Evaluation of Health Risks in the Blood Serum of People Working in the Welding Industry as a Result of Exposure to Heavy Metals in Diyala Governorate / Iraq

Evaluasi Risiko Kesehatan dalam Serum Darah Orang yang Bekerja di Industri Pengelasan sebagai Akibat dari Paparan Logam Berat di Kegubernuran Diyala / Irak

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Abstract. General Background: *The welding industry is associated with significant health risks due to occupational exposure to heavy metals.* ***Specific Background:*** *Workers in this industry are particularly vulnerable to toxic metals such as lead, cadmium, copper, iron, and zinc, which can lead to severe health issues.* ***Knowledge Gap:*** *There is limited data on the specific health risks and heavy metal concentrations in welders' blood serum in Diyala Governorate, Iraq.* ***Aims****: This study aims to identify the primary health risks associated with welding-related heavy metal exposure and to explore strategies to mitigate these risks.* ***Methods:*** *The study was conducted in several industrial areas in Diyala Governorate, where blood samples were collected from 40 welders and 40 control participants (employees and students from Diyala University). An atomic absorption spectrophotometer was used to measure heavy metal concentrations in blood serum.* ***Results:*** *Statistical analysis revealed significant differences in heavy metal levels between welders and the control group (P Value < 0.05), indicating higher exposure among welders. However, no significant differences were found within welder subgroups based on age, smoking status, and duration of exposure.* ***Novelty:*** *This study provides the first comprehensive assessment of heavy metal exposure among welders in Diyala Governorate, highlighting the urgent need for improved protective measures.* ***Implications****: The findings underscore the necessity for environmental and health authorities to implement rapid interventions to protect welders from heavy metal toxicity. Current protective measures are inadequate, as evidenced by elevated levels of lead, cadmium, nickel, and zinc in welders' blood serum. Enhanced protective practices and stricter regulations are critical to reducing these occupational health risks.*

Keywords – *health risks, welding industry, heavy metals ,blood serum*

Abstrak*.* ***Latar Belakang Umum:*** *Industri pengelasan dikaitkan dengan risiko kesehatan yang signifikan akibat paparan logam berat di tempat kerja.* ***Latar Belakang Khusus:*** *Pekerja di industri ini sangat rentan terhadap logam beracun seperti timbal, kadmium, tembaga, besi, dan seng, yang dapat menyebabkan masalah kesehatan yang parah.* ***Kesenjangan Pengetahuan:*** *Data mengenai risiko kesehatan tertentu dan konsentrasi logam berat dalam serum darah tukang las di Kegubernuran Diyala, Irak masih terbatas.* ***Tujuan:*** *Penelitian ini bertujuan untuk mengidentifikasi risiko kesehatan utama yang terkait dengan paparan logam berat terkait pengelasan dan untuk mengeksplorasi strategi untuk memitigasi risiko ini.* ***Metode:*** *Penelitian dilakukan di beberapa kawasan industri di Kegubernuran Diyala, dimana sampel darah diambil dari 40 orang tukang las dan 40 partisipan kontrol (karyawan dan mahasiswa Universitas Diyala). Spektrofotometer serapan atom digunakan untuk mengukur konsentrasi logam berat dalam serum darah.* ***Hasil:*** *Analisis statistik menunjukkan perbedaan signifikan kadar logam berat antara tukang las dan kelompok kontrol (P Value <0,05), yang menunjukkan paparan yang lebih tinggi di antara tukang las. Namun, tidak ada perbedaan signifikan yang ditemukan dalam subkelompok tukang las berdasarkan usia, status merokok, dan durasi paparan.* ***Hal baru:*** *Studi ini memberikan penilaian komprehensif pertama mengenai paparan logam berat di kalangan tukang las di Kegubernuran Diyala, yang menyoroti kebutuhan mendesak untuk meningkatkan tindakan perlindungan.* ***Implikasi:*** *Temuan ini menggarisbawahi perlunya otoritas lingkungan dan kesehatan untuk menerapkan intervensi cepat untuk melindungi tukang las dari toksisitas logam berat. Tindakan perlindungan yang ada saat ini tidak memadai, sebagaimana dibuktikan dengan peningkatan kadar timbal, kadmium,*

nikel, dan seng dalam serum darah tukang las. Peningkatan praktik perlindungan dan peraturan yang lebih ketat sangat penting untuk mengurangi risiko kesehatan kerja ini.

***Kata Kunci** – risiko kesehatan, industri pengelasan, logam berat, serum darah*

I. PENDAHULUAN

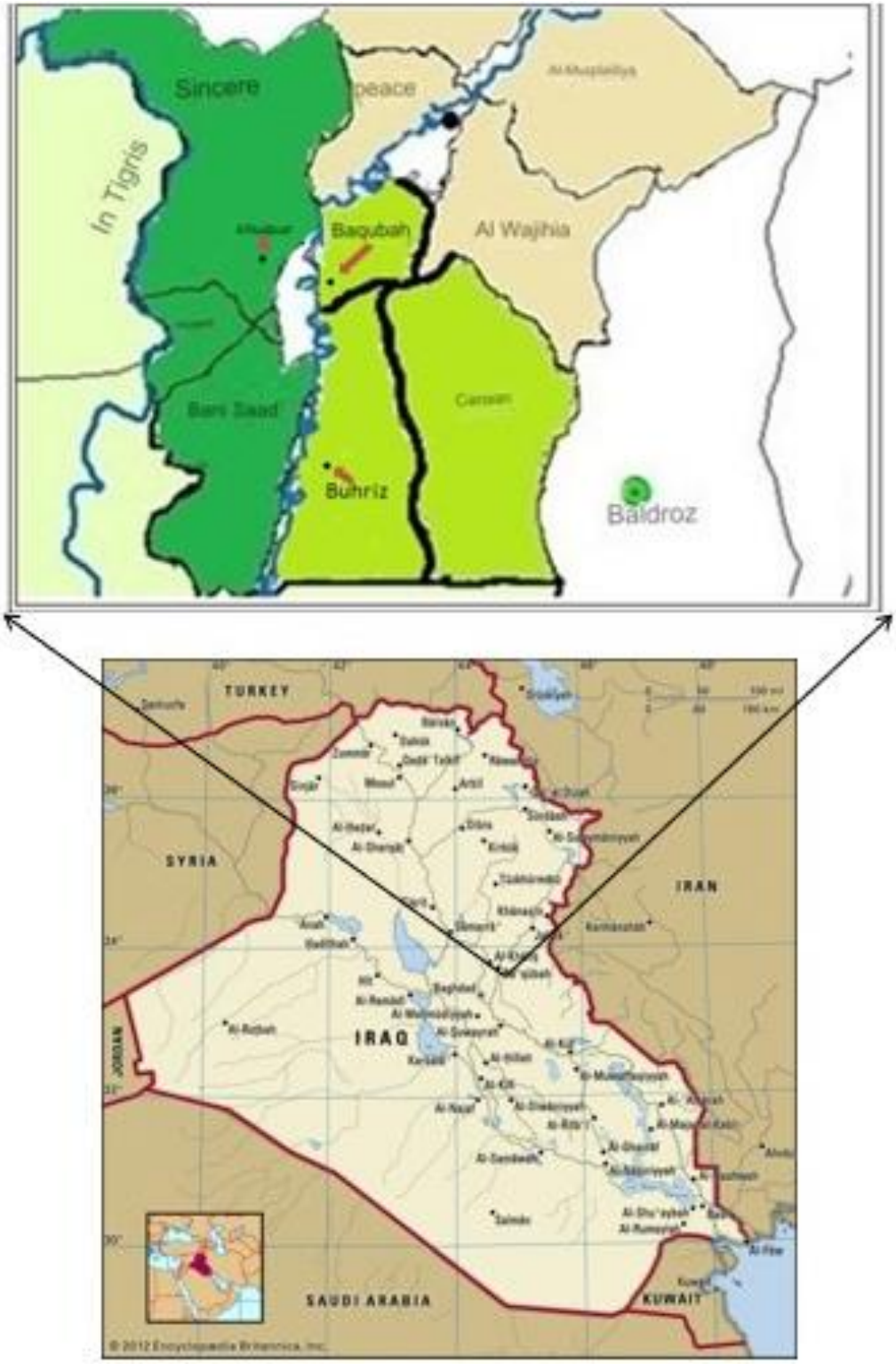
Welding is one of the basic and important processes by which metal pieces are joined together in various industries. It is considered the most preferred method compared to other operations such as bonding with glue, fixing, or nailing[1], as the welding industry is one of the important and diverse industries throughout Iraq, including Diyala Governorate; This is due to its importance in the economic and industrial growth of the region. However, the welding process can expose workers to a range of occupational hazards that can negatively affect their health [2]. The health risks of heavy metals associated with the welding industry are a major concern, especially in developing countries such as Iraq, where it lacks occupational health and safety regulations as in more developed countries (3.(These emissions contain a variety of heavy metals that can cause harm to the health of workers (4), as thousands of workers work in the welding industry, in Diyala Governorate, and they have an important role in building modern infrastructure (5), and high concentrations of fumes may lead to Welding poses a danger to the people working, which requires taking steps to control exposure (6), as these metals can enter the body through inhalation of metal fumes; Which leads to various health problems ،Industrial processes are considered one of the main sources of heavy metals that harm the health of working individuals (7). These metals melt at high temperatures resulting from burning a mixture of oxygen and acetylene (oxyacetylene); As a result of the melting of metals at the welding point (8). The primary heavy metals that can be found in the welding industry include lead, cadmium, chromium, iron, and zinc (9). These metals are characterized by their high toxicity and their effect on humans when the permissible limit is exceeded. This effect may not appear directly until after a period of time [10]. This may lead to the accumulation of heavy metals in the human body. Which causes many chronic infections and carcinogenic diseases, such as lead and cadmium [11], When humans are exposed to toxic metals at all ages, they will stimulate reactive oxygen species, which can reduce red blood cell membranes and extra tissue. [12]. It is estimated that there are more than one million workers who perform welding work around the world as part of their jobs[13]. Potential health risks may arise during the welding process, including welding fumes, a by-product of the process, exposure to physical hazards, as well as ergonomic stress, and chemical toxins. Welding fumes are a characteristic of various materials and the rate of their formation and generation depends on Components used [14]. The fine and ultrafine solder particles are often composed of several metals, including lead (Zn), iron (Fe), zinc (Pb), copper (Cu), cadmium (Cd), and chromium (Cr) [15]. Lead is a well-known toxic element and can have severe effects on the nerves and the central nervous system [16]. As for mercury, it is characterized by its high toxicity, especially when inhaled, as it causes scratches and ulcers in the respiratory system and is mainly produced from industrial processes [17]. As for cadmium, it is It is highly toxic and its effect on humans is directly through smoking. It is included as an essential element in cigarettes and their products through emissions from factories, contaminated water and food [18]. As for copper, increased exposure to it leads to the creation of oxidative stress and is a factor in the emergence and development of T2DM [19]. In addition to some essential minerals, there are toxic minerals that do not have any known biological functions that have been associated with the risk of metabolic syndrome and an increased incidence of diabetes, as these minerals can affect hormones by replacing essential minerals, such as iron and zinc, in biological systems, as well as stimulating oxidative stress [20]. Many researchers have confirmed in their studies that measuring heavy metals in the blood of people working in industrial areas[21], along with corresponding measurements of heavy metals in the blood of a control group, has shown that there is a significant weakness and clear accumulation in the blood of people who work in the welding industry. for heavy elements [22]. The aim of this study is to verify the safety and health of individuals working in welding and to protect them from the risks associated with welding activities and to develop the necessary strategies to mitigate those risks effectively, as it requires a comprehensive understanding of the risks that welders face and taking the necessary measures for prevention

II. METODE

To assess the health risks of workers in the welding industry in Diyala Governorate, Iraq, due to exposure to heavy metals, a multi-pronged approach was used.

2-1 Choosing the study area

A comprehensive survey of the study area was conducted to obtain detailed information about working conditions in terms of the number of people working in welding, and the extent of their commitment to using personal equipment and protection methods. To obtain important information to identify areas and potential risks resulting from exposure to heavy metals and to know the current measures in place to avoid those risks. The study area was identified as (the Alhudaid area in Baqubah, the industrial area in Baqubah, and the industrial area in Buhriz).Figure.1).



2-2 Selection criterion.

The criterion that was adopted for sampling the study based on which the samples were selected to be included in the study, the participant must be 15 years old and above and must have spent more than one year working in their shops.

2-3 Sample collection

Samples were collected. On [23/11/2022] From 9 am, Until 5 pm, (30) blood samples were taken from people working in the welding industry randomly, in addition to [30] samples being taken from students and employees at the University of Diyala as a control group. About 5 ml of blood sample was taken from the middle elbow vein in the arm using Disposable syringes from the blood of welding industry workers and from the control group were collected and transported on ice within 24 hours to the laboratory for testing using an atomic absorption spectrophotometer after separating the blood and isolating the serum from it.

2-4 Analyze the results

Statistical analysis was performed using SPSS [version 22]. Descriptive statistics were conducted to calculate heavy metal levels in both welders and the control group, such as calculating the mean, standard deviation, and between different subgroups of welders [e.g., based on age, smoking status, years worked].

III. HASIL DAN PEMBAHASAN

Table (1): Concentrations of heavy metals in the serum of people working in the welding industry and the control group.

Elements	Grouping	N	Mean ± SD (ppm)	P-Value
Pb	Workers Control	40 40	0.405±0.116 0.124±0.085	P<0.05
Cu	Workers Control	40 40	0.308±0.058 0.109±0.053	P<0.05
Cd	Workers Control	40 40	0.392±0.143 0.289±0.088	P<0.05
Fe	Workers Control	40 40	0.335±0.435 0.195±0.117	P<0.05
Zn	Workers Control	40 40	0.272±0.112 0.169±0.079	P<0.05

Significant P<0.05 P* adding detected by ANOVA P>0.05 NO Significant

The results showed that there were some significant differences in the heavy elements (Pb, Cd, Fe, Cu, Zn). There was a clear increase in the concentrations of the elements that were measured in the serum of people working in the welding industry compared to the control group, as the results showed that the value of [P value < 0.05] equal to [8.96339] for individuals working in the welding industry,

while the value of the control group was equal to[3.96.].

Table (2): Determining the levels of heavy metals among the age groups of people working in the welding industry

Elements	age grouping	N	Mean ± SD (ppm)	P-Value
Pb	(1-30) (31-60)	20 20	0.263±0.133 0.343±0.172	P<0.05
Cu	(1-30) (31-60)	20 20	0.281±0.108 0.300±0.056	P<0.05
Cd	(1-30) (31-60)	20 20	0.370±0.136 0.418±0.151	P<0.05

Fe	(1-30) (31-60)	20 20	0.426±0.359 0.549±0.518	P<0.05
Zn	(1-30) (31-60)	20 20	0.270±0.132 0.274±0.088	P<0.05

Significant P<0.05 P* adding detected by ANOVA P>0.05 NO Significant

The category of people working in the welding industry was classified according to (age group, smokers, non-smokers, period of occupational exposure).

The results for the age group among individuals working in the welding industry showed that there were no real significant differences, and the [P value < 0.05],for individuals whose ages ranged from [1-30] was [0.032], and for individuals whose ages ranged from [31-60], it was [0.010].

Table (3): Determining the levels of heavy metals between smokers and non-smokers working in the welding industry

Elements	smoking	N	Mean ± SD (ppm)	P-Value
Pb	smokers non-smokers	20 20	0.218±0.146 0.318±0.148	P<0.05
Cu	smokers non-smokers	20 20	0.224±0.150 0.305±0.063	P<0.05
Cd	smokers non-smokers	20 20	0.345±0.169 0.402±0.110	P<0.05
Fe	smokers non-smokers	20 20	0.482±0.406 0.485±0.407	P<0.05
Zn	smokers non-smokers	20 20	0.285±0.122 0.269±0.090	P<0.05

Significant P<0.05 P* adding detected by ANOVA P>0.05 NO Significant

The impact of the welding industry on [smokers and non-smokers] has been a source of great concern to many researchers, since the difference between these two groups has no significance in the differences between the two categories measuring heavy metals and the [P value < 0.05] was for individuals who smoked [0.267] and non-smokers [0.001].

Table (4): Determining the levels of heavy metals among people working in the welding industry according to the period of exposure.

Elements	period of Working year	N	Mean ± SD (ppm)	P-Value
Pb	(1-20) (21-40)	20 20	0.300±0.149 0.302±0.187	P<0.05
Cu	(1-20) (21-40)	20 20	0.293±0.098 0.281±0.019	P<0.05
Cd	(1-20) (21-40)	20 20	0.389±0.150 0.405±0.126	P<0.05
Fe	(1-20) (21-40)	20 20	0.487±0.448 0.476±0.438	P<0.05
Zn	(1-20) (21-40)	20 20	0270±0.117 0.279±0.100	P<0.05

Significant P<0.05 P* adding detected by ANOVA P>0.05 NO Significant

As for the results of exposure periods (1-20) and (21-40) years, they showed that there were no real significant differences with statistical significance between the two groups. The [P value < 0.05]for individuals whose

occupational exposure periods ranged from (1-20) [0.0015], and individuals aged from [21-40] amounted to[0.369], as shown in (Table: 4).

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4. Discussion

The high levels of these metals in the blood of workers in the welding industry is the result of improper professional practices and a lack of protective equipment against work environment pollutants. Results of a similar study conducted by [23], it was found that welders had higher levels of heavy metals in blood samples compared to the control group. They pointed out that unsafe practices and non-compliance with safety procedures contributed to increased exposure to heavy metals among welders. Furthermore, another study [24], emphasized the importance of appropriate personal protective equipment in reducing heavy metal levels in welders. They found that the use of respirator masks and improved protective clothing led to a significant reduction in lead and iron levels in blood serum. A study conducted by [25], found that older individuals tend to absorb and accumulate higher levels of heavy metals due to physiological differences and the period of potential environmental exposure. In general, The results indicate that age group may play a role in the levels of heavy metals in the body, and some changes in the concentration of heavy metals in individual workers as a result of smoking are due to a set of different parameters relevant to human subjects, namely the work environment, age, nutrition, and culture [26], and in a study that analyzed adult nail clippings reported by [27], their results indicated that smokers had significantly higher levels of Cd and Pb compared to non-smokers, while in a study of underground miners in the Murmansk region, they showed an increased risk of developing systemic diseases. Respiratory syndrome with an increased index of smoking [28], and, as previous studies have shown, exposure to heavy metals found in the welding industry. For years it can cause harmful effects in the future[29], due to the fumes and gases it contains that are emitted during the welding industry, and this will depend on many factors, including the time required to exist, density, entry route and poor nutrition..

IV. KESIMPULAN

Workers in the welding industry may face the risk of imminent death due to the high concentrations of heavy metals to which they may be exposed, which requires rapid and urgent intervention from all environmental and health authorities to protect them, as current results have confirmed that there is a noticeable increase in the levels of heavy metals for lead, cadmium, and nickel. And copper in the blood serum of all people who work in the welding industry compared to unexposed people. In addition, it has been observed that the levels of lead, cadmium, nickel and zinc in the blood serum of people working in the welding industry are below the permissible range, and that there are potential health risks. Which led to high blood serum levels of these metals as a result of their long and continuous professional practices, which lack means of protection from pollutants in the work environment, which increases their risk of exposure to poisoning.

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