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Research Article

General determinants of aging: The size and geometry of living beings

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Abstract

The relationship between basal metabolic rate and weight changes which are a normal part of the human aging process can be represented in holographic form. The purpose of the study is to verify the validity of said representation through the development of the objectives, which are to examine the relationship between the total amount of energy lost and the amount of energy lost per unit of body mass, as well as the relationship that exists between the total amount of energy lost and body mass. There are previous studies that relate the size of living beings with their metabolic rate. Our study provides the foundation for the holographic description of that relationship. The analysis of the data allowed us to generate a coherent description of our notion using the tools at our disposal. According to the results of the study, there is a correlation that can be considered statistically significant between the basal metabolic rate per dry kilogram of an organism and the total amount of energy it expends. Based on this observation, we can conclude that the biological system in question satisfies the conditions of the holographic principle.

Introduction

The relationship between dissipated energy and body weight has been the subject of numerous studies, both in humans and in animals in general. From the pioneering papers of Max Kleiber to the present. The proposal that is developed in the present study starts from the same base but moves toward the holographic representation of the mentioned relationship.

Some previous reflections are essential to understand the topic:

There is a directly proportional relationship between the size and weight of a living being. This is so because the small variations that may exist in its density are not enough to invalidate this relationship. And since the weight is an estimate of the mass, we can affirm that the greater the weight of a living being, the greater its mass and the greater its volume or size.

The holographic principle proposes that in any spatially bounded region, the entropy estimated as the energy dissipated or as information retrieved about the energy dissipated is proportional to the area that bounds the region rather than to its volume.

If we apply this concept to living beings, this implies that if the dissipated energy is more closely related to the relative surface area than to the total size or volume of the living being, we can represent the relationship between the dissipated energy and the living being's mass like a hologram. And that's exactly what we found in our previous studies and commented on in this one.

A direct consequence of the holographic representation of this relationship is that if the spatial region is bounded, the surface that bounds that region is also bounded. Therefore, there is an information density limit beyond which the system collapses or generates a new degree of freedom that we

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appreciate as a new level of organization. In turn, this explains that there is also a limit to the size of living beings according to their level of organization. And it is for this reason that we do not find bacteria that are the size of an elephant.

All these aspects mentioned the relationship between the dissipated energy and the mass of a living being influence the way in which the aging process occurs. We invite the reader to continue with the next sections.

The holographic principle in biology

In prior studies, our aim was to comprehend the biological process of aging by examining the correlation between an organism's body mass and Basal Metabolism Rate (BMR). In this study, our focus is on examining the changes over time in the Basal Metabolism Rate BMR per unit of Dry Weight (BMR/dry weight) and the total body mass across an individual's lifespan. A model based on a geometric phase change was proposed to explain this phenomenon [1,2].

This deliberation is not arbitrary, rather it stems from the notion that the metabolic function of a cell is contingent upon its interaction with matter and energy in its surroundings, which takes place via its surface [3-5]. The metabolic activity is contingent upon the ratio of its surface area to volume, specifically the surface area per unit of volume [6-9].

In the context of this study, body mass can be equated to volume due to the direct correlation between the two variables, despite any minor fluctuations in density that may occur. The BMR per unit of body mass aligns with the fundamental notion of the relative area or area per unit volume [10-13]. Upon examining a cell, it can be posited that the dissipated energy is positively correlated with its respective surface area or surface area-to-volume ratio. The genetic material of an individual is stored in their DNA and subsequently manifested in their physical characteristics. The transmission of information requires mediation prior to the dissipation of energy. This pertains to the demarcation of the human entity, where the surface of the cell serves as the boundary, as opposed to its body mass or volume [14-16].

The biological phenomenon exhibits a notable resemblance to the holographic principle, whereby the information within a confined spatial area is linked to its surface rather than its volume [17-19].

The implications of this phenomenon are noteworthy. Specifically, it is worth noting that there exists an upper bound on the amount of information that can be contained within a given spatial region, which is commonly referred to as the Bekenstein Boundary within the theoretical framework of the Holographic Principle. It is further noteworthy that this limit is determined by the surface area that encloses the region in question, rather than its volume [20-22].

When simplifying the biological problem, it is imperative to acknowledge that a cell possesses a finite size, which ultimately determines its capacity for informational density. The observation of a strong correlation between the total energy dissipation in an organism and the BMR/dry kg ratio, which aligns with the principle of relative surface, indicates that the biological system in question conforms to the Holographic Principle [23]. Conversely, when the correlation is low, it indicates that the dissipation of total energy is more closely associated with the organism's mass or overall volume rather than its BMR or dry weight per kilogram. In this scenario, it can be inferred that the system fails to adhere to the Holographic Principle. The stated objectives were to examine the association between overall energy dissipation and energy dissipation per unit of body mass over the course of the human lifespan.

- Verify the correlation between total energy dissipation and energy dissipation per unit body mass throughout the lifespan in human beings.
- Verify the correlation between the total energy dissipation and the body mass throughout the lifespan of human beings.

Examine the association between aggregate energy dissipation and the somatic mass over the course of the human lifespan.

When comparing the total BMR /day with the dry BMR / Kg, R2 has a value of 0.96 ($p < 0.02$), which is statistically significant. However, upon the comparison of the overall basal metabolic rate per day and the entire body mass, it was found that the R2 value is 0.84 (not significant), indicating that there is no statistically significant correlation. The outcomes presented are merely the systematization of uncomplicated logical deduction. Assuming a linear relationship between total body mass and energy expenditure, it can be hypothesized that a total body mass of 65 kg would dissipate approximately 3,466 Kcal/day, given that 6 kg of total body mass dissipates 320 Kcal/day. Nevertheless, that is not the outcome that transpires. An individual of advanced age, with a body weight of 65 kg, expends 1,280 kilocalories per day [23].

Upon observing the Basal Metabolic Rate (BMR) per dry kilogram and the dry weight corresponding to each age, the following observations can be made: The dissipation of 319.2 Kcal was observed in a neonate with a dry basal metabolic rate per kilogram of 228 Kcal and a dry weight of 1.4 kg. The individual in question is an elderly person with a body weight of 65 kg. Their Basal Metabolic Rate (BMR) per dry kilogram is 39 Kcal, and their dry weight is 32.5 kg. Their daily energy expenditure is estimated to be 1,267 Kcal. It is observed that a neonate expends approximately 320 kilocalories per day, while an elderly individual expends 1,280 kilocalories per day [23].

The authors posit that it is imperative to underscore that the phenomenon of human aging can be likened to a surface that curves upon reaching the threshold of information density, which typically occurs shortly after puberty [24].

It appears overly simplistic. This is a precise assessment of a novel concept: the correlation between information and dissipated energy, whereby the latter is determined by surface area rather than volume. According to the Holographic Principle, the amount of information is directly proportional to the surface area as opposed to the volume.

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The underlying principles and interconnections that underpin the outcomes are readily explicable. The holographic principle posits that the information within a finite spatial domain is correlated with its surface area, rather than its volume.

In the context of organisms, the transmission of information is intricately linked to the dissipation of energy. If the dissipation of energy in living beings is primarily influenced by their surface area rather than their volume, it may be feasible to employ the holographic principle in their study. Regarding humans, it can be inferred that the overall dissipation of energy is primarily associated with the Basal Metabolic Rate (BMR) in relation to the dry weight of the organism, which aligns with the notion of relative surface area, rather than the overall mass or volume.

The theoretical framework under consideration suggests that the results obtained provide confirmation of the satisfaction of the holographic principle by human beings. This is due to the observed relationship between the total dissipation of energy and the dissipation values per unit of body mass, rather than the values of the total body mass. The novelty aspect of our contribution is noteworthy.

The preceding paragraphs have expounded upon the notion of limits to informational density, which is contingent upon the amount of information being considered. The phenomenon of fertilization and segmentation is noteworthy. The oocyte is characterized by a substantial cell volume in relation to its limited surface area. This suggests a decreased metabolic rate and an increased informational density, coupled with the genetic data of the sperm. Upon reaching the limit of informational density, segmentation commences [24].

As a result of this phenomenon, the quantity of data contained within individual cells remains constant, while their density diminishes due to a reduction in size and a corresponding increase in relative surface area. The metabolic rate increases and the processes of differentiation commence [25,26]. The identification of a human being requires a minimum amount of supporting information. Stephen Gould coined the term “the left wall of minimal complexity” to refer to the threshold of the least retainable complexity [27]. The system’s capacity to accommodate further information is constrained by a maximum limit, also known as the limit of informational density. This phenomenon takes place within a cellular environment wherein the proportional reduction in surface area results in a concomitant decrease in metabolic capacity.

In the context of human development, a noticeable transformation occurs when growth comes to a halt after the onset of puberty. The system exhibits a characteristic of maintaining a constant physical size while experiencing an increase in informational density until it attains a maximum threshold. The aforementioned phenomenon will result in two outcomes, namely a reduction in the basal metabolic rate per unit of body mass and the manifestation of geometric alterations that will be perceived as the aging process. The aforementioned statement is inherently connected to the intricacy and magnitude of organisms [28]. Cellular growth is limited and cannot be sustained indefinitely. Upon reaching the limit of informational density, cells undergo division and aggregation, leading to the formation of intricate multicellular organizations [29]. Consequently, the system that ensues from this correlation contains a greater amount of data. One notable observation is that every component and individual cell of the system possesses data pertaining to the entirety of the system [30]. The uniformity of DNA across all cells is a viable means of its observation.

This feature also fulfills another attribute of holographic systems, whereby every constituent element encompasses data pertaining to the complete system. The intricate nature of the subject matter is not a fortuitous occurrence but rather stems from the presence of a constraint on the amount of information that can be conveyed within a given space or medium. Consequently, the geometry of the system is impacted. Upon reaching its maximum capacity, a cell undergoes a process of differentiation and aggregation, leading to the formation of complex multicellular structures commonly referred to as tissues. The morphology of these entities does not conform to the shape of their constituent cells, analogous to how the human form does not align with the configuration of its organs, tissues, or cells.

Nevertheless, it is noteworthy that all tiers of the biological hierarchy share a common feature, namely, their shape is dictated by the concentration of their data. The phenomenon under consideration is observable in the process of biological aging, as well as in the coherence of physical-biological systems, which can be elucidated through the application of the holographic principle.

Aging and biological oscillations

According to the research done on aging and biological oscillations, significant shifts take place in all of the variables that are investigated, culminating in stability and a decrease in the dispersion and frequency of oscillations towards the conclusion of the developing process. The conclusion that can be drawn from this is that biological oscillations and the aging process occur together. These shifts are conceivably going to be seen over a wide range of demographic categories, including gender and ethnicity, amongst others. The findings of previous research that were carried out on populations that belonged to a number of various ethnic groups yielded results that were similar to the ones that we have discovered [31-33].

What kinds of consequences may be drawn from this discovery, and how exactly should such conclusions be understood within the theoretical framework that the authors have presented?

Because the geometry of the system is being changed, the occurrence of a geometric phase change suggests that changes will become visible in all of the variables. This is due to the fact that the geometry of the system is being transformed. This is due to the fact that the component of the system that is being

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changed is the geometry of the system. There is a wide range of sensitivity among the system's variables to the impacts of changes in the geometry of the system [1,23,34]

Remembering that the shape of a biological system that may be found inside of a person, such as a single cell or an early embryonic structure like the morula, is that of a sphere is of the highest significance. This is due to the fact that the presence of such a system is necessary for the continuation of life. The surface in question has a positive Gaussian curvature that is consistent over its whole in terms of both its appearance and the degree to which it may be seen. The embryoblast goes through a transition in the latter stages of embryonic development, such as the blastula or gastrula stages, in which it takes on a flattened shape that is characterised by a lack of curvature. This occurs while the embryo is in the stage of gastrulation. This takes place when the embryoblast is unable to fold itself into a spiral form. Because of the creation of a cylindrical shape during the fourth week of embryonic development, at this stage in the development process, the curvature of the embryo is considered to be neutral. This is because the embryo has taken on the shape of a cylinder [1,35,36]

One of the aforementioned changes in the order that the components are organized in takes happen whenever the system demonstrates positive, zero, or neutral curvature. This might be because of the way the system was designed [37-39] The capabilities of the system are currently being expanded. Despite this, there are size restrictions that must be adhered to while handling the object [39]. The geometry of the object in question will experience a change as soon as the growth process comes to an end, which often occurs not too long after puberty. This change will take place instantaneously. If there are discrete patches of curvature that differ from one another across a system's surface, this disrupts the system's inherent order and causes it to become disordered [37].

When each variable is equated to a point on the surface of its own system, a geometric phase transition will result in a simultaneous change in the values of all variables. This change in values will be caused by the transition. This is due to the fact that a transition between various phases of the same system is what constitutes a geometric phase transition [1].

It is of the highest significance to underline the fact that, despite the fact that the variables make up a virtual parameter space, they are really formed inside a real physical domain. This is because it is essential to the understanding of the topic. The heart rate is not restricted to a certain portion of the system; rather, it is focused on a specific location within the system. This occurs rather than the heart rate being distributed over the system. This runs counter to how things would ordinarily play out in this situation.

In the context of physical systems that are related to biology, the significance of phase shifts in wave phenomena that occur across a number of different time periods bears a significant degree of relevance all on its own by virtue of the fact that it exists. The chronodisruption that was discovered in the aging process may be attributable to changes in the geometry of the system [40,41].

The wide range of species and types of living things calls for unavoidable attention to be paid to the genetic diversity that may be found among them. However, it is important to note that during the early phases of development for all of these systems, the geometric principles that were employed were precisely the same as one another. This fact lends some intrigue to the history of the creation of these systems. This is because the information included within a system does not dictate the geometry of the system; rather, the information stored within a system determines the information density of that system. The reason for this is due to the fact that the information contained within a system determines the information density. The information density of a system, as opposed to the information content itself, is what defines the geometric structure of the system. This is due to the fact that information density takes up less space than information content does. The research that has been done in academic contexts indicates that genes do not function as the primary driving force of evolution; rather, they serve as a mechanism for storing knowledge about the processes of evolution [39]. Because of this, it is vitally required to put greater attention not on the content itself but rather on the density of the information. This is because the content itself is not as important as the density of the information [42].

Conclusion

The general determinants of aging are those exposed because they are based on aspects common to all living beings, such as their shape, size, and geometry.

In the theoretical framework that leads us to such a conclusion, hormonal and neurological changes, changes in genetic expression, and any other organic or functional changes that we find during the aging process, are considered epiphenomenon of the general determinants of aging.

This allows us to suggest that regarding the aging process, economic and human resources should be allocated to improve the quality of life during aging. But they should not be assigned to trying to avoid an inherently unavoidable process.

The path we have traveled up to here, the authors summarize it like this: to avoid a process like aging, we must first understand it. And when we understand it, we realize that it is unavoidable.

It is a reasonable goal to try to age better, and we can achieve it by acting on the aforementioned epiphenomena. But it is clear that acting on such epiphenomena will not modify the general determinants.

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