Research Article

Assessment of Hematological Parameters among Cement Exposures in Barber town Sudan.

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Abstract:

The aim of this study is to determine complete blood count among Sudanese cement exposures. It was descriptive cross sectional analytical one, was carried out in Berber city in River Nile State – Northern Sudan from December 2022 to February2024. It included eighty (80) participants, fifty (50) of them were cement exposures as a case group and thirty (30) non exposures control group. Subjects were selected randomly based on set inclusion and exclusion criteria.3 ml of venous blood samples were collected using venipuncture technique into EDTA bottle for assay complete blood count,and Automated hematology analyzer (Mindray BC3000 plus) was used to analyze haematological indices . The results showed that the values of white blood cell (WBC) count,differential count of lymphocytes (LYM), mean corpuscular haemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) ,platelets (PLT), and platelets distribution width(PDW) were significantly increased in exposed peoples(P.Value <0.05) but red blood cell (RBC) ,haematocrit (HCT), red cell distribution width standard deviation(RDW-SD) , red cell distribution width - coefficient of variation (RDW-CV) , mean platelet volume (MPV), and plateletcrit (PCT), were significantly lower ($p < 0.05$). The results from this study has shown that exposure to cement dust has significant effects on some haematological parameter either by decrease or increase.

Keywords: Blood, Exposed and Unexposed workers, cement dust exposure, Hematological indices.

Introduction:

The cement industry is exhibiting increasing demand around the globe, particularly in low- and middle-income countries, due to the urbanization and development of infrastructure in these countries. However, with development comes the burden of pollution and health hazards for those within and around the factories where cement is manufactured.[(1)] Cement production, distribution, and use may lead to the emission of various toxic substances into the environment. [(2)] The composition of cement includes several heavy metals health in varying proportions, which are hazardous to humans, like lead ,cobalt , cadmium ,iron ,manganese ,chromium , arsenic ,and nickel.[(3)] The length of distance that the wind may carry the dust produced in the process of producing cement depends on the particle size. [(4)] Dust in the 10-2.5 μm range may deposit within the upper respiratory tract, and dust with a diameter less than 2.5 μm can penetrate circulation. [(5)] RBC play a vital role in physiology carrying oxygen from the lungs to the tissues where it is

utilized in oxidative metabolism ,hemoglobin is a highly specialized intracellular erythrocyte protein responsible for transporting oxygen from the lungs to tissue for oxidative metabolism and facilitating carbon dioxide transport from the tissues to lungs . the terms leukocyte and white blood cell are the synonymous names given to the nucleated cells that are involved in the defense against foreign pathogens or antigens . platelets were once simply considered "blood dust" first studies over the past 150 years have now show them to play an essential role in homeostasis. (6)

Rahnuma Ahmad and etal , Bangladesh ,2024, Dhaka Medical College,Study Impact of Occupational Cement Dust Exposure on Hematological Health Parameters: A Cross-Sectional Study, they found that was a reduction in MCHC and MCH levels in the cement dust-exposed subjects when compared to controls. (7)

Hassan A. Al-Shamery and etal ,Iraq,2021, Mosul University, Study the effect of cement dust exposure on the hematological variables in the workers of new badoosh cement factory in Mosul city, they found that decrease in the hemoglobin concentration ,packed cell volume ,and red blood cells count ,increase in count of white blood cells , lymphocytes and granules in the blood of workers.(8)

Rahnuma Ahmad and etal , Bangladesh,2021 , Dhaka Medical College, study Occupational Cement Dust Exposure and Inflammatory Nemesis: Bangladesh Relevance, they found that increase in total and differential WBC count . (9)

Rahnuma Ahmad and etal ,Bangladesh,2022 , Dhaka Medical College,study Effects of Exposure of Cement Dust on Platelet Count in Workers of a Cement Mill, they found that the platelet count was significantly higher than those of control group .(10)

Rationale:

Cement is considered one of the basic materials necessary for building houses, and with the extension of cities and population expansion, the need multiplied, so it was necessary to know the impact of dust and dust on exposures in order to avoid the effects and remove the damage because the safety of community. This research may be a rule that applies to other studies that include workers and may extend to other environmental studies.

Objectives of the study:

The general objectives of this study is to assess the hematological parameter among cement exposures in Barber town while the specific objectives are:.

1. To measure Hb, PCV, RBCs count ,RBCs indices, TWBCs count , differential count, platelets and platelet parameters in cement exposures in comparison with control group (non exposures).

2-To compare the hematological parameters of the cement exposures with duration of exposures in different ages and gender.

Material and methods:

The study was descriptive cross sectional analytical, carried out in Barber town in River Nile State – Northern Sudan from December 2022 to February2024 to determine complete blood count among Sudanese cement exposures .

Study populations :

Participants involved in this study were cement exposures in Berber locality as test group and healthy individuals as control group both of them with diferent age and gender groups.

Inclusion Criteria: Cement factory exposures were included in this study and others healthy people as control group .

Exclusion criteria: Cement exposures who have any disease

Sampling:

Three ml of venous blood samples were collect by standard procedure in vaccuated EDTA blood containers.

Sample size:

Atotal of 80 samples were collected 50 blood samples of cement exposures with different age and sex groups as test group, and 30 blood samples from healthy people were selected randomly as control group.

Data collection tools:

Structural interview questionnaire was filled, which contain name, age, duration of cement exposure, history of other chronic disease and investigations results.

Method:

Complete blood count were measured by standard method using Automated hematology analyzer (Mindray BC3000 plus).

Data analysis:

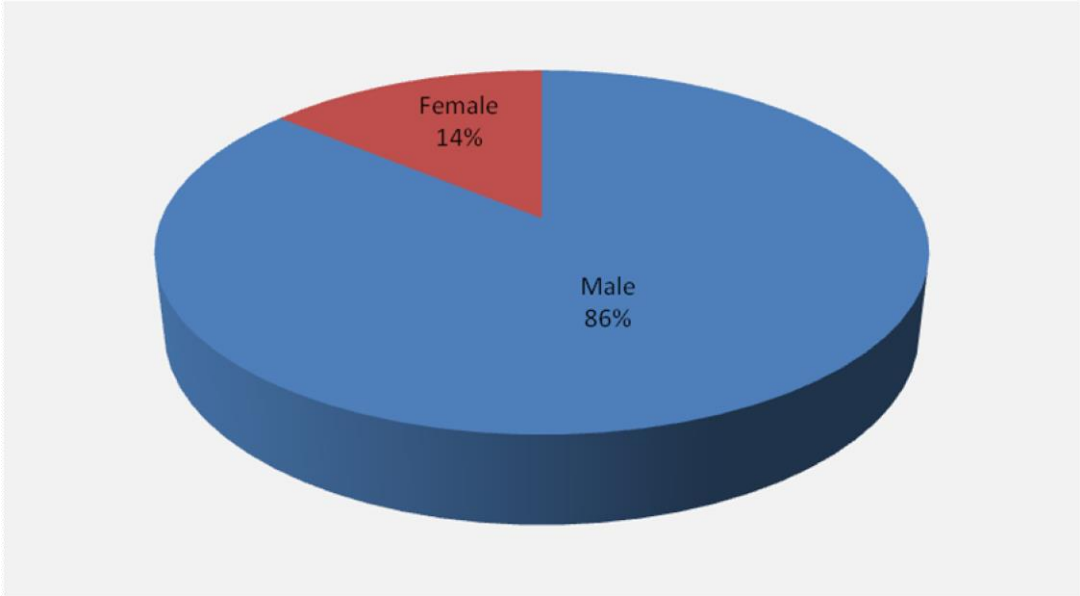
The collected data was analyzed with SPSS soft ware computer program, to obtained correlation; coefficient. Also paired t-test was used for calculating degree of variation, p.value<0.05 was considered to be significant.

Ethical clearance:

Research was approved by research ethical committee of Faculty Medical Laboratory sciences in Shendi University. After clarification of the aims of the study, informed consent was get from each participant. There was full commitment precaution as regard sampling procedure, privacy and confidentiality.

Result:

Figure (4.1): Distribution of the Study group According to the gender:



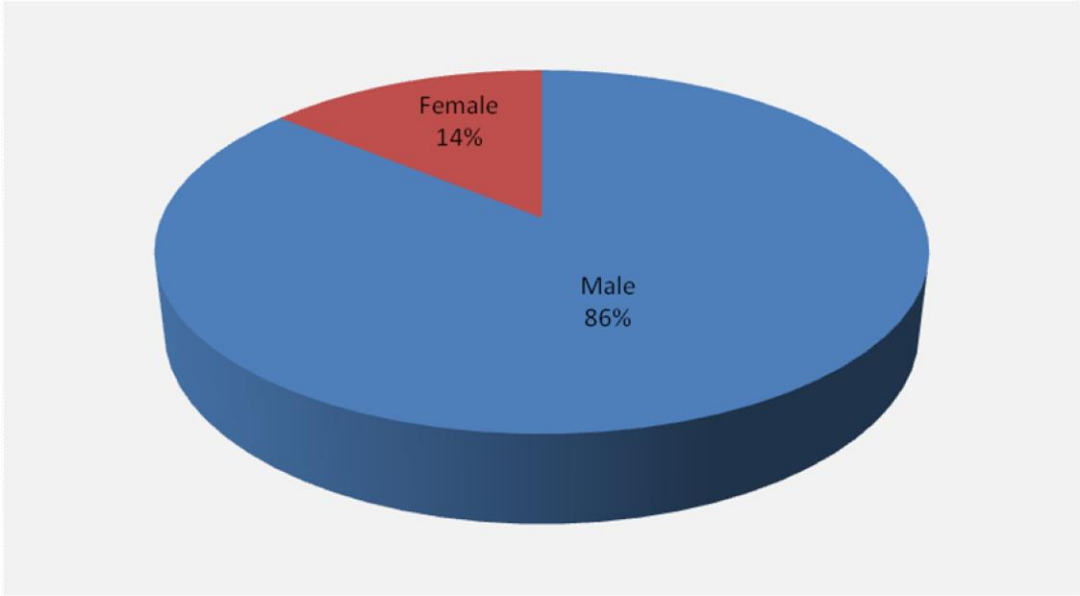


Fig (4.2): Distribution of the Study group According to the Age:

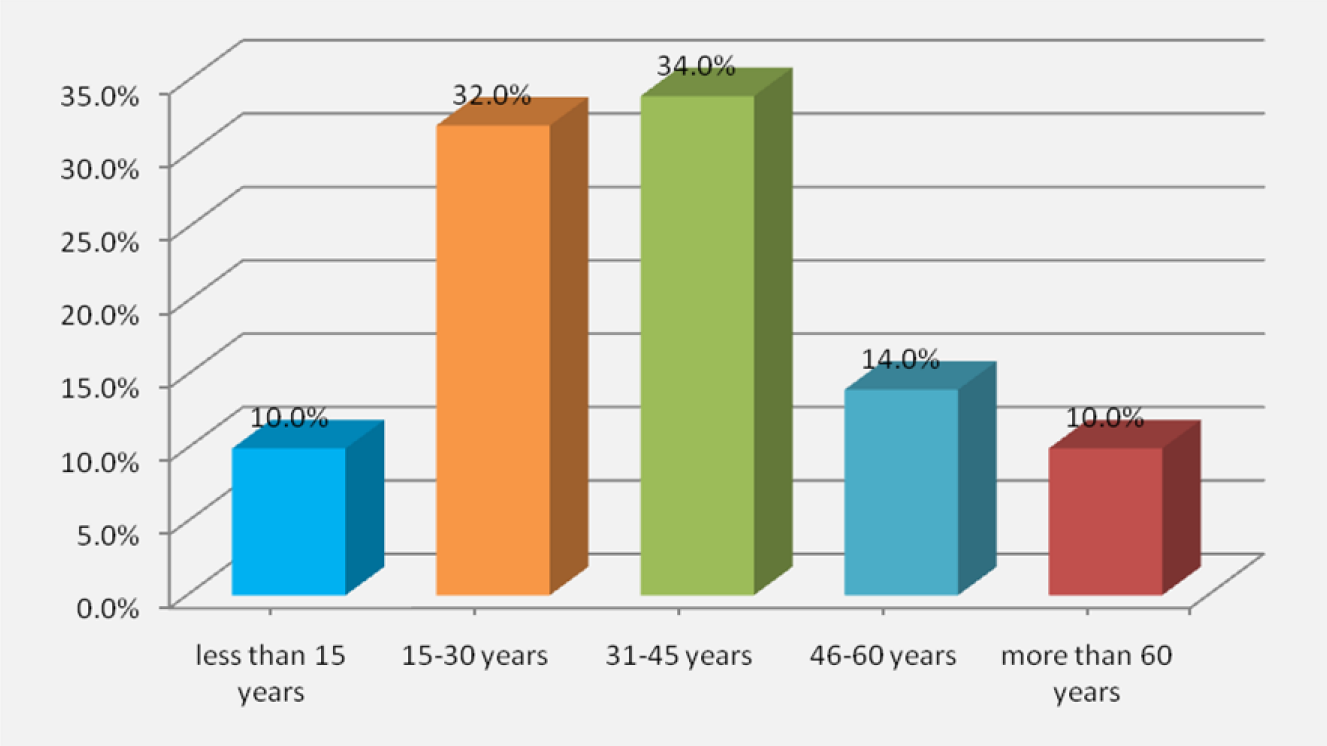


Figure (4.3): Distribution of the Study group According to the Duration:

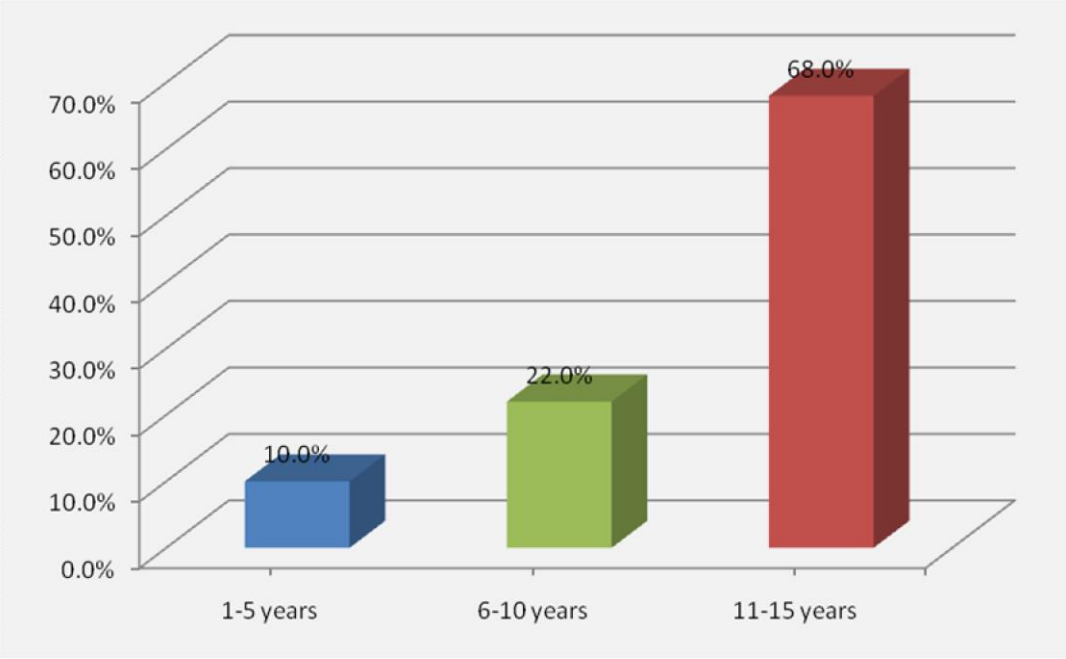


Table 4-1: Comparison between Case and control in WBCs parameter:

	Test	Mean	N	Std.	P.v
WBC	Case	5.152	50	1.66602	.005
	Control	3.400	30	.9036	
Lymph	Case	2.455	50	.72526	.000
	Control	1.820	30	.4567	
Mid	Case	.4913	50	.19949	.079
	Control	.420	30	.1157	
Gran	Case	2.309	50	1.21493	.527
	Control	2.143	30	.6157	
Lymph%	Case	47.430	50	10.3983	.002
	Control	39.943	30	7.5923	
Mid%	Case	9.173	50	1.5653	.174
	Control	9.753	30	1.9765	
Gran%	Case	44.000	50	10.7731	.116
	Control	48.507	30	8.3135	

Table 4-2: Comparison between Case and control in RBCs parameter:

	Test	Mean	N	Std.	P.v
HGB	Case	14.257	50	.9895	.176
	Control	13.685	30	1.9859	
RBC	Case	4.2743	50	.24225	.000
	Control	4.9147	30	.52505	
HCT	Case	36.380	50	2.2938	.000
	Control	41.973	30	5.2939	
MCV	Case	85.180	50	4.4246	.838
	Control	85.413	30	5.4451	
MCH	Case	33.013	50	2.8103	.000
	Control	27.720	30	2.6410	
MCHC	Case	39.157	50	.9842	.000
	Control	32.527	30	1.4973	
RDW.cv	Case	13.393	50	.6669	.000
	Control	14.747	30	1.2272	
RDW.sd	Case	38.927	50	2.8575	.000
	Control	46.080	30	2.2783	

Table 4-3: Comparison between Case and control in PLT parameters:

	Test	Mean	N	Std.	P.v
PLT	Case	253.20	50	53.677	.012
	Control	122.17	30	89.159	
MPV	Case	8.740	50	.9194	.026
	Control	10.840	30	5.6436	
PDW	Case	16.160	50	.3338	.000
	Control	15.533	30	.2468	
PCT	Case	.21777	50	.038050	.017
	Control	.25577	30	.073656	

Table 4-4: Comparison between Age Group and WBCs Parameters:

	Age	N	Mean	Std.	P.v
WBC	less than 15 years	5	15.656	15.91783	.002
	15-30 years	16	5.428	1.68819	
	31-45 years	17	5.323	1.93129	
	46-60 years	7	4.514	1.52230	
	more than 60 years	5	5.298	1.88125	
Lymph	less than 15 years	5	8.378	11.22280	.015
	15-30 years	16	2.706	.71762	
	31-45 years	17	2.387	.79496	
	46-60 years	7	2.098	.68033	
	more than 60 years	5	2.020	.55059	
Mid	less than 15 years	5	.9020	.59906	.020
	15-30 years	16	.5038	.20925	
	31-45 years	17	.4859	.19384	
	46-60 years	7	.4100	.11180	
	more than 60 years	5	.5040	.17743	
Gran	less than 15 years	5	6.376	4.81390	.000
	15-30 years	16	2.220	1.16018	
	31-45 years	17	2.630	1.45540	
	46-60 years	7	2.005	.89433	
	more than 60 years	5	2.774	1.55627	
Lymph%	less than 15 years	5	46.820	16.6917	.230
	15-30 years	16	51.338	9.8833	
	31-45 years	17	43.724	11.5017	
	46-60 years	7	47.186	7.9876	
	more than 60 years	5	40.220	9.5274	
Mid%	less than 15 years	5	6.780	1.8185	.306
	15-30 years	16	9.119	1.5206	
	31-45 years	17	8.771	1.8844	
	46-60 years	7	8.171	4.5857	
	more than 60 years	5	9.560	1.7827	
Gran%	less than 15 years	5	46.340	15.1836	.340
	15-30 years	16	40.675	11.2938	
	31-45 years	17	47.506	11.1863	
	46-60 years	7	43.071	7.2138	
	more than 60 years	5	50.180	10.0173	

Table 4-5: Comparison between Age Group and RBCs Parameters:

	Age	N	Mean	Std.	P.v
HGB	less than 15 years	5	10.700	1.6598	.008
	15-30 years	16	13.144	3.1671	
	31-45 years	17	14.141	1.1309	
	46-60 years	7	14.686	.8707	
	more than 60 years	5	13.480	1.6285	
RBC	less than 15 years	5	4.2100	.39674	.955
	15-30 years	16	4.2463	.32389	
	31-45 years	17	4.2741	.26740	
	46-60 years	7	4.2643	.43293	
	more than 60 years	5	4.3620	.23188	
HCT	less than 15 years	5	29.380	2.5470	.026
	15-30 years	16	34.193	6.5033	
	31-45 years	17	36.212	2.4602	
	46-60 years	7	36.486	3.1599	
	more than 60 years	5	36.860	2.1279	
MCV	less than 15 years	5	70.500	10.4888	.003
	15-30 years	16	80.263	13.4105	
	31-45 years	17	84.759	4.0252	
	46-60 years	7	85.643	2.1632	
	more than 60 years	5	84.420	2.3700	
MCH	less than 15 years	5	25.760	5.5536	.474
	15-30 years	16	34.200	14.8981	
	31-45 years	17	32.147	3.0643	
	46-60 years	7	33.871	1.1658	
	more than 60 years	5	31.760	3.0819	
MCHC	less than 15 years	5	36.200	2.7505	.119
	15-30 years	16	37.681	3.5686	
	31-45 years	17	38.953	.8179	
	46-60 years	7	39.600	1.3880	
	more than 60 years	5	37.820	2.9685	
RDW.cv	less than 15 years	5	16.260	3.5423	.292
	15-30 years	16	14.975	4.6200	
	31-45 years	17	13.512	.5700	
	46-60 years	7	13.386	.8194	
	more than 60 years	5	13.960	.8142	
RDW.sd	less than 15 years	5	37.480	1.6769	.560
	15-30 years	16	38.969	3.3623	
	31-45 years	17	38.965	2.0913	
	46-60 years	7	38.957	2.6906	
	more than 60 years	5	40.380	2.2016	

Table 4-6: Comparison between Age Group and PLT Parameters:

	Age	N	Mean	Std.	P.v
PLT	less than 15 years	5	373.00	291.471	.278
	15-30 years	16	257.50	74.830	
	31-45 years	17	256.82	63.054	
	46-60 years	7	279.57	50.911	
	more than 60 years	5	246.60	78.821	
MPV	less than 15 years	5	8.540	1.4415	.651
	15-30 years	16	8.781	.9340	
	31-45 years	17	8.971	1.0588	
	46-60 years	7	8.314	.7403	
	more than 60 years	5	8.640	.6877	
PDW	less than 15 years	5	16.480	.8556	.643
	15-30 years	16	16.125	.4568	
	31-45 years	17	16.235	.4182	
	46-60 years	7	16.186	.4018	
	more than 60 years	5	16.340	.2408	
PCT	less than 15 years	5	.29560	.202315	.326
	15-30 years	16	.22088	.054094	
	31-45 years	17	.21671	.031486	
	46-60 years	7	.23029	.033762	
	more than 60 years	5	.21680	.069009	

Table 4.7: Comparison between Gender group and WBCs Parameters:

	Gender	N	Mean	Std.	P.v
WBC	Male	43	5.168	1.77304	.000
	Female	7	13.068	13.72101	
Lymph	Male	43	2.474	.87765	.000
	Female	7	6.307	9.72730	
Mid	Male	43	.484	.18766	.000
	Female	7	.772	.54030	
Gran	Male	43	2.282	1.13511	.000
	Female	7	5.982	4.06097	
Lymph%	Male	43	47.656	9.9776	.003
	Female	7	40.143	16.4676	
Mid%	Male	43	8.991	2.3004	.930
	Female	7	6.757	1.7453	
Gran%	Male	43	43.519	9.9805	.005
	Female	7	53.029	15.2599	

Table 4.8: Comparison between Gender group and RBCs Parameters:

	Gender	N	Mean	Std.	P.V
HGB	Male	43	13.902	1.9214	.213
	Female	7	10.943	2.8100	
RBC	Male	43	4.2923	.31267	.784
	Female	7	4.1057	.27092	
HCT	Male	43	35.725	3.9313	.014
	Female	7	30.443	6.3786	
MCV	Male	43	83.309	8.1829	.012
	Female	7	73.843	13.2716	
MCH	Male	43	33.326	9.0092	.767
	Female	7	26.486	6.4419	
MCHC	Male	43	38.705	2.1254	.047
	Female	7	35.443	3.4952	
RDW.cv	Male	43	13.923	2.4508	.027
	Female	7	16.486	4.7242	
RDW.sd	Male	43	38.879	2.5812	.436
	Female	7	39.443	2.9698	

Table 4.9: Comparison between Gender group and PLT Parameters:

	Gender	N	Mean	Std.	P.v
PLT	Male	43	256.49	73.412	.001
	Female	7	358.86	223.694	
MPV	Male	43	8.705	.9317	.174
	Female	7	8.971	1.2958	
PDW	Male	43	16.191	.3939	.003
	Female	7	16.457	.7829	
PCT	Male	43	.21767	.052424	001

	Female	7	.29029	.146452

Table 4.10: Comparison between Duration Group and WBCs Parameters:

	Duration	N	Mean	Std.	P.v
WBC	1-5 years	5	15.656	15.91783	.000
	6-10 years	11	5.115	1.75547	
	11-15 years	34	5.270	1.77408	
Lymph	1-5 years	5	8.378	11.22280	.002
	6-10 years	11	2.307	.62511	
	11-15 years	34	2.450	.79009	
Mid	1-5 years	5	.902	.59906	.003
	6-10 years	11	.459	.19139	
	11-15 years	34	.490	.18515	
Gran	1-5 years	5	6.376	4.81390	.000
	6-10 years	11	2.350	1.42415	
	11-15 years	34	2.420	1.24871	
Lymph%	1-5 years	5	46.820	16.6917	.984
	6-10 years	11	47.100	11.9599	
	11-15 years	34	46.412	10.4433	
Mid%	1-5 years	5	6.780	1.8185	.164
	6-10 years	11	8.900	1.3675	
	11-15 years	34	8.885	2.5739	
Gran%	1-5 years	5	46.340	15.1836	.929
	6-10 years	11	44.000	10.9739	
	11-15 years	34	44.906	10.9816	

Table 4.11: Comparison between Duration Group and RBCs Parameters:

	Duration	N	Mean	Std.	P.v
HGB	1-5 years	5	10.700	1.6598	.012
	6-10 years	11	13.627	2.9893	
	11-15 years	34	13.853	1.8354	
RBC	1-5 years	5	4.2100	.39674	.916
	6-10 years	11	4.2682	.28958	
	11-15 years	34	4.2738	.31479	
HCT	1-5 years	5	29.380	2.5470	.013
	6-10 years	11	34.973	6.1151	
	11-15 years	34	35.814	3.8173	
MCV	1-5 years	5	70.500	10.4888	.011
	6-10 years	11	81.555	11.9458	
	11-15 years	34	83.812	7.3164	
MCH	1-5 years	5	25.760	5.5536	.110
	6-10 years	11	35.864	16.8866	
	11-15 years	34	32.209	4.3031	
MCHC	1-5 years	5	36.200	2.7505	.125
	6-10 years	11	37.927	3.1222	
	11-15 years	34	38.653	2.2806	
RDW.cv	1-5 years	5	16.260	3.5423	.262
	6-10 years	11	14.418	4.0904	
	11-15 years	34	13.947	2.3653	
RDW.sd	1-5 years	5	37.480	1.6769	.257
	6-10 years	11	38.445	2.9733	
	11-15 years	34	39.341	2.5596	

Table 4.12: Comparison between Duration Group and PLT Parameters:

	Duration	N	Mean	Std.	P.v
PLT	1-5 years	5	373.00	291.471	.082
	6-10 years	11	249.55	71.283	
	11-15 years	34	262.68	65.041	
MPV	1-5 years	5	8.540	1.4415	.554
	6-10 years	11	9.018	.8784	
	11-15 years	34	8.682	.9498	
PDW	1-5 years	5	16.480	.8556	.323
	6-10 years	11	16.100	.4382	
	11-15 years	34	16.232	.3998	
PCT	1-5 years	5	.29560	.202315	.102
	6-10 years	11	.21882	.049550	
	11-15 years	34	.22079	.043360	

Discussion:

Statistical analysis of results of this study showed that there was significant increase in the mean of the WBCs level in the test group when compared with control group with P.value of (0.005) this result was similar to the result of the study done by Hassan A. Al-Shamery and etal and the study of Rahnuma Ahmad and etal . [8,9]

Statistical analysis of results of this study showed that there was significant increase in the mean of the Lymph in the test group when compared with control group with P.value of (0.000)this result was similar to the result of the study done by Hassan A. Al-Shamery and etal and the study of Rahnuma Ahmad and etal . [8,9]

Statistical analysis of results of this study showed that there was insignificant difference in the mean of the Mid and Gran in the test group when compared with control group with P. value (> 0.05).

Statistical analysis of results of this study showed that there was insignificant differenve in the mean of the HGB nd MCV in the test group when compared with control group with P.value (> 0.05)

Statistical analysis of results of this study showed that there was significant decrease in the mean of the RBCs , HCT RDW-cv ,and RDW- sd in the test group when compared with control group with P.value of (0.000,0.000,0.000,0.000).

This results of this study showed that there was significant increase in the mean of the MCH and MCHC in the test group when compared with control group with P.value of (0.000 , 0.000).this result was similar to the result of the study done by **Rahnuma Ahmad and etal** [7] . This results of this study showed that there was in significant increase in the mean of the PLT in the test group when compared with control group with P.value of (0.012).this result was similar to the result of the study done by **Rahnuma Ahmad and etal** [10]. Statistical analysis of results of this study showed that there was significant decrease in the mean of the MPV and PCT in the test group when compared with control group with P.value of (0.026 ,0.017) respectivelly.

This results of this study showed that there was significant increase in the mean of the PDW in the test group when compared with control group with P.value of (0.000).

This results of this study showed that there was significant increase in the mean of the WBCS, LYMPH, MID and GRANin the in the age less than 15 years when comparedwith other ages groups with P.value of (<0.05).

Statistical analysis of results of this study showed that there was significant decrease in the mean of the HB,HCTand MCV in in the in the age less than 15 years when compared with other ages groups with P.value of (<0.05).

Statistical analysis of results of this study showed that there was insignificant difference in the mean of the RBCs, MCH, MCHC , MPV ,PIT,PDW,and PCT in the age groups with P.value of (> 0.0. Statistical analysis of results of this study showed that there was significant increase in the mean of theWBCs,LYMPH, MID, and GRAN in the females groups when compared with meals groups with P.value of (<0.05).

Statistical analysis of results of this study showed that there was significant decrease in the mean of the,MCV and MCHC in the females groups when compared with males groups with P.value of (<0.05).

Statistical analysis of results of this study showed that there was significant increase in the mean of theRDW.cv in the females groups when compared with males groups with P.value of(<0.05).

Statistical analysis of results of this study showed that there was

significant increase in the mean of thePLT ,PDW,and PCT in the females groups when compared with meals groups with P.value of (< 0.05).

Statistical analysis of results of this study showed that there was insignificant decrease in the mean of the HB,RBCS and MCH in the females groups when compared with meals groups with P.value of (>0.05).

Statistical analysis of results of this study showed that there was significant increase in the mean of theWBCs,LYMPH, MID, and GRAN the duration of 1-5 years when compared with other groups with P.value of (<0.05).

Statistical analysis of results of this study showed that there was significant decrease in the mean of theHB,HCT and MCV in the duration of 1-5 years when compared with other groups with P.value of (< 0.05).

Statistical analysis of results of this study showed that there was insignificant diffrence in the mean of the PLTs ,PDW and PCT between different the duration with P.value of (>0.05).

Conclusion:

Based on the above mentioned results we concluded that people in Berbar town exposed to cement dust for 1-5 years :

1- The results showed that the values of white blood cell (WBC) count,differential count of lymphocytes (LYM), mean corpuscular haemoglobin (MCH), mean corpuscular heamoglobin concentration (MCHC) ,platelets (PLT), and platelets distribution width(PDW) were significantly increased in exposed peoples but red blood cell (RBC) ,haematocrit (HCT), red cell distribution width standard deviation(RDW-SD) , red cell distribution width - coefficient of variation (RDW-CV) , mean platelet volume (MPV), and plateletcrit (PCT), were significantly lower . The results from this study has shown that exposure to cement dust has significant effects on some haematological parameter either by decrease or increase.

2- This study underscores the need for continuous environmental monitoring, medical examination people in Berbar town to promote health and safety.

References:

1. Sudhakar CV, Reddy GU: Impacts of cement industry air pollutants on the environment and satellite data applications for air quality monitoring and management. Environ Monit Assess. 2023, 195:840. 10.1007/s10661-023-11408-1
2. latunbosun NO, Sawa BA, Jibrin A, Ilori AE: Assessment of effect of cement dust from cement factory on elemental properties of some cultivated crops, Obajana, Kogi State, Nigeria. J Geogr Environ Earth Sci Int. 2020, 24:63-69. 10.9734/jgeesi/2020/v24i130194
3. Owonikoko MW, Emikpe BO, Olaleye SB: Standardized experimental model for cement dust exposure; tissue heavy metal bioaccumulation and pulmonary pathological changes in rats. Toxicol Rep. 2021, 8:1169-78. 10.1016/j.toxrep.2021.06.001
4. Ismail Z, Ali S, Zulfiqar A, El-Serehy HA: Impact of cement industries on potentially toxic elements' contamination and other characteristics of topsoil: a case study. Environ Pollut Bioavailability. 2023, 35:2271664. 10.1080/26395940.2023.2271664
5. Adeyanju E, Okeke CA: Effect to cement dust pollution: a mini-review. SN Applied Sciences. 2019, 1:1572-10. 10.1007/s42452-019-1583-0
6. Shiriyn B.Mckenziej. lynne Williams, Clinical Laboratory Hematology. 4th Edition. University of Texas Health Science Centre at San Antonio, Kristin Landis – Piwowar , 2020.
7. Ahmad R, Haq MA, Sinha S, Mehta M, Kumar S, Haque M, Akhter QS. Impact of Occupational Cement Dust Exposure on Hematological Health Parameters: A Cross-Sectional Study. Cureus. 2024 Oct 30;16(10):e72673. doi: 10.7759/cureus.72673. PMID: 39493081; PMCID: PMC11528039..
8. Hassan A. Al-Shamery and Muna H. Jankeer 2021 *J. Phys.: Conf. Ser.* 1999 012030**DOI** 10.1088/1742-6596/1999/1/012030.
9. Ahmad, R., Akhter, Q. S. and Haque, M. (2021) 'Occupational Cement Dust Exposure and Inflammatory Nemesis: Bangladesh Relevance', *Journal of Inflammation Research*, 14, pp. 2425–2444. doi: 10.2147/JIR.S312960.
10. https://www.researchgate.net/publication/360162512_Effects_of_Exposure_of_Cement_Dust_on_Platelet_Count_in_Workers_of_a_Cement_Mill.