

Effect of Welding Fumes on the DNA Damage and Chromosomes Aberration

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ABSTRACT

The paper aimed to evaluate the range of DNA harm and chromosomes in lymphocytes of blood of welding workers in Al-Anbar (Iraq) throughout distinguish the attendance of DNA harm and Chromosomes aberration in lymphocytes of blood of the welding workers and the groups of control . Welding workers (n=50) was sampled by indiscriminate sampling from 2 main sites in Al-Anbar: Falluja area. The group control (n=22) was randomly a selection of the residents with no relation and history of revelation to the C fumes. The steps of this research are divided into four parts, part one is choosing a test subject, the group control, and related information of biographical. Part two is Questionnaire will supply information on age, health history, and work conditions. Part three is Lab analysis that shows DNA damage and Chromosomes aberration detection by

Alkaline Comet Assay (ACA). Finally, Statistical software: SPSS v11 for data analysis. Based data of the study, it concluded that Falluja welding workers in urban areas has a certain amount of DNA harm and chromosomes aberration level. Age and exposure years have adopted the welding workers exposed to the extent of the damage.

Keywords: Welding, DNA damage, chromosomes aberration, Alkaline Comet Assay.

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INTRODUCTION

In countries such as Iraq, millions of welding workers are involved compared with several other professions, soldering technology might too risks and pose hazards . Potential hazards associated with soldering are revelation to toxic gases, metal vapors, ultraviolet, and IR. The most common cause of all hazards is exposure to metals, especially in the process of stainless steel welding. Below great temperatures where pressure material is useful accumulate, satisfying material is elective and adopts technique. Nanoparticles (0.01- 0.1 μ m) produced close to the arc of welding, later, turn into large volume (0.1-0.6 μ m) molecules absorbed due to constant temperature rise. [1]

“Welding fumes are a complex mixture of metallic oxides, silicates, and fluorides. Fumes are formed when a metal is heated above its boiling point and its vapors condense into very fine, particles (solid particulates). Welding fumes generally contain particles from the electrode and the material being welded.” [2]

The examples of welding gases [3]

- Gases utilized in cutting and welding operation, contain:
 - • gases Shielding like CO₂, Ar, He, etc.
 - • gases Fuel like butane, propane, acetylene etc.
 - • Oxygen, utilized for gases fuel and too in little amounts in some gas shielding mixtures
- Gases generated of cutting and welding operation contain:
 - • CO₂ from fluxes of the decomposition
 - • CO from the breakdown of CO₂ gas shielding in arc welding.
 - • Ozone of the interaction of electric arc for oxygen atm.
 - • oxides N₂ of the heating of oxygen atmo. and N₂.
 - • phosgene and Hydrogen chloride produced via the reaction among ultraviolet and the vapors from hydrocarbon chlorinated solvents degreasing (e.g., trichloroethylene, TCE).

➤ Gases are too generated of the thermal breakdown of coatings:

- Polyurethane coatings can produce hydrogen cyanide, formaldehyde, CO₂, CO, nitrogen of oxides, and vapors isocyanine.
- Epoxy coatings can produce CO₂ and CO .
- Phosphate rust-inhibiting paints can issue phosphine through welding methods.
- Minimizing revelation to degreasing vapors solvent.

Professional exposure to welding is mostly for welding fumes. [4] Welding fumes are a compound mix of fine particles and high precision. These vaporized metals oxidize with oxygen in the air, so the main components of welding smoke are metal oxides. Exposure to welding vapors be contingent only on the welding method, and welding material status. Active biologically substances reported in welding fumes contain molybdenum, vanadium (V), nickel (Ni), zinc oxides (ZN), fluoride, manganese (Mn), iron oxides, lead (Pb), aluminum (Al), beryllium (Be), magnesium (Mg) oxides, tin oxidation (Sn), titanium oxides (Ti), cadmium oxides (Cd), (Cr) and (Cu). In adding to vapors metal, welders are exposed to gaseous contaminants, counting CO, ozone, fluoride hydrogen, and oxides of nitrogen. [5]

Available studies have revealed respiratory and kidney disorders, nervous and reproductive systems, irritation of the skin, eyes ,metal fever of the fume and DNA damage. (MDA) is considered as a safe sign of oxidation. [6,7] .The paper aimed to evaluate the extent of DNA harm and chromosomes in lymphocytes of blood of welding workers in Al-Anbar (Iraq) throughout recognizing the attendance of DNA harm and Chromosomes aberration in lymphocytes of blood of the welding workers and the groups. control [8] (see appendix A “DNA damage and Chromosomes aberration samples”)

METHODS AND MATERIALS

The study area was the Anbar governorate that was situated in the west part of Iraq with a population of about 2.1

million in 2017. The sampling sites were along of Falluja area that was one of the most famous and major areas in the Anbar governorate.

Workers of welding (n=50) was sampled by haphazard sampling for 2 main sites in Al-Anbar: Falluja area. The group control (n=22) was randomly a selection of the residents with no relative and history of revelation to the fumes C. Though, the subjected to interchange contamination just similar welders but no to fumes metal. Groups control are no different of welding workers in sex, age and habits smoking. Altogether, subjects was purpose of the informed for paper and the consent was achieved. Clearance ethical was also acquired from the Ethics Commission of the Ministry of Health in Iraq.

2.1 Study structure

- Choose a test subject, group control, and related information of biographical.
- The questionnaire will supply information of age, history of health and work conditions
- Lab analysis that shows DNA damage and Chromosomes aberration detection by Alkaline Comet Assay (ACA). [9]
- Statistical software: SPSS v11 for data analysis

2.2 Questionnaire

Will take by an interview the welding workers for data of age and social habits such as drinking alcohol, smoking, daily working hours

Blood samples collection

Sample was composed from the test samples in the morning about 7 - 8 am. 5 ml of intravenous blood sample was composed. Sample was collected in the Blue Royal EDTA tube. The site collection was washed on the object with soap and water, shadowed via a swab of alcohol. Blood collect intravenously utilizing a needle phlebotomy. The tube of EDTA was reversed about 8-10 Tim to preclude blood coagulation. all sample tube is attached for a ID label. Sample was stored at 4 ° C. [7]

Alkaline comet assay (ACA)

The comet assay was implemented, according to which 740 µl of whole blood was additional to the alike volume of freezing mixes (12% D.M.S.O and R..P.M.I 1640) in 3.0 ml micro centrifuge tube and reversed different times to make certain complete mixing. The package was then moved to a zip lock and then placed freezer in -80 ° C to be frozen step at a rate of -1 °C / min. 10 liters of single suspension cells was mix with 75 µL of (w / v) 0.5% small melting point at 37 ° C and layers at (w / v) 0.5% usual agarose before coated on ice-covered slides. The slides was coverslips and located for 10 min at 4 ° C to agarose allow to harden. Coverslips was prudently detached and the slides was concealed for a layer of little melting point agarose and positioned at 4 °C of 12 min. The slides was then put in a recently practiced base tilts solution (2.5 m NaCl, 150 mM EDTA, 1% v/v Triton X-100 and 10% D.M.S.O, 10 mM Tries, PH = 10) at 4 °C for 60 minutes. All ways was implemented below light dimmed to avoid added DNA harm. Cell was experiential at a magnification of 30 × by a fluorescence optical microscope with light green excitation and a 610 nm barrier filter. [10]

The DNA harm was computed via accidentally including tailing DNA in 40 cells /sample. Cataloging of comets was 5 harm matching to DNA Tail %, counting grade from 0 to 3. Grade 0 was expressed not DNA harm and Chromosomes aberration and grade 3 were the maximum dangerous DNA and Chromosomes harm.

Data Analysis

The change of DNA and Chromosomes aberration will analysis by using SPSS v11 statistical software through using a t-test for monitors the difference between control groups among welding workers. Pearson produce-moment association analysis carry out to checked whether they is a association among several capable. Statistical meaning was defined as $p \leq 0.05$.

RESULTS AND DISCUSSION

Respondents don't provide any preventive measures given other than the sunglasses as shown in table 1. Conceivably, the considerate is that sunglasses protect the eyes of strength of the light but don't assist satisfactory protection for fumes and dust of welding going in to the eyes.

Table 1: Samples health history

Welding Group	Characteristics	Control Group
50	n	22
33.5 ± 11.25 (in Years)	Age	26.7 ± 6.1 (in Years)
16.4 ± 12.5 (in Years)	Exposure	0
Sunglasses	Protective devices	None

Table 2 shows that the amount of chromosomes aberration and DNA damage at several age groups for the welding group.

Table 2: Age impact for welding group

Age in years	DNA damage	chromosomes aberration
15 : 24	5.89	5.10
25 : 34	6.23	7.25
35 : 44	10.20	9.31

>= 45	17.56	11.35
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Table 3 shown that DNA damage and chromosomes aberration for the group of control.

Table 3: Exposure impact for welding group

Exposure in years	DNA damage	chromosomes aberration
0 : 9	5.12	4.32
10 : 19	7.12	6.24
20 : 29	9.45	8.87
> = 30	12.62	10.23

Table 4 showed that the amount of DNA damage and chromosomes aberration at several experience degrees among the welding group.

Table 4: Age impact in the control group

Age in years	DNA damage	chromosomes aberration
15 : 24	3.25	3.90
25 : 34	4.12	4.56
35 : 44	5.00	4.95
>= 45	0.00	0.00

The variance in level and extent of DNA harm and chromosomes aberration caused among the welding group and groups control was too established via the t-test. They important variance in the level of DNA harm and chromosomes aberration among test subjects and groups control ($p < 0.05$). The induction of DNA harm and chromosomes aberration could be an outcome of exposure to welding fumes which consist of numerous heavy spray. The welding group was likely exposed to advanced levels of traffic air contamination than the control topics, consequently, the consequences of the comet exposed here can be at smallest partially due to coverage to traffic in addition to welding vapors.

Aluminum and zinc could generate strand DNA breaks by the pressure oxidative talk into via fever welding-fume. The fumes for manufacturing steel stainless welding procedures likewise augmented chromosomal aberrations in welders 11. As kind of a great study on the shop, workers learned that 5 welders had an advanced frequency of DNA-crosslinks protein than group of control.

Conversely, perhaps appropriate to the minor number of welders complicated in the study, the biographers informed no rise in the frequency of micronuclei for these persons. Indifference, displayed that 12 welders have an amplified the frequency of micronuclei in epithelial buckle cells. moreover, advanced levels of DNA harm were described in nucleated marginal cells utilizing the comet check (ACA). Oxidized forms of nickel and chromium, that correspondingly are current in fumes welding, are genotoxic. Additional metals that might be current in welding fumes, then that might prompt DNA harm, contain principal, manganese, (Ca) and (Co). Pearson produces a moment correlation that was accomplished to limit the important relationship among capable. Though, They association among age inside and DNA harms and chromosomes aberration on the other side ($p < 0.05$) as appear in table 6. Alike, they correlation among years of revelation inside and DNA harm and chromosomes aberration on another side ($p < 0.05$) as appear in tab. 7

recounted the DNA harm and chromosomes aberration was greater in subjects with lengthier duration of revelation ($P < 0.05$). A linked study on hemotoxic revelation between welders in Copenhagen bring into being the aberrations of chromosomal and sister chromatid ex -changes have raised meaningfully for age. [11] A current study showed the result of revelation to welding vapors on the frequency of micronucleus, through the cells target in this study was lymphocytes.

Metalworkers may have been unprotected to greater levels of traffic contamination air compared to controls, so the effects of the comet reported here can be attributed at least in part to traffic revelation in adding to vapors mineral. [12] The presence of oxidizing forms such as chromium and nickel in the welding fumes can be toxic to genes. Other minerals might be past in welding fumes and may cause DNA harm. These minerals contain cadmium, manganese, cobalt, and lead. (Sani and Abdullahi, 2016) The fumes from steel stainless welding procedures too raised pigment aberrations in a group of welders. [13] kind of a great study on tanning workers, it appeared that a group of welders have a greater frequency of DNA protein bonds compared to the control group. [14] In contrast, another study showed that welders had an increase in the number for micronuclei in the cells epithelial buccal. Moreover, levels elevated of DNA harm was observed in the nuclear terminal cells utilizing the comet assay. [15] A study among welders in Copenhagen revealed that exposure to vapors containing genotoxic minerals leads to a significant increase in aberrations chromosomal and sister chromatid ex-changes that may age with age. [16,17]

CONCLUSION

Instituted data of the study, it entire Falluja welding workers in Anbar areas must a certain amount of damage DNA and chromosomes aberration level. Age and exposure years have adopted the welding workers exposed to the amplitude of the harm. .Welding works as presently proficient in urban

Falluja must be carefully supervise impertinent protection environmental agencies like National Investment and ecological Authority in Iraq (NIEA), the law no. 13 for 2016 and the Ministry of Environment in Iraq (MOEN). moreover studies are essential on the genotoxicity of welder of a larger population sampled to produce the essential result of an improved conception of this occurrence.

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APPENDIX A

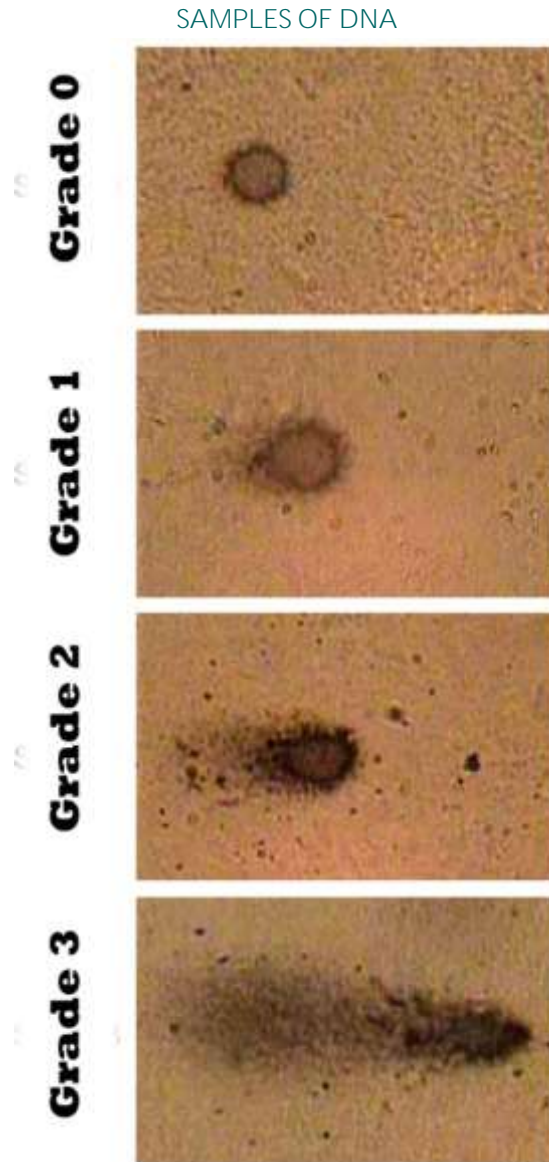


Figure 2: DNA damage (0:3)

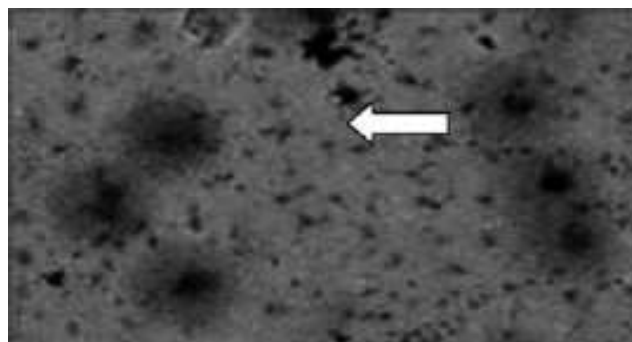


Figure 3: DNA damage sample for welding group

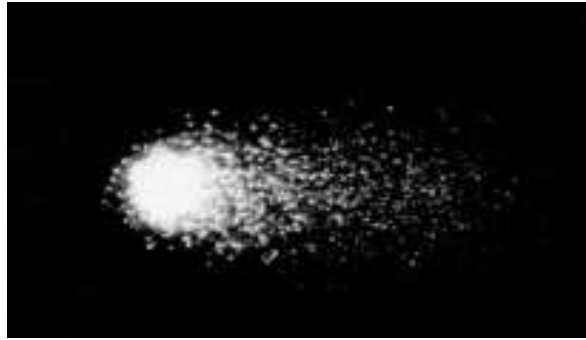


Figure 4: DNA damage sample for welding group



Figure 5: DNA damage sample for welding group

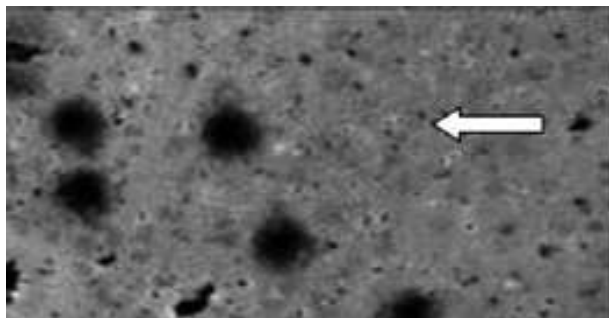


Figure 6: DNA damage sample for control group



Figure 7: DNA damage sample for control group

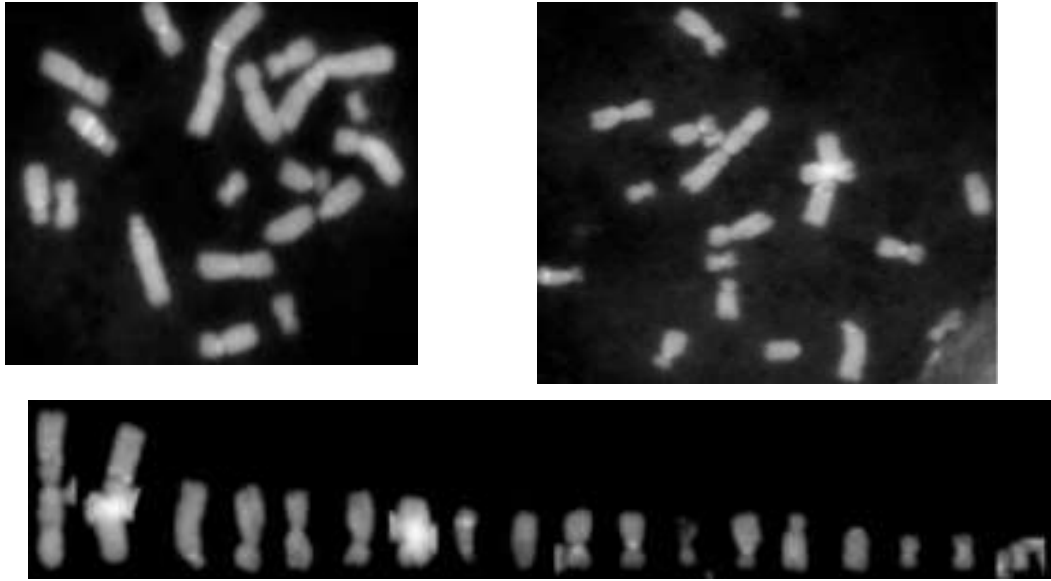


Figure 8: Examples of analysis chromosomes

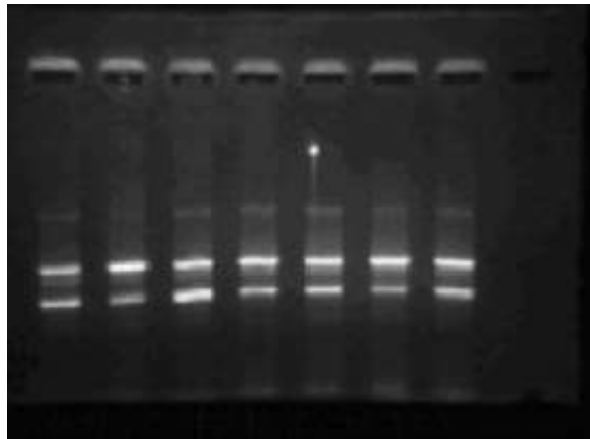


Figure 9: Duplex Image of DNA abstract

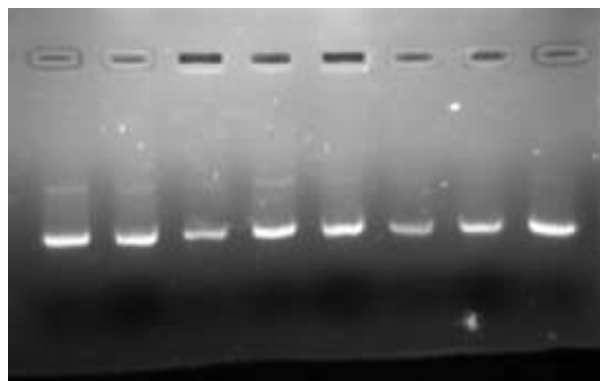


Figure 10: Simple image of DNA