International Journal of Pharmaceutical Science Invention
ISSN (Online): 2319 – 6718, ISSN (Print): 2319 – 670X
www.ijpsi.org Volume 2 Issue 2 // February 2013 // PP.21-26

A comparative study between plasma fasting glucose, body weight and hemoglobin% in chronic arsenic poisoning

Dr. Indranil Dawn[1], Dr. Susmita Sarkar[2], Dr. Rabindranath Biswas[3]

[1]*Faculty member of Biochemistry, Malda Medical College, Malda, India*
[2]*Faculty member of Biochemistry, Malda Medical College, Malda, India*
[3]*Faculty member of Dermatology, Murshidabad Medical College, Murshidabad, India*

ABSTRACT: *Intake of inorganic arsenic over a long period can lead to chronic arsenic poisoning (arsenic sis). Effects include skin lesions, peripheral neuropathy, gastrointestinal symptoms, diabetes, renal system effects, cardiovascular disease and cancer. Inorganic arsenic can bind to animal and human hemoglobin and can change cell shape, morphology, heme metabolism, and hemoglobin levels. Diabetes mellitus has also been recently found to be associated with arsenic exposure in some epidemiologic studies. In the present cross sectional study changes in the plasma levels of fasting blood glucose level along with altered levels of hemoglobin% and body weight were analyzed to find out any possible relationship between them. 55 patients suffer from chronic arsenic poisoning which was diagnosed from clinical symptoms, and classical skin lesions were selected. High prevelence of diabetes and anemia were found among patients suffer from chronic arsenic poisoning .Alter glucose tolerance mostly found in male patient but prevelence of anemia more among female patients. No significant relationship was found between hemoglobin% and fasting plasma glucose.*
Keyward: *Arsenic Poisoning, Hemoglobin%, Plasma Fasting Glucose,*

I. INTRODUCTION

Soluble inorganic arsenic is acutely toxic. Intake of inorganic arsenic over a long period can lead to chronic arsenic poisoning (arsenic sis). Effects, which can take years to develop depending on the level of exposure, include skin lesions, peripheral neuropathy, gastrointestinal symptoms, diabetes, renal system effects, cardiovascular disease and cancer. Organic arsenic compounds, which are abundant in seafood, are less harmful to health and are rapidly eliminated by the body.

During long-term exposure to high levels of inorganic arsenic (e.g. through drinking-water), the first changes are usually seen in the skin: pigmentation changes and then skin lesions and hard patches on the palms of the hands and soles of the feet. Other effects of long-term exposure to high inorganic arsenic levels include peripheral neuropathy, gastrointestinal symptoms, conjunctivitis, diabetes, renal system effects, enlarged liver, bone marrow depression, destruction of erythrocytes, high blood pressure and cardiovascular disease. [1]

In vivo and in vitro studies of inorganic arsenic exposure have shown that inorganic arsenic can bind to animal and human hemoglobin (Hb) [2-4] and can change cell shape, morphology, heme metabolism, and Hb levels [5-7]. Acute exposure to arsenite has been shown to cause anemia, leukopenia, and thrombocytopenia, secondary to bone marrow depression [8]. Furthermore, arsine gas is known to induce hemolytic anemia [2, 9, 10].Human studies provide further evidence that hematologic variables may be involved. Analysis of 102 human skin lesions found that cancerous skin lesions had less total Hb in skin cells than did benign lesions [11]. Another study found that chronic ingestion of arsenic-contaminated drinking water altered heme metabolism by increasing porphobilinogen deaminase and uroporphyrinogen decarboxylase enzyme activities in peripheral blood erythrocytes and increasing urinary excretion of total porphyrins [12]

Diabetes mellitus is a heterogeneous syndrome characterized by elevated blood glucose level. Most of the causes of diabetes mellitus are still unknown. However, impaired insulin secretion from the pancreas or impaired insulin action as a result of insulin resistance in the skeletal muscle, liver and adipose tissue have been noted in the

Diabetic patients [13]. Genetic predisposition and environmental factors are important in the development of diabetes mellitus. Family history, some ethnic groups, aging, physical inactivity, stress of life, intake of excessive calories, obesity, some viral infections, medications and chemicals are well-documented risk factors.[14] However, diabetes mellitus has only been recently found to be associated with arsenic exposure in some epidemiologic studies. Inorganic arsenic at relatively high concentrations increased glucose and insulin levels in animal models, [15] decreased glucose uptake in insulin sensitive cells, [16-18] and interfered with transcription factors involved in insulin signal transduction and insulin sensitivity in vitro.[19-22] In epidemiologic studies from Taiwan, Bangladesh, and Mexico, high chronic exposure to inorganic arsenic in drinking water (_100 μg/L) was

associated with diabetes. [23-29] High chronic exposure to inorganic arsenic in occupational settings was also related to higher levels of glycated hemoglobin; a marker of blood glucose levels.[30] However, the effect of lower levels of exposure to inorganic arsenic on diabetes risk is largely unknown.[31-34]

In the present study changes in the plasma levels of fasting blood glucose level along with altered levels of hemoglobin% and body weight were analyzed to find out any possible relationship between them in chronic arsenic poisoned patient. Hb is of particular interest because of its widespread use for assessing anemia, which is typically defined as a blood Hb level <12 g/dL [35-36]

II. METHODS

The present crosses sectional study is based on 55 patients suffer from chronic arsenic poisoning which was diagnosed from clinical symptoms, and classical skin lesions. The cases were not suffering from any other chronic or metabolic disorder at the time of diagnosis. The procedures followed were in accordance with the principles of the Declaration of Helsinki in 1975, as revised in 1983.

2.1 ESTIMATION OF PLASMA GLUCOSE BY GOD/ POD METHOD

Glucose is oxidized to gluconic acid and hydrogen peroxide in the presence of glucose oxidase. Hydrogen peroxide further reacts with phenol and 4-aminoantipyrine by the catalytic action of peroxidase to form a red colored quinoneimine dye complex. Intensity of the colour formed is directly proportional to the amount of glucose present in the sample.

2.2 ESTIMATION OF HEMOGLOBIN% BY CYANMETHEMOGLOBIN METHOH

The principle of the method is based upon the oxidation of the Fe^{2+} of the hemoglobin Fe^{3+} of the met hemoglobin by ferricyanide, with the met hemoglobin then converted into stable cyanmethaemoglobin by adding of potassium cyanide.

III. RESULT

The obtained data was analyzed using SPSS software.

Pie chart shows sex distribution in patients. (35% female and 65% male)

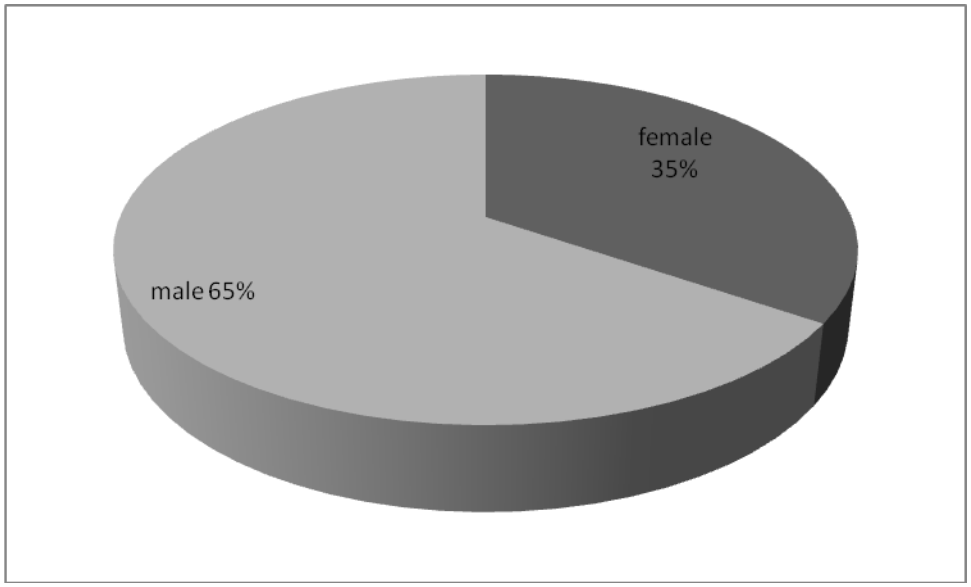


Table 1: Distribution of plasma fasting glucose of the study population

glucose fasting (mg/dl)	Frequency	Percent
Desirable (<100)	23	42.0
Impaired fasting glucose (100-125)	20	36.0
diabetics(≥126)	12	22.0
Total	55	100.0

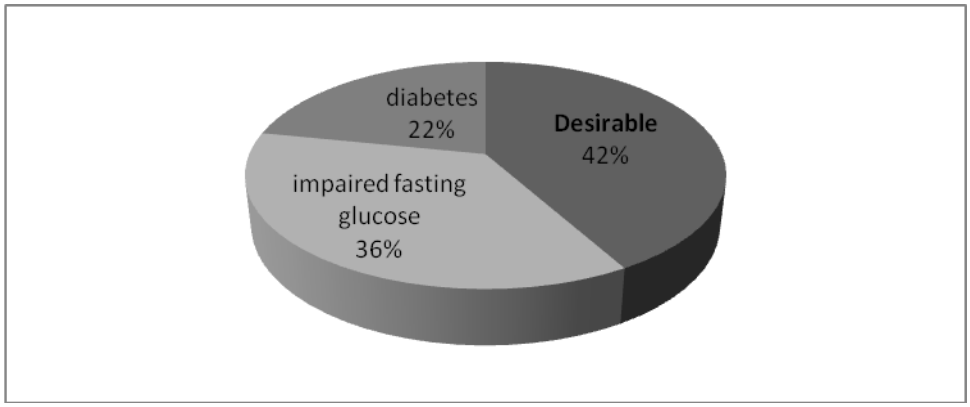
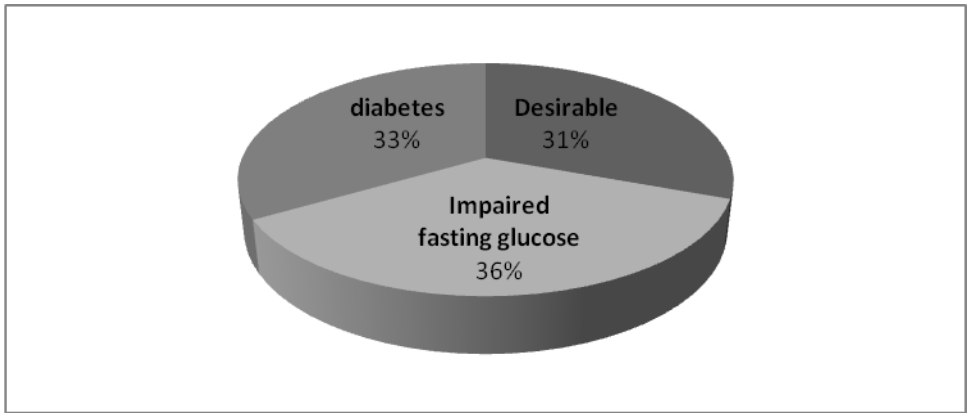


Table 1 Shows that 42 % of the study populations having desirable fasting blood glucose level, 36% having impaired fasting glucose and 22 % are diabetes.

Table 2 Distribution of plasma fasting glucose of the study population according to sex

	Total fasting glucose			
	Desirable	Impaired fasting glucose	diabetes	Total
male	11 31.0%	13 36.0%	12 33.0%	36 100.0%
female	12 63.0%	7 37.0%	0 0.0%	21 100.0%



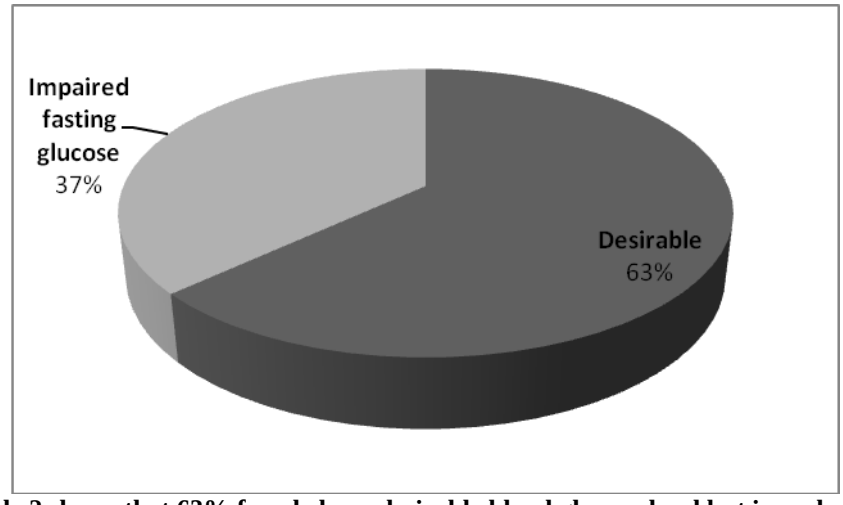
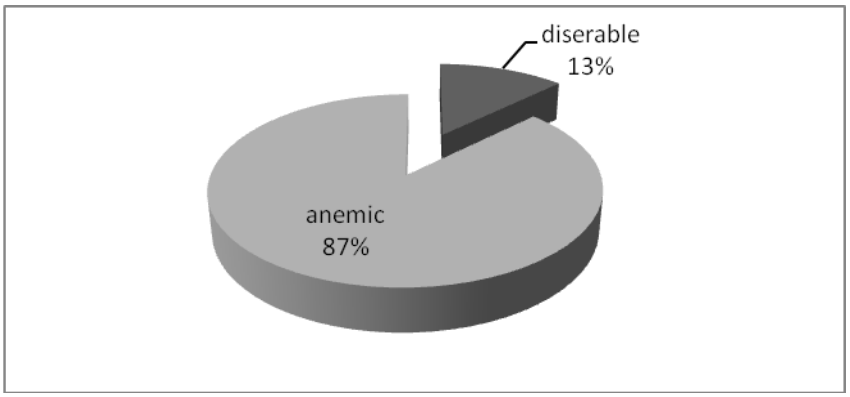


Table 2 shows that 63% female have desirable blood glucose level but in male only 31% have desirable fasting glucose level.

Table 3: Distribution of hemoglobin %of the study population

hemoglobin %	Frequency	Percent
Desirable (>12%)	7	13.0
Anemic (<12%)	48	87.0



In our study population 87% patients are anemic. (Table 3)

Table 4: Distribution of hemoglobin %of the study population according to sex

	Total hemoglobin%		Total
	Desirable	anemic	
male	7 19.0%	29 81.0%	36 100.0%
female	0 0.0%	21 100.0%	21 100.0%

Table 3 shows that 100% female are anemic but in male 81% are anemic.

Table-5: Bivariate correlation analysis between hemoglobin%, plasma fasting glucose and body weight
X 1= **hemoglobin%**, X2= **plasma fasting glucose**, X3= **body weight**

variable	Pearson's correlation coefficient r	P value
X1,2	.242	.075 NOT SIGNIFICANT
X1,3	-.568	‹.001

From the table 4 it is evidence that there was a significant positive correlation between hemoglobin % and body weight. No significant correlation found between hemoglobin percent and fasting plasma glucose.

IV. DISCUSSION

To scrutinize our findings related to the possible metabolic imbalance in chronic arsenic poisoning hemoglobin %, fasting plasma glucose and body weight were estimated and compare with each other.
In our study population 22% patients suffer from diabetes and 36% having impair fasting glucose.(table 1) .male patients are more diabetics and having impair fasting glucose . Table 2 shows that 63% female have desirable blood glucose level but in male only 31% have desirable fasting glucose level.

Animal and *in vitro* model systems have indicated that arsenic exposure can potentially increase the risk of diabetes through its effects on the inhibition of insulin-dependent glucose uptake (Walton et al. 2004) and insulin signaling (Paul et al. 2007), impairment of insulin secretion and transcription in pancreatic beta cells(DiazVillasenor et al. 2006),and modification of the expression of genes involved in insulin resistance (Diaz-Villasenor et al. 2007). However, the concentrations used in most mechanistic experiments are high, and the observed effects may not be applicable to populations chronically exposed to arsenic in the environment. Nevertheless, the epidemiologic literature suggests that diabetes is an adverse outcome associated with prolonged exposure to high levels of water arsenic (> 500 μg/L). For instance, in a cross-sectional study of 1,595 subjects in Bangladesh, Rahman et al.(1999) reported an OR for diabetes of 1.7 (95% CI, 1.0–2.9) comparing arsenic exposure of > 10,000 μg/L-years to the unexposed group among those free of skin lesion.

From the table 4 it is evidence that about **87%** patients having anemia and prevelence among female patient are more (**100%)** The findings are similar to that of earlier studies by Sikder *et al*.6,7,8 who identified observed in 89.23%, 100% and 47.41% patients anemic, respectively.

We found significant positive correlation between hemoglobin% and body weight indicating Malnutrition also responsible for anemia. **No significant correlation was found between hemoglobin% and fasting plasma glucose.**

V. CONCLUSION

The present study conducted an analysis of alter metabolism in chronic arsenic poisoning. High prevelence of diabetes and anemia were found among patients suffer from chronic arsenic poisoning .Alter glucose tolerance mostly found in male patients but prevelence of anemia more among female patients. No significant relationship was found between hemoglobin% and fasting plasma glucose. So Anemia is an important determinant in chronic arsenic poisoning and by improving the hemoglobin level may retard the progression of disease.

REFERENCE

[1]. Ahsan H, Chen Y, Parvez F, et al: Arsenic exposure from drinking water and risk of premalignant skin lesions in Bangladesh: baseline results from the health effects of arsenic longitudinal study. Am J Epidemiol 2006, 163:1138–1148.

[2]. Winski SL, Carter DE. Interactions of rat red blood cell sulfhydryls with arsenate and arsenite. J Toxicol Environ Health 1995; 46:379 – 97.

[3]. Lu M, Wang H, Li XF, et al. Evidence of hemoglobin binding to arsenic as a basis for the accumulation of arsenic in rat blood. Chem Res Toxicol 2004; 17:1733 – 42..

[4]. Delnomdedieu M, Styblo M, Thomas DJ. Time dependence of accumulation and binding of inorganic and organic arsenic species in rabbit erythrocytes. Chem Biol Interact 1995; 98:69 – 83.

[5]. Delnomdedieu M, Basti MM, Styblo M, Otvos JD, Thomas DJ. Complexation of arsenic species in rabbit erythrocytes. Chem Res Toxicol 1994; 7:621–7.

[6]. Kannan GM, Tripathi N, Dube SN, Gupta M, Flora SJ. Toxic effects of arsenic (III) on some hematopoietic and central nervous system variables in rats and guinea pigs. J Toxicol Clin Toxicol 2001; 39:675 – 82.

[7]. Flora SJ, Bhadauria S, Pant SC, Dhaked RK. Arsenic induced blood and brain oxidative stress and its response to some thiol chelators in rats. Life Sci 2005; 77:2324– 37.

[8]. Szymanska-Chabowska A, Antonowicz-Juchniewicz J, Andrzejak R. Some aspects of arsenic toxicity and carcinogenicity in living organism with special regard to its influence on cardiovascular system, blood and bone marrow. Int J Occup Med Environ Health 2002; 15:101 – 16.

[9]. Hatlelid KM, Brailsford C, Carter DE. Reactions of arsine with hemoglobin. J Toxicol Environ Health 1996; 47:145 – 57.

[10]. Winski SL, Barber DS, Rael LT, Carter DE. Sequence of toxic events in arsine induced hemolysis in vitro : implications for the mechanism of toxicity in human erythrocytes. Fundam Appl Toxicol 1997; 38:123 – 8.

[11]. Garcia-Uribe A, Kehtarnavaz N, Marquez G, et al. Skin cancer detection by spectroscopic oblique—prevelence reflectometry: classification and physiological origins. Appl Opt 2004; 43:2643 – 50.

[12]. Hernandez-Zavala A, Del Razo LM, Garcia-Vargas GG, et al. Altered activity of heme biosynthesis pathway enzymes in individuals chronically exposed to arsenic in Mexico. Arch Toxicol 1999; 73:90 – 5.

[13]. DeFronzo, R.A., Bonadonna, R.C., Ferrannini, E., 1997. Pathogenesis of NIDDM. In: Alberti, K.G.M.M., Zimmet, P., DeFronzo, R.A., Keen, H. (Eds.), International Textbook of Diabetes Mellitus, second ed. Wiley, New York,pp. 635–711.

[14]. The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, 2001. Report of the Expert Committee on the Diagnosis and Classification on Diabetes Mellitus. Diabetes Care 24 (Suppl. 1), S5–S20.

[15]. Izquierdo-Vega JA, Soto CA, Sanchez-Pena LC, De Vizcaya-Ruiz A, Del Razo LM. Diabetogenic effects and pancreatic oxidative damage in rats subchronically exposed to arsenite. *Toxicol Lett*. 2006; 160 (2):135-142.

[16]. Walton FS, Harmon AW, Paul DS, Drobna Z, Patel YM, Styblo M. Inhibition of insulin-dependent glucose uptake by trivalent arsenicals: possible mechanism of arsenic-induced diabetes. *Toxicol Appl Pharmacol*. 2004; 198(3):424-433

[17]. . Bazuine M, Ouwens DM, Gomes de Mesquita DS, Maassen JA. Arsenite stimulated glucose transport in 3T3-L1 adipocytes involves both Glut4 translocation and p38 MAPK activity. *Eur J Biochem*. 2003; 270 (19):3891-3903.

[18]. Paul DS,Harmon AW, Devesa V, Thomas DJ, Styblo M. Molecular mechanisms of the diabetogenic effects of arsenic: inhibition of insulin signaling by arsenite and methylarsonous acid. *Environ Health Perspect*. 2007; 115(5):734-742

[19]. Paul DS,Harmon AW, Devesa V, Thomas DJ, Styblo M. Molecular mechanisms of the diabetogenic effects of arsenic: inhibition of insulin signaling by arsenite and methylarsonous acid. *Environ Health Perspect*. 2007; 115(5):734-742.

[20]. MacfarlaneWM,McKinnon CM, Felton-Edkins ZA, Cragg H, James RF, Docherty K. Glucose stimulates translocation of the homeodomain transcription factor PDX1 from the cytoplasm to the nucleus in pancreaticbeta-cells. *J Biol Chem.* 1999; 274(2):1011-1016.

[21]. Salazard B, Bellon L, Jean S, et al. Low-level arsenite activates the transcription of genes involved in adipose differentiation. *Cell Biol Toxicol*. 2004; 20(6):375-385.

[22]. Wauson EM, Langan AS, Vorce RL. Sodium arsenite inhibits and reverses expression of adipogenic and fat cell-specific genes during in vitro adipogenesis. *Toxicol Sci*. 2002; 65(2):211-219

[23]. Rahman M, Tondel M, Ahmad SA, Axelson O. Diabetes mellitus associated with arsenic exposure in Bangladesh. *Am J Epidemiol*. 1998; 148(2):198-203.

[24]. Tseng CH, Tai TY, Chong CK, et al. Long-term arsenic exposure and prevelence of non-insulin dependent diabetes mellitus: a cohort study in arseniasishyperendemicvillages in Taiwan. *Environ HealthPerspect*. 2000; 108(9):847-851.

[25]. Wang SL, Chiou JM, Chen CJ, et al. Prevalence of non-insulin-dependent diabetes mellitus and related vascular diseases in southwestern arseniasis-endemic and nonendemic areas in Taiwan. *Environ Health Perspect*.2003; 111(2):155-159.

[26]. Coronado-Gonza´ lez JA, Del Razo LM, Garcia-Vargas G, Sanmiguel-Salazar F, Escobedo-de la Pen˜ a J. Inorganic arsenic exposure and type 2 diabetes mellitus inMexico. *Environ Res*. 2007; 104(3):383-389.

[27]. Navas-Acien A, Silbergeld EK, Streeter RA, ClarkJM, Burke TA, Guallar E. Arsenic exposure and type 2 diabetes: a systematic review of the experimental and epidemiological evidence. *EnvironHealth Perspect*. 2006; 114(5):641-648.
[28]. Chen CJ, Wang SL, Chiou JM, et al. Arsenic and diabetes and hypertension in human populations: a review. *Toxicol Appl Pharmacol*. 2007; 222(3):298-304.
[29]. Lai MS, Hsueh YM, Chen CJ, et al. Ingested inorganic arsenic and prevalence of diabetes mellitus. *Am J Epidemiol*. 1994; 139(5):484-492.
[30]. Jensen GE, Hansen ML. Occupational arsenic exposure and glycosylated haemoglobin. *Analyst*. 1998; 123(1):77-80.
[31]. Zierold KM, Knobeloch L, Anderson H. Prevalence of chronic diseases in adults exposed to arsenic contaminated drinking water.*AmJ Public Health*. 2004; 94(11):1936-1937.
[32]. Lewis DR, Southwick JW,Ouellet-Hellstrom R, Rench J, Calderon RL. Drinking water arsenic in Utah: a cohort mortality study. *Environ Health Perspect*. 1999; 107(5):359-365.
[33]. Ruiz-Navarro ML, Navarro-Alarco´ n M, Lopez Gonza´ lez-delaSerranaH,Pe´rez-ValeroV,Lopez-Martinez MC.Urine arsenic concentrations in healthy adults as indicators of environmental contamination: relation with some pathologies. *Sci Total Environ*. 1998;216(1-2):55-61.
[34]. Wang SL, Chang FH, Liou SH, Wang HJ, Li WF, Hsieh DP. Inorganic arsenic exposure and its relation to metabolic syndrome in an industrial area of Taiwan.*Environ Int*. 2007; 33(6):805-811. WHO/UNICEF/UNU. Indicators and strategies for iron deficiency and anaemia programmes. Report of consultation, Geneva, 1993 Dec 6-10. Geneva: WHO; 1997.
[35]. Khusun H, Yip R, Schultink W, Dillon DH. World Health Organization hemoglobin cut-off points for the detection of anemia are valid for an Indonesian population. J Nutr 1999; 129:1669 – 74.