Nuclear Medicine: Cancer: Bone Scans:

Bone Scan Quantitative Parameters Significance for the Evaluation of Survival Rate in Prostate Cancer Patients

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Abstract:
This paper proposed a new approach for studying the function of the brain in the frame of the physics laws. In this paper, the concentration of elements in the body and their sources are introduced and discussed. The concentration of trace elements, Br, Fe, K, Rb, Na, Se, Zn, H, O, and C in the brain are listed. Data analysis of these trace elements are presented and discussed. This study suggests that future human brain researches should take into account the effect of the Cosmic Rays, Schumann Resonances Frequencies and the Earth's Magnetic Field.
Keywords: Trace Elements**,** Human Brain, Cosmic Rays, Schumann Resonances, Earth's Magnetic Field, Magnetism.

1. Introduction

The study of human brain structure, its components and the way it works in the medical community is of great interest in advanced research centers at the global level [1-3]. The importance of this subject lies in the fundamental questions posed by science, namely how the human brain works, which includes awareness, imagination, memory, Computational processes and diseases that are generated by brain dysfunction. Of course, there are no answers to these questions because the brain has a complex system.

Some studies have been directed towards the concept of nutrition and how the lack of certain nutrients in the brain may lead to some pathological features without explaining how these elements exist in the brain and how they are related to the nervous system [4-13]. Other studies have been directed towards determining the trace elements in the brain without explaining the mechanism functions of these trace elements in the brain [14-17].

This paper explores the cosmic effects on the human brain in frame of the physics laws, in the hope of knowing the physical properties that control the functioning of the brain.

2. Materials and Methods:

2.1 Elemental Concentration in the Human Body:

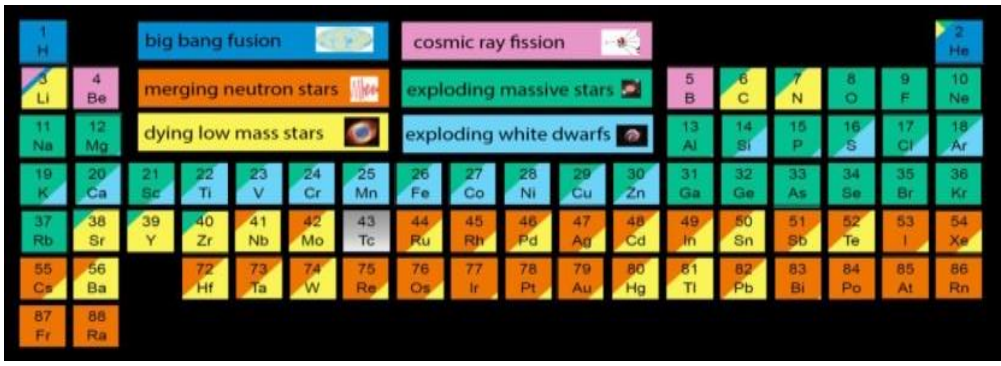
The total atomic composition in a human body weighing about 70-kg is estimated to be $7x10^{27}$ atoms. However, H, O, and C comprise 94.6% of its total atoms. On the other hand, H and O amount to 75% for the human body and the brain compositions. Detailed of elemental concentration in the human body is shown in table 1.

Table 1: Estimated number of atoms in the human body [18].

Z	# of atoms	Z	# of atoms	Z	# of atoms
H	4.22×10^{27}	Rb	2.2×10^{21}	Zr	2×10^{19}
O	1.61×10^{27}	Sr	2.2×10^{21}	Co	2×10^{19}
C	8.03×10^{26}	Br	2×10^{21}	Cs	7×10^{18}
N	3.9×10^{25}	Al	1×10^{21}	Hg	6×10^{18}
Ca	1.6×10^{25}	Cu	7×10^{20}	As	6×10^{18}
P	9.6×10^{24}	Pb	3×10^{20}	Cr	6×10^{18}
S	2.6×10^{24}	Cd	3×10^{20}	Mo	3×10^{18}
Na	2.5×10^{24}	B	2×10^{20}	Se	3×10^{18}
K	2.2×10^{24}	Mn	1×10^{20}	Be	3×10^{18}
Cl	1.6×10^{24}	Ni	1×10^{20}	V	8×10^{17}
Mg	4.7×10^{23}	Li	1×10^{20}	U	2×10^{17}
Si	3.9×10^{23}	Ba	8×10^{19}	Ra	8×10^{10}
F	8.3×10^{22}	I	5×10^{19}		
Fe	4.5×10^{22}	Sn	4×10^{19}		
Zn	2.1×10^{22}	Au	2×10^{19}		

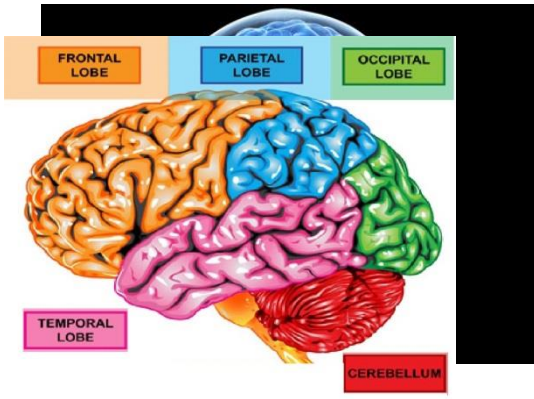
2.2 Sources of the Elemental Composition in the Human Body:

As shown in figure 1. that the most common element in the Universe is hydrogen. Hydrogen was produced by the Big Bang about 14 billion years ago. The rest of those atoms were formed by dying low mass stars, exploding massive, merging neutron stars, and exploding white dwarfs



billions of years after the formation of the Universe, in addition to a small fraction attributed to cosmic rays. It can be concluded that all elements in human body shown in table 1, were made in the interiors of collapsing stars and events outside the solar system. Figure1. shows the periodic table for all the elements according to their origin [19].

Figure 1: Elements and their sources.



2.3 Elemental Concentration in the Brain

Trace elemental concentrations measurements in 31 human brain samples were carried out by [20] using neutron activation analysis. These brain samples were selected for people with ages range, 51-95 years of both genders. Brains were removed during autopsy within 4–20 h after death. Brain samples were dissected from the regions of hippocampus, frontal, temporal, occipital, parietal, and cerebellum [20]. Figure2 shows the selected brain samples. Table 2, shows the results of brain analysis.

(a) **(b)**

Figure 2: (a) frontal, temporal, occipital, parietal, and cerebellum. **(b)** The hippocampus.

3. Results

Brain regions (*n*)*	Br	Fe	K	Na	Rb	Se	Zn
Hippocampus (31)	2.57 ± 1.16	199.7 ± 37.6	11,375 ± 1,644	7,506 ± 1,317	22.2 ± 5.2	0.553 ± 0.087	66.0 ± 7.6
Frontal (31)	3.08 ± 1.18	242.0 ± 35.2	12,225 ± 1,302	7,964 ± 1,685	21.2 ± 4.5	0.607 ± 0.107	59.6 ± 8.8
Temporal (18)	2.91 ± 0.80	242.1 ± 32.0	13,343 ± 1,598	8,199 ± 1,347	21.6 ± 4.1	0.628 ± 0.110	59.8 ± 7.8
Occipital (18)	2.57 ± 0.69	254.4 ± 37.4	12,365 ± 1,239	6,020 ± 1,014	21.1 ± 3.7	0.665 ± 0.084	55.9 ± 9.3
Parietal (18)	2.79 ± 1.01	235.6 ± 38.9	12,181 ± 1,022	6,410 ± 986	23.2 ± 5.0	0.61± 0.11	56.2 ± 8.2
Cerebellum (18)	3.36 ± 0.69	222.7 ± 91.4	15,873 ± 1,415	6,297 ± 1,085	24.5 ± 5.0	0.715 ± 0.100	64.4 ± 4.9
Overall value	2.88 ± 0.31	232.8 ± 19.2	12,894 ± 1,589	7,066 ± 938	22.4 ± 1.2	0.629 ± 0.056	60.9 ± 5.3

* *n* indicates number of samples analyzed

Table 2. Mean element concentrations in different regions of normal human brains. Results are given on dry basis in mg kg^{-1} [20].

4. Discussion and Conclusion

From data analysis, it can be seen from table2, that the total elemental mass in the brain is 1.192 Kg. Since the mass of the brain amounts from 1300-1400 grams, assuming the mass of the brain 1.4Kg and subtracting it from 1.192 Kg, leaves a mass difference of 0.21 Kg. This value must include H, C, and O concentration in the brain. Since the concentration of (H 60%, O 23%, C 11.4%) with respect to the human body (see table1), the same percentage can be used for the concentration of H, O, and C in the brain. Table3 shows the mass element and the number of atoms in the brain including H, O, and C elements.

Table 3: Calculated elemental mass and number of atoms in the Human brain

Element	**Mass of element in the brain (kg)**	**# of atoms in the brain**
Br	2.866×10^{-6}	2.16×10^{19}
Fe	2.31×10^{-4}	2.5×10^{21}
K	0.012	1.99×10^{23}
Na	7.06×10^{-3}	1.85×10^{23}

Rb	$2.12x10^{-5}$	$1.5x10^{20}$
Se	$1.17x10^{-7}$	$8.98x10^{17}$
Zn	$5.6x10^{-5}$	$5.6x10^{20}$
H	0.126	$7.58x10^{25}$
O	0.048	$1.80x10^{24}$
C	0.023	$5.01x10^{22}$

The vibrational frequencies (υ) of elements or molecules can be calculated from the equation:

$$\upsilon = \frac{1}{2\pi}\frac{\sqrt{K}}{m} \qquad (1)$$

Where k is the force constant and m is the mass or the reduced mass. Therefore, Schumann resonances frequencies (7.83, 14, 21, 26, 33, 39 Hz) can be applied in equation1, to determine the force constant and other parts of the brain which respond to such frequencies. Schumann resonances frequencies have been applied in a variety of research disciplines such as the developmental biological processes and the most favorable functioning of the human brain waves. The source of Schumann resonances frequencies are the cosmic rays. Cosmic rays generate lightning in the ionosphere. These lighting activities produce electromagnetic waves that make the earth resonate with specified frequencies, called Schumann resonances frequencies [21- 26].

For the whole of the Human brain with mass 1.4Kg using the main Schumann resonances frequency (7.83 Hz), the calculated force constant is 611.76 N/m. This force constant can be used to determine the other parts of the brain which respond to other Schumann resonances frequencies. Table4 shows the elemental masses in the brain which respond to Schumann resonance frequencies and the estimated elements (see table3).

Table 4: The estimated elements in the brain which respond to Schumann resonance frequencies.

Schumann resonances frequency	Mass (Kg)	Estimated element
14 Hz	0.079	H
21Hz	0.035	O
26Hz	0.023	C
33Hz	0.014	K
39Hz	0.011	Na

Appropriate combinations of these trace elements in the brain are shown in table5. It can be seen that such combinations consist of nonpolar covalent, polar covalent and ionic bonds due to difference in their electronegativity, but most of bonds are ionic. The vibrational frequency for these bonds was calculated, applying equation1 and assuming single bonds (see table5). Results of calculation show that the vibrational frequencies of these bonds lie in the far infrared band of the visible light. The source of the infrared bands are the solar system (the Sun) and cosmic ray (outer the solar system). Infrared bands are responsible for cell growth and metabolic process in the brain and body.

Table 5: Calculated vibrational frequencies of trace element bond combinations

Z	υ (Hz) x10^{13}	Z	υ (Hz) x10^{13}	Z	υ(Hz) x10^{13}	Z	υ(Hz) x10^{13}
H-C	11.6	H-O	8.98	Zn-Rb	1.43	Fe-O	2.48
H-K	9.10	Br–Br	1.38	Fe-C	2.70	Fe-Se	1.52
H-Rb	8.76	Se-Se	1.39	Fe-K	1.82	H-Na	8.90
H-H	12.3	H–Se	8.79	K-O	2.59	Fe-H	8.81
Br-Na	2.06	Se-O	2.40	C–Br	2.79	Se-K	1.70
Br-Rb	1.36	Se-C	2.70	Br–H	1.79	Se-Br	1.38
Fe-Rb	1.50	Rb-Na	2.63	K-C	2.88	Se-Na	2.07
Rb-Rb	1.33	Fe-Na	2.16	Br-K	1.70	Rb-C	2.69
Na-Na	2.50	Na-Rb	2.05	Zn-Na	2.12	Rb-K	1.68
Zn-C	2.70	Zn-O	2.43	Rb-O	2.38	Na-O	2.85
Zn-K	1.76	Zn-Se	1.46	Na-C	3.11	Zn-H	8.81
K-K	9.97	Na-K	2.29				

4.1 The Magnetism of the brain:

It is of great interest to explore the magnetic property of the elemental compositions of the brain. More specifically, the effect of the magnetic fields on the Human brain. This allows to gain more knowledge about the mechanism by which the brain works. Since the human brain

contains an appreciable number of trace atoms (see table3), it is worth studying the effect of the earth's magnetic field on such atoms. These atoms have paramagnetic, ferromagnetic, and diamagnetic types. The earth's magnetic field is about $5x10^{-5}$ T [27-28]. In order for the earth's magnetic field to have interactions with these atoms, it is required that large number of atoms should be available; more than 10^6 atoms for each element and the magnetic interaction energy should exceed the thermal energy, kT. [29]. For ferromagnetic atoms like Fe with n unpaired electrons, the effective magnetic moment is given as [29]:

$$\mu_{eff} = \sqrt{n(n+2)}\ \mu_B \qquad (2)$$

Where μ_B is Bohr magneton. For a number **N** of ferromagnetic atoms, the collective magnetic moment **m** is given as:

$$\mathbf{m} = N.\ \mu_{eff} \qquad (3)$$

The interaction energy E of that moment with the earth's magnetic field (B_{earth}) is given as:

$$E = \mathbf{m}\ B_{earth} \qquad (4)$$

The degree of magnetic moment alignment is the ratio $\frac{E}{kT}$.

For Paramagnetic and diamagnetic atoms the magnetic moment is given as [29],

$$\mathbf{m} = \xi\ B_{earth} \qquad (5)$$

Where ξ is the magnetizability is given as,

$$\xi = \frac{\chi}{\rho\mu_0} \qquad (6)$$

Where χ is the magnetic susceptibility, and ρ_x for each element x with y number of atoms is given as,

$$\rho_x = \frac{N_A}{y} \qquad (7)$$

Results of calculations are shown in table6. As can be seen from table6, the ratio of interaction energy of elements magnetic moment with the earth's magnetic field is greatly exceeds the elemental thermal energy at room temperature. This implies that the magnetic moment alignments for all trace elements are the dominant process at room temperature. This also suggests that the earth's magnetic field may play a central role for the functions of the brain related to awareness, imagination, memory, Computational processes and diseases that are generated by brain dysfunction

Table 6: Shows the trace elements magnetic type and their ratios $\frac{E}{kT}$

Trace element Z	Magnetic Type	Mass Magnetic Susceptibility m3/Kg	Ratio $\frac{E}{kT}$
Br	Diamagnetic	-4.9×10^{-9}	10^{9}
Fe	Ferromagnetic	-	10^{15}
K	Paramagnetic	6.7×10^{-9}	10^{13}
Na	Paramagnetic	8.8×10^{-9}	10^{9}
Rb	Paramagnetic	2.6×10^{-9}	10^{5}
Se	Diamagnetic	-4×10^{-9}	10^{3}
Zn	Diamagnetic	-2.21×10^{-9}	10^{6}
H	Diamagnetic	-2.48×10^{-8}	10^{12}
O	Paramagnetic	1.335×10^{-6}	10^{12}
C	Diamagnetic	-6.2×10^{-9}	10^{8}

5. Conclusion:

Although the significance of physics in this study is still limitedly used in biophysics and medical fields, more researches are necessary to explore the links between the environment of the outer space and the function of the Human brain. These focus physics researches may provide a relevant knowledge about how the Human brain works and are candidate for new therapy strategies in biotechnology, medical fields and a new industry.

References:

[1] TARLTON, STOA Secretariat, STOA workshop, (2016), "UNDERSTANDING THE HUMAN BRAIN A new era of big neuroscience", European Parliament, Brussels Henry Spaak building, room 7C050

[2] Sultan Tarlaci, (2010), "A Historical View of the Relation Between Quantum Mechanics and the Brain: A Neuroquantologic Perspective", NeuroQuantology, Vol 8, Issue 2, Page 120-136

[3] Sultan Tarlacı and Massimo Pregnolato, (2015), "Quantum neurophysics: From non-living matter to quantum neurobiology and psychopathology, International Journal of Psychophysiology, http://dx.doi.org/10.1016/j.ijpsycho.2015.02.016

[4] Chantal Zevenbergen et. al. (2016), "Association of antiepileptic drug usage, trace elements and thyroid hormone status", European Journal of Endocrinology, 174, 425–432

[5] Sanjeev Kumar et. al., (2014), "Role of Trace Elements in Alzheimer's Disease", Open Access Library Journal, 1: e714

[6] Patil Smita B and Pawar SS, (2017), “Effect of fluoride ingestion on trace elements on brain and liver of Rat Rattus rattus (Wistar)”, Int. J. of Life Sciences, Special Issue, A8, 125-128
[7] John Beard, (2003),”Iron Deficiency Alters Brain Development and Functioning”, The Journal of Nutrition, 133: 1468S–1472S
[8] Herbert Levine, (2014], “Introduction to Physics in Cancer Research”, American Association for Cancer Research, 74(17), 4572- 4573
[9] Patrícia Sofia Rodrigues Ramos, (2012), “TRACE ELEMENTS IN HUMAN BRAIN: AGE-RELATED CHANGES IN DIFFERENT ANATOMICAL REGIONS AND CHANGES RELATED WITH NEURODEGENERATIVE PROCESSES”, Dissertation of the 2nd Cycle of Studies Leading to Master's Degree in Analytical, Clinical and Forensic Toxicology, University of Porto.
[10] Dr. C. P. Gupta, (2014), “Role of Iron (Fe) in Body”, IOSR Journal of Applied Chemistry, Volume 7, Issue 11, PP 38-46
[11] Michael J. Wenger, (2017), Effect of iron deficiency on simultaneous measures of behavior, brain activity, and energy expenditure in the performance of a cognitive task”, Nutritional Neuroscience, pp 1-11 http://dx.doi.org/10.1080/1028415X.2017.1360559
[12] Vijay Kumar et. al, (2016), Zinc Deficiency and Its Effect on the Brain: An Update”, International Journal of Molecular Genetics and Gene Therapy, Volume: 1.1, pp 1-07
[13] Kosagi S. et. al, (1999), “ Trace elements in Alzheimer’s disease brain: A new hypothesis”, Alzheimer’s Reports, Vol. 2, number 4, pp 241-246
[14] Mona Mohammed Musa Elradi, (2007), “Investigation of Selected Trace Elements in Sudanese Patients with Leukemia using NAA” Sudan Academy of Sciences (SAS), Atomic Energy Council
[15] Ammar Mubark Ebrahim, (2003), Study of Selected Trace Elements in Cancerous and Non-Cancerous Human Breast Tissues Using Neutron Activation Analysis”, University of Khartoum.
[16] R.F.B. Serpa et. al., (2006), “Elemental concentration analysis in brain structures from young, adult and old Wistar rats by total reflection X-ray fluorescence with synchrotron radiation”, Spectrochimica Acta Part B 61 1205–1209.
[17] JOSEPH L. KIRSCHVINK. et. al, (1992), “Magnetite biomineralization in the human brain”, Biophysics, Proc. Natl. Acad. Sci. USA, Vol. 89, pp. 7683-7687,
[18] Robert A. Freitas Jr., (1998), “Human Body Chemical Composition”., Nanomedicine., Foresight Institute., https://foresight.org/Nanomedicine/Ch03_1.php
[19]https://www.sciencealert.com/this-awesome-periodic-table-shows-the-origins-of-every-atom-in-your-body
[20] M. Saiki. et al., (2012) “Trace element concentration differences in regions of human brain by INAA”, J Radioanal Nucl Chem, Volume 296, Issue 1, pp 267–272. https://link.springer.com/article/10.1007/s10967-012-2055-9

[21] S. A. Hamouda. et al. (2017),” Schumann Resonances and Their Potential Applications: a Review Article”, Vestnik Mordovskogo universiteta, Mordovia University Bulletin; 4(27):476–489.
[22] European Geosciences Union 2005. Annales Geophysicae http://www.ann-geophys.net/23/2559/2005/angeo-23-2559-2005.pdf
[23] R. Chand1, M. Israil1, and J. Rai2, Ann. Geophys., 2009 http://www.ann-geophys.net/27/3497/2009/angeo-27-3497-2009.pdf
[24] https://www.heartmath.org/gci-commentaries/earths-atmosphere-schumann-resonance-and-the-ionosphere/
[25] Colin Price, ELF Electromagnetic Waves from Lightning: The Schumann Resonances http://www.mdpi.com/2073-4433/7/9/116/pdf
[26] Iona Miller & Richard Alan Miller, 2003, “Schumann Resonances & Human Physiology “Nexus Magazine, Vol. 10, No.3
[27] S. A. Hamouda. et. al., (2017), “STUDY OF PLANETARY MAGNETIC FIELDS”, International Journal of Research – Granthaalayah, Vol.5 (Iss.3), pp 29-44
[28] S. A. Hamouda, (2018), “Sunspots Production and Relation to Other Phenomena: A Review”, INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY, Vol.:9, Issue:4.
[29] Markus Meister., (2016), “Physical limits to magnetogenetics”, California Institute of Technology, Pasadena, CA 91125, United States. https://elifesciences.org/articles/17210
[30] S. A. Hamouda. et. al. (2017), “MAGNETIC BACTERIA AND THEIR POTENTIAL APPLICATIONS: A REVIEW ARTICLE”, Vestnik Mordovskogo universiteta, Mordovia University Bulletin; 1(27):108-122

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