Interdisciplinary Analysis of Earth's Geomagnetic Quantum Field: A Study on Human Physiology & Agronomy

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Running Title: Earth's Geomagnetic Quantum Field and Human Physiology

Abstract: ***This analytical thesis explores various intricacies and connections of the Earth's geomagnetic quantum field on edaphological soil science and human physiology. By conducting an extensive review of empirical studies and performing qualitative analyses with quantitative overtones, this thesis examined the influence of geomagnetic fluctuations on soil health, plant growth, and human physiological responses. Our research indicates that geomagnetic quantum fields are pivotal in maintaining ecological balance and promoting human well-being. These findings underscore the importance of further interdisciplinary research in this domain. This study not only enhances our understanding of the biological effects of geomagnetism but also outlines potential avenues for future research. By elucidating the interactions between the Earth's geomagnetic field, soil health, and human physiological processes, this paper contributes to a more comprehensive understanding of the role of geomagnetism in both ecological systems and human health.***

Keywords: Geomagnetic field, Quantum field, Agronomy, Edaphology, Human Physiology, Electromagnetic, Soil Health

1. Introduction

Costello and Gwilliam (2021) suggested that quantum field theory assigns a dynamic quantity, or field, to every point in space and moment in time. The magnetic field B(x) exemplifies this by assigning a direction to each point in three-dimensional space, requiring a dynamic variable for every location. The Earth's geomagnetic field (GMF), also known as the geomagnetic quantum field, originates from the planet's interior and extends through the crust into the upper atmosphere. This pervasive field influences various Earth ecosystems, including soil, land, water, and the atmosphere. Because living organisms are partially regulated by and responsive to electromagnetic and magnetic frequencies, the geomagnetic field significantly impacts biological processes and health. Magnetic fields are measurable using magnetometers, which are hypersensitive instruments capable of detecting, qualifying, and quantifying the strength and direction of geomagnetic or external magnetic fields at specific locations. However, understanding geomagnetism is inherently complex and interdisciplinary, requiring expertise in electromagnetism, fluid dynamics, and planetary physics.

This thesis reviews empirical literature on the impact of the Earth's GMF on edaphology and human physiology. It begins with an overview of the geomagnetic field and then explores its relationships with soil and plant health, as well as its effects on human physiological processes and health.

Overview of the Earth's Geomagnetic Field

The Earth's GMF is believed to be primarily generated by the movement of molten iron and nickel within its outer core. Ampere's circuit law, also known as Ampere's law, describes the relationship between magnetic fields and electric currents or changing electric fields. This relationship is expressed mathematically as $B = \mu_0(I/C)$, where μ_0 is the permeability of free space. However, the Earth's magnetic field strength is typically measured in terms of magnetic field intensity (H), which relates to the magnetic flux density (B) through the equation $B = \mu_0(H + M)$, where M represents the magnetization of the Earth's core material.

This geomagnetic field significantly influences various natural processes, such as the mineral composition of soils. The magnetic properties of different soils and regions, the availability of nutrients, microbial activity, and plant responses like germination and growth are all affected by geomagnetic forces. Additionally, animal behavior, hormonal regulation, immune and neurological functions, and electrochemical processes in both soil and organisms are influenced by these magnetic fields (Dubrov, 2013; Okano & Ueno, 2022; Tema et al., 2020; Tong & Kong, 2021). The geomagnetic field's presence is evident in everyday tools like navigation compasses, which align with Earth's magnetic poles. In closed magnetic systems, the Biot-Savart law explains the magnetic field produced by a steady current in a wire. According to this law, the magnetic field (dB) at a point due to an infinitesimal current element (dI) of length (dl) is proportional to the product of dI, dl, and the sine of the angle between dl and the position vector (r) from the current element to the point.

The mathematical expression for the magnetic field generated by a current element is given by the Biot-Savart law: $dB = (\mu_0/4\pi) * (dI * dl \times r)/r^3$, where μ_0 represents the permeability of free space. The widely accepted theory posits that the Earth's GMF arises from the movement and interaction of molten iron and nickel in the core. This dynamic movement, combined with the Earth's rotation, generates electric currents that produce the geomagnetic field through a process known as the geodynamo (Dubrov, 2013; Okano & Ueno, 2022). The geomagnetic field is composed of three main components: the

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primary dipole field, secular variation, and the non-dipole anomaly field. The primary dipole field is the most dominant and stable component. Secular variation refers to changes in the geomagnetic field's direction and strength over time. The non-dipole component represents deviations from the primary dipole field (Dubrov, 2013).

The geomagnetic field also creates the Earth's magnetic poles, which align vertically through the points where the Earth's rotation axes intersect the surface. These magnetic poles, generally aligning with the geographic poles, are dynamic and can shift over time owing to changes within the Earth's core. Geological records show that the Earth's magnetic field has undergone north-south reversals throughout history (Dubrov, 2013).

Extending through the atmosphere and into space, the geomagnetic field forms the magnetosphere, which interacts with the sun's charged solar wind particles. This interaction creates a protective shield that deflects most solar wind particles, safeguarding biological processes on Earth (Tema et al., 2020; Tong & Kong, 2021). The magnetosphere's protective function is one of the many ways in which the Earth's GMF influences biological processes and supports ecological systems, creating an environment conducive to life on Earth.

Solar activity, such as coronal mass ejections and solar flares, can significantly disturb the Earth's magnetosphere, altering the strength and configuration of the geomagnetic field on the planet's surface (Dubrov, 2013; Okano & Ueno, 2022; Tema et al., 2020; Tong & Kong, 2021). Understanding the impact of geomagnetic fields on biological processes and soil health requires a holistic perspective on the interactions between the magnetic and electric components of the sun, atmosphere, and Earth as interconnected systems.

The existence and influence of the geomagnetic field can be observed using a navigation compass, and many animal species are thought to rely on magnetic sensitivity for seasonal migration and navigation (Tong & Kong, 2021). Some research also suggests that humans might have an inherent, albeit subconscious, sensitivity to changes in the Earth's GMF (Karim & Sc, 2016; Karim, 2010). Extensive studies have documented the myriad ways in which the geomagnetic field affects living systems, from cellular processes to soil nutrient composition, impacting natural processes, neurological activity, and broader aspects of individual and ecological health (Okano & Ueno, 2022; Tema et al., 2020; Tong & Kong, 2021). Okano and Ueno (2022) described the Earth's magnetic field as "indispensable for the origin and evolution of life" (p. 215), highlighting correlations between measurable geomagnetic storms and disruptions in biological processes and human health (Cowan, 2016; Erdmann et al., 2021). Erdmann et al. (2021) emphasized the importance of geomagnetic fields in stabilizing environmental conditions. Karim (2010) and Karim and Sc (2016) discussed the potential subtle qualitative effects of geomagnetic and electromagnetic frequencies on all aspects of biological health and developmental processes. Similarly, Cowan (2016) proposed that the Earth's geomagnetic and electromagnetic fields play crucial roles in regulating and supporting cardiovascular health. Dubrov (2013) provided empirical evidence showing the interactions between changes in the geomagnetic field and biological processes in humans, including biological regulation and neurological and cognitive functions. These speculations and supporting evidence are explored in greater depth in the following sections.

Relationship Between Geomagnetic Field and Edaphology

Edaphology, the study of soil composition and health in relation to plant growth, is a fundamental aspect of ecological, environmental, and human health. This section explores how geomagnetic fields influence edaphology, shedding light on various interactions between the Earth's GMF and soil properties. The Earth's GMF impacts soil magnetism, magnetic susceptibility of minerals and nutrients, water movement through soils, microbial activity, and electric induction—all of which play crucial roles in plant growth and development (Hart, 2023). For example, certain minerals, like magnetite, respond more strongly to magnetic fields, influencing the overall magnetism of the soil and its interactions with the environment (Mullenax et al., 2021).

Furthermore, changes in soil's magnetic properties can affect water interaction with soil particles, influencing nutrient transport and plant hydration. Many biological processes rely on specific electromagnetic properties and charge interactions of water, underscoring the importance of these geomagnetic influences (Cowan, 2016). The following sections will delve into the geomagnetic field's relationship with soil health and plant health. Though these topics are complex and interconnected, they are presented separately here for clarity and organization.

Geomagnetic Field and Soil Health and Composition

Research suggests that the Earth's GMF significantly influences soil health and composition, primarily through interactions with soil magnetism and mineral content. Different minerals in the soil, such as magnetite and nickel, are particularly responsive to magnetic fields, which affects the overall magnetism of the soil and its behavior (Vigani et al., 2021). The degree of soil magnetism can impact water and nutrient movement, influencing their distribution and availability for plant uptake (Mullenax et al., 2021).

The magnetic properties of soil affect water retention, filtration, and drainage, thereby determining water availability for plants. For instance, stagnant water, which has distinct electrical and compositional properties, differs from water that is frequently filtered through soil. This affects microbial content and the suitability of water for various plant species (Mullenax et al., 2021). Structured water, characterized by its movement through a vortex pattern and positively charged structure, is more beneficial for neurological transmissions and metabolic processes in cells (Cowan, 2016). Therefore, soils with magnetic properties that facilitate water drainage may better support plant growth.

Furthermore, water that moves or drains frequently becomes more oxygenated, leading to a different microbial composition in the soil. Aerobic microbes thrive in well-drained soils with frequent water movement, whereas dense, poorly drained soils tend to support anaerobic microbes (Dubrov, 2013). These variations in microbial composition and activity result in diverse symbiotic relationships and vegetation types, highlighting the intricate connection between soil magnetism and plant health (Dubrov, 2013). Dubrov (2013) highlighted the potential of the Earth's GMF to influence electromagnetic induction and currents within soils, impacting electrochemical processes such as redox reactions, ion exchanges, and nutrient availability. While these processes are often discussed individually, they interact in a complex, dynamic web with significant implications for soil health.

Electromagnetic changes can also affect soil pH levels. Mullenax et al. (2021) observed significant correlations between annual increases in soil acidity and corresponding decreases in geomagnetic field strength during the summer months. Data from the late 1900s across sites in South America, Australia, and North America indicated that reduced geomagnetic field strength between June and August was associated with increased soil acidity.

Lower soil pH values, corresponding to decreased geomagnetic strength, are linked to reduced nutrient availability for plants, lower foliar mineral content, deteriorated plant health, and decreased fertility among animals in the affected areas. Conversely, higher pH levels correlate with improved soil nutrient availability and better health indicators for plants and herbivores (Mullenax et al., 2021). This relationship highlights the importance of understanding geomagnetic influences on soil chemistry and ecosystem health.

Regarding the influence of GMF on plant nutrient uptake, Vigani et al. (2021) investigated how environmental factors, such as changes in GMF, affect sulfur and iron uptake in Arabidopsis plants. Their study focused on the expression of genes related to sulfur and iron metabolism. The researchers discovered that variations in the GMF significantly influenced metal concentrations in plants, particularly copper, and enhanced the expression of genes responsible for the uptake of iron and sulfur. These findings indicate that shifts in the Earth's GMF can alter the heavy metal balance within plants, affecting their ability to uptake essential minerals and nutrients, which in turn impacts their growth (Vigani et al., 2021).

Islam et al. (2020) explored how GMF modulates nutrient status and lipid metabolism in Arabidopsis thaliana. The researchers manually manipulated the localized magnetic fields around the plants, simulating low and high magnetic field conditions, and observed the plants from early seedlings to mature stages. The study found that changes in the GMF were perceived by the plants as a form of environmental stress. Specifically, lower magnetic fields were associated with reduced lipid composition and altered gene expression related to lipid metabolism. These findings suggest that geomagnetic changes can significantly impact plant growth and metabolic processes, demonstrating the complex relationship between GMF and plant physiology (Islam et al., 2020).

Several researchers have studied the effects of changes in GMF on the growth and development of Arabidopsis thaliana. Narayana et al. (2018) investigated the influence of a low GMF, approximately 40 times weaker than the Earth's normal GMF, on the roots of A. thaliana. They examined changes in gene expression and various nutrient levels, including magnesium, sulfate, chloride, potassium, calcium, ammonium, and nitrate. Within minutes of exposure to the simulated weak GMF, the plants exhibited significant changes in nutrient levels and gene activity responsible for nutrient uptake, indicating a stress response similar to the findings of Islam et al. (2020). Narayana et al. (2018) concluded that these findings have important implications for plant growth in potential future biologically simulated space environments.

Ercan et al. (2022) found that positive changes in plant health and soil composition were associated with increases in GMF activity. While increases in simulated GMF activity were linked to cellular injuries and reduced macro-element content in plants, they also improved micro-element content, germination rates, and photosynthetic processes. Additionally, the magnetic character of plant roots shifted from diamagnetic to superparamagnetic at a GMF strength of 250 mT, which is significantly stronger than the Earth's average GMF of approximately 25 to 65 μT (Ercan et al., 2022). These findings suggest that while significant increases in GMF strength can positively impact plant growth, they may also have detrimental effects.

Recognizing the substantial influence of the Earth's GMF on soil characteristics, nutrient uptake, and plant growth underscores the importance of further exploring the interactions between GMF and plant health. This leads to a more in-depth discussion of how the Earth's GMF affects plant development and overall ecosystem health.

Geomagnetic Field and Plant Growth and Health

Research indicates that plant growth and health are influenced by changes in GMF through various factors, including soil magnetism, nutrient composition, and uptake. Additionally, GMF affects the orientation of roots and germination shoots (Maffei, 2014). This phenomenon can be likened to how certain blooms, such as sunflowers, follow the sun throughout the day. Similarly, some plants exhibit magnetoreception, responding to changes in GMF; however, the specific mechanisms behind this are not yet fully understood (Driessen et al., 2020).

Studies suggest that GMF changes can impact seed germination and growth. Variations in exposure to external magnetic fields, whether through increased exposure or shielding, are associated with alterations in seedling shoot growth, cotyledon orientation, root direction, and other developmental aspects (Bellino et al., 2023; Maffei, 2014; Parmagnani et al., 2023). Plant roots, sensitive to GMF changes, may align accordingly, affecting their ability to absorb nutrients and water from the soil, which is crucial for overall plant health (Bellino et al., 2023; Maffei, 2014). Controlled studies have also shown that the timing of flowering and reproductive cycles in certain plant species can be influenced by GMF variations (Maffei, 2014). Additionally, plant stress responses, including the production of various chemical compounds and changes in gene expression, may be affected by GMF changes (Bellino et al., 2023). Therefore, further research is needed to fully understand these interactions.

A recent study examined the effects of weak magnetic fields (75 Hz and 1.5 mT) on the cellular chemical composition and growth behavior of parsley, basil, tomatoes, and lettuce (Bellino et al., 2023). The findings revealed significant changes in the chemical compounds of all studied plant varieties. While some beneficial compounds increased, levels of harmful compounds also rose. Additionally, the altered magnetic field exposure reduced the decomposition rate of plant litter, suggesting that weak magnetic fields could potentially enhance soil carbon storage capacity, thereby reducing carbon dioxide emissions (Bellino et al., 2023). However, the research presents mixed results regarding the benefits and drawbacks of varying magnetic field strengths on plant health and growth. Therefore, the Earth's GMF plays a critical role in maintaining plant health and edaphology. Moreover, soil and crop scientists need to consider multiple factors when artificially altering crop exposure to different magnetic frequencies, as well as the impact of natural geomagnetic frequency changes on soil and crop health.

Researchers have concluded that plants, having evolved alongside the Earth's magnetic field, perceive changes in geomagnetic intensity as abiotic stress, which alters their developmental processes. Similar to Bellino et al. (2023), Parmagnani et al. (2023) investigated the effects of near-null GMF exposure on Lima bean photosynthesis, focusing on aspects such as stomatal density, chloroplast ultrastructure, and carbon and protein content. These studies found significant alterations in all these aspects due to exposure to extremely low magnetic frequencies. The researchers concluded that stable natural levels of GMF are essential for efficient photosynthesis in Lima beans and likely other plant species (Parmagnani et al., 2023).

Despite the limited empirical understanding of plant sensitivity to GMF compared to their sensitivity to light, electrical currents, or other environmental conditions, Maffei (2014) highlighted that plants respond to GMF similarly to how they respond to light waves, gravity, electric signals, and tactile touch. These responses are described by terms such as phototropism, thigmotropism, and gravitropism.

The earth's GMF strength varies geographically from 30 μT to nearly 70 μT. Maffei (2014) explains that different plant species, with their unique sensitivities and biological requirements, have evolved in these varying magnetic environments. When a plant species adapted to a specific geographic region is relocated from its natural environment, it can experience significant developmental changes. Therefore, introducing stronger magnetic fields could potentially stimulate plant growth in a non-toxic manner (Teixeira da Silva & Dobranszki, 2015). Hafeez et al. (2022) proposed using artificial magnetic frequency alteration and exposure as a sustainable agricultural practice. This method does not produce harmful radiation, waste products, or require external power sources. While such research shows promise for improving agricultural production, it also emphasizes the need to consider the impacts of electromagnetic field (EMF) radiation on the Earth's natural GMF (Karim & Sc, 2016). Investigating ways to maintain the Earth's natural GMF strength, rather than altering it, is crucial for the holistic benefit of ecological health.

The influence of GMF on soil and plant health is closely tied to human health and physiology. As humans and other animals consume vegetation grown in these soils, it is crucial to understand the interconnectedness of edaphology and human well-being (Cowan, 2016). Recent research has predominantly highlighted the negative effects of soil on human health, such as exposure to toxins and pathogens, and the consequences of nutrient-deficient soils due to modern agricultural practices like synthetic fertilizers and monocropping. Brevik et al. (2020) argued for a broader perspective that acknowledges the vital role of healthy soils in supporting physiological health in animals and humans. For instance, soils that are rich in nutrients and microbial diversity—enhanced by natural activities of mycelium and earthworms—can significantly boost human immune health (Brevik et al., 2020). They described soil as an "ecosystem with a myriad of interconnected parts" (p. 117). Consequently, the impact of the Earth's GMF on soil health must be viewed in relation to its broader implications for human physiology, both directly and indirectly through plant health.

The following section will explore the intricate relationship between GMF and human physiology, highlighting how these natural forces influence our health and well-being.

Relationship Between Geomagnetic Field and Human Physiology

The precise mechanisms by which the Earth's GMF influences human physiological health remain underexplored. However, existing research highlights the significant impacts of GMF on various aspects of human health. These impacts manifest both indirectly, through GMF's effect on soil and plant health and, consequently, on crop health and nutrient density, and directly, through observed changes in human physiological processes due to fluctuations in magnetic fields (Brevik et al., 2020; Hafeez et al., 2022; Hart, 2023; Karim, 2010). Historically, it was believed that human magnetoreception was less developed compared to other animal species (Hart, 2023). However, research from the early 2000s suggest that humans may possess a more refined sense of magnetoreception than previously thought (Karim, 2010; Karim & Sc, 2016). Significant changes in human metabolism, circadian rhythms, sleep patterns, mental health, neurological and cognitive functions, cellular metabolic processes, and cardiovascular health have been correlated with variations in magnetic field exposure (Chai et al., 2023; Cowan, 2016; Hart, 2023; Karim, 2010; Karim & Sc, 2016).

The following subsections will delve deeper into this topic, beginning with a synthesis of empirical research on the relationship between GMF and human physiological processes, and concluding with a discussion on how GMF impacts overall human health.

Relationship Between Geomagnetic Field and Physiological Processes

Studies have indicated that variations in GMF strength can significantly influence physiological processes in both animals and humans. These changes most notably affect behavior, neurological function, circadian rhythms, and cardiovascular health (Hart, 2023). For instance, many migratory species rely on the Earth's magnetic field for navigation during their seasonal migrations (Hart, 2023). Additionally, GMF changes are known to impact various metabolic and cellular processes that interact with endocrine functions. This includes influences on melatonin production and neurotransmitter activity, which regulate sleep patterns, memory, and cognitive functions (Mavromichalaki et al., 2021). While the exact mechanisms behind these interactions are not fully understood, they might explain why some individuals experience symptoms like poor focus, sleep disturbances, or brain fog during geomagnetic storms, solar flares, or other disruptions in the Earth's magnetic and electrical fields.

Studies have also highlighted GMF's strong influence on cardiovascular health. Changes in GMF exposure have been correlated with variations in heart rate, blood pressure, and other cardiovascular health indicators (Chai et al., 2023; Cowan, 2016). Alterations in electromagnetic induction due to GMF changes are believed to affect physiological processes such as nerve conduction, iron transport, and other cellular metabolic activities (Karim, 2010; Karim & Sc, 2016).

Moreover, ongoing studies suggest that geomagnetic activity may significantly affect hormone regulation, including cortisol and melatonin production, thereby influencing sleep patterns, emotional regulation, and stress responses in humans and other animals (Mavromichalaki et al., 2021). The effects of geomagnetic activity on human physiological processes are intricate, multifaceted, and span multiple disciplines. A recent study by researchers from the University of Athens, in collaboration with international partners, explored the relationship between meteorological changes, including GMF variations, and human health indicators (Mavromichalaki et al., 2021). The researchers focused particularly on cardiovascular health indicators, examining how they correlate with changes in geomagnetic activity and cosmic ray intensity across different locations, time periods, and populations. They found that high cosmic ray intensity and increased geomagnetic activity were significantly associated with peak values of certain human physiological markers, some of which increased while others decreased. Notably, there was a positive correlation between geomagnetic and solar activity changes and instances of arrhythmia. These findings suggest that stable GMF activity is associated with optimal cardiovascular function, whereas sudden or extreme variations in GMF can lead to maladaptive cardiovascular responses (Mavromichalaki et al., 2021).

Cowan (2016) proposed a theoretical framework to explain the physiological mechanisms behind these cardiovascular changes. Cowan emphasized the importance of structured water in facilitating blood circulation and maintaining optimal physiological health. Instead of focusing solely on the heart's muscular pumping action, Cowan highlighted the role of polarized charges in blood flow. Blood, primarily composed of water, circulates more effectively when it contains structured, oxygenated water. This structured water features an outer layer of positively charged particles that interact with the interior surfaces of veins and vessels, promoting smoother blood flow and enhanced circulation. This research highlights the need for a comprehensive understanding of these relationships to inform health and medical practices.

This positive charge contrasts with the surrounding negative charge of veins and vessels, which is reinforced by regular contact with the Earth's natural negative ionic charge (Cowan, 2016). This theory may explain the benefits of practices such as earthing or grounding, which have been associated with reduced inflammatory markers and improved cardiometabolic health (Sinatra et al., 2023). These benefits arise from the body's contact with the Earth's natural geomagnetic frequencies and the resulting electrical charges in conductive materials like soil, rock, and vegetation (Sinatra et al., 2023). The Earth's negative ionic charge is maintained by its geomagnetic and electromagnetic homeostasis. This balance can be disrupted by solar flares, which introduce positively charged solar particles that breach the protective geomagnetic shield, altering the Earth's surface charges. Additionally, the rapid increase in electromagnetic radiation from modern technology is speculated to disrupt the Earth's natural GMFs, potentially weakening them and affecting human physiological processes (Karim, 2010; Karim & Sc, 2016).

A recent study examined the effects of a hypomagnetic environment on eight men aged 26 to 44. Participants exhibited physiological stress responses, including activation of lipolysis and glycolysis processes that affected the body's pH balance, the hepatobiliary system, and endothelial function (Markin et al., 2023). These changes led to increased fatigue among the participants, despite their reporting minimal subjective changes in health or energy levels (Markin et al., 2023). These findings provide objective evidence of the connection between the Earth's geomagnetic activity and human physiological processes. Optimal human physiological function appears to depend on stable geomagnetic activity levels, with deviations potentially inducing stress responses in the body.

Hart (2024) explored the relationship between geomagnetic activity and physiological processes, emphasizing the role of key compounds used in cellular functions. Hart noted that many physiological processes and proteins utilize iron ions, which possess significant magnetic properties. The magnetization of these iron ions by the Earth's GMF not only affects human physiological processes but also contributes to the magnetic field generated by humans, which interacts with external electromagnetic fields. By recognizing the interplay between the GMFs of living organisms and Earth, the impact of space weather events, such as solar flares, on biological systems has become increasingly clear (Janashia et al., 2020). While the human body can adapt to minor fluctuations in GMF, significant changes can induce stress responses in the autonomic nervous system, such as variations in heart rate (Janashia et al., 2020). Hanzelka et al. (2021) found that adverse changes in solar activity significantly disrupted subjects' skin conductance, electromyography readings, and diaphragmatic breathing and ventilation. These findings support the idea that geomagnetic interactions are crucial for regulating physiological processes and maintaining homeostasis. Practices such as grounding, which involve direct contact with the Earth, help maintain these interactions by stabilizing the Earth's GMF. These observations highlight

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the need for further research to fully understand these complex relationships.

Relationship Between Geomagnetic Field and Human Health

Research has highlighted the significant impact of the Earth's GMF on various aspects of human health and physiological processes, including sleep patterns, circadian rhythms, mental health, neurological and cognitive functions, endocrine and immune systems, and cardiovascular health. Although the specific physiological mechanisms behind these effects remain unclear, this section explores the health implications associated with the Earth's GMF.

Alterations in the Earth's GMF can contribute to sleep disturbances and irregularities, as geomagnetic frequencies are known to influence the physiological processes that regulate circadian rhythms and melatonin production (Martel et al., 2023). Sleep is crucial for maintaining thermodynamic homeostasis, hormone regulation, neurological cognition, anti-inflammatory processes, metabolic functions, and emotional well-being. Therefore, disturbances in geomagnetic activity can decrease sleep quality, which in turn can negatively affect overall health. Symptoms of decreased health quality due to sleep disturbances include increased anxiety, depression, mood disorders, and fatigue (Martel et al., 2023). Changes in geomagnetic activity also influence cardiovascular processes. GMF stabilization is linked to optimized cardiovascular health, reducing the risk of stroke, heart attack, and other cardiovascular diseases (Chai et al., 2023; Cowan, 2016). This underscores the importance of maintaining stable geomagnetic conditions for promoting overall health and well-being.

While EMF is a distinct frequency component of the Earth's ecology compared to GMF, the two interact in ways that significantly impact human health. For example, changes in the Earth's GMF can generate electric currents in the Earth's crust, influencing physiological processes such as metabolism, cell transport and function, and circadian rhythms (Sinatra et al., 2023). Subtle electric currents in the Earth's crust, like the Schumann resonance, typically hold a more negative ionic charge than the exterior charge of structured water in the human body. These currents play a crucial role in regulating cardiovascular health and minimizing inflammatory responses, even though they have historically been under-recognized (Cowan, 2016; Sinatra et al., 2023). Furthermore, electromagnetic currents are believed to affect the human body by influencing endocrine function and hormone regulation, thereby impacting immune health through alterations in cortisol levels and other stress response markers (Tong & Kong, 2021).

Evidence suggests that natural geopathic stressors, such as geomagnetic anomalies, geological faults, underground waterways, and radon gas, disrupt the Earth's natural GMF, creating geopathic stress zones that negatively affect human health (Tong & Kong, 2021). Karim (2010) discussed these geopathic stressors within the framework of subtle energy and qualitative physics, emphasizing the concept of the Earth's geomagnetic and electromagnetic grids, known as ley lines, Hartmann grids, Curry grids, and Benker lines (Karim, 2010). Hartmann-Curry grids and Benker lines refer to grid-oriented zones of geopathic stress caused by natural or artificial factors, which negatively impact human physiological processes. By contrast, ley lines are considered zones of balanced, optimal geomagnetic field activity, beneficial to physiological processes and other natural formations (Karim, 2010). Karim (2010) elucidated the impact of geomagnetic stress and beneficial zones through a spectrum of wavelengths that can be correlated with colors or sound octaves. By translating complex dimensions into the confines of time, space, and human perception, Karim explained that vertical wavelengths tend to be detrimental to biological processes, while horizontal wavelengths are generally supportive. Specifically, the vertical negative green wavelength is associated with Curry, Hartmann, and Benker geopathic stress grid lines, as well as pathological electromagnetic frequencies, whereas the horizontal negative green wavelength is linked to ley lines, which are considered beneficial (Karim, 2010). Ancient techniques such as dowsing, radiesthesia, gas discharge, vegetative resonance, electric vector analysis, and light interference techniques have been employed to identify areas of geopathic stress versus beneficial zones (Tong & Kong, 2021). Biogeometry, which combines qualitative and quantitative physics, aims to detect and understand the multifaceted dimensions of geopathic stress and its implications for human biological systems (Karim, 2010; Karim & Sc, 2016). The effects of various geopathic and geomagnetic events on human health may extend beyond the scope of modern quantitative science, necessitating an interdisciplinary approach that includes quantum physics, subtle energy, and qualitative physics for a comprehensive understanding (Karim, 2010; Tong & Kong, 2021).

Hart (2023) described the evolution of life on Earth in tandem with geomagnetic fields, noting that conditions characterized by 1 g of gravity and GMF activity ranging from 20 to 70 μT have been optimal for the development of complex life forms. This includes Homo sapiens, whose neurological and cardiovascular systems generate their own geomagnetic and electromagnetic fields, integral to physiological functioning. Consequently, the interplay between the Earth's fields and those of humans suggests a mutual influence, observable in metabolic, neurological, and cardiovascular processes (Hart, 2023). When we view Earth and its species as an interconnected system, much like the parts of a single organism, the importance of GMF stability for human health becomes clear. Similarly, considering the solar system as a unified system reveals how solar activity, such as sunspots, affects the Earth's GMF and, consequently, human health (Martel et al., 2023). Thus, reducing electromagnetic pollution and practicing grounding can help counteract the negative effects of geopathic stress, harmful electromagnetic radiation, and sunspot interference, thereby promoting better health (Martel et al., 2023).

Chai et al. (2023) analyzed data from 1996 to 2019 using a linear regression model to explore the relationship between changes in GMFs, geopathic events, and cardiovascular health across different populations and regions. They accounted for various confounding factors and found that higher total GMF intensity was consistently linked to increased cardiovascular disease mortality. By contrast, higher horizontal GMF intensity was associated with lower cardiovascular disease mortality. In wealthier areas, frequent geomagnetic storms were positively associated with cardiovascular disease mortality, a trend that lessened with decreasing latitude from polar to equatorial regions, suggesting greater health impacts of geopathic stress near the poles (Chai et al., 2023). Janashia et al. (2022) found that geomagnetic storms can dramatically increase the strength of the Earth's GMF, posing significant health risks. They measured heart rate variability in 25 healthy participants exposed to varying levels of geomagnetic activity, using the geomagnetic K index to track activity levels on different days. Their research highlighted the potential health dangers of intense geomagnetic fluctuations.

The findings indicated that on days with relatively stable geomagnetic activity (K=1-3), there were few significant changes in heart rate or other cardiovascular health markers. However, on days when geomagnetic activity intensified ($K \geq 5$), significant changes in cardiovascular activity were observed, suggesting the body’s response to geopathic stress (Janashia et al., 2022). These results, along with those of Chai et al. (2023), support the theories of Karim (2010) and Cowan (2016) regarding the crucial role of GMF in regulating human cardiovascular health and other biological processes.

In addition to studying geomagnetic changes as a source of stress, researchers have also explored how the human heart rate may synchronize with geomagnetic frequencies. Zenchenko et al. (2024) analyzed heart rate data over an 11-year period in two healthy middle-aged women. They found that in approximately 50% of the recordings, there were significant minute-to-minute connections between the horizontal components of the Earth’s GMF and heart rate changes. Furthermore, the patterns of heart rate and magnetic field changes were similar in 60% of the observations. This synchronization, which consistently occurred within five minutes before or after geomagnetic changes, highlights not only the impact of the geomagnetic field on biological processes but also its essential role in supporting, maintaining, and regulating these functions as an intrinsic part of life on Earth.

Interdisciplinary Implications

The focus of modern research on GMF and its effects on living systems leaves significant room for expansion. Much of existing research has primarily concentrated on the quantitative impacts of GMF on biological systems. However, qualitative studies exploring the intersection of qualitative physics, environmental harmonization, and the influence of subtle electric and magnetic frequencies provide valuable insights. These studies complement modern quantitative science by offering a deeper understanding of the complex, interdisciplinary nature of the topic. They highlight the importance of viewing Earth's organisms, ecosystems, frequency compositions, and structures as parts of a single, coherent, unified system (Karim, 2010; Karim & Sc, 2016). For example, Karim and Sc (2016) updated the concept of ley lines within the context of the Earth's electromagnetic and geomagnetic fields, exploring their impact on living systems and the physical growth or formation processes in plants and animals. Karim (2010) argued that modern health sciences and technologies often overlook the critical role of GMF in regulating biological systems. He emphasized that disturbances in this delicate balance, caused by modern technologies like Wi-Fi, low magnetic field batteries, and electronics, can significantly affect biological health.

Supporting Karim’s (2010) views, Sarimov and Binhi (2020) conducted a systematic review calling for more research on the potential health impacts of weak static magnetic fields (SMF) and high-voltage direct currents found in many modern devices and electric cars. Their review highlighted several studies showing that SMF exposure is associated with significant changes in neurotransmitter activity, disrupted serotonin and melatonin synthesis, and altered cardiovascular rhythms, including blood pressure, in rats and mice.

The long-term health impacts of exposure to EMF and SMF remain uncertain. However, Karim (2010) highlighted a blind experiment conducted in Hemburg, where participants reported significant health complaints, such as migraines and debilitating illnesses, correlating with the installation of major cell towers in the early 2000s. Remarkably, these complaints were significantly reduced following the introduction of biogeometry interventions, which were designed to subtly interact with surrounding geomagnetic and electromagnetic frequencies. Karim’s findings open avenues for future research to explore the interdisciplinary implications of these interactions, aiming to

1) Better understand the interaction between modern technology and the Earth’s GMF
2) Assess the health implications of these interactions
3) Develop life-supporting technological interventions based on these insights

As chronic illness rates rise globally, there is an urgent need to understand their root causes and design both treatment modalities and preventative environments (Martel et al., 2023). Insights into the progression of chronic inflammatory diseases could be gained by studying the interplay between factors like sunspots, which weaken the Earth’s GMF, natural geomagnetic and electromagnetic fields, and modern SMF technologies. For example, Martel et al. (2023) indicated that seasonal changes marked by a weakened GMF are associated with increased instances of chronic and infectious diseases. These findings suggest that prolonged exposure to SMF from wireless devices, electric cars, or Wi-Fi signals may disrupt circadian rhythms and increase the risk of heart disease (Martel et al., 2023).

Moreover, research could focus on interventions to support biological rhythms in soils, which are essential for ecosystem maintenance. By examining the interactions between GMF, EMF, and SMF, researchers could assess their effects on soil health, plant health, nutrient density, and the broader ecological systems and consumers. This holistic approach could lead to innovative solutions for enhancing both environmental and human health.

2. Summary

The synthesis of research findings discussed here highlights the intricate connections between the Earth’s GMF, human physiology, and soil science (edaphology). Viewing Earth as a unified, living system—from its core through its atmosphere and encompassing all its inhabitants—helps us understand the way in which the Earth's GMF influences various aspects of soil health and human physiology. For example, different minerals in the soil exhibit varying levels of magnetism, which affect the overall magnetic properties and frequencies in a given soil region. Consequently, variations in the Earth's GMF can influence soil compositions differently, thereby supporting diverse types of vegetation.

Research has shown significant correlations between GMFs and various aspects of plant growth, including shoot and root orientation, nutrient and water uptake, growth rates, germination rates, and nutritional density. As animals, including humans, consume vegetation and are part of Earth's ecosystems, soil health directly impacts biological health. Just as mycelia and microorganisms in soils work together to break down nutrients and aerate the soil, edaphology is crucial for all biological health. The reviewed research suggest that the Earth's GMF influences human physiological processes indirectly through its effects on soil and plant health. More specifically, the GMF's impacts can be directly observed in changes to cardiovascular, endocrine, and neurological functions, among other physiological processes. As modern technology continues to evolve, there is an interdisciplinary need to better understand the interface between health and GMFs, as well as the interaction of contemporary developments with these natural processes. By doing so, we can support ecological health and sustainability and adapt interventions that promote biological health rather than those that might be harmful.

3. Conclusion

In summary, this thesis presents an in-depth analysis of the impact of Earth's GMF on soil health and human physiological systems. The findings underscore the vital role of GMFs in sustaining ecological balance and enhancing human well-being, pointing to the necessity for further multidisciplinary research to explore their broader implications. Future studies should aim to elucidate the mechanisms behind these effects, offering valuable insights for developing targeted interventions in health and agriculture.

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