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	'BRAHMACHARYA" (CELIBACY) PROLONGS LIFE SPAN BY REDUCING THE AGEING PROCESS	
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INTRODUCTION

Brahmcharya followed in Hinduism means spotless chastity. Brahmacharya has a profound meaning (Brahmaojas/energy, supreme force; Charya-to follow). Since thousands of years "Brahmacharya" has been in practice in Indian culture. All Hindu scriptures emphasise on brahmacharya. Practice of brahmacharya increases one's power, all sickness is destroyed and life is lengthened. Hindu sages and saints practised brahmacharya entire long life. During the period of learning Veda (Holy Book of Hinduism) students learn to practice Brahmacharya. A minimum of 12-48 years are essential for the complete study of Vedas. One who observes unbroken brahmacharya for a period of 12 years gains power and realises God. A student of Vedam may need to spend his whole life avoiding contacts with opposite sex. While preserving the energy, strength and vitality of mind and various organs, one can lead a happy, energetic and healthy life. Maintaining brahmacharya throughout life gains great intellectual and spiritual power, where sexual energy is transformed into spiritual energy. A brahmachari's mind will be clear and brain will be superb. Brahmacharya literally means that mode of life which lead to the realization of God (Gandhi 1948). A "Brahmachari", is the one who correctly practices "Brahmacharya" does not look or talk with any woman with an intention of sex (Bijlani 2004).

"Brahmacharya" differs from celibacy not by simply restricting the deed of abstinence but also in its thoughts and words related to sex (Guruprasad 2018; Hebbar 2012). A married couple is worthy of being considered dared brahmacharis if they never think of sexual intercourse except for the purposes of procreation. Such an intercourse is not possible unless both parties desire it. What is true of physical thing is equally true of spiritual things (Gandhi 1948). Celibacy is "an unmarried state of a man especially that of one under vow". A celibate is who is not married and not having sex mainly for religious reasons (Schwarz et al. 1992).

Ayurveda, the oldest medical practice in the world, teaches "Brahmacharya" as the best means for prolonging life span with proper health (Sharma 1983). Ayurveda says semen has a vital role and advise for its preservation. It is essential for the stability of mind and the body (Swami 1999). Conservation of semen has a direct relation with energy (Lad 2008). The complete control of sexual energy is possible by strict abstinence from sex and rigid control of thought and desires (Taimini 1961). Those belonging to the age above 16 and below 79 are advised not to conduct intercourse to have a prolonged life (Sharma 1983). Mental exertion will not tire him easily nor will he show the ordinary signs of old age. Sexual desire has its root in one's thought. Therefore, complete control over sex is necessary. Erotic literature should be avoided. Food should be just to sustain the body (Gandhi 1948). Brahmacharya is a purposefully done intervention in the reproductive phenomenon, which increase the life span (Shivananda 1997).

Many studies are not conducted on celibacy though practised by some married people (Laumann et al. 2000). Donnelly (1993) reported 16% of married persons were sexually inactive. His detailed studies showed several men were forcibly made celibate for doing their job away from their partners (Donnelly et al. 2001). In some, involuntary celibacy, cause worry after a certain length of time (Donnelly et al. 2001). Poor relationship with the partner is another likely reason for abstinence with decrease interest in sex. Reason for decreased frequency of sex in older age may be due to noninterest in sex. Today celibacy is practised by people for cultural and or religious reasons or out of fear of HIV, other STDs or to exclude pregnancy (Leigh, Stall 1993).

Ageing is a bridging link from reproduction to death. Randou and Chang (2012) correctly printed out aging has a mystery in biology. In their review they came out with some suggestions for maintaining youthfulness. Senescence or biological aging is a gradual deterioration of body and its functional capacity. Longevity may result from a lifelong (more than 100 years) Interaction between genetic and environmental factor (Lescai et al. 2009). Sexual reproduction lead to complicated events leading to ageing process. This is universally applicable to animals and plants.

Widely accepted general rule reads, life span is inversely proportional to metabolic rate of the organism. A look at the nature clearly shows that life of plants and animals is meant for producing progeny followed by death.

Plant kingdom

Several examples can be seen in plant kingdom. The best example is a banana plant which grows to give birth to "young ones" from root and produce one set of bananas which become fruits and mother banana plant falls. Sexual and asexual reproduction are present among eukaryotic plants. Several species lack sexual phase and they have the capacity to proliferate without detectable senescence. Noggle and Fritz (1983) showed the growth retardants are responsible for accelerating flowering in some plants. Flowers show close to an end of its life. In case of perennial trees and shrubs flowering is followed by sleep in winter. Senescence of premature leaf negatively affect its yielding. In case of rice its yield depends on proper growth of the plant. Abscisic acid (ABA) is the responsible initiating factor of a chain of chemical reactions leading to the process of senescence (Liang et al. 2014). Authors made a strong case of ABA for an important role in senescence of plant organs such as leaves, fruits, flowers etc. (Salisburry, Ross 1999). Senescence is determined by the level of ABA. Experimental work carried out by different group of workers shown that addition of abscisic acid proved this plays a key role in stress tolerance at cellular layers (Tougane et al. 2010).

Heavy crops on the same tree, in successive years are rare, too many fruits on a tree in one year means too little in the next,

worse is that it permanently weakens the trees (Davidson 1929).

Hormones like auxins have a major role in ageing associated which promote fruit development. It causes root and stem growth arrest. There is an interaction with auxins and metabolic processes accompanying senescence.

Animal Kingdom

Unicellular animals reproduce sexually and asexually. A long living organism shows slow reproductive rate and vice versa. In case of asexual reproduction like fission the biological ageing is restricted. In nature, it looks that introduction of sexual reproduction was a measure to curtail longevity of the animal. Biological ageing is not present among organisms which multiply by fission. Among lower animals fission is more as reproductive process and sexual phase is limited.There is an interaction of metabolism accompanying senescence. The evolutionary advantage of sexual reproduction is with cell senescence.

In many species where sexual phase is absent no detectable senescence is present. All Organisms maintaining sexual reproduction undergo a stage of decline in normal health status finally leading to death.

Walker (1952) discussed in detail about reproduction and its relation to aging. From lower animals some informations are gathered regarding the life span. Experiments conducted in sea urchin proved lesser temperature in surrounding caused the prolongation of its life span. Experiments conducted among castrated salmon showed they increased their life span three fold. This is termed accelerated ageing (Morbey et al. 2005).

Man

The influence of active reproductive period is a crucial factor in the sexual union where male is the active participant. A large amount of energy is spent during spermatogenesis. Male is capable of having sex throughout. If he is abstained from coitus, he saves large amount of energy. Authors opined for increase in the longevity conservation of natural life rhythms is very essential from early age (Marcado-Saenz et al. 2010). Though this is applied to Brahmachari, a case for evaluation on their long life is not done. Here authors bring the facts about body and shall be considered in terms of Brahmacharya.

Energy requirement for production of each sperm is to be considered. Number of sperms present in each ejaculation varies according to species. In a normal person the number is > 40 million/ml of semen (Prasad et al. 2021; Skandhan et al. 2010; 2017) whereas in bull it is >11.01 million/ml (Hafs et al. 1959) and in African elephant it is >200 billion/ejaculate. The role of hormones and energy expenditure for gamate production, are to be pondered while analysing the ageing process in human beings.

McGraeth (2020) reported that females are capable of living longer life (18.6%) than males. In general population, it is known that out of ten people who are above hundred and ten years old, nine are female. Davis et al. (1998) sex ratio non-sex ratio of male to female births 1.06: 1, has come down in last decades. In the recent past this ratio has significantly reduced in different industrialised countries. James (1995) observed that stabilising sex ratio is under coital rates and psychological. Among human beings sexual activity is an important function equivalent to that of his mental, physical and social health. Which modulates quality of life of all (Mc Call-Hosen Feld et al. 2008; Smith et al. 1997).

In a U.S population survey that non possessed high quality of

sexual activity, good quality of sexual life and interest in sex when compared with women. There was this gender gap. This widened with age. Sexual life and interest in sex were positively associated with health throughout life (Lindau, Gavrilova 2010). Lindau and others (2007) observed sexual activity in both gender decreased as age advanced. Women were more reluctant to report to others about their sexual problems. Sleep enhance ageing. The brain tissue is having the longest life span. It might be due to its inability to reproduce (Walker 1952). Also comparatively brain ageing is earlier in male than in female.

Sex hormones play important role in growth, development and ageing. Testosterone plays a key role in reproductive as well as normal health Physiology. Reproductive functions of testosterone include growth of accessory male sex organs, development of secondary sex characters like hair growth, masculine voice, sperm production etc. Testosterone, male hormone which generates restlessness, agitation and violence and that causes strain, stretch of body and utilization of a large amount of energy. Testosterone and Y chromosome shortened life to 10%. Activity is not increasing the age which is decreasing. Testosterone is anabolic in action. It directly stimulates DNA and m RNA polymerase and increases the RNA and incorporation of amino acids to protein. Testosterone induces muscle fiber hypertrophy. Which improves the muscle protein. Muscular development, bone growth and RBC production are also promoted by it. All these factors are in favour of good health status. Ageing in man is associated with decreased testosterone level and testicular function (Barrett et al. 2019). Regular sexual activity is done where testosterone provide protection against some Physiological changes in ageing. Repeated regular sexual activity should lead to the earlier death of the hormone producing cells which lead to the earlier death of the person (Masters, Jhonson 1966). Retarded reproductive activity delays the ageing.

It is also noteworthy that, tooth erosion is a well-documented mechanical senescence. The rasayana therapy promoted by Ayurvedic Medical Speciality, claims that it could prevent ageing and grace humanity with long life span (Balasu bramani et al. 2011).

Generally women outlive men, due to premenopausal hormone protection. Their reproductive activity is seasonal and in case of man it is present throughout. The female requires a large amount of energy at the time of conception, zygote formation and embryo development (Noggle, Fritz 1983). The study of Mason et al. (2009) reported that transplantation of young ovary in ovariectomised mice resulted a positive effect of longevity.

Reproductive senescence was tightly controlled by facts that enhance female longevity (Kaplan 1995). Fertile years have not been prolonged in the cohort of women whose life expectancy has increased so dramatically in this century (Kaplan 1974). Among centenarians, females outstand males (Passarin et al. 2002). In women bone mineral density (BMD) is considerably decreased in the post menopausal stage. Replenishing it, supplements is not available except for testosterone.

Generally body's functional decline start after sexual development roughly at the age of 19 and some functions decline sooner. The study of Passarin and others (2002) showed initiation of senescence is possibly due to invasion of pathogens leading to diseases or by the natural physiological changes. Williams (1957) proposed the theory of Antagonistic pleiotropy explaining harmful biological changes seen in old age caused by selection for pleiotropic genes which are beneficial during early life but harmful at later stage. The best example is gene codes which is responsible for calcium deposition in bones. Which gives strength in younger age. In later life the deposition of calcium in arteries cause negative atherosclerotic effects.

Each generation is shortened its life due to overload usage of energy. Tissues have limitation of regeneration, may be in number. It is accelerated or slowed down by different factors. Repeated regular sexual activity may lead to earlier death of hormone producing cells followed by earlier death of the person. A reduction in the level of the testosterone may lead to its pathology and death of Leydig cells. Testosterone makes a man to feel a state of weakness, tiredness, poor appetite, decreased sexual desire, reduction or loss of potency, irritability and impaired ability to concentrate. This state shall be reversed by testosterone injection.

Some cells are liable to degenerate but germ line cells are not. Testosterone and Y chromosome shorten life of a man by 10%. A person with high level of testosterone is known to be susceptible for infections. The probable explanation is, this hormone increases the basal metabolic rate of body. Free radical accumulation due to increased metabolic activity by hormonal action reduce life span of man. Vitamin C, a major antioxidant in plasma, will get depleted when steroid genesis become excess that is, which will deplete Vit C thus causing accumulation of free radical and other degenerating effects(Vasudevan 2019).

Study of Brincat et al. (1983) observed that hormones eostrogen and testosterone prevent the decrease in the content of collagen in the sin s seen within aging. Bronson (1979) studying on mammalien reproductive ecology author observed that ovulation is females, adult or prepubertal is accelerated with male urinary cues. Similarly, female urinary cues may be responsible for increasing phermonal potency in adult males.

A cell of a new born will divide average 30 times before its cytoplasmic function lost and dies. In a normal average man the metabolic activity reach its peak at the age of 30. If the peak value is attained earlier due to hormonal action the rapidity of cell division will increase and the free radical accumulation will be at a rate much faster in comparison. This would have a bad effect on life span of aging expressing the early deterioration process leading to death (Dhami, Sreevastav 2008). As an example over load of pancreas lead subsequent to the exhaustion of the function of it and stoppage of functioning leading to diabetes. This is a clear example showing increased work load lead to early decline of cells.

The decline in working memory in age related condition shall be eliminated by addressing the molecular needs prefrontal cortex circuits (Wang et al. 2011).

A point to be considered at this level is Spermidine. This is a natural polyamine recognized as a promoter of cellular growth present in abundance inside the cell of all organisms from bacteria to men (Pohjanpelto, Raina 1972). Its level declines during the process of aging. Experimentally added spermidine extended the life span of yeast, flies, worms, and human immune cells. In essence it is now recognised as an universal anti-ageing drug.

Many anti-aging effects of spermidine are connected to induce cytoprotective autophagy. Ensuring general cell homeostasis and proteostasis. Which helps directly in the degradation and removal or recycling cytoplasmic material of damaged, potentially toxic organelles and harmful protein aggregates. If it is accumulated which leads to aging. Thus spermidine increase the life span. Its depletion from cells lead to early necrotic death (Eisenberg et al. 2009).

Spermidine is present in human diets in different varying amounts (Madeo et al. 2010). Good dietary sources of spermidine are aged cheese, mushrooms, soya products, legumes, corn, and whole grains (Atiya et al. 2011). Exogenous supply of spermidine prolongs the life span of several organisms. This is proved in case of mammalian cells and authors suggest this may be used for increasing life span (Madeo et al. 2010).

Spermidine is known to reduce various molecular and physiological age-associated adversities. In clinical trials it was showing low toxicity yet strong efficacy. Increased uptake of spermidine has protective effects against cancer, metabolic disease, heart disease, and neurodegeneration (Madeo et al. 2018). It is known extra supply of spermidine prolongs the life span across species and counteracts age-associated pathologies such as cardiovascular disease, neurodeg eneration, and cancer. Spermidine has also been reported to protect the heart from aging and prolong the lifespan of mice, while in humans it was correlated with lower blood pressure (Eisenberg et al. 2016). Among Brahmacharis spermdine level in blood may be high. However no record is available to show the level of spermidine in them.

In conclusion, authors have detailed the different mechanisms of body function and the energy expenditure during sexual activities. Brahmacharis save energy as not having activities related to sex and also their eating items are rich in spermidine which essentially increase the chance to have a prolonged life.

SUMMARY

Brahmacharya is well advocated in Hinduism. The present review deals with Brahmacharya in detail. Thousands of years back, Ayurveda, the oldest medical practice, advocated "Brahmacharya" for healthy and increased life span. "Brahmacharya" is much more than celibacy. A Brahmachari, who practices Brahmacharya does not look or talk with a woman in terms of sex.

Authors have evaluated different aspects of the normal body function which may be modified and considered as in Brahmacharis who have a prolonged life. However no exclusive study is done to reveal the secrets of long life of Brahmacharis.

REFERENCES

- Atiya AM, Eric P, Roger S, Agneta Y. "Polyamines in foods: development of a 1. food database". Food Nutr Res. 55: 5572,2011 Balasubramani SP, Venkatasubramanian P, Kukkupuni SK, Patwardhan B.
- 2. Plant- Based Rasayana Drug from Ayurveda. Chin J Integr Med 17(2): 88-94, 2011
- Barrett KE, Barman SM, Brooks HL, Jason X-J Yuan. Review of Medical Physiology.edn. 26, 2019 Bijlani RL. Understanding Medical Physiology. A Textbook for Medical
- 4. Students. New Delhi, Jaypee Publications, edn. 3, 2004
- Brincat M, Moniz CF, Studd JW, Darby AJ, Magos A, Cooper D. Sex hormones and skin collagen content in postmenopausal women. Br Med J (Clin Res Ed) 287 (6402) 1337-8 1983
- Bronson FH. The Reproductive Ecology of the House Mouse. Quart Rev Biol 6. 1979:54:265-271
- Davis DL, Gottlieb MB, Stampnitzky JR. Reduced ratio of male to female birds in several industrial countries. A sentinal health indicator? JAMA 1998;279: 1018-1023
- Davidson HC. Fruit culture. Handbook of Practical Gardening. London, John 8. Lane the Bodley Head Limited. 1929, p2-8
- Dhami PS, Sreevastav. Pradeep's Book of Biology, Growth, Repair and Regeneration, Ageing and Death. New Delhi, S. Dhami and Dhami 9 Publication, 2008
- Donnelly D, Burgess E, Andarson S, Davis R, Dilliard J. Involuntary Celibacy: A life course analysis. J Sex Rese 2001;38: 159-169
- Donnelly DA. Sexually inactive marriages. J Sex Rese 30:171-179,1993 11
- Eisenberg, Tobias; Abdellatif, Mahmoud; Schroeder, Sabrina; Primessnig, 12. Uwe; Stekovic, Slaven; Pendl, Tobias; Harger, Alexandra; Schipke, Julia; Zimmermann, Andreas (2016). "Cardioprotection and lifespan extension by the natural polyamine spermidine". Nature Medicine. 22 (12): 1428–1438
- Eisenberg T, Knauer H, Schauer A, Buttner S, Ruchenstuhl C, Carmona-13. Gutierrez D, Ring J, Schroeder S, Magnes C, Antonacci L, Fussi H, Deszcz L, Hartal R, Schraml E, Criollo A, Megalou E, Wieskopf D, Laun P, Heeren G,Breiten Bah M,Grubeck-Loebenstein B, Herker E, Fahren Krog B, Frohlich U, Sinner F, Tavernarakis N, Minois N, Kroemer G, Madeo F. Induction of

VOLUME - 10, ISSUE - 07, JULY- 2021 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Autophagy by spermidine promotes longevity. Nat Cell Biol 11:1305-1314,2009

- Gandhi MK. Key to Health. Ahmedabad, Navajivan Publishing House, 1948
 Guruprasad K. Brahmacharya-The conceptual analysis. World j pharma res7(6):194-203,2018
- Hafs HD, Hoyt RS, Bratton RW. Lipido, sperm characteristics, sperm output, and fertility of muture dairy bulls ejaculated dairy or weekly for thirty-two weeks. Journal of dairy science 42(4):26-636, 1959
- 17. Hebbar JV. Ashtanga Hrudaya Sutra Sthana, Ayurvedic Text Book. e-book 2012
- 18. James WH. What stabilizes the sex's ratio? Ann Hum Genet; 59:243-249, 1995
- Kaplan HS. The Sexual Desire Disorders. New York, Brunner-Routledge 1995
 Kaplan HS. The New Sex Therapy. Active Treatment of Sexual Dysfunctios. Brunner-Routledge, New York, 1974
- Lad V.Sapthadadukkal(the 7 elements), the Science of Self Healing, a Practical Guide. New Delhi, Motilal Banarasidas Publisher Private Limited, 2008
- Leigh B, Stall R. Substance use and risky sexual behaviour for exposure to HIV. American Psychologist 48(10):1035-45 1993
- Laumann EO, Gagnon JH, Michael RT, Michael S. The social organization of sexuality: sexual practice in the United State. Chicago, University of Chicago Press 2000
- Lescai F, Blanche H, Nebel A, Beekman M, Sahbtou M, Flachsbart F, Slagboom E, Schreiber S, Sorbi S, Passarino G, Franceschi C. Human longevity and 11p15.5: a study in 1321 Centenarians. Eur J Hum Genet 2009;17(11):1515-1519
- Liang C, Wang Y, Zhu Y, Tang J, Hu B, Liu L, Ou S, Wu H, Sun X, Chu J, Chu C. OsNAP connects abscisic acid and leaf senescence by fine-tuning abscisic acid biosynthesis and directly targeting senescence-associated genes in rice. Proc Natl Acad Sci 2014;111(27)10013-10018
- Lindau ST, Gavrilova N. Sex, health, and years of sexually active life gained due to good health: evidence from two US population based cross sectional surveys of ageing. BMJ 9:340,2010
- Lindau ST, Schumm LP, Laumann EO, Levinson W, O'muircheartaigh CA. A study of sexuality and health among older adults in the United States. N Engl J Med 357:762-774,2007
- Madeo F, Eisenberg T, Buttner S, Ruckenstuhl C, Kromer G. Spermidine: A novel autophagy inducer and longevity elixir Autophagy 6:160-162,2010
- Madeo F, Eisenberg T, Pietrocola F, Kroemer G. spermidine in health and disease 359(6374),2018
- Marcado-Sanez S, Ruiz-Gomez MJ, Morales-Moreno F, Martiez-Morillo M. Cellular aging: theories and technological influence Braz Arch Biol Technol 2010; 53(6):1319-1332
- Mason JB, Cargell SL, Anderson GB, Carey JR. Transplantation of young ovaries to old mice increased life span in transplant recepients. J Gerontol A: Biol Sci Med Sci 64 (12): 1207-1211,2009
- Masters W, Johnson VE. Human Sexual Response. Boston; little, brown and Co,1966
- Mc Call- Hosen Feld JS, Jaramillo SA, Legault C, Freund KM, Cochrane BB. Correlates of sexual satisfaction among sexually active post menopausal women in the women's health initiative_observational study. J Gen Intern Med 23:2000–2009, 2008
- Mc Grath M. Mammal study explains 'Why female live longer' BBC News, March 2020
 Morber Y Brassil CE. Hendry AP Banid Senescence in Pacific Salmon. Am
- Morbey Y, Brassil CE, Hendry AP. Rapid Senescence in Pacific Salmon. Am Naturalist 5:556-568, 2005
 Noggle GR, Fritz GJ. Intorductory Plant Phisiology. New Delhi, Prentice Hall of
- Noggie GR, Fritz GJ. Inforductory Plant Philsiology. New Deini, Prentice Hall of Indian Private Limited, 1983
- Passarino G, Calignano C, Vallone A. Male/female ratio in centenarians: a possible role played by population genetic structure. Exp Gerontology 2002;37:1283-1289
- Pohjanpelto P, Raina A. Identification of a growth factor produced by a human fibroblasts in vitro as putrescine. Nature New Biol (1972)235:247
- Prasad BS, Skandhan KP, Pawankumar G, Mehra BL, Singh G. Level of gold in semen at gold mine area and non-gold mine areas. Global J Res Analysis, 2021 (Under Publication)
- Rando TA, Cheng HY. Aging, Rejuvenation and Epigenectic Reprogramming: Resetting the Aging Clock. Cell 148: 46-57,2012
- Salisburry FB, Rose CW. Plant Physiology. New Delhi. CBS Publisher and Distributors, edn. 3,1999 p345-346
 Schwarz C, Davidson G, Seaton A, Tebbit V. Chambers English Dictionary,
- Schwarz C, Davidson G, Seaton A, Tebbit V. Chambers English Dictionary, New Delhi Allied Publishers, 1992
 Sharma PV (Editor): Caraka Samhitha. Varanasi, Chaukambha Orientalia,
- Shiranada V (Dalo), Calada Saminina, Yatanisi, Charachisha Chendula, 1983
 Shirananda SS. Practise of Brahmacharya . Shirandha nagar, The divine life
- society 1997
 Skandhan KP, Sumangala B, Sahab Khan P, Amith S, Avni KPS. About gold in
- human semen. International J Ayur Res 1:220-221, 2010 46. Skandhan KP Valsa J, Sumangala B, Avni KPS, Jaya V. Gold in semen: Level in
- seminal plasma and spermatozoa of normal and infertile patients. Alexandria J Med 53:31-33, 2017
- Smith DG, Frankel S, Yarnell J. Sex's and death: Are they related? Finding from the CAERPHILLY cohort study. BMJ 315:1641 – 1644, 1997
- Swami M. Hata Yoga Pradipika . Munger, Yoga Publication Trust, 1999
 Taimini IK. The science of yoga Madras, The Theosophical Publishing House
- Tomani K. Komatsu K. Bhayan SB, Sakata Y. Ishizaki K. Yamato KT, Kohchi T.
- Takezawa D. Evolutionary Conserved Regulatory Mechanisms of Signaling in Land Plants: Characterization of Abscisic acid insensitive, like Type 2C Protein Phosphatase in the Liverwort Marchantia polymorpha. Plant Physiology 152:1529-1543, 2010
- Vasudevan DM, Sreekumari S, Kannan Vaidyanathan. Text Book of Biochemistry for Medical Students. New Delhi, The Health Science Publishers, 2019
- Walker K. Commentary on Age. London, Jonathan Cape, p 35-36, p 45;1952
 Wang M, Gamo NJ, Yang Y, Jin L, Wang XJ, Leubach.M, Mezer JA, Lee.D,
- 18 ቋ GJRA GLOBAL JOURNAL FOR RESEARCH ANALYSIS

Arnsten A. Neuronal basis of age related working memory decline. Nature 476:210-213, 2011

 Williams GC. Pleitropy, natural selection, and the evolution of senescence. Evolution 11(4): 398-411, 1957