



## Estimation of serum electrolyte concentration among fuel pump/petrol station workers in Kirkuk city

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### ABSTRACT

Occupational exposure to petrol has been reported to cause serious health hazards especially liver and kidney disease. Electrolytes like  $\text{Na}^+$ ,  $\text{K}^+$ , and  $\text{Cl}^-$  are the important mediators of several physiological functions. The present study aims to evaluate the effect of petrol exposure on the serum electrolyte concentration among the workers at the Kirkuk petrol station. The cross-sectional study analyzed 29 petrol pump workers who were continuously exposed to petrol more at least one year in the Kirkuk city and did not have a history of any systemic illness, and 10 healthy age-matched controls who never had exposure to petrol were enrolled. The serum electrolyte levels ( $\text{Na}^+$ ,  $\text{K}^+$ , and  $\text{Cl}^-$ ) were assessed in the petrol station workers working at Kirkuk city petrol station and the controls by FUJI DRI-CHEM system (Fujifilm (Japan) and expressed as mmol/l. These serum electrolyte levels were compared between the workers and the controls by Mann-Whitney U test and p values  $\leq 0.05$  was considered statistically significant. All the participants in the study were males. None of the participants was smokers or alcohol consumers. No significant ( $p=0.32$ ) difference was found in the mean age of the petrol station workers ( $34.22 \pm 6.57$ ) years and the controls ( $36.70 \pm 6.33$ ) years. The serum  $\text{Na}^+$  levels were significantly higher in the petrol station workers as compared to the controls. Similarly, serum  $\text{Cl}^-$  levels were significantly higher in the petrol station workers as compared to the controls. Although the levels of the electrolytes studied were in the normal recommended range but the levels of  $\text{Na}^+$  and  $\text{Cl}^-$  were significantly higher in the petrol station workers than the controls. Extensive studies involving larger sample sizes should be conducted to conclude the effect of petrol exposure on the electrolyte levels.

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### INTRODUCTION

Occupation related introduction of different unsafe synthetic compounds can prompt plenty of health hazards. Petroleum station workers who refuel the vehicles are presented to oil exhaust on a standard premise (Khisroon *et al.*, 2015). In this way, these workers are at high risk of occupation-related health hazards.

Petroleum is made of various particulate and non-particulate mixes. It contains a blend of aliphatic and aromatic hydrocarbons and non-hydrocarbons like the trace elements (Nitrogen, Sulfur, Oxygen, Vanadium and Nickel) (Peters *et al.*, 2018).

The major components of petrol are benzene, toluene, ethyl benzene and xylene (BTEX). In this way, the oil station workers are routinely presented to these harmful chemicals. By various routes like cutaneous and respiratory routes, these hazardous components of the petrol fumes enter the body (Allegretti *et al.*, 2004). Benzene and its derivatives are reported to be potential carcinogens. There are several other health impacts of benzene exposure like leukaemia, respiratory and neurological problems (Kirkeleit *et al.*, 2008; Smith, 2010; Tun-saringkarn *et al.*, 2012).

Exposure of petrol fumes and its harmful components have been reported to cause several health-related issues. Among the health hazards caused by petrol fumes exposure, respiratory issues are the most prevalent among the petrol station workers. Exposure of halogenated hydrocarbons through petrol fumes in the petrol station workers accounts for the cause of hepatitis and liver cirrhosis in the workers at petrol stations (Gunathilaka *et al.*, 2017). The components of petrol fumes have been studied for their impact on the liver and kidney health. Studies have revealed the harmful effects of these fumes on the liver and kidney (Periago and Prado, 2005; Benson *et al.*, 2011; Adami *et al.*, 2007).

Kidney adenoma (Benson *et al.*, 2011), altered activities of liver enzymes, deranged levels of serum urea, creatinine, potassium ( $K^+$ ), chloride ( $Cl^-$ ) and sodium ( $Na^+$ ) have been observed in laboratory animals exposed to petrol fumes (Uboh *et al.*, 2009). Studies have also reported deranged activities of liver enzymes (aspartate aminotransferase, soluble phosphatase, alanine aminotransferase), proteinuria, elevated levels of serum bilirubin in the drivers of vehicles running on petrol. Xylene and toluene, the significant parts of petroleum have been recorded to cause liver and kidney damage (Neghab *et al.*, 2015). We have recently analyzed the effects of petrol exposure in the petrol station workers in the Kirkuk city and found that the workers had significantly altered lipid profiles as compared to the controls that had no petrol exposure but the workers showed normal levels of aspartate aminotransferase, soluble phosphatase, and alanine aminotransferase (unpublished data). Electrolytes like  $Na^+$ ,  $K^+$ , and  $Cl^-$  and other ions have very critical jobs to play in the body, for example, controlling fluid levels, pH maintenance, nerve conduction, blood coagulation, and muscle contraction. Electrolyte imbalance is indicative of kidney dysfunction (Liamis *et al.*, 2014; Elmehdawi and Elmagerhei, 2010). So, this study was planned to analyze the serum electrolyte levels in these petrol station workers and compare with the controls. In

the present study, the petrol station workers in the Kirkuk city who were working for more than at least one year were analyzed for serum electrolyte levels ( $Na^+$ ,  $K^+$ , and  $Cl^-$ ) and compared with the controls that never had petrol exposure.

## MATERIALS AND METHODS

### Study population

This was a cross-sectional study that included 29 petrol station workers who continuously worked not less than one year in Government petrol stations in Kirkuk city and 10 healthy age-matched controls who never worked in petrol stations or petroleum industries. Petrol station workers who had diseases affecting renal and liver function, who were taking medications that affected renal and liver function, smokers, and alcohol consumers were excluded from the study.

### Ethical consideration

The principle of the declaration on the right of the subject was employed for this study. The participants were included in this study only after obtaining signed informed consent from them.

### Estimation of serum electrolyte levels

Five ml of blood was drawn from a peripheral vein and centrifuged for 5 minutes at 10,000 rpm and serum was collected. Serum electrolytes and  $Cl^-$  were estimated by FUJI DRI-CHEM system. Fujifilm (Japan) and expressed as mmol/l.

### Statistical analysis

Data were analyzed by SPSS version 21. Mann-Whitney U test was used for comparing different parameters between both the groups. Frequencies/percentages were calculated for qualitative variables and compared between groups through the Chi-Square test. P-value < 0.05 was considered statistically significant.

## RESULTS AND DISCUSSION

### Study participants

In the present study, 29 petrol pump workers who continuously worked not less than one year in the petrol station and 10 healthy controls who never worked in petrol stations or petroleum industries were enrolled. All the participants were males. There was no significant ( $p=0.32$ ) difference in the mean age of the petrol station workers ( $34.22\pm 6.57$ ) years and the controls ( $36.70\pm 6.33$ ) years. None of the participants had any chronic diseases like diabetes, hypertension, cardiac disease, or any other systemic illness at the time of the study.

None of the participants was smokers or consumed alcohol. All the participants were enrolled for the study after signing informed consent forms Table 1.

### Serum electrolyte levels

The serum Na<sup>+</sup> levels were notably higher in petrol station workers in comparison to the controls. Similarly, serum Cl<sup>-</sup> levels were appreciably higher in petrol station workers in comparison with the controls. Although statistically non-significant, workers at the petrol station had higher mean serum levels of K<sup>+</sup> compared to that of controls Table 2. Na<sup>+</sup>: Sodium ion, K<sup>+</sup>: Potassium ion, Cl<sup>-</sup>: chloride ions. Statistics used: Mann-Whitney U test was used for comparing various parameters between both the groups. P value < 0.05 was taken as statistically important.

The human body is composed of 24 components, among which K, Na and Ca are viewed as basic. These vital components are essential for several critical physiological activities including control of the electrical and mechanical activity of the heart. Imbalance in water-electrolyte could result in cardiovascular arrhythmias, muscle contraction issues, affect neuronal impulse transmission. The key organ engaged in maintaining the potassium and sodium homeostasis is the kidney and renin-angiotensin-aldosterone (RAA) is the most essential hormone involved in this homeostasis (Fijorek *et al.*, 2014). There are important proteins and channels that regulate the intra and extracellular levels of K<sup>+</sup> thereby maintain the serum levels of K<sup>+</sup>. Numerous protein channels and ionic pumps managed by RAA hormones and associated with Na<sup>+</sup> and K<sup>+</sup> homeostasis are present. Na<sup>+</sup>/K<sup>+</sup>-ATPase are the most basic ones among them, which are responsible for the maintenance of transmembrane potential and also keeping up the resting potential in each living cell. They also adequately transport K into and Na out of the cells (Clausen *et al.*, 2017). The physiological serum levels of K<sup>+</sup> ranges from 3.5 to 5.0 millimole per litre (mM). K<sup>+</sup> is the most critical ion present in the intracellular fluids. K is a crucial element that plays important physiological roles in various processes, for instance, in the conduction of electrical impulse and the contraction of skeletal and smooth muscles, which also includes the heart. Also, the resting state is achieved due to the extended efflux of K<sup>+</sup> particles from the cardiomyocytes. Its activity is especially necessary for the volatile cells, for instance, neurons. Resting capacity of volatile cells depends principally on (Pinnell *et al.*, 2007).

Hypokalaemia is characterized as the serum level of potassium below 3.5 mmol/L. Low serum potas-

sium may have been caused due to diminished oral intake, excessive loss of potassium through kidneys or gastrointestinal tract, or due to potassium flowing inside the body's liquid chambers. Basic clinical manifestations of hypokalaemia include muscle weakness and absence of peristalsis, to heart arrhythmias, for example, ventricular tachycardias. Increase of Hyperkalaemia to levels more than 5.0 mmol/L might be caused due to excessive intake, tissue injury, medications such as diuretics, and generally because of renal diseases. Clinical manifestations of hyperkalaemia incorporate weakness in muscles, hypotension, bradycardia and loss of heart yield (Fijorek *et al.*, 2014). In the present study, we observed a statistically non-significant rise in serum K<sup>+</sup> levels in petrol station workers as compared to the controls. This is in line with the report of (Neghab *et al.*, 2015), according to which there was no notable difference in the serum K levels of petrol station workers and the controls (Neghab *et al.*, 2015). The human body has 105 grams of sodium, found in most parts of the body, especially the bones, extracellular liquids (i.e. serum) and tissues. Its role is very crucial in the nerves and muscle tissues, and in the heart. The physiological level of Na in the serum ranges from 135 mM to 145 mM. Na<sup>+</sup> is the main extracellular cation, in charge of the osmotic properties of body fluids. Na<sup>+</sup> ions help in the maintenance of the action potential in excitable cells like muscles and neurons (Fijorek *et al.*, 2014). The serum electrolyte levels can be influenced by demographic, sociological and physiological elements, including age, ethnicity, geographic area and diet (Hawkins, 2010). In the present study, all the participants were from Kirkuk, Iraq. Na<sup>+</sup> is the most essential electrolyte in the body and is in charge of various vital functions. Hyponatraemia is viewed as serum sodium levels below 134 mEq/L. Typical reasons for hyponatraemia are water retention, cardiovascular or renal or hepatic diseases. Hyponatremia has been reported to be associated with confusion, lethargy, fatigue, headache, nausea, vomiting, loss of appetite, spasms, cramps, seizures, depressed neural reflexes (Fijorek *et al.*, 2014). Hypernatraemia is characterized as serum sodium levels higher than 145 mEq/L. Reasons for hypernatraemia may be anything that prompts water loss or salt gain. Unnecessary ingestion of sodium is uncommon, yet compounds containing sodium, for example, sodium chloride or sodium bicarbonate may prompt hypernatraemia. Clinical manifestations of hypernatraemia include fever, dizziness, sluggishness, fatigue, laziness and perplexity (Fijorek *et al.*, 2014) (Neghab *et al.*, 2015) have

**Table 1: Demographic features of the study participants**

Demographic features	Petrol station workers (n=29)	Controls (n=10)
Age, years (mean±SD)		
Gender	Males (n=29) Females (n=0)	Males (n=10) Females (n=0)
Duration of work in the petrol station	>1 year	0
Any systemic or chronic disease	None	None
Smokers	None	None
Alcohol consumers	None	None

**Table 2: Comparison of serum electrolyte levels between petrol pump workers (n=29) and controls (n=10)**

Groups	Na <sup>+</sup> (mmol/l)	K <sup>+</sup> (mmol/l)	Cl <sup>-</sup> (mmol/l)
Petrol pump workers (n=29)	141.96±3.27	4.45±0.31	103.48±4.87
Controls (n=10)	136.60±3.34	4.24±0.24	93.30±6.06
P value	0.000	0.057	0.000

reported in one of his studies involving workers at petrol stations that petrol exposure resulted in reduced serum Na<sup>+</sup> levels as opposed to that of controls (Neghab *et al.*, 2015). However, in the present study, we observed a significant increase in the serum Na<sup>+</sup> levels in the petrol station workers as compared to the controls. This discrepancy in the results may be due to the fact that in the study conducted by (Neghab *et al.*, 2015), most of the petrol station workers were smokers and in the present study, none of the participants was smokers. Smoking can be a confounding factor in the study by (Neghab *et al.*, 2015). We excluded the participants who were smoking because smoking has been reported to increase Na<sup>+</sup>, K<sup>+</sup> and the marker enzymes of the liver (Osman *et al.*, 2011; Fijorek *et al.*, 2014).

Another important electrolyte is Cl<sup>-</sup>. It functions similarly as Na<sup>+</sup>, K<sup>+</sup> ions and contributes to the osmotic properties of the body fluids. Chloride toxicity has been reported in congestive heart failure. The normal blood levels of chloride in healthy adults are 96 to 106 milliequivalents (mEq) per litre. All the participants in the present study had normal serum Cl<sup>-</sup> levels. Imbalances in the serum Cl<sup>-</sup> levels can lead to several health conditions like alkalosis or acidosis. Cl<sup>-</sup> concentration in the blood is controlled by the kidney. So, any imbalance in its level in the blood is suggestive of kidney dysfunction (Zhang *et al.*, 2013). In the current study, we observed higher levels of serum Cl<sup>-</sup> ions in the petrol station workers in comparison with controls. So, these workers should be constantly mon-

itored for kidney functions. Put essentially, electrolytes are normally existing minerals with an electric charge, which exist in the human body. They are additionally supplied and maintained by liquids we ingest every day. A few generally known electrolytes are potassium, magnesium, sodium-calcium and phosphate. These electrolytes serve vital functions in the body, for example, keeping water in parity, maintaining body's pH levels, and also transporting supplements and waste to and from cells. Electrolyte irregularity can be a marker of numerous normal infections and sicknesses. Some electrolyte imbalances get rectified on their own without any ill-effects, whereas others are set right by simply drinking water. However, electrolyte imbalance can cause serious complications if not treated properly. Electrolyte imbalances mostly are self-corrected and have no ill effects. However, these imbalances in the serum electrolytes can have serious consequences on normal health if left untreated. In the study done, we observed that serum levels of Na<sup>+</sup>, K<sup>+</sup>, and Cl<sup>-</sup> were in the normal healthy range in the petrol station workers. Interestingly it was observed that the workers, although had their electrolytes in the normal healthy ranges but had higher levels of Na<sup>+</sup>, K<sup>+</sup>, and Cl<sup>-</sup> as compared to the controls.

## CONCLUSION

It was concluded that the workers at the petrol station of Kirkuk are at higher risk of developing kidney diseases and other complications related to electrolyte imbalance. Although the levels of the electrolytes

studied were in the normal recommended range but the levels were considerably higher than that of controls. As we have conducted a cross-sectional study employing small sample size; so, extensive studies involving larger sample sizes should be conducted to conclude the effect of petrol exposure on the electrolyte levels. Also, petrol exposure should be quantified, and the range of harmful exposure in terms of the time of exposure and the quantity of exposure should be established.

## REFERENCES

- Adami, G., Larese, F., Venier, M., Barbieri, P., Coco, F. L. 2007. Penetration of benzene, toluene and xylenes contained in gasoline through human abdominal skin in vitro. *Toxicol In Vitro*, 20(8):1321–1330.
- Allegretti, A. P., Thiesen, F. V., Maciel, G. P. 2004. Analytical method for evaluation of exposure to benzene, toluene, xylene in blood by gas chromatography preceded by solid phase microextraction. *Journal of Chromatography B*, 809(1):183–187.
- Benson, J. M., Gigliotti, A. P., March, T. H., Barr, E. B., Tibbetts, B. M. 2011. Chronic Carcinogenicity Study of Gasoline Vapor Condensate (GVC) and GVC Containing Methyl Tertiary-Butyl Ether in F344 Rats. *Journal of Toxicology and Environmental Health, Part A*, 74(10):638–657.
- Clausen, M. V., Hilbers, F., Poulsen, H. 2017. The Structure and Function of the Na,K-ATPase. *Frontiers in Physiology*, 8(371).
- Elmehdawi, R. R., Elmagerhei, H. M. 2010. Profile of diabetic ketoacidosis at a teaching hospital in Benghazi, Libyan Arab Jamahiriya. *Eastern Mediterranean Health Journal*, 16(3):292–299.
- Fijorek, K., Püsküllüoğlu, M., Tomaszewska, D., Tomaszewski, R., Glinka, A. 2014. Serum potassium, sodium and calcium levels in healthy individuals - literature review and data analysis. *Folia Medica Cracoviensia*, 54(1, 2014):53–70.
- Gunathilaka, M. L., Niriella, M. A., Luke, N. V., Piyarathna, C. L., Siriwardena, R. C. 2017. Possible gasoline-induced chronic liver injury due to occupational malpractice in a motor mechanic: a case report. *Journal of Medical Case Reports*, 11(1):179.
- Hawkins, R. C. 2010. Differences in serum potassium concentrations between Chinese, Indians and Malays. *Clinical Chemistry and Laboratory Medicine*, 48(1):105–108.
- Khisroon, M., Gul, A., Khan, A., Ali, N., Zaidi, F., Rasheed, S. B., Akbar, H. 2015. Comet assay based DNA evaluation of fuel filling stations and automobile workshops workers from Khyber Pakhtunkhwa province Pakistan. *Journal of Occupational Medicine and Toxicology*, 10(1):27–10.
- Kirkeleit, J., Riise, T., Bråtveit, M., Moen, B. E. 2008. Increased risk of acute myelogenous leukemia and multiple myeloma in a historical cohort of upstream petroleum workers exposed to crude oil. *Cancer Causes & Control*, 19(1):13–23.
- Liamis, G., Liberopoulos, E., Barkas, F., Elisaf, M. 2014. Diabetes mellitus and electrolyte disorders. *World Journal of Clinical Cases*, 2(10):488–496.
- Neghab, M., Hosseinzadeh, K., Hassanzadeh, J. 2015. Early Liver and Kidney Dysfunction Associated with Occupational Exposure to Sub-Threshold Limit Value Levels of Benzene, Toluene, and Xylenes in Unleaded Petrol. *Saf Health Work*, 6(4):312–316.
- Osman, E. A. I., Dafallah, A. A., Omer, W. H., Elimiri, G. M. 2011. Effect of cigarette smoking on blood sodium and potassium levels in sudanese subjects. *International Journal of Pharma and Bio Sciences*, 2(3):75.
- Periago, J. F., Prado, C. 2005. Evolution of Occupational Exposure to Environmental Levels of Aromatic Hydrocarbons in Service Stations. *The Annals of Occupational Hygiene*, 49(3):233–240.
- Peters, C. E., Parent, M. E., Harris, S. A., Bogaert, L., Latifovic, L., Kachuri, L., Villeneuve, P. J. 2018. Occupational Exposure to Diesel and Gasoline Engine Exhausts and the Risk of Kidney Cancer in Canadian Men. *Annals of Work Exposures and Health*, 62(8):978–989.
- Pinnell, J., Turner, S., Howell, S. 2007. Cardiac muscle physiology. Continuing Education in Anaesthesia, Critical Care and Pain. *Skeletal Muscle Physiology*, 7(3):85–88.
- Smith, M. T. 2010. Advances in Understanding Benzene. *Health Effects and Susceptibility. Annual Review of Public Health*, 31(1):133–148.
- Tunsaringkarn, T., Siriwong, W., Rungsiyothin, A., Nopparatbundit, S. 2012. Occupational exposure of gasoline station workers to BTEX compounds in Bangkok, Thailand. *International Journal of Occupational and Environmental Medicine*, 3(3):117–125.
- Uboh, F., Ebong, P., Umoh, I. 2009. Comparative Hepatoprotective Effect of Vitamins A and E Against Gasoline Vapor Toxicity in Male and Female Rats. *Gastroenterology Research*, 2(5):295–302.
- Zhang, Z., Xu, X., Fan, H., Li, D., Deng, H. 2013. Higher serum chloride concentrations are associated with acute kidney injury in unselected critically ill patients. *BMC Nephrology*, 14(1):235.