hypothalamus-pituitary–testis. Al exposure decreases testosterone level and then inhibits testicular development, spermatogenesis, and androgenic hormones as it crosses the blood-testis barrier, after inducing oxidative stress that damages the biological membranes of the testes. This, in turn, disturbs spermatogenesis (Boudou et al., 2020).

Aim of Work

To determine the blood levels of metals among welders and to investigate their impact on male reproductive health.

Materials and Methods

- Study design: It is a comparative cross-sectional study.

- Place, and duration of the study: From January to May 2021, the study was conducted in one of Helwan, Cairo, Egypt’s private stainless steel utensil companies. Stainless steel components were joined using gas metal and electric arc welding. A work shift of 8 h/day was assigned to all employees.

- Study Sample: Out of 87 employees working in the factory, a total of 71 ones (male) were considered eligible based on inclusion and exclusion standards. **Inclusion criteria:** Married men with a job duration of at least five years, between the ages of 20 and 50 years.**Exclusion criteria:** Workers with a history of using medications that are likely to affect sexual drive, sterility, or any serious disorders that negatively impact sexual performance (hyperglycemia, endocrine or hormonal diseases, and congenital-related fertility illnesses), hormonal therapy, testicular cancer, and wives with a heath problem which prevent pregnancy.

Age, social, and economic-matched corresponding controls (No = 71) without direct welding fume exposure, were recruited within the factory's administrative office.

Study Methods:

1- A questionnaire was used for data collection: The information was gathered by two-parts questionnaire via a face-to-face interview. The first was a semi-structured survey that all participants completed, which included sociodemographic information, prior or current illnesses, and detailed occupational history. The second part of the questionnaire assessed erectile function using validated arabic version of the international index of erectile function (IIEF-5) standardized self-completed questionnaire with a total score of 1–7 was interpreted as Severe erectile dysfunction (ED); 8–11 as Moderate ED; 12–16 as Mild-Moderate ED; 17–21 as Mild ED; 22–25 as No ED (Shamloul et al., 2004).

2- Investigations:

Blood collection: Venous blood (8 ml) was drawn from each participant in the early morning before their shift began using dry plastic disposable syringes, where two melliliters were put into heparinized plastic tubes for measuring the blood lead, the remaining 6 ml blood samples were allowed to coagulate and centrifuged at 4000 g for 10 min to separate the sera, then preserved at -80 ^{o}C for further testings.

a- Superoxide dismutase (SOD)

The MBS2022511 kit, an enzyme-linked immunosorbent assay (ELISA) Kit for human SOD, is used to quantify SOD following the manufacturer's recommendations.

b-Blood Pb, serum Al, Mn, and Zn

The elements (blood lead Pb, serum Al, and Mn) were determined by atomic absorption spectrometry (Thermo elemental M6, Cambridge, England) with Zeeman background correction at various wavelengths, while the flame atomic absorption spectrophotometer was used to determine the quantity of Zn in the serum (Bolann et al., 2007).

c-Serum Follicle-stimulating hormone (FSH), luteinizing hormone (LH), and testosterone

Serum LH, FSH, and testosterone levels were determined using a quantitative double-antibody sandwich ELISA technique, following the manufacturer's instructions, using commercially available kits. LH (catalog number MBS9711570), FSH (catalog number MBS260964), and testosterone (catalog number MBS580035).

Consent

Workers were appropriately informed about the study's purpose, significance, and procedures including the blood tests by the research team and informed consent was obtained.

Ethical Approval

The study was implemented according to Ethical Committee of the Department of Occupational and Environmental Medicine, Faculty of Medicine, Cairo University, Egypt, and in compliance with the Declaration of Helsinki's ethical criteria. Prior to the study approval from the factory was obtained.

Data Management

The Statistical Package for the Social Sciences version 26 (IBM Corp., Armonk, NY, USA) was used for data entry and coding. Mean, standard deviation, median, minimum, and maximum were used for quantitative variables, whereas frequency (number of cases) and relative frequencies (percentages) for categorical variables. The evaluations were performed using the unpaired *t*-test in normally distributed quantitative variables while a non-parametric Mann-Whitney test was used for non-normally distributed quantitative variables. The Chi-square ($\chi 2$) test was performed for categorical data comparison. The Exact F-test was used instead when the expected frequency is <5 (in 25% of cells). Correlations among quantitative variables were determined utilizing the Spearman correlation coefficient. Linear regression analysis was done to detect independent predictors of IIEF-5. p-values of <0.05 were considered statistically significant.

Results

The mean age ± SD of the exposed group was 46.56 ± 9.94 years, whereas it was 44.01 ± 10.08 years among the control group, additionally the mean duration of marriage was 18.97±8.05 among welders and 16.32±8.92 among the control group with no statistically significant difference. The mean duration of employment among welders was 24.3 ± 11.25 years and the mean weekly working hours (h) was 46.2 ± 4.5 h. The mean duration of employment among the control group was 21.83 ± 11.26 years, and they all worked for 48 h weekly.

Among welders, 69% used personal protective equipment (PPE). The lack of availability was the most significant barrier to welders using PPE.

Table 1: Distribution of genitourinary symptoms and grading of the international index of erectile function (IIEF-5) score among the studied participants.

Genitourinary Symptoms		Welders (No = 71)		Control (No = 71)		p-value
		%	No	%	No	
Libido	**Positive**	**34**	**47.9%**	**64**	**90.1%**	**<0.001***
The International Index of Erectile Function (IIEF-5)	Moderate ED (8–11) Mild to moderate ED (12–16) Mild ED (17–21) NO ED (22–25)	11 21 23 16	15.5% 29.6% 32.4% 22.5%	0 4 36 31	0.0% 5.6% 50.7% 43.7%	**<0.001***
Ejaculation	Delayed Normal Premature	0 40 31	0.0% 56.3% 43.7%	0 62 9	0.0% 87.3% 12.7%	**<0.001***
Morning erection	Present Absent	40 31	56.3% 43.7%	45 26	63.4% 36.6%	0.392
Oliguria	Yes	4	5.6%	2	2.8%	0.681
Hematuria	Yes	1	1.4%	0	0.0%	1
Burning micturition	Yes	10	14.08%	9	12.7%	0.62

IIEF-5: The International Index of Erectile Function; ED: Erectile Dysfunction;

*: Statistically significant

Table (1) showed that there was a statistically significant difference between welders and control group as regards IIEF-5 score and premature ejaculation as it was higher among the exposed group.

However, there was a statistically significant decline in the libido and intercourse frequency/week among welders (mean±SD 1.44 0.86 vs 1.73 0.84) compared to the control (non-tabulated data).

Table 2: Means and standard deviations of biochemical parameters among the studied participants.

	Welders (No = 71)				Controls (No = 71)				p-value
	Mean	SD	Median	Range Min-Max	Mean	SD	Median	Range Min-Max	
AL (µg/L)	7.71	2.08	8.10	–4.01 10.9	5.21	1.27	5.02	–2.8 8.9	**<0.001***
Pb (µg/dL)	15.03	5.19	14.90	–6.40 27.1	5.94	1.78	5.60	–3.1 10.2	**<0.001***
Mn (µg/L)	10.95	4.89	10.20	–4.30 19.3	7.04	1.88	7.20	–4.2 10.3	**<0.001***
Zn (µg/dL)	101.98	21.51	109.20	–42.9 132.7	106.34	19.19	112.40	–42.9 131.6	0.205
FSH (IU/L)	17.22	9.49	15.60	–5.20 34.5	7.43	2.37	7.60	–4.09 12.1	**<0.001***
LH (IU/L)	8.25	3.25	7.30	–3.20 14.8	5.89	6.53	4.70	–2.1 57.1	**<0.001***
Testosterone (ng/dL)	288.84	54.71	284.70	–212.5 384.5	414.28	57.90	423.10	–318.6 490.4	**<0.001***
SOD (U/mL)	13.62	3.47	13.50	–8.10 23.8	20.04	3.68	19.10	–14.2 29.5	**<0.001***

Al: aluminum; Pb: lead; Mn: manganese; Zn: zinc; FSH: follicle-stimulating hormone; LH:luteinizing hormone; SOD: superoxide dismutase; *: Statistically significant.

Table (2) showed that the mean of blood Pb, serum Al, and Mn concentrations among welders were significantly higher than that of the control. No significant difference was found in the mean serum Zn concentration of welders compared with the control . The mean serum concentrations of reproductive hormones were significantly higher among welders compared to the control ($p < 0.001$). The mean level of testosterone and antioxidant enzyme (SOD) among welders was statistically significantly lower than that of the control group ($p < 0.001$).

Table 3: Distribution of IIEF-5 score and sexual life parameters according to welders' duration of exposure.

		Welders' duration of exposure				
		≤10 years (No = 16)		**>10 years (No = 55)**		**p-value**
		No	%	No	%	
The International Index of Erectile Function (IIEF-5)	Moderate ED	0	0.0%	11	20.0%	**0.011***
	Mild to moderate ED	2	12.5%	19	34.5%	
	Mild ED	10	62.5%	13	23.6%	
	NO ED	4	25.0%	12	21.8%	
Morning erection	Present	6	37.5%	34	61.8%	0.084
Libido	Positive	12	75.0%	22	40.0%	**0.014***
Ejaculation	Delayed	0	0.0%	0	0.0%	**0.022***
	Normal	13	81.3%	27	49.1%	
	Premature	3	18.8%	28	50.9%	

IIEF-5: The International Index of Erectile Function *: Statistically significant

Table (3) showed a statistically significant increase in the prevalence of moderate and mild to moderate ED according to IIEF-5 score among welders with a working duration of >10 compared to welders of ≤10 years of exposure. Moreover, a statistically significant difference was found between both groups regarding normal and premature ejaculation as they were higher among welders with >10 years of exposure compared to ≤10 years of exposure.

Table 4: Correlations of different parameters among welders group.

	AL level (μg/L)		Pb level (μg/dL)		Mn level (μg/L)		Zn level (μg/dL)		IIEF-5	
	CC	p	CC	p	CC	p	CC	p	CC	p
FSH (IU/L)	0.697	**<0.001***	0.756	**<0.001***	0.541	**<0.001***	0.189	0.115	-0.695	**<0.001***
LH (IU/L)	0.659	**<0.001***	0.788	**<0.001***	0.685	**<0.001***	0.198	0.098	-0.644	**<0.001***
Testosterone (ng/dL)	-0.692	**<0.001***	-0.889	**<0.001***	-0.667	**<0.001***	-0.131	0.276	0.765	**<0.001***
SOD (U/mL)	-0.491	**<0.001***	-0.722	**<0.001***	-0.596	**<0.001***	0.048	0.690	0.689	**<0.001***
Age	0.169	0.158	0.355	**0.002***	0.474	**<0.001***	0.090	0.454	-0.173	0.148
Duration of employment/ years	0.290	**0.014***	0.440	**<0.001***	0.515	**<0.001***	0.126	0.297	-0.219	0.067
IIEF-5	-0.654	**<0.001***	-0.736	**<0.001***	-0.562	**<0.001***	-0.071	0.554	-	-

CC: Correlation Coefficient; Al: Aluminum; Pb: Lead; Mn: Manganese; Zn: Zinc; FSH: Follicle-stimulating hormone; LH: Luteinizing hormone; SOD: Superoxide dismutase, IIEF-5: The International Index of Erectile Function; *: Statistically significant

Table (4) displayed a positive correlation between blood Pb, serum Al, and Mn levels and FSH, LH, age, and duration of employment ($p < 0.001$), while a negative correlation was found between blood Pb, serum Al, and Mn levels, and testosterone and SOD levels. It also illustrated the association between IIEF-5 score grading and metal concentrations (Al, Pb, Mn, and Zn), reproductive hormones, and SOD levels, where a negative correlation was detected between IIEF-5 score and the blood Pb, serum Al, and Mn and reproductive hormones (FSH, LH) levels ($p < 0.001$), while a positive correlation was found between IIEF-5 score and testosterone and SOD levels.

Table 5: Linear regression among irrespective forecasters of IIEF-5 in welders group.

Model B		Unstandardized Coefficients		Standardized Coefficients	t	p-value Lower Bound	95.0% Confidence Interval for B	
		Std. Error	Beta				Upper Bound	
IIEF-5	(Constant)	4.758	3.936		1.209	0.231	-3.099	12.615
	testosterone (ng/dL)	0.041	0.010	0.499	4.146	**<0.001***	0.021	0.061
	SOD (U/mL)	0.277	0.123	0.211	2.261	**0.027***	0.033	0.522
	AL level (μg/L)	-0.457	0.225	-0.209	-2.034	**0.046***	-0.906	-0.008

IIEF-5: The International Index of Erectile Function; Al: Aluminum; SOD: Superoxide dismutase; *: Statistically significant B: Unstandardized Beta

Table (5) demonstrated the multiple linear regression analysis for investigating the independent predictors of the IIEF-5 score and revealed that serum testosterone, antioxidant enzyme (SOD), and Al levels significantly predict erectile function among welders.

Discussion

Welders are exposed to a complex mix of metals, which can lead to reproductive dysfunctions. Several studies have looked into reproductive toxicity among welders (Kumar et al., 2003), but none have looked into this particular combination of metals and erectile dysfunction (ED).

The studied welders have comparatively high blood Pb, serum Al, and Mn levels, which have been linked to a variety of reproductive abnormalities and a lower IIEF-5 score (Table1). Telišman et al. (2000) in their study on semen quality and reproductive endocrine function in relation to biomarkers of lead, cadmium, zinc, and copper in men (industrial workers in Zagreb, Croatia) detected that males who have been exposed to Pb at work for a long time had lower fertility. Also, Anis et al. (2007) in their study on chronic lead exposure may be associated with erectile dysfunction in Cairo , Egypt ,found that chronic Pb exposure has also been associated with ED.

The studied group of welders had a statistically significant higher mean blood Pb, Al, and Mn concentrations but had lower mean serum Zn concentration compared to the control group with no statistically significant difference. The exposed group had higher mean reproductive hormones (FSH and LH) levels, but testosterone and antioxidant enzyme (SOD) levels were statistically significantly lower (Table 2).

These findings were consistent with those of Li and Taneepanichskul (2021), who studied workers exposed to welding fumes in confined spaces in Chonburi, Thailand, and found that the Mn and Cr levels of the welding group were significantly higher than those of the non-welding group. In contrast to our findings, they claimed that there was no statistically significant difference in Pb levels between the welding and non-welding groups.

According to the IIEF-5 score, the present study revealed that the prevalence of moderate and mild to moderate ED was significantly higher among welders with a working duration of > 10 years than among welders with ≤10 years of exposure. Furthermore, welders with > 10 years of exposure had a larger percentage of premature ejaculation than those with ≤10 years of exposure (Table 3). These were in line with the findings of Bowler and his colleagues (2007), who claimed that there were strong association between sexual dysfunction and long-term exposure to welding fumes.

According to the findings of the current study, there was a positive correlation between blood Pb levels in welders and FSH, LH, age, and length of work, but a negative correlation between blood Pb levels and testosterone , SOD levels and IIEF-5 score (Table 4).

El Zohairy et al. (1996) revealed that infertile Egyptian males with occupational Pb exposure as painters , storage battery workers had the highest serum Pb levels (370.2 mg/L), whereas fertile males had the lowest (169 mg/L) ($p < 0.01$). LH and FSH levels were significantly higher among infertile males with industrial exposures than in healthy people without work-related circumstances.

The findings of the current study were also consistent with those of Dehghan et al. (2019), who investigated the relationship between exposure to lead-containing welding fumes and the levels of reproductive hormones. They discovered that the blood lead concentration was much greater than the biological exposure index (BEI) advised by the American Conference of Governmental Industrial Hygienists (ACGIH) ($p< 0.05$). The mean levels of LH and FSH were greater among the exposed compared to the control group ($p < 0.05$), whereas the mean levels of testosterone were lower in the exposed group when compared to non-exposed ones ($p < 0.05$). Blood lead levels were directly associated to LH and FSH levels and negatively related to testosterone levels.

Employees who were exposed to Pb particles had significantly higher levels of LH and FSH according to Taher et al. (2006). Also, the current results were in agreement with Yu et al. (2010), who investigated the effects of Pb exposure on serum sex hormone values in male employees and discovered that testosterone concentrations were considerably lower in the exposed group. Additionally, they speculated that Pb exposure might affect male sexual hormones, affecting the hormonal activity and Sertoli cells.

In contrast with the results of the current study, a work done in India by Kumar et al., 2003 on semen quality and reproductive hormones among welders, detected normal FSH, LH, and testosterone levels, was observed in the high exposure group (>10 years) as compared to the low exposure group

(≤10 years). This could be because their studied sample was only 17 welders.

Also, the current results were in contrary to that of Erfurth et al. (2001), who measured hormonal profiles (e.g., serum FSH, LH, testosterone, and sex-hormone–binding globulin levels) among lead smelters workers in Sweden and found that there is no influence on the male reproductive endocrine profile.

There was a positive correlation between serum Mn levels in welders and FSH, LH, age, and length of work, but a negative correlation between serum Mn levels and testosterone, SOD levels, and IIEF-5 score among the studied group (Table 4).These results were in accordance with Yang et al. (2019), who investigated the relationship between occupational Mn exposure, reproductive hormones, semen quality and revealed that testosterone levels were considerably lower in the Mn-exposed group compared to the control group, but LH levels were significantly higher. Urinary Mn was favorably connected with serum LH levels and was adversely correlated with testosterone levels. However, no difference was found in FSH, which plays a role in maintaining homeostasis and its disorders. The considerable reduction in testosterone levels revealed that Mn was suppressing testicular steroidogenesis, implying the existence of faulty Leydig cells (Cheng et al., 2003).

The current findings supported an experimental work by Wu et al. (2020), which showed that Mn exposure resulted in significant reductions in sperm count. The normal sperm morphology changed in the Mn-exposed group, and double-tailed spermatozoa and neck abnormalities manifested. In comparison to the control group, the Mn-exposed group had decreased testosterone levels. This suggested that prolonged exposure to manganese can harm the male reproductive system.

There was a positive correlation between serum Al levels among studied welders and FSH, LH, age, and duration of work, but a negative correlation between serum Al levels and testosterone, SOD levels, and IIEF-5 score (Table 4).

This was in accordance with Beshir et al. (2021), in their study on implication of aluminum in exerting some health disorders among exposed workers in Egypt and observed significantly higher urinary Al among 56 male Al welders, while total antioxidant capacity was markedly lower compared to the control. Serum FSH was markedly greater among the exposed group compared to the controls. Urinary Al level was negatively correlated with total antioxidant capacity.

These outcomes also agreed with an experimental study carried out by Lokman and her colleagues (2021), who claimed that oral administration of Al was linked to oxidative damage and observed significant decreases in the levels of the male reproductive hormones testosterone, luteinizing hormone, and follicle-stimulating hormone in the blood as well as an increase in inflammatory markers. In parallel, testis tissues showed substantial histological changes

The findings of the current work corroborated those of Boudou et al. (2020), who hypothesize that sub-acute exposure to Al affects the Leydig cells, causing a drop in testosterone levels and an increase in LH levels as a result of the disruption of testosterone-negative feedback. Low testosterone levels have an impact on spermatogenesis and result in an inflammatory response as a result of the increased rate of apoptosis in the epididymal epithelial tissue.

The studied welders exhibited a lower level of serum Zn than the control with no statistically significant difference (Table 2).

Zinc influences both testosterone and pituitary hormones, and a lack of Zn lowers the release of LH and FSH as well as testosterone production. The interaction of Pb with Zn, which is required for male reproductive performance, appears responsible for its reproductive effects. Pb appears to cause Zn insufficiency in certain people. Nevertheless, changes in the quantity and/or physiological availability of Zn in certain body compartments (e.g., due to a Pb- related decrease in the optimal supply of Zn to the cell) may have an impact on sperm proliferation, maturation, and viability (Telišman et al., 2000).

The studied welders experienced oxidative stress, as indicated by a decreased level of antioxidant enzyme (SOD) in comparison to the controls, which was statistically significant (Table 2). A negative correlation between blood metal levels (Pb, Al, Mn) and the level of SOD among welders was found (Table 4).

Aminian et al. (2019) from Tehran, Iran, observed significant decrease in total serum antioxidant status (TAS) levels (8.3%), SOD

(8%) and glutathione peroxidase (36.7%) activities among welders in a Boiler and Power plant equipment construction factory. Prabhu et al. (2020) from Mangalore, India detected a significant difference with respect to serum (malondialdyhyde) MDA, total antioxidant capacity (TAC), and serum levels of iron, copper, and lead among healthy mechanical welders. Welding fume exposure was linked to lower erythrocyte glutathione concentrations and SOD activities in Taiwanese welders, with no significant differences in plasma homocysteine, MDA, and total antioxidane status (TAS), erythrocyte glutathione peroxidase (GPx), and glutathione S-transferases activities, or urinary 8-hydroxy-2>-deoxyguanosine (8-OHd) (Liu et al., 2013).

A Turkish study on the correlation between serum metal levels and oxidative stress biomarkers among welders identified a clear positive link between 8-OHdG levels and serum Cr, Mn, Cu, and Pb levels (Tokaç et al., 2020).

Exposure to Pb reduces spermatozoa count and motility, as well as induces testicular ROS, which is followed by reduced functions of SOD, GPX, and CAT enzymes and elevated MDA levels in the testicular tissue of rodents (Hassan et al., 2019).

Conclusion: Occupational exposure to welding fumes was associated with a significant increase in the blood level of some metals, such as Al, Pb, and Mn in welders, and was significantly associated with reproductive disorders in the form of decreased IIEF-5 score, decreased libido, and premature ejaculation. Additionally, welders had a state of oxidative stress represented by a decreased level of antioxidant enzyme (SOD) and disturbance in the reproductive hormones.

Recommendations: Work-related medical practitioners must use safety precautions, such as implementing proper ventilation infrastructures, limiting overexposure, biological monitoring of heavy metals, periodic medical examinations, and giving adequate respiratory protection devices for welders. More research is needed to investigate long-term preventative health techniques to manage and minimize toxic gas risks and fertility health implications.

Conflict of Interest

None to be declared

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