Al-Qadisiyah Journal of Pure Science

ISSN(Printed): 1997-2490 ISSN(Online): 2411-3514

DOI: 10.29350/jops

Al-Qadisiyah Journal of Pure Science

The frequency of chromosomal aberrations among brick factory workers in Al-Diwaniyah Governorate

first Author name: Huda Muslim mahdi[1]

second author name: Hayder Ayyal Mutar[2]

Author(s) affiliations: College of biotechnology, University of AL-Qadisiyah, Iraq

The number ;07809691046

Corresponding author huda.m.mahdi@qu.edu.iq

haider.eyal.mutar@qu.edu.iq

ORCid: 0009-0006-6510-0928

Abstract

The study was carried out on workers employed in brick factories in Al-Qadisiyah Governorate to assess the prevalence of chromosomal abnormalities among them. Samples were collected from workers and non-workers (the control group) after exposure to toxic gases and chemicals. The impact of these substances on genetic material and chromosomes was then assessed. The results showed that most chromosomal aberrations were present when comparing various abnormalities (gaps, lsogap, breaks, and deletions) in laboratory workers and healthy individuals. Mean of Gap were 0.108 ± 0.011 and 0.022 ± 0.007, in brick factories workers and healthy control subject respectively; the level was higher in brick factories workers in comparison with healthy control subject and the difference was highly significant ($P < 0.001$). But the mean of Isogap were non-significant higher in brick factories in comparison with healthy control subject 0.027 ± 0.003 versus 0.013 ± 0.008, ($P= 0.260$). Regarding the Breaks, the present results show the mean of breaks in petrol station workers was significant higher than the mean of breaks in healthy control subject, 0.029 ± 0.004 versus 0.005 ± 0.001 respectively, ($P=0.007$). But the mean of deletions in workers brick factories was non-significant higher than the mean of deletions in healthy control subject, 0.0047± 0.001 versus 0.0027± 0.0001 respectively, ($P= 0.143$) The present results show the mean of all aberrationsin brick factories was

significantly higher than the mean of all aberrations in healthy control subject, 0.181 ± 0.018 versus 0.026 ± 0.007, respectively, (P≤ 0.001).

Keywords: (: Types of chromosomal aberrations, brick kiln workers, Al-Diwaniyah Governorate**)**

Introduction

The study of brick making is often considered the study of civilization because bricks, made from mud and straw, have been used for thousands of years. Brick is a crucial material in the construction industry. The traditional method of brick production has some clear drawbacks The use of earth-based materials like clay, shale, and sand in brick production has led to resource depletion, health issues, environmental degradation, and increased energy consumption (1). The number of brick factories in Iraq has increased over the past five years, and all of them use black oil as an energy source for their processes. This situation leads to increased air pollution in the environment (2) In developing countries, brick kilns pose an increased threat to the environment and the health of workers and people in surrounding areas. Health problems related to brick kilns include musculoskeletal issues. (3) Musculoskeletal (MSK) symptoms related to work are a major health concern for brick kiln workers. These symptoms encompass a variety of inflammatory and degenerative diseases and disorders. (4) Furthermore, poor posture during brick-making and carrying heavy loads led to a high number of complaints among brick kiln workers. Specifically, 50% reported low back pain, 38% reported neck pain, and 29% reported shoulder pain. (5)

Workers in numerous industries are exposed to a wide range of chemical mixtures, including synthetic and natural organic solvents, heavy metals, and fuel emission particles. Many of these chemicals have been identified as mutagens. (6)

Genotoxic chemicals can harm DNA but do not always lead to the development of cancerous cells, like Peripheral T-cell Lymphoma (PTCL) (7)

Dicentric chromosomes are formed when two centromeres are positioned on the same chromosome due to genome rearrangement. The stability of dicentrics varies after their formation, depending on the organism (8).

Materials and Methods

Samples were taken from brick factories workers in Diwaniyah Governorate, consisting of 50 random samples from different sections of the factories. After that, they filled out the questionnaire form, where 3-5 ml of blood was drawn using a syringe, where a 2 ml heparin tube was used, and then it was transported to the laboratories by using cool box at a temperature of 1-4 degrees Celsius, for the purpose of completing the cytogenetic examination.

Cytogenetic analysis of human blood lymphocytes

Samples were taken from brick factory workers in Diwaniyah Governorate, consisting of 50 random samples from different sections of the factories. After that, they filled out the questionnaire form, where 3-5 ml of blood was drawn using a syringe, where a 2 ml heparin tube was used, and then it was transported to the laboratories using refrigerated boxes at a temperature of 1-4 degrees Celsius, for the purpose of completing the cytogenetic examination.

The blood obtained is cultured on pre-prepared RPMI 1640 culture media with the addition of PHA, and incubated for 71 hours. After that, we take out the samples to add 0.2% of colgecin one hour before the harvesting stage. The samples were then centrifuged at 1000 revolutions for 10 minutes. After that, we get rid of the liquid and leave the sediment to add KCL (5 ml) and put it in the incubator for 15-30 minutes. Then it goes out to be centrifuged at the same speed. We remove the liquid, and keep the sediment to add the Fixative solution in the form of shortenings with continuous shaking using a mixer. It is left in the incubator for 30-60 minutes.

Results and Discussions

Demographic characteristics Brick Kilns workers and control subjects

The study involved 93 Brick Kilns workers as the study group and 20 apparently healthy subjects as the control group. The demographic characteristics of both groups are presented in tables (1).

Distribution of study group and control subjects according to age and duration of exposure

The mean age of petrol station workers was 33.03 ± 5.58 years and the range was 25–45 years, whereas the mean age of control subject was 31.35 ± 4.34 years and he range was 21– 37 years. Indeed, there was no significant difference in mean age between study group and control subjects (P = 0.208). The frequency distribution of study group and control subjects according to age groups was also shown in table (1). On the other hand, most of the petrol station workers enrolled in the present study were between 30-39 years of age. Again, there was no significant difference in the frequency distribution of petrol station workers and control subjects according to age group (P = 0.131).

Table (1): Demographic characteristics of study group and healthy control subjects

Characteristic	Study group $n = 93$	Healthy control $n = 20$	*P*
Age (years)			
Mean ± SD	33.03 ± 5.58	31.35 ± 4.34	0.208 † NS
Range	25 – 45 years	21 – 37 years	
< 30 years, *n* (%)	25 (26.9%)	6 (30.0%)	0.131 ¥ NS
30-39 years, *n* (%)	52 (55.9%)	14 (70.0%)	
≥ 40 years, *n* (%)	16 (17.2%)	0	

Frequency distribution of chromosomal abnormalities according to duration of exposure.

The comparison of some chromosomal abnormalities (Gap, Isogap, Breaks, Deletions and All aberrations) according to duration of exposure has been carried out and the results were demonstrated in table (2). The present results show non-significant difference of all chromosomal abnormalities according to duration of exposure, (P< 0.05). Chromosomal aberrations are caused by well-understood factors such as polyploidy resulting from failed

cytokinesis, aneuploidy due to nondisjunction or premature chromosome separation, and structural rearrangements caused by chromosome breakage (11).

Table (2): Frequency distribution of chromosomal abnormalities according to duration of exposure.

Chromosomal abnormalities	< 5 years *n* = 6	5-9 years *n* = 52	≥ 10 years *n* = 35	*P*
Gap				
Mean ± SD	**0.076 ± 0.037**	**0.109 ± 0.015**	**0.112 ± 0.020**	**0.458 A NS**
Range	0.008 – 0.242	0.004- 0.336	0.003-0.430	
Isogap				
Mean± SD	**0.022 ± 0.004**	**0.027 ± 0.005**	**0.028 ± 0.005**	**0.576 A NS**
Range	0.007 -0.031	0.002-0.170	0.002-0.084	
Breaks				
Mean ± SD	**0.017 ± 0.004**	**0.024 ± 0.004**	**0.037 ± 0.008**	**0.226 A NS**
Range	0.012 -0.040	0 - 0.112	0 -0.300	
Deletions				
Mean ± SD	**0.0031 ± 0.001**	**0.0034 ± 0.001**	**0.006 ± 0.001**	**0.164 A NS**
Range	0 -0.05	0-0.040	0-0.05	
All aberrations				
Mean ± SD	**0.061 ± 0.016**	**0.186 ± 0.029**	**0.194 ± 0.021**	**0.076 A NS**
Range	0.024 -0.110	0.014 -0.776	0.017-0.583	

Frequency distribution of chromosomal abnormalities according to age group.

The comparison of some chromosomal abnormalities (Gap, Isogap, Breaks, Deletions and All aberrations) according to age group has been carried out and the results were demonstrated in table (3). The present results show the mean of Isogap were significant higher in workers with less than 30 years in compared to other age groups, (0.042 ± 0.009

vs 0.020 ± 0.002 and 0.029 ± 0.005) respectively, (P = 0.011). Regarding other chromosomal abnormalities, the present results show non-significant difference between different age groups (P< 0.05).

Table (3): Frequency distribution of chromosomal abnormalities according to age group.

Chromosomal abnormalities	< 30 years *n* = 25	30-39 years *n* = 52	≥ 40 years *n* = 16	*P*
Gap				
Mean ± SD	**0.115 ± 0.023**	**0.114 ± 0.014**	**0.077 ± 0.015**	**0.465 A NS**
Range	0.006 – 0.336	0.003- 0.430	0.003-0.190	
Isogap				
Mean± SD	**0.042 ± 0.009**	**0.020 ± 0.002**	**0.029 ± 0.005**	**0.011 A S**
Range	0.004 -0.170	0.002-0.075	0.002-0.084	
Breaks				
Mean ± SD	**0.029 ± 0.006**	**0.024 ± 0.003**	**0.043 ± 0.017**	**0.232 A NS**
Range	0 -0.311	0 - 0.104	0.009-0.300	
Deletions				
Mean ± SD	**0.009 ± 0.003**	**0.0023 ± 0.001**	**0.005 ± 0.001**	**0.053 A NS**
Range	0 -0.05	0-0.040	0-0.04	
All aberrations				
Mean ± SD	**0.203 ± 0.05**	**0.165 ± 0.022**	**0.199 ± 0.025**	**0.623 A NS**
Range	0.014 -0.776	0.014 -0.713	0.017-0.399	

Frequency distribution of chromosomal abnormalities according to smoking.

The comparison of some chromosomal abnormalities (Gap, Isogap, Breaks, Deletions and All aberrations) according to smoking has been carried out and the results were demonstrated in table (4). The present results show non-significant difference of all chromosomal abnormalities according to smoking, (P< 0.05). Cigarette smoke contains many chemical compounds that can cause DNA damage. These compounds contain toxic chemicals like nitrosamines, polycyclic aromatic hydrocarbons, and aromatic amines,

which can affect DNA adducts and cause damage (9). Elevated promoter activity can increase the risk of lung cancer from smoking. Furthermore, DNA damage can accelerate the progression of smoking-related lung cancer. (10)

Table (4-4): Frequency distribution of chromosomal abnormalities according to smoking

Chromosomal abnormalities	Smoking *n* = 27	Non-smoking *n* = 66	*P*
Gap			
Mean± SD	**0.120 ± 0.014**	**0.080 ± 0.012**	**0.120 † NS**
Range	0.003 – 0.430	0.003- 0.190	
Isogap			
Mean± SD	**0.030 ± 0.004**	**0.019 ± 0.003**	**0.107 † NS**
Range	0.002 -0.170	0.002-0.049	
Breaks			
Mean ± SD	**0.029 ± 0.003**	**0.028 ± 0.001**	**0.852 † NS**
Range	0 -0.112	0.001 - 0.300	
Deletions			
Mean ± SD	**0.0064 ± 0.001**	**0.0044 ± 0.002**	**0.114 † S**
Range	0 -0.05	0-0.05	
All aberrations			
Mean ± SD	**0.200 ± 0.025**	**0.134 ± 0.015**	**0.109 † NS**
Range	0.014 -0.776	0.018-0.272	

The results indicated a rise in direct/oxidative DNA damage and micronuclei frequency among the exposed workers (12).

Conclusion:

Brick manufacturing is a workplace highly prone to pollution. (13) Brick kiln workers experience a range of health issues, including respiratory, musculoskeletal, gastrointestinal, injuries, reproductive, and mental health problems. To address respiratory health issues, (14), Brick factories are industrial contaminants that have a significant impact due to the toxins they emit, whether in gaseous, liquid, or solid form. (15) Brick factories have a direct impact on the environment surrounding them, particularly on the vegetation nearby. This leads to soil degradation, which in turn affects crop productivity in the region [16]. Brick kilns use harmful raw materials to bake bricks, which has a negative impact on the health of both the workers at the kilns and the nearby residents. The comet assay technique is utilized to monitor DNA damage in the lymphocytes of brick kiln workers. (17) The brick kilns are semi-enclosed environments with an average temperature range. 10°C-25°C, Exposure to high dust density, elevated temperatures, and particulate matter from kilns can lead to harmful effects like DNA damage and occupational health issues, including lung cancer, (18). The pollutants emitted from brick kilns can cause significant DNA damage in workers who are exposed to them. This heightened DNA damage is likely a result of working without any protective measures, Brick kiln workers should be informed about the dangers of prolonged exposure to pollutants from brick kilns. (17).

References

1. **Fatima**, I., Bhat, G. A., & Kamili, A. N. G. **(2011)**. *Impact of brick kiln emissions on the ambient air quality and vegetation: A case study of district Budgam* (Doctoral dissertation).
2. **Khan,** R., & Vyas, H. **(2008).** A study of impact of brick industries on environment and human health in Ujjain City (India). *Journal of Environmental Research and Development*, *2*(3), 421-425.
3. **Kaushik,** R., Khaliq, F., Subramaneyaan, M., & Ahmed, R. S. **(2012)**. Pulmonary dysfunctions, oxidative stress and DNA damage in brick kiln workers. *Human & experimental toxicology*, *31*(11), 1083-1091.

4. **Bijetri**, B., & Sen, D. **(2014)**. Occupational stress among women moulders: A study in manual brick manufacturing industry of West Bengal. *Age (yrs)*, *24*, 4-16.
5. **Joshi,** S. K., Dahal, P., Poudel, A., & Sherpa, H. **(2013).** Work related injuries and musculoskeletal disorders among child workers in the brick kilns of Nepal. *International Journal of Occupational Safety and Health*, *3*(2), 2-7.
6. **Scheepers**, P. T. J., Coggon, D., Knudsen, L. E., Anzion, R., Autrup, H., Bogovski, S., ... & Zwirner-Baier, I. **(2002)**. BIOMarkers for occupational diesel exhaust exposure monitoring (BIOMODEM)—a study in underground mining. *Toxicology letters*, *134*(1-3), 305-317.
7. **Auda,** N. A., Jaafar, Z. M., & Sa'adyia, O. M. **(2015).** Chromosomal Aberrations in Peripheral Blood Lymphocytes in Brick Kilns Workers. *Iraqi Journal of Science*, *56*(4B), 3066-3071.
8. **MacKinnon,** R. N., & Campbell, L. J. **(2011).** The role of Dicentric chromosome formation and secondary centromere deletion in the evolution of myeloid malignancy. *Genetics research international*, *2011*.
9. **Maffei,** F., Forti, G. C., Castelli, E., Stefanini, G. F., Mattioli, S., & Hrelia, P. **(2002).** Biomarkers to assess the genetic damage induced by alcohol abuse in human lymphocytes. *Mutation Research/Genetic Toxicology and Environmental Mutagenesis*, *514*(1-2), 49-58.
10. **Huang,** C. C., Lai, C. Y., Tsai, C. H., Wang, J. Y., & Wong, R. H. **(2021)**. Combined effects of cigarette smoking, DNA methyl transferase 3B genetic polymorphism, and DNA damage on lung cancer. *BMC cancer*, *21*, 1-12.
11. **Bonetta,** S., Macrì, M., Acito, M., Villarini, M., Moretti, M., Bonita, S., ... & Carraro, E**. (2024).** DNA damage in workers exposed to pigment grade titanium dioxide (TiO2) and association with biomarkers of oxidative stress and inflammation. *Environmental Toxicology and Pharmacology*, *105*, 104328.
12. **Sanjel,** S., Thygerson, S. M., Khanal, S. N., & Joshi, S. K. **(2016).** Environmental and occupational pollutants and their effects on health among brick kiln workers.
13. 13-**MC-Nepal (2013)** Situatinal Analysis of Workers in Some Brick Industries around Kathmandu Valley. Kathmandu
14. **Al-Khateeb**, A. H. N., & Mahmoud, M. B. **(2020)**. STUDY OF THE ECOLOGICAL IMPACTS OF AIR POLLUTANTS EMITTED FROM BRICK MANUFACTURING IN ALSINAIYA, QADISIYAH GOVERNORATE, IRAQ. *Plant Archives*, *20*(2), 176-181.

15. **Akinshipe**, O., & Cornelius, G. **(2017).** Chemical and thermodynamic processes in clay brick firing technologies and associated atmospheric emissions metrics-a review.
16. **Khisroon,** M., Khan, A., Ullah, U., Zaidi, F., & Ahmadullah. **(2018)**. Bio-monitoring of DNA damage in matchstick industry workers from Peshawar Khyber Pakhtunkhwa, Pakistan. *International journal of occupational and environmental health*, *24*(3-4), 126-133.
17. **Naicker,** N. **(2006).** Pilot study to determine the extent and nature of occupational exposure to airborne pollutants associated with clay mining and brick-making.