

## Suspected Relationship between Pure Sodium and Bone Marrow Failures

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### Abstract

Despite better healthcare infrastructure, food quality and environment incidence of haematological cancer in developed countries like Canada and the United States is more prevalent than developing countries like India. Pure sodium table salt appears to be one of the major causes of bone marrow failures leading to haematological cancer. Natural salt contains a large number of trace elements most of which have been identified as essential for the body by FDA that help in maintaining electrolyte balances and DNA health. The study has been substantiated through observations of haematological cancer among urban and rural Indian populations.

**Keywords:** Bone Marrow Failure; Haematological Cancer; Himalayan Rock Salt; Table Salt; Trace Elements

### Introduction and Methodology

Prevalence statistics on acquired and inherited bone marrow failures in developed countries like Canada and the USA is appalling. Haematological cancer is the 4th most frequent cancer in Canada and every 25 minutes one case is detected and every 75 minutes one death is reported. In 2014, 110,000 cases were estimated with addition of 19,130 new cases of haematological cancer [1,2]. Prevalence of adolescent cancers in the USA and elsewhere is linked with obesity [3,4]. Incidentally, sodium is strongly related with obesity as well [5]. These are the places where 100 percent pure sodium table salt is consumed through the domestic and food processing industry. Of late, India also started experiencing incidence of paediatric bone marrow failure (BMF) over the entire urban geographical area extending to nearby urban villages. Haematological cancer in India ranks 9th among all the cancers [6] compared to Canada so far. It is worthwhile to mention that India undertook salt iodization programme in 1950 (circa) to contain goitre endemic in iodine deficient areas of central India and made mandatory consumption of iodised salt through State legislature in 1998 across the country irrespective of iodine deficiency [7]. Incidence of haematological cancer before the early 1970s was almost unknown in India. These observations suggest a close relationship of BMF with consumption of pure sodium table salt. With growing consumption of iodised sodium salt incidence of haematological cancer and many other types of cancers increased.

### Observations

A brief comparative chart on socio-economic lifestyle for Canada and India is presented at table 1 for assessment of reasons for incidence of haematological cancer.

### Interpretation of observations

Analysing above factors impacting lifestyles of respective populations, it is surprising that despite a better lifestyle and strict state controls over pollution, adulteration and misbranding in developed countries, incidence of BMF is astronomically high in Canada as compared to India as on date. In India, BMF disorders are almost in the preliminary stage or we can say on the first step of the prevalence ladder and being reported from major 4-5 metropolitan cities like Mumbai, Delhi, Kolkata, Chennai, and Bangalore. Steady increase in bone marrow transplants throws some light on the incidence trend. Between 1986 and 2007 an average 45 cases of bone marrow transplants were carried out each year at CMC Vellore [8] medical facility near Chennai, this number rose to 200 each year by 2015. According to the GLOBOCAN 2012 report of World Health Organization (WHO) International Agency for Research in Cancer, India has the third largest number of haematological cancers after the USA and China with 32,000 cases in 2012 and 26,000 non-Hodgkin's lymphoma and 16,000 deaths [8]. According to the National Cancer Registry Programme of the Indian Council of Medical Research (ICMR) more than 1300 die every day due to various

#	Canada	India
1.	Developed country almost for a Century.	Still a developing country in 21 <sup>st</sup> century.
2.	Per capita income in 2017: \$45,750  (almost 6.5 times higher than India)	Per capita income in 2017: \$7060
3.	Exposure to pesticides, insecticides, and other agriculture aides like fertilizers, auxins within permissible limits.	No effective control; thus products are highly laced with various agro-chemicals. Some of these are carcinogenic.
4.	Serious food adulteration with toxic materials like chemical dyes and non-edible substances is unheard.	Population is exposed to high levels of adulteration and toxic adulteration in food.
5.	Highly nutritional diet.	Majority of rural and semi-urban population is deprived of nutritional diet due to economic factors.
6.	Hygiene levels are very high.	Hygiene levels are very low especially in the countryside and poor segments of the society.
7.	Availability of narcotics restricted.	Availability of narcotics is easier.
8.	State-of-art medical facilities available to all.	Very poor coverage even for basic medical care.
9.	Consumption of natural sea and rock salt is almost negligible and rare.	Consumption of natural sea and rock salt despite state policy of iodized table salt is still high among socially weaker populace in the countryside.
10.	High level of incidence of haematological cancer. Number increased by 25% from 2014 to 2016.	Only a handful of cases were reported in the 1970s. Rapidly increasing at paediatric stage and new adults.

**Table 1:** Comparison of socio-economic status and BMF incidence.

types of cancers in India [6]. During 2012-14, the mortality rate due to all cancers increased by approximates 6%. In 2012, there were 478,180 deaths out of 1,934,314 cases reported while in 2018, mortality was 784,821 out of estimated living 2.25 million with addition of 1,157,294 new cases. A mathematical insight on body metabolism dynamics at cellular levels pinpoints towards consumption of refined pure sodium salt on the prevalence of non-communicable diseases [8]. Though in India, iodized pure sodium salt was introduced in 1962 as National Goitre Control Programme assisted by WHO and UNICEF, but it was enforced for all in 1998 through state legislature [6,10]. During this intervening period, the urban population adopted the refined iodized sodium salt whereas

rural population could not adopt it due to financial constraints being almost 5-6 times costlier than sea salt and this is clearly visible in the incidence of haematological cancer in urban and rural areas.

**Discussion**

Extensive work on BMF has been documented in the annals of medical science that includes damage to hematopoietic stem cells and their microenvironment, maturation defects due to vitamin B-12 or folate deficiency, and differentiation defects like myelodysplasia. Electrolyte composition governing cell microenvironment is one of the vital parameters for correct metabolism at cellular level and solely depends upon dietary profile. Salt is most consumed dietary item on a regular daily basis, so it is likely to have a dominant effect on dynamics of different cells.

India alone consumes \$0.35 billion worth of branded sodium per year amounting to about 3.8 million tons and growing 7-8 percent annually [10]. These branded salts contain more than 99.999 percent of sodium salt fortified with >15 ppm iodine along with anti-lumping agents those again contain sodium. Iodised table salt doesn't contain any other micro mineral or trace elements found in the unprocessed rock or sea salts. Natural salts contain micro minerals and 86 trace elements including 12 radioactive elements (MMTE) in case of Himalayan rock salt, table 2, and account for almost 14% by weight of the natural salt [11].

Manufacturing process of refined free flowing table salt completely removes MMTE components from the natural salt, and is substituted by sodium and sodium based anti-lumping agents. Daily intake of sodium salt bring in major changes in electrolyte composition leading to impairment of various fundamental cell processes such as Na-K pump, calcium pump, and a whole lot of thermodynamic and chemical equilibrium. Once the body's smart adaptive system recognizes electrolytic changes on an everyday basis, it tries to normalize the changed situation by internal adjustments that make the body metabolism dynamics topsy-turvy with unpredictable outcomes. So far the USA Food and Drug Administration could understand and identified 60 elements of the natural salt as essential nutrients [12]. In June 2016, the US National Research Council labelled 29 of these 60 micro and trace elements as "possibly" or "probably" essential and beneficial to human health. These include bromine, boron, chromium, calcium, copper, fluoride, iodine, iron, manganese, magnesium, molybdenum, potassium, phosphorus, selenium, silver, sulphur, and zinc. The 14 percent fraction of natural salt consisting of MMTE that contains these 29 identified essential elements is large enough to ignore and neglect. Supplementation of these essential elements is no substitute for natural occurrence in the unprocessed natural salt. Rest of the trace ele-

S. No.	Element	Atomic No.	Concentration	S. No.	Element	Atomic No.	Concentration
1.	Hydrogen	1	0.3 g/kg	45.	Indium	49	<0.001 ppm
2.	Lithium	3	0.4 g/kg	46.	Tin	50	<0.01 ppm
3.	Beryllium	4	<0.01 ppm	47.	Antimony	51	<0.01 ppm
4.	Boron	5	<0.001 ppm	48.	Tellurium	52	<0.001 ppm
5.	Carbon	6	<0.001 ppm	49.	Iodine	53	0.01 g/kg
6.	Nitrogen	7	<0.024 ppm	50.	Cesium	55	<0.001 ppm
7.	Oxygen	8	1.2 g/kg	51.	Barium	56	1.96 ppm
8.	Fluoride	9	<0.1 g/kg	52.	Lanthanum	57	<0.001 ppm
9.	Sodium	11	382.61 g/kg	53.	Cerium	58	<0.001 ppm
10.	Magnesium	12	0.16 g/kg	54.	Praseodymium	59	<0.001 ppm
11.	Aluminium	13	0.661 ppm	55.	Neodymium	60	<0.001 ppm
12.	Silicon	14	<0.1 g/kg	56.	Promethium*	61	Unstable
13.	Phosphorus	15	<0.1 ppm	57.	Samarium	62	<0.001 ppm
14.	Sulphur	16	1.24 g/kg	58.	Europium	63	<3.0 ppm
15.	Chloride	17	590.93 g/kg	59.	Gadolinium	64	<0.001 ppm
16.	Potassium	19	3.5 g/kg	60.	Terbium	65	<0.001 ppm
17.	Calcium	20	4.05 g/kg	61.	Dysprosium	66	<0.4 ppm
18.	Scandium	21	<0.0001 ppm	62.	Holmium	67	<0.001 ppm
19.	Titanium	22	<0.001 ppm	63.	Erbium	68	<0.001 ppm
20.	Vanadium	23	0.06 ppm	64.	Thulium	69	<0.001 ppm
21.	Chromium	24	0.05 ppm	65.	Ytterbium	70	<0.001 ppm
22.	Manganese	25	0.27 ppm	66.	Lutetium	71	<0.001 ppm
23.	Iron	26	38.9 ppm	67.	Hafnium	72	<0.001 ppm
24.	Cobalt	27	0.6 ppm	68.	Tantalum	73	1.1 ppm
25.	Nickel	28	0.13 ppm	69.	Wolfram	74	<0.001 ppm
26.	Copper	29	0.56 ppm	70.	Rhenium	75	<2.5 ppm
27.	Zinc	30	2.38 ppm	71.	Osmium	76	<0.001 ppm
28.	Gallium	31	<0.001 ppm	72.	Iridium	77	<2.0 ppm
29.	Germanium	32	<0.001 ppm	73.	Platinum	78	0.47 ppm
30.	Arsenic	33	<0.01 ppm	74.	Gold	79	<1.0 ppm
31.	Selenium	34	0.05 ppm	75.	Mercury	80	<0.03 ppm
32.	Bromine	35	2.1 ppm	76.	Thallium	81	0.06 ppm
33.	Rubidium	37	0.04 ppm	77.	Lead	82	0.01 ppm
34.	Strontium	38	0.014 g/kg	78.	Bismuth	83	<0.01 ppm
35.	Yttrium	39	<0.001 ppm	79.	Polonium*	84	<0.001 ppm
36.	Zirconium	40	<0.001 ppm	80.	Astatine*	85	<0.001 ppm
37.	Niobium	41	<0.001 ppm	81.	Francium*	87	<1.0 ppm
38.	Molybdenum	42	0.01 ppm	82.	Radium*	88	<0.001 ppm
39.	Technetium*	43	Unstable	83.	Actinium*	89	<0.001 ppm
40.	Ruthenium	44	<0.001 ppm	84.	Thorium*	90	<0.001 ppm
41.	Rhodium	45	<0.001 ppm	85.	Protactinium*	91	<0.001 ppm
42.	Palladium	46	<0.001 ppm	86.	Uranium*	92	<0.001 ppm
43.	Silver	47	0.031 ppm	87.	Neptunium*	93	<0.001 ppm
44.	Cadmium	48	<0.01 ppm	88.	Plutonium*	94	<0.001 ppm

Table 2: Spectral analysis of Himalayan rock salt.

\* Radioactive elements.

ments must have also played a much bigger role in human body evolution over millions of years but their contributions have not been understood completely.

### Conclusion

It is observed that prevalence of non-communicable diseases including haematological cancer in India spreads from metropolitan cities to smaller cities, villages adjacent to cities [9,10]. Very remote rural population which is economically poor still depend upon natural sea salt, being cheaper in cost compared to branded iodized salt and as a blessing in disguise they are almost untouched by the burden of non-communicable diseases including cancer or haematological cancer. With passing times, consumption of pure iodized sodium salt is increasing almost at a rate of 6 - 7 percent that almost matches growth in incidence of haematological cancer. It is, therefore, logically interpreted and inferred that sodium table salt without MMTE plays a key role in BMF on account of impairment of microenvironment of hematopoietic cells. Moreover, it is also felt that initially BMF is acquired on account of excess sodium consumption from refined manufactured table salt leading to impairment of DNA due to deprivation of magnesium and other MMTE, and then inheritance starts playing a bigger role in prevalence of haematological cancer. It is interesting to mention that almost all instances of haematological cancer reported are found to be from the population consuming synthetic iodized sodium table salt. It is also observed in this limited study that Indian adults in the present age group 30-50 years who have switched from natural salt to synthetic sodium salt remained unaffected compared to children who start their life with synthetic sodium salt and falling prey to bone marrow failure perhaps due to more susceptibility of BMF at the paediatric stage on account of exposure to imbalanced exposure to sodium right from the fetus state.

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### Conflict of Interest

None.

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