

Protective Effect of Vitamin C on Body Weight of Albino Rats with Lead Toxicity

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ABSTRACT

Aim: To investigate whether lead toxicity can reduce the body weight of albino rats. If the reduction occurs, with what dose the animals can be protected by vitamin C against lead toxicity and reduction of body weight.

Study design: Experimental study

Place and duration of study: This study was conducted in Post Graduate Medical Institute, Lahore from May 2007 to March 2013 in Department of Anatomy.

Methods: From National Health Institute, Islamabad 90 Albino rats were purchased and divided into five groups A, B, C, D, and E. Each group has 18 animals. Group A was given normal saline, B lead acetate, C, D and E lead acetate with high dose of vitamin C.

Results: The lead treated animals reduced 16% of body weight in 4 weeks as reported by Harvey. The loss of body weight was due to loss of appetite and gastrointestinal disturbance. In another study by Biswas and Gosh, the animals gained weight with lead toxicity but not to the extent gained with normal saline in 14 days. In this experiment it has proved that lead toxicity reduced the body weight of albino rats and this reduction can be protected with heavy dose of vitamin C

Conclusion: Lead toxicity reduced the body weight. This reduction can be protected with heavy dose of Vit. C.

Keywords: Lead toxicity, Body weight, Vitamin C

INTRODUCTION

Lead is a heavy metal present in earth crust. It is also end product of uranium disintegration. Lead is a common environmental toxic metal used by human beings for thousands of years. Lead is present as inorganic metal in lead oxide, lead chloride, lead sulfide etc and as organic metal in lead tetra ethyl chloride etc. Lead can replace the trace metals from human body such as calcium, copper, chromium, manganese and magnesium. Its absorption enhances from gastrointestinal tract if these trace elements are deficient in human beings.¹ No organ of the body is immune for lead poisoning if it is exposed to it chronically. Lead is continuously emitted from the industries.² The mechanism by which blood lead concentration increases depends upon both ingestion and inhalation. It can be mobilized from bone where lead is deposited.³ It can catalyze the oxidative reaction and produce excessive reactive oxygen species.⁴ Beverages and acidic foods can dissolve the lead from improperly glazed containers.⁵ Heavy metals exert their toxic effects by combining with more reactive groups reducing the appetite and body weight.

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MATERIAL AND METHOD

For this study, 90 animals (albino rats) were taken from National Health Institute Islamabad. These were divided into five groups. Each group has 18 animals as group A,B,C,D and E . The animals of group A were given 1 cc normal saline daily intraperitoneally. Group B animals were given lead acetate 10 mg/kg body weight daily intraperitoneally. Group C animals were given lead acetate 10 mg/kg body weight and vitamin C 250 mg/kg body weight daily intraperitoneally. Group D animals were given lead acetate 10 mg/kg body weight and vitamin C 500 mg/kg body weight daily intraperitoneally. Group E animals were given lead acetate 10 mg/kg body weight and vitamin C 1000 mg/kg body weight daily intraperitoneally.

In the beginning of experiment, Group A was divided into subgroup A1, A2 and A3. Group B into subgroup B1, B2 and B3. Group C, D and E were divided into C1, C2 and C3, D1, D2 and D3 and E1, E2 and E3 respectively. Subgroup 1 was sacrificed after 5th week, subgroup 2 was sacrificed after 6th week and subgroup 3 was sacrificed after 7th week. The weight of these animals was measured by the electronic balance as initial weight was recorded in the beginning of experiment and final weight was recorded before sacrificing. Lead acetate was purchased from Anarkali near King Edward Medical

University, Lahore. Vitamin C was given by the courtesy of Mr Shoaib from Novartis.

All values were presented by SPSS version 17. The initial and final weights of all the same subgroups were taken and compared as A1, A2 and A3 etc, and with each other as A1, B1 and C1 etc. The difference between initial and final weight of the same subgroups and the different subgroups were taken are compared. The significant and insignificant P values were calculated by ANOVA. The initial and final weights were taken with the electronic balance. The mean difference of weight has been detected by subtracting the initial weight from the final weight. ANOVA was applied and P value was calculated.

RESULTS

The rats which were treated with lead acetate showed a significant decrease in body weight and the rats which were treated with both lead acetate and vitamin C showed improvement in body weight as compared to those rats which were only treated with lead acetate as evident from table 1 and graph 1. The rats which were treated with maximum dose of vitamin C (1000mg/kg body weight daily) showed the most improved body weight. Similarly in the subgroup 2 the effect of lead toxicity and its reversal by vitamin C is more pronounced as given in table 2 and graph 2. The mean initial weight of subgroup B2 was 263.70±12.764 gm and the mean final weight of these rats was 258.466±12.728 gm (Table 2). This showed a significant weight loss in these rats, only treated with lead acetate. The effect of lead toxicity was reversed by vitamin C. The higher the dose of vitamin C, the greater reversal was seen as evident from table no 1, 2 and 3. In subgroup 3, the effect of reversal of lead toxicity with vitamin C was the most significant as the mean initial weight of subgroup E2 was 272.866±12.366 gm and the mean final weight was 277.016±12.327 gm (Table 3).

Table 1: Mean body weights of albino rats in grams of subgroup 1

Subgroups	Initial Weight(gm)	Final Weight(gm)
A1	252.216± 7.356	256.700± 7.799
B1	251.766± 11.238	247.716± 10.831
C1	247.466± 7.469	243.833± 7.825
D1	251.100± 8.020	251.950± 8.324
E1	249.633± 20.890	252.683± 21.411

Effect of lead toxicity and its reversal by vitamin C on weight of albino rats can also be concluded with mean body weight difference. In table no 4, 5 and 6 the mean body weight difference of rats of different subgroups showed that the rats which were treated with lead alone showed a significant decrease in mean body weight difference while those treated with vitamin C along with lead acetate showed better

results. The subgroup C showed less decline in mean body weight difference as compared to subgroup B. The subgroup D showed increased mean body weight difference while subgroup E showed more increased mean body weight difference as compared to subgroup D. This showed that the rats which were treated with higher dose of vitamin C showed better weight gain as compared to those which were treated with lower doses of vitamin C (as evident in graph 4)

Graph 1: Comparison of Initial and final weights of subgroup 1

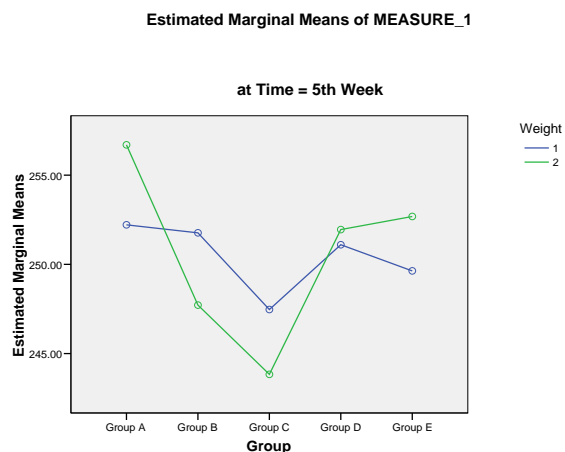


Table 2: Mean body weights of albino rats in grams of subgroup 2

Groups	Initial Weight(gm)	Final Weight(gm)
A2	280.383± 8.09	285.533± 8.33
B2	263.700± 12.764	258.466±12.728
C2	266.950± 11.796	263.966± 11.553
D2	264.383± 7.218	265.983± 7.168
E2	274.116± 8.322	277.983± 8.782

Graph 2: Comparison of initial and final weights of subgroup 2

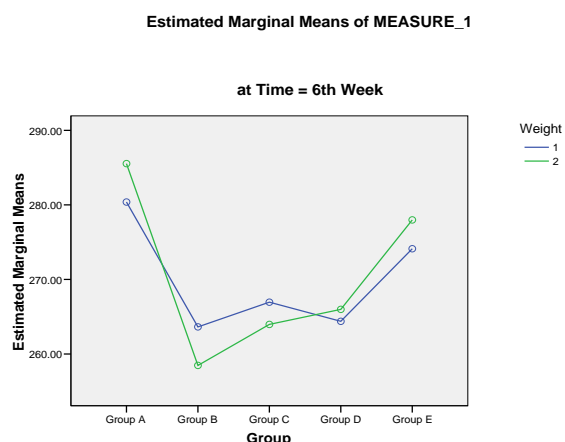


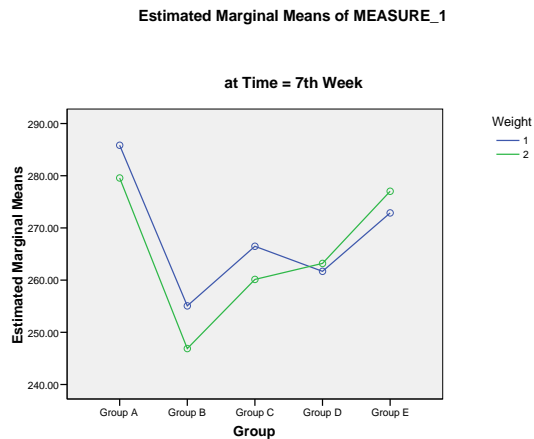
Table 3: Mean body weights of albino rats in grams of subgroup 3

Groups	Initial Weight (gm)	Final Weight (gm)
A3	285.833± 8.972	279.566± 8.442
B3	255.066± 18.928	246.883± 18.815
C3	266.483± 21.741	260.133± 21.102
D3	261.683± 13.651	263.200± 14.338

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E3	272.866± 12.366	277.016± 12.327
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Graph 3: Comparison of initial and final weights of subgroup 3



Graph 4: Comparison of mean weight difference of all subgroups

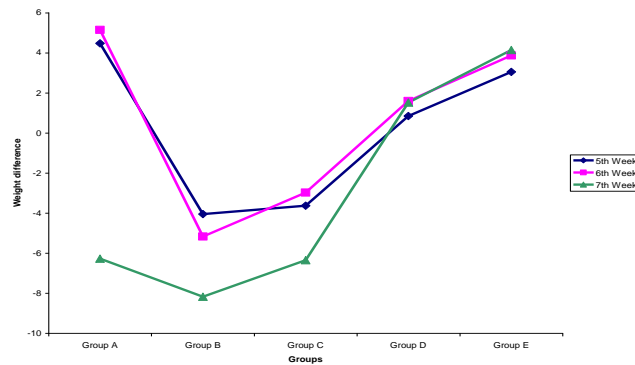


Table 4: Mean body weight differences of rats in grams of subgroup 1

Sub group	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A1	6	4.4800	0.00000	0.00000	4.4800	4.4800	4.48	4.48
B1	6	-4.0500	0.00000	0.00000	-4.0500	-4.0500	-4.05	-4.05
C1	6	-3.6300	0.00000	0.00000	-3.6300	-3.6300	-3.63	-3.63
D1	6	0.8500	0.00000	0.00000	0.8500	0.8500	0.85	0.85
E1	6	3.0500	0.00000	0.00000	3.0500	3.0500	3.05	3.05
Total	30	0.1400	3.51087	0.64099	-1.1710	1.4510	-4.05	4.48

Anova

	Sum of Squares	Df	Mean Square	F	Sig.
Between Sub Groups	357.461	4	89.365	8.049E33	0.000
Within Groups	0.000	25	0.000		

Table 5: Mean body weight differences of rats in grams of subgroup 2

Sub group	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A2	6	5.1500	0.00000	0.00000	5.1500	5.1500	5.15	5.15
B2	6	-5.1700	0.00000	0.00000	-5.1700	-5.1700	-5.17	-5.17
C2	6	-2.9800	0.00000	0.00000	-2.9800	-2.9800	-2.98	-2.98
D2	6	1.6000	0.00000	0.00000	1.6000	1.6000	1.60	1.60
E2	6	3.8700	0.00000	0.00000	3.8700	3.8700	3.87	3.87
Total	30	.4940	4.02874	0.73554	-1.0104	1.9984	-5.17	5.15

Anova

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	470.691	4	117.673	8.447E33	0.000
Within Groups	0.000	25	0.000		

Table 6: Mean body weight differences of rats in grams of subgroup 3

Sub group	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A3	6	-6.2700	0.00000	0.00000	-6.2700	-6.2700	-6.27	-6.27
B3	6	-8.1800	0.00000	0.00000	-8.1800	-8.1800	-8.18	-8.18
C3	6	-6.3500	0.00000	0.00000	-6.3500	-6.3500	-6.35	-6.35
D3	6	1.5200	0.00000	0.00000	1.5200	1.5200	1.52	1.52
E3	6	4.1500	0.00000	0.00000	4.1500	4.1500	4.15	4.15
Total	30	-3.0260	4.98890	0.91084	-4.8889	-1.1631	-8.18	4.15

Anova

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	721.784	4	180.446	9.094E33	0.000
Within Groups	0.000	25	0.000		

DISCUSSION

The rats of group B which were treated only with lead showed a significant decrease in weight over different times of scarification. This significant decrease in weight was due to loss of appetite and gastrointestinal disturbances, which were documented by Harvey⁶. According to another study by Ahmad I et al the reason for the loss of appetite and loss of body weight was due to lesions produced in gastrointestinal tract of albino rats by toxic effect of lead.⁷ The group C rats which were treated with lead and vitamin C (250mg/kg body weight daily) showed less decrease in weight as compared to group B rats which were treated with lead only and showed a significant decrease in body weight. This shows that the toxic effect of lead is being lessened by vitamin C. The protective action of vitamin C against lead acetate can be attributed to the antioxidant action of vitamin C⁸. A study conducted by Bassem M. Raafat et al showed that administration of vitamin C with lead exposed animals exerts an obvious ameliorating as well as treatment effects⁹. The rats of group D showed more improvement in weight gain as compared to group C animals, the reason behind this is that the group D rats were treated with higher dose of vitamin C as compared to rats of group C. The rats of group E were treated with the highest dose of vitamin C while all experimental groups (group B, group C, group D and group E) were given the same quantity of lead. The rats of group E showed most improved weight gain among the experimental groups. A study by Hsu P C et al showed that vitamin C in considerable concentration showed significant reversal of lead toxicity in rats¹⁰. Thus greater the amount of vitamin C the more is the reversal against lead toxicity. In addition to acting as an antioxidant vitamin C also has an inhibiting effect on lead uptake on a cellular level¹¹.

A number of studies showed that lead has no effect on the weight. A study conducted by Ping-Chi Hsu et al showed that there were no essential differences among the body weights of rats either taking lead or not¹². While Beta M. Pace et al showed in their studies that there were significant changes in pup body weights over the first 3 weeks of lead treatment, when compared with the control group.¹³ In another study, a slight reduction of body weight of rats was observed where lead acetate was given for 14 days.¹⁴ Thus, lead has decreased the normal growth of the rats which is also shown in this study. The effect of vitamin C on lead levels has been clarified by studies, showed that ascorbic acid (vitamin C) decreased intestinal absorption of lead.¹⁵ Vitamin C has a significant role in reversing the lead

toxicity which is proved by a number of studies. On rat pharmacokinetic study, found that intravenously administered vitamin C lowered lead tissue levels in rats those were continuously administered lead.¹⁶ Another study showed that the adults with the highest ascorbic acid (vitamin C) levels had 60-80% decreased prevalence of elevated blood lead.¹⁷ Thus vitamin C reduces the toxic effects of lead on weight of rats, which is shown in this study.

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