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ELECTROLYTES, TOTAL PROTEIN AND ALBUMIN CONCENTRATIONS IN CARPENTERS EXPOSED TO SAWDUST IN MARINE BASE CARPENTRY SHADES, PORT HARCOURT METROPOLIS, NIGERIA

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ABSTRACT

Background: The carpenters in Marine base carpentry shade, Port Harcourt saw timber woods without proper protective clothing and also use the saw dust produced as part of the floor covering of their carpentry shade as a consequence, they are directly expose to the sawdust produce through inhalation and skin contact. Most of the carpenters are unaware of the health implication involve in direct exposure to saw dust. **Objectives.** The objective of this study is to determine Electrolytes, Total protein and Albumin concentrations in carpenters exposed to sawdust within Marine base carpentry shades, Port Harcourt metropolis, Nigeria. **Methods**. Plasma Electrolytes, Total protein and Albumin concentrations of thirty (30) carpenters exposed previously within 1-15 years to sawdust were compared with thirty two (32) apparently healthy individuals not exposed to saw dust (control).Ion selective electrode (ISE) analyser was used to determine the concentrations of Electrolytes, biuret method was used to determined total protein concentrations while bromocresol green method was used to determine Albumin concentrations. **Results:** The results showed that subjects had Potassium, Sodium, Chloride and Bicarbonate imbalance as a consequence of exposure to saw dust. The mean ± standard deviation of Sodium, Potassium, Chloride, Bicarbonate, Anion gap, Total protein and Albumin concentrations for carpenters that were exposed to saw dust are 133.60 ± 2.37mmol/l (Sodium), 3.61 ± 0.30 mmol/l (Potassium), 106.07 ± 1.31 mmol/l (Chloride), 24.07 ± 3.50mmol/l (Bicarbonate), 3.67 ± 2.16mmol/l (Anion gap), 83.00 ± 12.81g/l (Total protein), and 44.93 ± 6.38 g/l (Albumin), respectively while the values for control are 135.80 ± 206 mmol/l (Sodium), 3.44 ± 0.36 mmol/l (Potassium), 101.25 ± 2.42 mmol/l(Chloride), 15.94 ± 3.35 mmol/l (Bicarbonate), 15.94 ± 3.53 mmol/l (Anion gap), 73.52 ± 1.40 g/l (Total protein), 44.15 ± 0.30 g/l (Albumin) respectively. **Discussions:** The concentrations of Total protein, Potassium, Chloride, Bicarbonate, Sodium and Anion gap were significantly different in carpenters exposed to sawdust when compared to control ($p < 0.05$). **Conclusions:** The results in this study indicate that exposure to saw dust predisposes carpenters to electrolyte imbalance. Carpenters are therefore advised to wear protective mask and clothing while working with sawdust; Carpenters are also advised to stop the use of saw dust as part of the floor covering in their carpentry shades.

KEYWORDS: Electrolytes, Protein, Albumin, Sawdust, Carpenters.

Abbreviations

g/l grams per litre mmol/l Millimoles per litre rpm Revolutions per minute P probability SS sum-of-squares df degrees of freedom MS Mean Square F(MSR) regression mean square F crit Fcritical

INTRODUCTION

Sawdust or wood dust is a by product obtained from the cutting, grinding, drilling, sanding and pulverizing of wood with a saw or other tool.[1] Sawdust is composed of cellulose, polyoses, lignin and a number of substances of lower relative molecular mass such as resins, acids, waxes, alcohol, terpenses, sterols, sterile esters and glycerol.[2] Wood dust contains micro organism, toxins and chemical substances and they may significantly affect human body.[3] Other agents that exist in wood dust are endotoxins.[4] which may cause inflammatory reactions.[5]

The cardiovascular health consequences of air pollution generally equal or exceed those due to pulmonary disease.[6] Several literature have documented the

harmful cardiovascular event of air pollution.[7,8] Occupationally related pulmonary disease is most likely due to dust deposition in the lungs that are influenced by the composition of the dust, the duration of exposure to dust, the concentrations and physical properties of air borne dust in the breathing zone.[9] Inhaled wood dust will settle in various parts of the respiratory organs depending on the type of particles, the length of time of exposure, particle size and concentrations of pollutant.[10] Dust particles which are inhaled and lodged in the lung, irritate and set up inflammatory reaction. Healing of this inflammation causes diffusion and impaired lung function.[11]

An electrolyte is a compound which when dissolved in water will conduct electric current.[12] Electrolyte is present in the human body and the balance of the Electrolytes in the body is essential for normal functioning of cells and organs.[12] Common Electrolytes include Sodium, Potassium, Chloride and Bicarbonate. These electrolytes play a vital role in functioning of the body system. Sodium regulates the total amount of water in the body, potassium regulates the normal balance of the body and bicarbonate maintains the normal level of acidity (ph) in the blood and other fluids in the body.[12]

Proteins are essential nutrients for the human body.[13] They are one of the building blocks of the body tissues and can also serve as a fuel source.[13] Albumin is a family of globular Proteins, the most common of which is serum Albumin.[14]

Carpenters that work in marine base, carpentry shades saw timber woods without proper protective clothing and also use the saw dust produced as part of the floor covering of their carpentry shade as a consequence they are directly expose to the sawdust produce through inhalation, hand and foot contact. Most of the carpenters are unaware of the health implication involve in exposure to saw dust. It is pertinent therefore to investigate if exposure to these saw dust affect normal body function. This study therefore sought to determine the concentrations of Electrolytes, Total protein and Albumin in carpenters exposed to sawdust.

Methods

Study Area

This study was conducted in marine base carpentry area within Port Harcourt Metropolis Rivers State of Southern Nigeria. Port Harcourt is the capital of Rivers state and it is located in the Niger Delta.

Study Population

The study comprised of a total of 62 subjects aged between 21 – 45 years. The subjects comprises of 30 carpenters who saw timber wood and are directly expose to saw dust in their working environment and 32 apparently healthy individuals who work in an office setting far away from marine base carpentry shades which formed the control group. The number of years of exposures to saw dust among the carpenter was determined by years of working with timber wood. Years of exposure to saw dust among these carpenters ranged between 1–15 years. Informed and well understood consent was obtained from the participants. Each participant gave well informed, written and properly understood consent in accordance with Helsinki declaration.[15]

Questionnaire was used to obtain data on nasal problem, smoking, chest pain, eye problem, blood pressure, weight, height and years of working with saw dust.

Sample Collection

2.5mls of blood was collected from each participant from the median vein into a well labelled lithium heparin bottles. The samples were centrifuged at 1500 rpm for 5 minutes to obtain blood plasma samples, Each sample were then analyzed for Electrolytes, Total protein and Albumin.

Test Method

Protein was estimated using biuret method.[16] Albumin was estimated using bromocresol method.[17] while Electrolytes were estimated using ion selective Electrode (ISE) analyser by Beckman coulter synchrone CX9 PRO.[18]

Statistical Analysis

Statistical analysis were performed using excel and student t test. P values of < 0.05 were considered statistically significant.

RESULTS

The study was conducted to estimate the concentrations of Electrolytes (Sodium, Potassium, Bicarbonate, Chloride, Anion gap), Total protein and Albumin in 30 carpenters exposed to sawdust and 32 individual not exposed to sawdust. Data are presented in the tables i-v below:

Table i: Concentrations of Electrolytes, Total protein and Albumin in carpenter exposed to sawdust and control

Parameter	Carpenters exposed to sawdust n=30	Control n= 32	P value
Total protein (g/l)	83.00 ± 12.81	73.52 ± 1.40	0.0001*
Albumin (g/l)	44.93 ± 6.38	44.15 ± 0.30	0.4921
Sodium (mmol/l)	133.60 ± 2.37	135.80 ± 2.06	0.0002*
Potassium (mmol/l)	3.61 ± 0.30	3.44 ± 0.36	0.0486
Chloride (mmol/l)	106.07 ± 1.31	101.25 ± 2.42	0.0001*

Bicarbonate (mmol/l)	24.07 ± 3.51	15.94 ± 3.53	0.0001*
Aniongap (mmol/l)	3.67 ± 2.16	15.94 ± 3.35	0.0001*

*Significant at P values of < 0.05

In table i above the concentrations of Total Protein, Potassium, Chloride, Bicarbonate is significantly increased in carpenters exposed to sawdust than in control ($p < 0.05$) the concentrations of Sodium, and Anion gap is significantly decreased in carpenters exposed to sawdust than in control ($p < 0.05$) the concentrations of albumin is not significantly increased in carpenters exposed to sawdust than in control ($p > 0.05$).

Table: ii Concentrations of Electrolytes, Total protein and Albumin with respect to years of exposure to sawdust between 1-5 years (n=12)

Source of Variation	*SS*	*Df*	*MS*	*F(MSR)*	*P-value*	*F crit*
Between Groups	195170.4	6	32528.4	883.8515	7.68E-69	2.218817
Within Groups	2833.833	77	36.80302			
Total	198004.3	83				

Table: iii Concentrations of Electrolyte, Total protein and Albumin in respect to years of exposure to sawdust between 6-10 years (n=10)

Source of Variation	*SS*	*Df*	*MS*	*F(MSR)*	*P value*	*F crit*
Between Groups	155946.7	6	25991.11	916.4396	2.7E-59	2.246408
Within Groups	1786.741	63	28.36097			
Total	157733.4	69				

Table: iv Concentrations of Electrolyte, Total protein and Albumin in respect to years of exposure to sawdust between 11-15 years (n=8)

Source of Variation	*SS*	*Df*	*MS*	*F(MSR)*	*P value*	*F crit*
Between Groups	126033.6	6	21005.59	552.2271	3.34E-43	2.290432
Within Groups	1863.86	49	38.03796			
Total	127897.4	55				

Table: v Concentrations of electrolyte, total protein and albumin in carpenters that smoke and those that do not smoke.

Parameter	**Carpenters that smoke n=8**	**Carpenter that do not smoke n=22**	**P value**
Total protein (g/l)	79.0 ± 12.07	84.50 ±12.07	0.3071
Albumin (g/l)	45.5 ± 5.57	44.73 ± 6.82	0.7773
Sodium (mmol/l)	135.0 ± 2.05	133.00 ± 2.23	0.0189*
Potassium (mmol/l)	3.5 ± 1.17	3.65 ± 0.33	0.5813
Chloride (mmol/l)	106.0 ±1.31	106.09 ± 1.34	0.8712
Bicarbonate (mmol/l)	26.5 ± 1.77	23.18 ± 3.59	0.0191*
Aniongap (mmol/l)	3.0 ± 1.31	3.91 ± 2.37	0.3150

*Significant P values of < 0.05

In table v above there no significant increased ($p > 0.05$) in the concentrations of Total protein, Albumin, Potassium, Chloride and anion gap in carpenters that do not smoke than those that smoke. There is a significant increased ($p < 0.05$) in the concentrations of Sodium and Bicarbonate in carpenters that smoke than those that do not smoke

DISCUSSION

The concentrations of total protein in this study were significantly increased in carpenters exposed to sawdust than in control as presented in table i. Proteins help in maintenance of osmotic pressure of blood and enzyme coagulation. Wood dust (sawdust) causes liver damage[19] and proteins are produced in the liver.[20]

The concentrations of albumin in carpenters exposed to saw dust in this study did not show any significant difference when compared to control as shown in table i, this is in agreement with previous studies conducted on saw dust.[21] A drop in albumin level is usually the result of decrease protein synthesis by the liver or increase protein loss through the gall or kidney.[22] This study documented an increase in total protein in carpenters expose to saw dust. This would account for the insignificant difference observed in Albumin concentration of carpenters when compared with control.

In this study, the concentration of potassium was significantly increased in carpenters exposed to sawdust than in control, ($P < 0.05$). Proper level of potassium is essential for normal cell function and regulation of heart

beat. Increased potassium level is due to insulin deficiency and could lead to severe renal failure, ketoacidosis and systemic lupus erythematosis.[12]

In this study, Anion gap was significantly decreased in carpenters exposed to saw dust when compared to control. Anion gap is a mathematical approximation of the difference between the cations and the anions routinely measured in serum. Decrease anion gap may be due to hypoalbuminemia while increased anion gap may indicate uremia, diabetic ketoacidosis, lactic acidosis, renal failure, exposure to salicylates and propylene glycol.

The concentration of chloride in this study was significantly increased in carpenters exposed to sawdust than in control ($p < 0.05$). Chloride aids the regulation of osmotic pressure in the body. Increased level of chloride is observed in congestive heart failure and decreased renal blood flow.[12]

The concentrations of bicarbonate in this study was significantly increased in carpenters exposed to saw dust when compared to control. Bicarbonate regulates the acid base balance in the body and when there is an increased or disturbance it causes acidosis and alkalinosis.12 This study shows that the concentration of sodium is significantly reduced in carpenters exposed to saw dust when compared to control (table 1). Reduction in sodium is due to dilution state. The most common causes of this decrease is salt-losing nephritis, gastrointestinal fluid loss, excessive sweating.[12]

Anova tables ii to iv shows that concentrations of Electrolytes (Sodium, Potassium, Bicarbonate, Chloride, Anion gap), Total protein and Albumin increased as the number of years of exposure to sawdust increased. To differentiate if there is statistical significance in the level of exposure to saw dust, analysis of variance for single factor experiment using F-distribution was carried out on concentrations of Electrolytes (Sodium, Potassium, Bicarbonate, Chloride, Anion gap), Total protein and Albumin. At 95% confidence level (0.05), the MSR (F) calculated for carpenters exposed between 1-5years,6-10years and 11-15years is greater than the MSR (F) tabulated. This implies that concentration of Electrolytes (Sodium, Potassium, Bicarbonate, Chloride, Anion gap), Total protein and Albumin differ significantly due to years of exposure to sawdust.

CONCLUSIONS

This study confirms that Electrolytes, Total protein and Albumin concentrations are affected by sawdust therefore carpenters are advised to wear protective mask and clothing during work with sawdust to avoid direct inhalation and body contact. Carpenters are also advised to stop the use of saw dust as floor covering in their carpentry shades to avoid foot exposure. Futher study is needed to determine the effect of saw dust on other biochemical parameter in the serum of carpenters.

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