

## Review

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# In Search of Rationality in Human Longevity and Immortality

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## ABSTRACT

*The human body is machine-like, but self-moving, self-regulating, and self-adjusting, governed by willpower and intelligence. Aging of the body is basically a maintenance problem and so it could perhaps be postponed by thorough and frequent maintenance. Aging brings on a cascade of ills and health problems leading to deterioration of physical, mental, emotional, and social dimensions of life. This paper deals with solution of the problem philosophically in the light of Indian scriptures without entering into traditional bioethical issues. With a meaningful reason for existence, life can be extended. Examining the scientific perspectives on aging, some common manipulations for its extension are discussed. These are calorie restriction, vitamin and antioxidant treatment, exercise and hormonal interventions, etc. Finally, the question of longevity is explored through pursuance of eternal value-based activity and spirituality in the tradition of Indian heritage.*

**Key Words:** Accumulation of damage; Aging; Gene-evolved mechanism; Human evolution; Indian philosophical perspectives; Life span; Longevity; Manipulation of aging; Psychosocial and spiritual dimensions of aging; Spirituality; Unselfish love

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## Introduction

Let us start with two prehistoric quotes on aging and longevity. Hippocrates in 400 BC said:

*All parts of the body which have a function if used in moderation and exercised in labors in which each is accustomed, become thereby healthy, well developed and age more slowly; but if unused and left idle they become liable to disease, defective in growth, and age quickly.*

-(As quoted in Ferrucci and Simonsick, 2006<sup>[23]</sup>)

The other quote is from Chanakya, who in 250 BC, as the principal Minister of Maurya Emperor Chandragupta put up a set of social rules widely known as *Chanakya Niti* and also economic rules known as *Kautiyla's Arthasastra*. *Chanakya Niti* is elaborated in 17 chapters, and the following quote from one of them is relevant in the present context of human longevity:

आयुः कर्म च वित्तं च विद्या निधनमेव च ।  
पञ्चैतानि हि सृज्यन्ते गर्भस्थस्यैव देहिनः ॥

*Ayuhu karma cha vittam cha vidya nidhanmeva cha.  
Panchaitani hi shrjyante garbhasthasaiva dehinah.*

-(As quoted in Davies and Murthy, 2006<sup>[15]</sup>)

(Translated to mean: The five crucial features of human beings: duration of life span, profession, wealth, education, and time of passing away, are all predetermined while entering the mother's womb.)

Longevity as suggested by the first quote is one of the established techniques being used at present. The second one, however, opines that our longevity, along with four others aspects (work, wealth, knowledge, and time of death), is finalized once we enter the mother's womb. Our genes as the intrinsic scientific basis for longevity were confirmed only in the last century. The emphasis of this paper, however, is that longevity has a deeper root and cannot simply be addressed from a materialistic view-point.

Due to impermanency of this world, the Indian scripture says this living body, like any other living animal in the world, is impermanent, and subjected to decay, passing through the following six stages, being the so-called *shara-vikara* or 6-fold essential changes from birth to death:

**जायते अत्थि बरधते बिपरिनमते अब्खयते नस्यते.**

*jayate athi bardhate biparinmate abkhyate nasyyate.*

(Translated to mean: After birth, one continues to exist, develop, mature, deteriorate, and finally collapse, which is the end of everything.)

It is, therefore, not worth living this life any longer once its purpose is fulfilled. Hence, the message is that we are required to keep alive through proper maintenance till our goal is fulfilled. This is one of the most popular understandings of Vedanta philosophy and is meant to indicate the impermanency of all worldly matter with reference to the supreme reality, which is the only permanent, being everlasting one in the universe.

## **Aging and Commitment to Unselfish Love**

Aging brings on a cascade of ills and health problems leading to deterioration of physical, mental, emotional, and social dimensions of life. It has two dimensions, internal and external. The former is hereditary while the latter is environmental. Weakening of physical and mental abilities is inevitable. External conditions such as activity, nutrition, and life style can be controlled and regulated. As organisms age, they slowly breakdown, experience tissue death and general malfunction. Our internal structure tends to become increasingly disordered: this is very similar to a machine's wear and tear. Though initially self-repairing, the body undergoes a continued decrease in immunity with age, leading to the ultimate collapse of the body's immune system.

Aging is the active result of a life span regulation mechanism. It is for adaptation and evolution of the species. If the older generation did not die, it would not allow the species to advance because the older generations would continue to procreate and advance the older gene pool generation after generation. Hence, through elimination of such older gene pool, the species advances. While other species advance strictly by improving their gene pool in terms of physical adaptation, human advance is not just according to physical traits, but according to what they know and how they interact, meaning knowledge and experience, which are becoming more important for the survival of humanity. It is this experience that human beings can manipulate and thereby alter limiting factors that are inbuilt in their bodies.

All ages beyond 30 years are not equally vulnerable to death (Siddiqi, 2006<sup>[48]</sup>). While on the other hand Vaillant, 2008<sup>[60]</sup>, says, "The average longevity of major American companies is <40 years; great personal fortunes rarely survive more than three generations; few nations and still fewer dynasties have lasted for more than 300 years. In contrast, the world's great religions ...

share two things in common: they are all based, in part, upon a commitment to unselfish love and they have all endured for more than 1400 years." Vaillant has made some crucial observations one can hardly deny. It is a fact that more liberal and philanthropic persons are more acceptable to a wider cross-section of people. Hence, the secret, as he has generalized, is positive attitude. This is elaborated upon more in connection with my discussion on spirituality later in this paper. This "commitment to unselfish love" has a deep root, which can be traced back to the Rig Veda (Bose, 1999a<sup>[9]</sup>), where, in the so-called *samgnan sukta* of social harmony, it is stated that if we speak, aim, and assemble with our mind and heart united, we can happily live together indefinitely.

सं गच्छध्वं सं वदध्वं सं वो मनांसि जानताम् ।  
देवा भागं यथा पूर्वे सज्जानाना उपासते ॥१॥

*Sam gacchadhvam sam vadaddhwam sam wo manansi janatam*  
*Deva bagam yatha purve sajjananam upasate.*

This when translated means: Let us all think, speak, and work together, commonly termed as "manasa, vacha, and karmana" since all the gods and Gods and Goddesses have shown that to us all along. (This harmony is the basic principle of creation of the universe and that is why it is advised for success in work - one's feeling and speaking must be in unison with work - in scripture this is commonly termed *manasa, vacha, and karmana*.)

This has been further elaborated in the Yajur Veda (Bose, 1999b<sup>[10]</sup>):

*Vraten diksham apnoti, dikshya apnoti dakshinam*  
*Dakshina shradham apnoti, shradhya satyam apyote*

(Translated to mean: *Diksha* starts with *vrata* [self-dedication] to a higher ideal, from there one attains *Diksha* [devotion], and then comes *Dakshina* [grace] on its own, then *Sraddha* [reverence] which leads to the ultimate reality. [Note: There are two ways of living this life, one is *Viksha* or *begging*, and the other is *Diksha*, which means elevating/upgrading oneself, i.e. making oneself prepared in body-mind complex for acceptance so that things come to oneself on their own accord]).

It may be pertinent to mention here that Ramakrishna Mission, set up by Swami Vivekananda in 1897 continues to flourish as it adopted the above-mentioned principle of "commitment to unselfish love" through offering society four categories of services, namely, *anna daan*, *prana daan*, *vidya daan*, and *jnana daan* (relief, health, education, and spiritual knowledge).

## Human evolution

Human evolution has to pass through four stages for successful development: compulsion, motivation, cooperation, and finally dedication, we define evolution as a self-operating and self-transforming process which generates not only greater variety but also a higher level of organization. In the words of Swami Vivekananda, evolution is of the nature thereby manifesting divinity (Vivekananda, 2005<sup>[53]</sup>). Evolution involves three processes: the inorganic (cosmological), the organic (biological), and human (psychosocial). From the living cell up to human beings, biological evolution was motivated by organic satisfactions, numerical increase, and organic survival. At the human level, due to the development of the cerebrum, the primary motivation becomes fulfillment and evolution becomes conscious, deliberate, and goal-oriented, unlike blind processes in the prehistoric ages. In a self-centered human, the mind or psyche is limited being confined to the physical level. In the ethical human, it expands beyond the limitations of his/her physical self. Julian Huxley (Huxley, 1974<sup>[29]</sup>) in his book, *Evolution: The Modern Synthesis*, commented:

*As regards human progress, it is clear that subjective criteria cannot and should not be neglected; human values and feelings must be taken into account in deciding on the future aims for advance.*

The first two stages would not lead to the highest development, but with the developed human cerebral system, the latter two activities appear to lead toward ultimate improvement. Flat and Hughes, 2013<sup>[24]</sup>, echo similar views as does Ranganathananda 2005<sup>[55]</sup> who elaborated on this aspect in his book, *The Messages of Brihadaranyaka Upanishad*. That might perhaps also be the reason why the Madrid International Plan on Aging (MIPPA, 2002<sup>[37]</sup>) stressed the need for taking proper care of both the objective and subjective aspects (Parkar, 2015<sup>[42]</sup>) for the elderly.

## Life span

It has been estimated that if we successfully conquer all the diseases that are currently lethal, including the major three diseases (cancer, stroke, and cardiovascular disease, the major killers in industrialized societies), our average life span would be greatly extended. This increase could be achieved through factors such as better diet, cleaner water and, most significantly, due to successful medical interventions and palliative care. Mention may be made of improvement in longevity in middle and old age from cardiovascular disease through drugs and diets to lower blood pressure and cholesterol. This may not be good as such, since this body gradually loses the capability of enjoyment with age. For example, in the *Kathopanishad* (Radhakrishnan, 1953<sup>[45]</sup>) in its chapter 1, slokas 26 and 27, the impermanent nature of the body is elaborated upon by the disciple

Nachiketa when he was offered by the teacher Yamaraj, the very best of wealth of the world and an unusually long life span to enjoy it:

**श्रोभावा मर्त्यस्य यदन्तकैतत्सर्वेन्द्रियाणां जरयन्ति तेजः**

*Svo'bhava martyasya yad antakaitat sarvendriyanam jarayanti tejah 1.26.*

(Translated to mean: "Transient are the things of mortals, they all end and the sense organs wear away all and lose the vigour of their intensity of senses with use. Even a full life is too short to utilize the enjoyment").

It further elaborates:

**न वित्तेन तर्पणीयो मनुष्यो लप्स्यामहे वित्तमद्राक्ष्म चेत्वा**

*na vittena tarpaniyo manushyo, lapsyamahe vittam adrakshma cetva 1.27.*

(Translated to mean: Human cannot be satisfied with wealth. Nobody can enjoy wealth any more when he/she gets a glimpse of undecaying immortality, like that of yours, God, the supreme reality. Hence, as long as you are there, I will also be there, this is my prayer [Note: This is the statement of *Nachiketa*, a young learner, when he happened to meet *Yama*, the Dharmaraj and the supreme controller. Dharmaraj offered Nachiketa all the prosperity of the universe. However, having beheld Dharmaraj, Nachiketa had already obtained all wealth and would also live as long as he ruled. Therefore, Nachiketa found no other boon acceptable but the one that he has asked for - to understand the mystery of life and death]).

The same is reflected in the Mahabharata, Adi Parva, where King Yayati said on the question of enjoying youth all throughout life span:

**न जातु कामः कामानामुपभोगेन शाम्यति ।  
हविषा कृष्णवर्त्मैव भूय एवाभिवर्धते ॥१०॥**

*Na jatu kamah kamanam upabhogen shamyati  
Havisha krishna vartameva bhuy evabhi vardhate.*

This when translated means that fulfillment of our desires cannot be an end through enjoyment; passion, on the other hand, goes on ever increasing like putting butter on fire. What we learn from this is that peace in life comes not through *bhoga* or enjoyment of sense pleasures but through *yoga*, i.e. sticking to an idealistic path. *Bhoga* and *yoga* can never go together; it is either *bhoga* or *yoga*, as all scriptures say.

Complete removal of the biological causes of the limitations on human longevity will not make people immune to death since the role of modern medicine essentially is easing the severity of pain without removing its cause (Singh, 2010<sup>[49]</sup>). Without a meaningful reason for existence, the purpose of life becomes simply to die. There have several reviews on this, for example, Strulik and Vollmer (2011<sup>[50]</sup>), Bortz and Stickrod (2010<sup>[8]</sup>), and Farrant (2010<sup>[22]</sup>).

The present article is an attempt to highlight both some popular ways of extending the life span biologically and also living a value-based purposeful life through spirituality.

## **Human Aging and the Automobile Analogy**

The human body goes through a variety of changes as it gets older. In general, muscles, blood vessels, and other tissues lose their elasticity. The heart becomes less efficient, bones become weaker, and metabolism slows down. "Natural" death, for most of us, occurs not because of the sudden failure of all 60 trillion cells of our body, but because a critical component stops working, for example, brain, heart, and lungs. It is just like the strength of a chain is judged by its weakest link.

The life of a car depends on four elements: design/structure, accidents, maintenance, and, finally, aging. If the car has design/structural flaws, it is involved in a major accident, or is poorly maintained, it will not have the chance to get old, but will be afflicted before that as one of the above factors comes into play. The same four categories apply to the human organism, but are more appropriately designated, respectively, by genes, internal factors, external factors, and aging. These four, occurring in innumerable combinations and chronologies, account for the totality of the human health experience. If the first two of these four factors could be stabilized through a perfect design and gene set, if there were no accidents or external disruptions, and if there were ideal maintenance and balanced internal dynamics, we could have the opportunity to die of natural causes after reaching the limit of our potential.

Aging of the body, like that of a machine, or a car, appears to be a maintenance problem of wear and tear of sense vigour as discussed above (*Kathopanishad*, Radhakrishnan, 1953<sup>[45]</sup>), and so it could perhaps be postponed through frequent and careful maintenance including balanced use of all the sensory organs before visible breakdown. The natural decay of organs with aging can be slowed down through such balanced and regulated use. Aging, among other things, is predominantly caused by random accumulation of damage in human organism's cells, worsening thereby functioning of regulatory systems such as central nervous system and endocrine system. Hence, health maintenance and preventive measures can contribute markedly to the maintenance of independent

function and quality of life in the elderly individual. As aging is basically a physical deterioration, and because damage accumulates faster than it can be repaired, there now exist both programmed and non-programmed theories of aging based on maintenance and repair functions. Living organisms possess extensive maintenance and repair functions that act to repair damage. This is a major difference between living organisms and nonliving entities. However, one should be cautious with this analogy that it is not simply wear and tear.

Apart from having the ability to self-construct and self-repair, all organisms have a sense of self-awareness (*atma-bodh*, meaning conscious of self), which is true for all animates, namely, plants and animals (lower and higher), not just human beings. This self-awareness is more than and beyond all algorithmic reasoning of artificial intelligence; it is something that an inanimate cannot have. Patanjali Yogasutra (Iyengar, 2002<sup>[30]</sup>) elaborates upon this:

### **अविद्यास्मितारागद्वेषाभिनिवेशाः क्लेशाः ।**

*Avidyasmīta-rāga-dveṣābhīniveśāḥ kleśāḥ II.3.*

(Translated to mean: Lack of self-awareness has been classified into five distinct categories, and it is the root cause of human suffering. They are *avidyā* [lack of wisdom], *asmīta* [the sense of "I," attachments], *rāga* [passion], *dveṣā* [aversion], and *abhīniveśa* [clinging to life]. [A Yogi, on the other hand, by detaching from these earthly attachments, including removing the self-feeling, tries to be one with the cosmic self]).

Living beings construct themselves out of raw materials starting from a microscopic cell. If they can construct themselves, why can they not also repair themselves? Repair and maintenance certainly seem much easier to do than original construction. The body has a host of self-repair and self-maintenance processes, which machines basically do not have; hence we are not really machines at all, at least not only machines. The body is a great deal more complicated than any human-made machine — and what is more, we did not design it, so to understand it we have to reverse engineer its workings, i.e. starting from the bottom, from the simplest to the present complex state.

One might point out that there could be some general limits to the ability of an organism to perform self-repair. Once this limit is reached, damage would accumulate. This perhaps explains why the human experience of aging so precisely resembles our automobile experience. Some mechanisms that have been suggested as "causing" aging in humans, such as oxidation (discussed later), are very similar to the mechanisms that cause aging in automobiles. Human appearance changes are similar to those of an automobile. Colours fade and become less uniform, and performance deteriorates. Similarly, human skin sags, wrinkles. In addition, performance deteriorates with age,



becoming weaker and slower. It is a biological wearing out process resulting out of incrementally accumulated damage. Like the malfunction of car parts, a person may develop malfunction of different organs such as liver, kidneys, and sensory organs. The “accumulation of damage theories” for biological aging generally believes that there is no possible treatable common factor in aging. These include free radicals theory, DNA damage theory, cross-linking theory, wear and tear theory, theory of error catastrophe, somatic mutation theory, and living theory, all of which are often classified under two major categories, namely, programmed theories and error theories (Gao *et al.*, 2014<sup>[27]</sup>; Bengtson *et al.*, 2009<sup>[4]</sup>; Aledo *et al.*, 2011<sup>[1]</sup>; de Magalhaes and Church, 2006<sup>[34]</sup>; and Freitas and de Magalhaes, 2011<sup>[26]</sup>).

The other category is called psychosocial theory of aging which is discussed later under spirituality. I believe that the factor common to all the various manifestations of aging – accumulation of damage – seems to be a fundamental property of life. Perhaps, treatments can be found for individual manifestations of malfunctions such as heart disease, cancer, and stroke, but there is no possible treatment at present for the common factors in aging. Studies on longevity are, however, trying to find these though it remains a challenge requiring a multidisciplinary approach comprising, among others, biologists, biochemists, and computer scientists.

## **Some Scientific Perspective on Aging**

Three causes of aging have been identified: Failure of cellular mechanisms, decreasing secretion of body hormones, and environmental factors such as quality of diet, lack of body movement, and perhaps also lack of proper knowledge/ utilization of these and other entities. Our biological clock is ticking away at a predetermined rate. Hence, the cells’ genetic material, DNA, appears to hold the key to our planned demise from day one (Franklin and Tate, 2009<sup>[25]</sup>). However, biology is not destiny. One cannot change genes, but can slow their march or delay them with better nutrition, regular physical activity, etc., as discussed later. Aging happens due to a discrepancy between the rate of biological damage and the rate of repair. Any intentional attempt making the equalization of the rate of damage versus repair more likely would result in retardation of aging. If all the causes of aging can be addressed using biotechnological solutions, human beings might be able to live for thousands of years (of course, only if they do not die by unnatural means).

Biology has a general tendency to advance from simple to complex sophistication, whereas physics has an opposite tendency, from complex to simple (Mitteldorf, 2010<sup>[40]</sup>). Physical laws of thermodynamics seek a state of lowest energy, i.e. minimal entropy. Biology and physics are apparently entangled in an overall balance. To influence this balance, we need to reduce

the impact of physical laws and/or strengthen our biological assets. Complexity declines with age due to the accumulation of damage within that which is not repaired because of limited available energy resources in the body. On the other hand, organisms, while young in their growth phase, become stronger and more robust; no physical law can prohibit this progress from continuing indefinitely. However, physical laws, if applied in a suitable manner, may ultimately enhance understanding in biology as can be seen in the application of the law of thermodynamics to aging (Mitteldorf, 2010<sup>[40]</sup>). Many aspects of aging, for example, oxidative damage, somatic mutations, and protein cross-linkage are characterized by increased entropy in biomolecules. A fundamental understanding of aging should proceed not from physics but from an evolutionary perspective: the body is being permitted to decay because systems of repair and regeneration that are adequate to build and rebuild a body of ever-increasing resilience are being held back.

## Gene-evolved Mechanism

Many researchers seem to suggest that aging is due to genes of a similar kind, which are responsible for the timing of our aging and our death (Mathur *et al.*, 2011<sup>[36]</sup>). The DNA protein structure situated at the tail of chromosomes called telomere is regarded as a bio-marker of aging. It is dependent on various factors including physical activity, socioeconomic status, parental age at the time of the offspring, and multivitamin intake. However, this telomere length parameter has not yet fulfilled the criteria of the American Federation for Ageing Research (Mathur *et al.*, 2011<sup>[36]</sup>), although it is more precise than chronological age marking. Challenges of future research on telomeres will be as follows:

1. It must predict the rate of aging and should be able to predict exactly where a person is in his/her total life span
2. It must retard, even reverse, the aging process
3. It must be replicable
4. It must be validated in laboratory animals before being validated in humans.

Out of the daily intake of energy, some might go to growth, some to physical work and movement, and some to reproduction. Some energy, instead, might be stored as fat to protect against an emergency, but much gets burned just to fix the innumerable faults that arise every second to keep the organism alive. Another segment of these scarce resources goes to proofread the genetic code involved in the continual synthesis of new proteins and other essential molecules. And still another allocation powers the energy-hungry garbage disposal mechanisms that clear molecular debris out of the way. If the normal bodily functioning gets compromised to the extreme, death ensues. As soon as the specialist cells surrendered the role of continuing the species, they also abandoned any need for immortality; they could die after the body had passed on its genetic legacy through the germ line to the next generation. "No biological software program,

then, dictates precisely when it is time to die, but growing evidence suggests that certain genes can nonetheless influence how long we live" (Kirkwood, 2010<sup>[31]</sup>).

It is not a fact that genes are fixed agents of determinism that largely regulate who we are and what we will become. It is not that specific genes control specific functions and determine specific health outcomes, for example, the onset of a great many diseases as well as our life span. First, genes must be "expressed." What that means is that they are like switches that must be turned on to perform their designated functions. An even better way of thinking about it is to think of genes as functioning like a "dimmer" switch, with variable responsiveness, not just a simple "on-off" switch, as in an electronic circuit. Second, genes typically act in concert, in groups, or even networks. Genes are rarely intended to function independently. They work in coordinated ensembles, which in turn are closely matched with biochemical metabolic complexes. Hormones are important modulators. Genes are functionally de-localized and structurally entangled. Genes are plastic and dynamic as discovered by Barbara McClintock, the 1963 Nobel laureate in medicine. It has been said that "genes are often redundant" as quoted in Bortz and Stickrod, 2010<sup>[8]</sup> so that the notion of one gene for one function is simply not valid. If genes were the only factor determining our health status, and the other three agencies were only negligible factors in ensuring health, identical twins would die more or less simultaneously of the same disease. But, the actual situation is far from the case. It is now generally assumed that the genetic contribution to our overall health and our prospects for longevity fall within a range around 20%–25% (Bortz and Stickrod, 2010<sup>[8]</sup>).

## **Accumulation of Damage Mechanism**

Aging is a fundamental property of life and an unavoidable adverse side effect of a necessary process. The structural proteins, enzymes, and tissues do not always behave as they are supposed to, though the molecular machinery handling all of this is highly sophisticated for self-maintenance and repair with a capability to get rid of more serious mistakes. Like the people who possess them, molecules sometimes make mistakes in the jobs they perform. These errors can have deleterious consequences for the organism. It is believed that one of those consequences is the aging process, inadvertent generation of a reactive set of molecules termed free radicals. All of our life processes begin at the cellular level, so also our health and wellness. Mitochondria are the energy factories of the cells. The aging process involves incremental damage to cells through oxidation, coupled with the accumulation of toxins from metabolism, food, and environment. Like most manufacturing processes, this energy production factory also produces toxic waste. Glucose is burned in the powerhouses of the cells known as mitochondria to generate 90% of the energy used in the cell, while also producing free radicals and reactive oxygen species (ROS or free radicals).

$$\text{Glucose} + \text{Oxygen} \rightarrow \text{Energy} + \text{Carbon Dioxide} + \text{Water}$$

The production of free radicals by mitochondria extracts energy from food and converts it into adenosine triphosphate (ATP, a complex nanomachine that serves as the primary energy currency of the cell). ATP is a form of energy usable directly by the cell and it is at the root of much of the aging process (Bortz and Stickrod, 2010<sup>[8]</sup>). Each animal cell contains anywhere from a few 100 to more than 1000 mitochondria. Mitochondria are important as they supply all the necessary biological energy to the cell. They are referred to as the “power houses” of the cell. Well-functioning mitochondria are crucial to normal healthy existence. However, because of minute imperfections of biological chemistry, oxygen is transmuted into damaging free oxygen radicals or oxidants (Kirkwood, 2011<sup>[32]</sup>). This is not like smoke from a chimney or some kind of odd organic molecule, but Reactive Oxygen Species (ROS). The problems created by storing toxic ROS molecules are the same as encountered when storing any kind of hazardous waste. If ROS molecules are allowed to hang around inside a cell, they can create a tremendous amount of damage. One percent of the oxygen we consume turns into ROS (Wu, 2004<sup>[63]</sup>). The gastrointestinal tract, especially the stomach with its highly acidic environment, is constantly generating ROS from food. Billions of free radicals are being produced in the body at any time. But, metabolism is not the only source of oxidants. They are also created by the so-called ionizing radiation, such as ultraviolet radiation in sunlight. This free radical damage, similar to the oxidizing rusting of metal, adds up, causing tissues and organs to deteriorate with age. Like a lot of industrial waste, these reactive species can indiscriminately damage anything that gets in their way. Protein is especially vulnerable to attack by free radicals since much of the cell's structure is protein. In spite of their destructive power, the body in fact uses free radicals for useful purposes, for example, their homicidal power is used by the white blood cells to destroy invading organisms. Free radicals play a role in the synthesis of major biomolecules – proteins, carbohydrates, lipids, and nucleic acids and in the detoxification of chemicals inside organelles in the interior of cells. Free radical reactions play a role in the generation of cellular energy in the mitochondria. Two types of damage have been identified (Kirkwood, 2010<sup>[31]</sup>): damages in the cell DNA and also in the energy-forming unit of mitochondria. Very sophisticated molecular circuitry controls the level of damage till the cell locks itself against division while performing the essential functions of the body.

Free radicals are thus indispensable to life, but they need to be managed so that their usefulness outweighs their destructiveness. Further, our state of mind and susceptibility to stress can actually contribute to our level of oxidative damage. Too much stress can increase our oxidation damage and overwork our immune system. Inflammation is a consequence of the accumulation of toxins in the body, and this global inflammation characteristic of the aging process is associated with the reduced capacity to cope with immune stressors, resulting in a weakening of related enzyme systems and progressive increase in pro-

inflammation. Contributors to low-level chronic inflammation include smoking, alcohol, fatty foods, refined carbohydrates and sugars, pollution, pharmaceutical by-products, lack of exercise, and stress. Modern human is becoming increasingly “denatured” due to heavy metal poisoning, oxidation, and inflammation because of a cooked diet, mineral deficiency, and phytochemical deprivation.

## The Manipulation of Aging: Objective and Subjective

As said earlier, one is as strong as one’s weakest link. It, therefore, follows that raising one or more of the baselines of entire health could reduce the overall weakness. So, let me first consider and look into how this is handled through techniques of the biosciences.

### Bioscience Techniques

#### Caloric restriction

It is not surprising that those of us who would like to live a long and healthy life should pay careful attention to what we eat and drink, neither overfeeding nor being malnourished. High calorie intake is a known risk factor for diabetes and cardiovascular disease, being a major cause of mortality in later years. Fasting and calorie restriction (especially carbohydrates) is the most profound method of reducing the aging process. (Rockefeller and Madeo, 2010<sup>[47]</sup>). It is possible to extend the mean life span of mammals by reducing dietary calories, protein, methionine, or by reducing insulin (Fahy *et al.*, 2010<sup>[21]</sup>). These interventions reduce primary aging of the heart, greatly slowing the decline in diastolic function and reducing the markers of inflammation, and also delay the onset of deleterious age-related physiological changes and diseases (Carrillo and Flouris, 2011<sup>[12]</sup>). Okinawans (Japanese island inhabitants), predominantly vegetarian because of being followers of this theme of calorie restriction, consume, on average, just 80% of the calorie intake of the rest of the Japanese population, who are anyway long-lived. This example is taken because here there are more centenarians per millions of population, lowest death rate from the major three killer cancers, heart disease, and stroke, and highest life expectancy over 65 (Stibich 2014<sup>[52]</sup>). Vegetarians tend to live longer, healthier lives than meat eaters (McNaughton *et al.*, 2012<sup>[35]</sup>). It might be that the vegetarian diet contains something good for longevity. Research (McNaughton *et al.* 2011<sup>[35]</sup>) on this has been done on three healthy categories of diet scores: Mediterranean diet score (MDS), and recommended food score (RFS). While MDS and RFS show promising results on longevity, it still requires further investigation. However, calorie restriction is very difficult to maintain for long periods. It is a general feeling that this calorie restriction of a lesser degree such as every-other-day feeding would serve the purpose and be more acceptable. Perhaps, a feed day can be alternated with a fast day (Whitman, 2015<sup>[62]</sup>).

## Vitamin and antioxidant treatment

There is evidence showing that life span can be extended by vitamin or antioxidant supplementation. An antioxidant is capable of inhibiting the oxidation of other molecules. Oxidation reactions in our body metabolism produce free radicals. Even though oxidation reactions are crucial for life, they can also be damaging. Accumulation of oxidation damage contributes to the aging process. Antioxidants terminate through chain reactions on the free radical intermediates and inhibit other oxidation reactions. Common antioxidants include Vitamins A, C, and E. Fresh raw fruit and vegetables are loaded with antioxidants; such a diet is often advised to reduce silent inflammation through removal of toxins from our cells and building the reserves of nutrients that fight against free radicals. When a molecule of Vitamin C encounters a free radical, it becomes oxidized and thereby renders the free radical innocuous. Antioxidants are widely used as ingredients in dietary supplements and have been investigated for the prevention of diseases such as cancer and coronary heart disease (Glade, 2010<sup>[28]</sup>). Linus Pauling, the double Nobel laureate, for example, became convinced that vitamin C, because of its antioxidant properties, could be effective in preventing and treating cancer and heart diseases. But, later this could not be firmly founded.

## Physical exercise

One can live longer following the oft-given parental advice of regular exercise and adequate nutrition. Exercise forces continuing high levels of physical activity, increases strength and endurance, decreases body fat, increases muscle mass, generally improves health, and increases life span. As people age, they become less physically active, have a higher body fat percentage and less muscle. Extended inactivity weakens muscles and bones, generally detracts from health, and decreases life span. Exercise increases oxygen consumption and increases metabolism. That is why exercise is so useful for losing weight. Physical activity protects against many chronic health conditions by improving glucose uptake and insulin sensitivity, improving blood lipid profiles, lowering blood pressure, improving the health of blood vessels, and protecting against obesity. The benefits of regular physical activity on health, longevity, and well-being easily surpass the effectiveness of any drugs or other medical treatments (Weiler, 2010<sup>[61]</sup>). It is important to reduce one's "sitting" time and attempt to maintain a high level of daily low-intensity activity such as standing, walking, and climbing stairs to reduce the metabolic risk of a sedentary lifestyle, especially for people who do not exercise.

Regular low-intensity exercise also minimizes the production of free radicals while strengthening indigenous antioxidants, enzymes, and proteins (Powers and Lenon, 1999<sup>[43]</sup>). Without regular exercise, the body's internal defenses against free radicals may become too fragile for the antioxidants in

our food and supplements to have their full affect. Trained muscles become resistant to oxidative damage because of the increased supply of the body's own antioxidants. Exercise builds up resistance to free radical damage from all stressors and reduces the production of stress chemicals. Exercise is famously good for our muscles and cardiovascular system, as well as for controlling weight. Exercise is good not only for its general effect on muscle strength and the fitness of the heart and lungs, but also for combating aging itself. Walking is a fine exercise if one does not have the amenities or inclination for other sports. Using stairs instead of lifts is a good idea, not only because the exercise is a bit more taxing than walking on a flat surface, but also because the slight jolt that one gets as one walks upstairs/ downstairs stimulates one's osteoblasts to build more bone (all this of course after taking due advice of one's doctor, especially for those prone to osteoarthritis and osteoporosis). Battling the force of gravity is somehow important for bone maintenance, as astronauts who spend long periods in the weightless conditions of life in space find at their cost. Research has shown the enormous health benefits of a programme of regular exercise for older people (Miskotnykh, 2012<sup>[39]</sup>) and it is never too late to start.

## Hormonal Interventions

Hormones are very heavily involved in growth, reproduction, digestion, nutrient utilization, and many other normal biological processes. Observed concentrations of many hormones vary with age. They work in pairs or even in larger groups. Hormones produced by different glands are known to interact in complex ways. Negative feedback is almost always a part of mechanical or electronic control systems' stability (Terman, 1955<sup>[57]</sup>). In the context of aging, a hormone might cause a tissue to age. The important one is human growth hormone (HGH) which is secreted by the anterior lobe of pituitary. It also stimulates cells in the liver to secrete polypeptide molecules known as somatomedins, the most studied one is insulin-like growth factor-1 (IGF-1). HGH with IGF-1 influences many systems of our body such as muscular development, connective tissue growth and repair, skeletal strength and structure, and regulation of various metabolic functions. However, there are some hormones such as growth hormone (GH), IGF-1, which inhibit aging in a tissue that was otherwise programmed to age. In all species examined to date, endocrine manipulations slow aging without concurrent costs in reproduction, but increases in stress resistance (Tatar *et al.*, 2003<sup>[58]</sup>). HGH has also been used as an anti-aging treatment for a long time, and beneficial effects have been observed: for example, elderly claim to feel younger (Barzilai and Bartke, 2009<sup>[3]</sup>). But, there have been negative effects such as weight gain, high blood pressure, diabetes, and faster growth of cancer, if there be any (Robson, 2015<sup>[46]</sup>). Other hormones whose bodily production decreases with age include dehydroepiandrosterone (DHEA) and melatonin. DHEA has been reported to improve well-being in the elderly through improved

memory, immune system, muscle mass, etc., but it is again problematic with certain types of cancer. It is the most abundant steroid hormone in the body and is also one of the most significant age-related biomarkers. Patients with prostate cancer have lower levels of DHEA (Dean, 2013<sup>[16]</sup>). Melatonin hormone made in the pineal gland declines significantly as we age, its production trigger being total darkness. It is a circadian rhythm hormone, thereby affecting the patterns of sleep. It is also claimed to be associated with aging and life extension. The benefits of its supplementation include enhanced immune system, antioxidant capabilities, better sleep, and mood elevation (Barzilai and Bartke, 2009<sup>[3]</sup>). Estrogen, a popular anti-aging therapy for women generally used with other hormones in hormone replacement therapy, is claimed to reduce the effects of menopause, as also protecting against heart disease and osteoporosis, but could increase the risk of breast cancer and may lead to weight gain and thrombosis as side effects (Megalhaise<sup>[38]</sup>). It may be mentioned in passing here that, on an average, it takes about 12 years from the discovery of molecular mechanisms to the development of a drug plus 10 years of clinical tests to make a drug available. In the case of aging medication, the time scale may be longer (PHARMA, 2007<sup>[44]</sup>; Kirkwood, 2010a<sup>[31]</sup>).

### Manipulation of aging subjectively

One cannot overcome all the limitations that attack old age even though it is not an entirely fruitless exercise. But, why this adventure? This life indeed has a goal, it is not rudderless, unpleasant, and dry, if it aims for a goal and hence happiness. If one does not achieve that in one's working life span, one may pursue and linger for that even after formal retirement from services, as many do in their retired life.

The question is what is the ultimate goal of life? Consumer capitalism dictates that happiness is to be pursued by the acquisition, possession, or consumption of goods and services. But, in spite of marvellous achievements in science and technology, most people define themselves as being happy regardless of their materialistic value (Einstein, 1944<sup>[20]</sup>). Scriptural teaching is that happiness comes from inside, not from the things and events outside. If one is dependent on external factors, there would be no limit of hankering since whatever one gets there is still more to get; even it be the best today, after some years, it would be obsolete because something better would come into market. Hence, more and more people in affluent societies are growing tired of the shallowness of their materialistic lives and are searching for a new set of values by which to live. At the introduction in the *Kathopanishad* Ch 1.27, it has already been said that human cannot be satisfied with wealth alone (Radhakrishnan, 1953<sup>[45]</sup>). The scripture also says our true identity is *sat, chit, and ananda* (meaning we eternally exist with knowledge and grace). This means that our existence can be eternally blissful. But, why are we so miserable? We have forgotten this real nature through attachments of the five *kleshas* or delusions as discussed in connection with



Patanjali Yogasutra (Iyenger, 2002<sup>[30]</sup>). Swami Vivekananda, one of the respected spiritual teachers in recent history, said:

*Each soul is potentially divine. The goal is to manifest this divinity by controlling nature, external and internal. Do this either by work, or worship, or psychic control, or philosophy - by one, or more, or all of these - and be free. Doctrines, or dogmas, or rituals, or books, or temples, or forms, are but secondary details (Vivekananda, 2000<sup>[54]</sup>).*

All of us have them but they remain dormant to different extents. They can become manifest by one or more of the above means. Philosophy of Vedanta says that there is no distinction between brightness and darkness, between intelligent and ignorant, and between rich and poor; the differences are in the intensity of parameters which are, respectively, strength of light, knowledge, and wealth.

All that we are trying in worldly affairs is to upgrade our passions. In fact, a full-fledged human development comprises of all the following four stages: physical, intellectual, moral, and spiritual. The first two form our objective development while the remaining two are connected with spiritual development. The spiritual dimension accounts for our morality and provides our living a higher purpose as we mature. Objectivity is the basis of science, while subjectivity forms the basis of spirituality, where the rule of space, time, and causality (STC) is not applicable. One famous scripture says:

*Dhik balam khatra balam brahma teja balaysya balam.*

(Translated to mean: Physical and intellectual strengths are far inferior to spiritual strength. Spiritual strength overrides all strengths).

This means that spiritual strength (*Brahma teja*) is superior to physical and intellectual strengths. Since the body and mind do not allow for the further pursuance of physical and intellectual development in old age, we have only the remaining two possible developments, moral and spiritual, although they could have been attended to and developed at an earlier stage of life. Plato once said, "*When physical eyesight declines, spiritual eyesight increases*" (Chittester, 2008<sup>[13]</sup>). Carrel, a French surgeon, biologist, and Nobel laureate in Physiology and Medicine, 1912, also recognized this dimension of humans, apart from anatomical, physiological, emotional, and intellectual dimensions, which he elaborated on in his celebrated book, *Man, The Unknown* (Carrel 1938<sup>[11]</sup>). Spirituality concerns the development of our holistic being, raising us from petty worldly matters to a higher self, leading from a mundane life to a profound one. We are so immersed in the narrow picture and small details of things that we lose sight of the whole. We are so bogged down with the innumerable cares and minute details of living that we hardly enjoy the vast and variegated life that spreads before us. A rational mind tends to think he/she lives by virtue of the visible/sensible forces that he/she can control, but in fact he/she is governed

by power from unrevealed sources, power over which he/she has no control. Many things happen in our life not according to expectations for which we have worked hard. The total force of human being is not the resultant of his/her physical, intellectual, and spiritual forces (gross to subtle); it is the dominant one that is usually active, but over and above it, the subtler one is most active. This is the revelation from spiritually enlightened persons. It is often said that our real power comes from the heart not from the brain (Bhar, 2012<sup>[4,5]</sup>). If there be a conflict between heart and brain, it is advised to follow the heart. As Swami Vivekananda once said:

*The heart is great indeed; it is through the heart that come the great inspirations of life. I would a hundred times rather have a little heart and no brain, than all brains and no heart. Life is possible, progress is possible for him who has heart, but he who has no heart and only brains dies of dryness (Vivekananda, 2000<sup>[43]</sup>).*

Apart from physical or anatomical heart with which we are more concerned, human beings are characterized by two more vital functions/ roles of the heart. These are emotional and spiritual. They are not direct logical brain functions. Our entire life is a combination of these three, the logical, emotional and spiritual -objective and subjective together. It is true that the brain rules all the body's organs, including the heart. It is also true that brain helps us to think, imagine, speak, plan, engage in several activities simultaneously, and continues to function even when we are in sleep. However, medical science cannot explain how this situation of brain domination can occur despite the fact that it has been scientifically demonstrated that the heart starts beating in the unborn foetus before the brain actually starts forming.

On the other hand, we know that one who is carried along by the heart alone has to undergo many difficulties, for now and then he/she is liable to tumble into pitfalls. The combination of heart and head is what we want. I do not mean that a human should compromise his/her heart for his/her brain or vice versa. Let everyone have an infinite amount of heart and feeling, and at the same time, an infinite amount of reason. Is there any limit to what we want in this world? Is not the world infinite? There is room for an infinite amount of feeling, and so also for an infinite amount of culture and reason. Let them come together without limit, let them be running together, as it were, in parallel lines each with the other (Vivekananda, 2000<sup>[53]</sup>). Because power is effortless, it goes unseen and unsuspected. Force is experienced through the senses; power can be recognized only through inner awareness. It means that we are more than just our physical bodies.

Modern science has discovered that our brain changes throughout our age through neuroplasticity (Bhar, 2014<sup>[6]</sup>). The only necessity is that we expose ourselves to appropriate environment which may be either by studying the scriptures or association with enlightened persons. All mystics have taught that

the profound spiritual dimension is hidden in every human being, a sense of connection with a transcendent power. Immortality is hidden within us. Both mortality and immortality are established in this human body. Our power has degenerated through fragmentation and it can be regenerated by will force. Our scripture has directed us to that goal through the four so-called *Purusharthas* (aims of life): *Dharma* (righteousness), *Artha* (wealth), *Kama* (desire), and *Moksha* (liberation from earthly attachments), while the *param purushartha* is the freedom from body, mind, and spirit. The first three result in gaining earthly happiness, and involve earning livelihood ethically through educating oneself for the fulfillment of desires. This would lead to abiding happiness if pursued ethically, but it is not ever lasting. Through continued enjoyment of life, our sensory organs gradually, but inevitably, lose vigour. As a result, happiness is bound to decrease day by day. That is why the ancient *Rishis* directed us to pursue eternal happiness wholeheartedly in the last two phases of life by categorizing the entire life span into these four phases or *ashramas*: *Brahmacharya*, *Grihastha*, *Vanaprastha*, and *Sanyasa*. The first two stages are meant for preparation and worldly duties, which are appropriate and necessary for those stages. But, the emphasis here is on the latter two stages of life, *Vanaprastha* and *Sanyasa*, when leaving the physical and intellectual/working life, one is advised to pursue mental work for ultimate goal of life after delinking from earthly attachments. While the Westerner senior citizen faces the empty nest syndrome, the vanishing of work relationships, and the death of loved ones, and enters a retirement community like an elder/retirement home/institution, in the Indian context, the same life stage transformations are freely chosen and valued as modes of liberation. This phase of life can also be treated as a time to return to the community, guiding and supporting it with the inner wisdom that had been attained so far in this life, and also with the promise of unprecedented new opportunities.

### **Decline in physiological function, growth in psychosocial and spiritual dimensions**

As the functions of the body decline, we tend to focus on what we have lost rather than on the message the body is giving us: slow it down and listen inwards. There maybe a decline in physiological functions due to aging, but there remains the potential for continued growth in the psychosocial and spiritual dimensions. This is the ideal time to meditate. The metabolic changes of meditation arise from a natural reduction in metabolic activity at the cellular level, not from forced changes of breathing as in exercise. Circulation, especially in muscle and brain, is closely related to the metabolic requirements of tissues. Meditation provides an increased exercise tolerance and enhances neural functioning of the brain in ways that improve physical and emotional health, thereby providing relief from stress. It has also been reported that long-term meditative practices are associated with the improvement of general physiological function, sleep, and biological rhythms by increasing GH levels in blood, improvement of immunological parameters, etc., (Balaji *et al.*, 2012<sup>[2]</sup>). These physiological changes lead to psychological

benefits of enhanced physical and mental health, delay in aging process, and an enhancement of the feeling of well-being (Donovan *et al.*, 1997<sup>[17]</sup>). That is why Swami Yatiswarananda (Yatiswarananda, 2007<sup>[56]</sup>), one of the leading monks of Ramakrishna Mission of the last century, used to say our entire life is a spiritual journey. This latter aspect has also been recently discussed by Lavretsky (Lavretsky *et al.*, 2010<sup>[33]</sup>) and Dalby (Dalby, 2006<sup>[14]</sup>). Spiritual wisdom is mentioned by them. As a human being ages, he/she continues to acquire knowledge, starting from the gross and proceeding towards the subtle.

Coming into a physical world with a divine spirit is a challenge to us all; our body is of the earth but our spirit is of the divine creator. Hence, we are constantly being tugged apparently by two different “masters,” one earthly and the other cosmic. We are provided with two states of mind. The lower mind is preoccupied with the sensory world, whereas the higher mind is linked to higher knowledge or intuition, which is the creative lying in the spiritual regime, and so is boundless, where the earthly bondage has been cut off through higher knowledge of detachment, and so, rationality in reasoning commonly termed Space Time and Causality (STC) in the axiom of science is not applicable. The lower state of mind is the controller of our five sensory organs and in fact our mind has been termed the sixth sense organ in the scriptures. All worldly activities are under this STC. The higher mind is the extra sensual perception organ where actions are not subjected to quantification through STC (Bhar 2015<sup>[7]</sup>, Stevenson<sup>[51]</sup>). So is the evidence to suggest that other worlds or dimensions exist just beyond the range of our normal sensory perception, it is actually subjective experience, perceived through rigorous spiritual practice and so cannot be objectively verifiable by laymen. Let me further clarify this matter with the illustration of catching fishes with a net from a lake as given by the noted astronomer Eddington (Eddington, 1928<sup>[18]</sup>) at the beginning of the last century. Catching of fish is the acquired knowledge while the net is the sensory organ. One cannot catch all kinds of fishes from the lake. It is the characteristics of the net alone that determines the quality and mass of the fishes that can be caught. Hence, it is always the subject, the net quality, that determines the object. But, we remain unaware of this because our minds are not objectively conscious of the higher level.

Albert Einstein, who added value to the entire concept of science, once said: *Try not to become a man of success, but rather try to become a man of value* (Einstein, 1955<sup>[20]</sup>). The former requires mere intelligence, which can be corrupt, but to be a man of value takes character in the first place. Many people today are alive, vital, and active at advanced ages, may be old in their chronological age, but young in their impact on society. They have achieved this impact because they maintained values. Underhill, in her classic work, *Mysticism*, suggests that human beings are vision-creating beings rather than merely tool-making animals (Underhill, 2011<sup>[59]</sup>). They are driven by goals that are more than mere physical perfection or intellectual supremacy. A human alone has the capacity to know, understand,

express, visualize, realize, and actualize. These capacities could also serve as indications of the extent to which spirituality is manifested in our individual life. Spiritual intensity can be guessed from personal life patterns and the values one upholds. These values are based on truths both subjectively and objectively.

On the objective side, there are great scholars, litterateurs, scientists, musicians, politicians such as Lincoln, Shakespeare, Tagore, Einstein and Gandhi who contributed great values in their fields with longstanding acceptability, extending far beyond their lifetime. This makes us realize that the loss of our mind and degradation of certain organs is not an inevitable effect of the aging process. So, only those who stick to idealism and pursue higher values beyond self, especially those that are good for humanity, will be everlasting to civilization. The work of great men are properly judged and valued usually after their time. It is only those ideas that touch higher values that are remembered. The great men talk ahead of their time; this is why, since it opposes existing custom, apart from a handful of followers, the rulers and masses are often against it. History offers evidence for the fate of such past great spiritual teachers. For example, Jesus Christ was not properly understood in his time, so also Swami Vivekananda. If we take a more recent example, Swami Vivekananda's message is being properly valued today only after his 150<sup>th</sup> birth anniversary.

Hence, the quality of human beings and the merit of their work are best judged by time. In scientific research too, a discovery is also best judged with the passage of time: because with time, people know about it, refer to it, and utilize it only if it is proven of any worth. Only time-tested theories ultimately stand. That is why, even after many years of publication, a research paper of merit continues to be referred to by others, irrespective of the existence of the person concerned. Further, out of the billions of books written to date, we recall only those which discuss eternal values. Think of Tagore's and Shakespeare's works in this connection, as also the examples of Ramayana and Mahabharata, the Bhagvad Gita, and the Bible: all of them refer to eternal values. They are still relevant to our society and will so continue in the years to come. This is seeking and discovering the latent spiritual dimension in us. Swami Vivekananda<sup>[54]</sup> said latent and eternally lasting spiritual truth is exposed with time and time alone. The values inculcated in the said scriptures are still relevant to our present society.

Aging of the body is basically a maintenance problem and so it can be postponed through thorough and frequent maintenance, even though it brings on a cascade of ills and health problems leading to deterioration of physical, mental, emotional, and social dimensions of life. We have dealt with a solution of the problem mainly philosophically in the light of Indian scriptures of eternal values without entering into traditional bioethical issues. With a meaningful reason for existence, life can be extended. Examining the scientific perspectives on aging, some common manipulations for its extension can indeed be done. These are calorie restriction, vitamin and antioxidant

treatment, exercise and hormonal interventions, etc. Undefined biological extension of life is out of question but those who dedicated to welfare activities and stick to eternal value get apparent extension of life span long after physical termination.

It is basically our lifestyle factors that determine our longevity. These are already elaborated upon under different headings: physical exercise to maintain good health, eating habits that prevent degeneration, for example, plenty of organic vegetables and fruits with minimal animal meat, combined with positive ways of thinking and feeling. It might be interesting to conclude with what the elderly Japanese people believe, being a nation with the highest average life span in the world. They prefer to live healthy and happy, not for long, but with the wish to pass away without giving any trouble to others, well-wishers, or relatives (Nara, 2009<sup>[41]</sup>).

### **Concluding Remarks (See Figure 1)**

1. Examination of the scientific perspectives on aging with some common manipulations permits longevity, but there is a need to upgrade mental, emotional, and social dimensions of life. This requires fixing a meaningful goal of life early in one's career so as to upgrade attitude through value-based activity without blind submission to sensory enjoyment.
2. From the perspective of the four human developments, our physical body is the grossest; there is no ultimate solution to stop its decay. Death is definite. Even when death occurs, a small fraction of our cells have already marched toward the future through our children produced through ova and sperms.
3. Dedicated scientific researches would certainly be there to further longevity, but a change in attitude as mentioned could perhaps make the end more rewarding and satisfying. Science has done a great deal in all these fronts: calorie restriction, vitamin and antioxidant treatment, exercise, and hormonal interventions, etc. But, for fruitful progress, one needs to upgrade attitude through value-based activity without blind submission to sensory enjoyment.
4. On the other hand, the great intellectual development of Tagore, Einstein, etc., is indeed subtle and lasts for centuries; while the subtlest spiritual message of Buddha, Christ, and many other spiritual teachers as demonstrated in their lives are eternally true and everlasting. The litterateurs, artists, and scientists are remembered for their lasting creations. Good scientific work keeps on getting citations for many years.

### **Take Home Message**

- The ultimate goal in life is longevity with well-being.
- Developing and maintaining goal-oriented sustainable good habits are of importance not only for long-term healthy well-being, but also for healthy

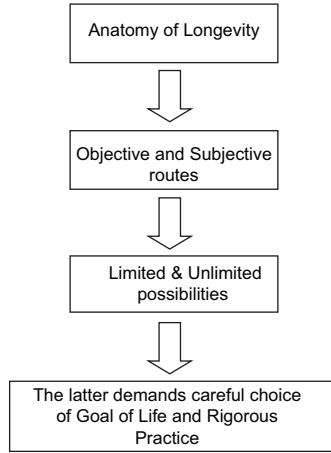


Figure 1: Flowchart of paper

genetic modification and for liberation from bondage. This is *Abhyasa* and *Vairagya* (habit and renunciation) often referred to in scriptures (Bhar, 2014<sup>[6]</sup>).

- As it has far reaching consequences, one should keep in mind involvement in welfare activities at gross worldly or subtle level (Editor, 1973<sup>[19]</sup>).
- Physical immortality is impracticable. Though remarkable progress has been made on the identified major causes of aging, namely, failure of cellular mechanisms, decreasing secretion of body hormones, and environmental factors such as quality of diet and lack of body movement, one has to accept limitations, and within that limitation, one must play one's role so that he/she is remembered for that act.
- Different parts of the body grow old at different rates. "It is when our physiological activities begin to weaken that our minds attain the summit of development" says Carrel, (Carrel<sup>[11]</sup>). Only at this time do our insight, judgment, reasoning and perspective develop and mature. So, one is required to fruitfully utilize the time in creative and idealistic activities as supported by age-old Hippocrates' concept (as quoted in Ferrucci and Simonsick, 2006<sup>[23]</sup>) and in neuroplasticity as well (Bhar 2014<sup>[6]</sup>).

### Conflict of interest

None declared.

### Declaration

This is my original unpublished piece, not under consideration for publication elsewhere.

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### **Questions that this Paper Raises**

1. Is living longer, if not indefinitely, possible through careful and cautious control of active living habits?
2. Does trouble-free longevity need to be explored through need-based researches?
3. Is it worth living longer for life's sake without a definite purpose?
4. Is there a need to fix a goal of life early in career to pursue?
5. Can we not be happy with what we have achieved with fruitful utilization, rather than invite unhappiness through hankering for more?
6. What type of scientific research into telomeres, genetics, antioxidants, diet, lifestyle modifications, etc., will prove key factors in our search for longevity with well-being?

### About the Author



*Dr. G. C. Bhar is one of the pioneers of laser researches in India and, according to CSIR (National Institute for Science and Technological Development Studies). He tops the list of 10 identified prolific authors in experimental laser research and applications in the first 25 years of laser researches in India. After his Doctorate in Laser Physics from Southampton University under a Commonwealth Fellowship in 1973, he set up a Laser Laboratory at his parent Burdwan University, which earned prestigious research collaborations e.g. Indo-USSR, Indo-US, Indo-Japan and Indo-Israel. The UGC, through its evaluation, graded this laboratory as one of the best in India in 1990. He is credited with about 150 publications mostly in international peer reviewed journals and his papers have so far earned over 1200 worldwide citations. On retirement from Burdwan University he joined the Ramakrishna Mission Vivekananda University (RKM) at Belur as a Research Professor (Honorary) working on Philosophy of Sciences. Some of his recent publications include: 'Laws of Karma and Thermodynamics', 'Roles of Brain and Heart in Life Management'. 'Time, Our Constant Companion', 'Mind and its Control: Scientific and Vedantic Viewpoints', 'In Search of Possible Physical Laws in Spirituality' etc.*