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SHORT COMMUNICATION

ESTIMATION OF ZINC CONTENT IN HUMAN LUNG AND LIVER AUTOPSY TISSUE SAMPLES: A STUDY ON THE POPULATION OF AJMER (INDIA)

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ABSTRACT

Zinc (Zn) is an important element in human biological system. Human autopsy wet tissues (67) of lungs and liver, collected at random from Ajmer population of Rajasthan (India), were analyzed for Zn content. The samples were taken from non-putrefied dead bodies received at JLN Medical College (JLNMC), Ajmer. The samples from human undergone death due to burn injury or drowning were not considered. Seven demographic data for each case were collected from their medical status reports (post-mortem report) and from the pathological and anatomical reports available at the Forensic Medicine Department, JLNMC and also from the relatives of sampled human cases. Fresh autopsy tissues were digested in di-acid and analyzed by graphite furnace atomic absorption spectrometry. In lungs and liver, the average Zn content was 26.4 and 46.1 μg g^{-1}, respectively. The Zn content in lungs and liver samples varied from 11.59 to 97.51 and 26.63 to 114.29 μg g^{-1}, respectively. In females the mean Zn levels were higher than males in both lung and liver. Rural residents had higher mean Zn content than peri-urban and urban residents. In occupation environment sub-group exposed to polluted area had low mean Zn content than non-exposed cases.

Key words: Autopsy, demographic profile, human, liver, lung, zinc

INTRODUCTION

Zinc (Zn) is one of important trace elements present in nature and living forms. In human body it is a multi-purpose element playing crucial role in numerous biochemical pathways. Indian Council of Medical Research (ICMR) has recommended the dietary allowance of Zn intake of 5-9 mg in children of 1-12 years age and 10-12 mg Zn in adults (FAO, 2004). Deficiency or excess of Zn can moderate numerous metabolic processes which may adversely affect the human health (Prasad, 2013). Zn deficiency has been noticed in 17% of world population and in coming times half of the world population may be under the risk of Zn deficiency (Akhtar, 2013; Chasapis *et al.*, 2020). Plants are one of the major sources of Zn for humans; the cultivating soils too are becoming deficient in Zn, thus enhancing the probability of Zn deficiency in food chain (Singh *et al.*, 2009). Zn deficiency results in the impairment of some defined metabolic pathways and weakening of immunity (Rahil *et al.*, 2000). Variations in Zn content have been noted with respect to age, gender, genetics, body composition, habitat and dietary factors (Teresa *et al.*, 2009). The content of trace elements including Zn varies in human tissue, blood, hair, nails, etc., and also differs as per the health status of people. Strong correlations have been observed for trace element content in tissues with disease incidence, its severity and duration also. The variation may not show direct relationship for establishing cause and effect relations but can provide needful information to decipher the factors affected by trace element content per unit body mass (Robson, 2003). Living organisms are exposed to variable environments, so assessing autopsy samples compared to body fluids reflects the actual status of elements in the body. Differences do exist among human populations; hence random or specific assessment of human population for trace elements can provide a valuable information for correlating deficiency or toxicity symptoms happening dynamically in human body over time or location (Yoo *et al.*, 2002). Ajmer district has population residing in urban, rural and peri-urban areas. The elemental load of trace elements with respect to the occupational environment has been assessed in past on Ajmer population (Mehra *et al.*, 2004, 2010, 2016; Khan *et al.*, 2015, Kumari *et al*., 2018) but no studies are reported about the status of trace elements in autopsy tissues of Rajasthan population. In present study non-purified human dead bodies were selected at random for assessing the Zn levels in wet tissues of lungs and liver.

MATERIALS AND METHODS

The human autopsy tissue (wet) samples were randomly collected from the dead bodies, received by the Jawahar Lal Nehru Government Medical College (JLNGMC), Ajmer (India) from different area of Ajmer district during 2019-2020. Autopsies were performed by Forensic Medicine Department, JLNGMC in accordance with the principles of Declaration of Helsinki. Human body physical parameter like age, gender, body mass index (BMI) and demographic data on education level, habitat, social status and working environment were collected from the family. Standard procedures were followed for sample collection, handling and digestion of human tissues. The study was conducted after approval from the Ethical Committee of JLNGMC [vide No. 2370/Acad-III/MCA/2016 dated 18 Dec., 2018]. Fresh wet tissue mass of 2.0-2.5 g from specified organs (lung, liver) was kept in HNO_3 overnight, then digested in $HClO_4$ by heating method on hot plate until the solution became colourless. With the evaporation of $HClO_4$ white fumes digestion process was terminated. The solution was allowed to cool at room temperature before filter to make up the final volume with distilled water. The samples were analyzed using graphite furnace atomic absorption spectrometry (model AAS Z-Xpress 8000, Spectrum Instrument, Germany). The metal concentration in autopsy tissues was expressed in $\mu g\ g^{-1}$. Triplicate values for each sample were obtained. Student's t test at $P < 0.01$ level of significance was performed for statistical analysis. The mean, geometric mean and standard deviation were derived for each demographic group.

RESULTS AND DISCUSSION

In present study, the physical body and demographic data of 67 cases were collected. The range of age of these cases was 7-75 years and were sub-classed in 5 age groups. There were 19 female and 48 male cases. The body mass index (BMI) varied from 14.40 to 36.44 (only 8 cases were under-weight with BMI < 18.5). Ajmer region has rural, peri-urban and urban habitats. The 23 cases were from villages reflecting rural locality, 16 cases were from peri-urban regions of Ajmer city and small towns while 28 cases were from urban region of Ajmer city. The education level of cases was diverse; 12 were uneducated, 36 had primary education, 11 educated upto secondary level and 8 were under-graduate. The social status based on income was low and medium class only; 42 cases were of low-income group and 25 of medium income group. Based on the occupation of each case, secondary data for occupation environment was formed. The humans employed in rural region and unemployed cases were considered as non-exposed to polluted environment (50 cases) whereas, humans employed in peri-urban and urban region were considered to be exposed to polluted environment (17 cases) based on the nature of work.

Table 1: Arithmetic mean, geometric mean (GM), standard deviation (Sd-mean) and range of Zn content ($\mu g.g^{-1}$) present in lung and liver autopsy tissues (wet) from Ajmer

Demographic groups		N	Lungs				Liver			
Main group	Sub-group		AM	GM	Sd	Range	AM	GM	Sd	Range
Age (years)	< 19	05	24.34	24.09	4.1	20.77-31.25	45.77	45.00	9.3	34.21-55.45
	19-30	25	25.62	24.26	11.0	15.48-72.22	42.29	41.60	9.7	27.80-72.47
	31-40	23	25.72	24.44	8.0	11.59-42.60	47.85	44.75	20.5	26.63-114.29
	41-59	07	34.87	28.28	28.7	12.67-97.51	53.31	47.83	28.9	30.37-107.88
	> 59	07	24.42	24.01	4.9	17.84-32.34	46.28	45.47	8.9	31.67-56.23
Sex	Female	19	28.39	24.39	21.0	11.59-97.51	49.00	47.04	16.7	33.20-107.88
	Male	48	25.61	24.79	6.6	12.67-42.60	44.96	42.77	16.5	26.33-114.29
BMI	<18.5	08	26.65	25.84	6.9	15.48-38.79	36.31	36.22	2.6	31.25-39.65
	18.5-25.0	50	25.84	24.16	12.3	11.59-97.51	47.53	44.95	18.3	26.63-114.29
	>25.0	09	29.30	26.64	16.8	17.84-72.22	46.86	45.98	9.9	31.67-67.50
Habitat	Rural	23	32.86	29.97	18.0	14.73-97.51	54.97	51.01	23.7	33.20-114.29
	Peri-urban	16	22.48	21.82	5.4	11.59-31.25	42.89	42.19	7.8	26.63-54.75
	Urban	28	23.33	22.57	6.2	12.67-40.65	40.66	39.78	8.7	26.99-58.53
Education level	Uneducated	12	23.72	22.51	7.5	11.59-33.96	47.55	46.11	12.3	27.80-75.10
	Primary	36	28.42	26.03	15.5	14.47-97.51	48.20	45.13	20.5	26.63-114.29
	Secondary	11	22.85	22.62	3.6	19.35-31.25	43.68	43.33	5.8	34.21-54.75
	Under-graduate	08	26.22	25.10	8.2	15.48-40.65	37.82	36.97	9.0	26.99-56.23
Social status	Low	42	27.18	24.80	15.0	11.59-97.51	47.24	44.54	19.0	26.63-114.29
	Medium	25	25.09	24.47	5.8	16.53-40.65	44.20	42.95	11.4	26.99-75.10
Occupation environment	Exposed	17	23.81	23.34	4.5	12.67-31.72	41.49	40.53	8.8	26.63-58.53
	Non-exposed	50	27.28	25.15	13.7	11.59-97.51	47.67	45.16	18.0	26.99-114.29

N = Number of cases; AM = Arithmetic mean; GM = Geometric mean; Sd = Standard deviation

The analysis of Zn content in human tissues showed highly significant variation at 1% level of significance for both lung- and liver-tissue estimates on wet basis. In lungs, Zn levels ranged from 11.59 to 97.51 $\mu g\, g^{-1}$; whereas in liver tissues it ranged from 26.63 to 114.29 $\mu g\, g^{-1}$ (Table 1). Mean Zn content in lung tissues was 26.40 ± 1.92 $\mu g\, g^{-1}$ with geometric mean of 24.68 $\mu g\, g^{-1}$. Zn levels in Ajmer population seems to be in normal human range, demographic parameters showed highest mean value for Zn content as 29.97 $\mu g\, g^{-1}$ for rural residents followed by the age group 41-59 years (28.28 $\mu g\, g^{-1}$), the cases having body mass index > 25.0 cases had mean Zn levels of 26.64 $\mu g\, g^{-1}$. Lowest mean Zn content was found in peri-urban residents (21.82 $\mu g\, g^{-1}$). The mean Zn content in liver tissue was 46.10 ± 1.98 $\mu g\, g^{-1}$ with geometric mean of 43.94 $\mu g\, g^{-1}$. Demographic parameters of Ajmer cases depicted highest mean Zn value in rural residents (51.01 $\mu g\, g^{-1}$), followed by age group 41-59 years (47.83 $\mu g\, g^{-1}$), female sex (47.04 $\mu g\, g^{-1}$). Whereas, the lowest mean Zn content was recorded in cases having BMI < 18.5 (36.22 $\mu g\, g^{-1}$). Lower mean value was noticed in urban residents (39.78 $\mu g\, g^{-1}$) (Table 1). The mean levels were under the normal range but comparatively on lower side.

Bio-monitoring of the status of trace elements in human body and its effects on human has received attention in recent years. The reported normal limits are of 30 $\mu g\, g^{-1}$ Zn in human lung tissues. The Russian urban populations show Zn estimates up to 208 μg g^{-1} on dry weight basis (Zakas *et al.*, 2019), while in Korean population it ranged from 3.3- 22 μg g^{-1} (Yoo *et al.*, 2002). The normal limits of Zn in liver tissue are reported to be 93 μg g^{-1} (Caroli *et al.*, 1994). Report on Russian population cites revealed Zn estimates up to 272 μg g^{-1} (on dry weight basis) (Zakas *et al.*, 2019), in Norway population it ranged from 35.9-110.8 μg g^{-1} (Khazen *et al.*, 2002), whereas in Koreans it ranged from 9.7 to 91 μg g^{-1} (Yoo *et al.*, 2002). Zinc content has also been studied on human population of various countries like Germany (Bode *et al.*, 1988), Nigeria (Khazan *et al.*, 2002), Czech Republic (Benes *et al.*, 2000) and Norway (Khazan *et al.*, 2002) which suggests high variation for Zn levels in lung and liver tissues. These findings suggest that Zn levels are normal to low in Ajmer population. Demographic factors revealed variation with respect to age, gender and body mass index pre-dominantly. Place of residence or living environment classified as urban, peri-urban and rural also affected Zn content. Low levels of Zn in urban resident's shows that food habits and living environment of rural residents may be playing role in deciding Zn levels in humans.

Ethical statement:–The study was conducted after acquiring proper permission from the Ethical Committee of JLN Medical College, Ajmer, Rajasthan (India) vide No: 2370/Acad-III/MCA/2016 dated 18 December, 2018 for the conduct of research.

Conflict of interest: The authors declare that they have no conflict of interest.

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