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To understand yoga's effects on reverse aging in terms of telomere length & telomerase activity: A narrative review

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***Abstract*---**A challenge in front of is the rapid aging of the population. Aged population contributes the largest in the spectrum of chronic disorders. Various therapies have been studied to determine their effect on longevity or healthspan.However, ageing experts are focusing about there research on methods that work against by the organic sequence of the ageing procedure in order to postpone it, and the results, as well as the side effects, of these methodologies are unknown.Yoga is a comprehensive practise that promotes health by incorporating dietary, lifestyle, behavioural, but also psychological therapies. Yogic intervention is to restore all the system's homeostasis and function simultaneously at the body, mind, and spirit levels. A search of the literature was made by using keywords such as: " Yoga" OR "asana" OR "pranayama" OR "meditation" OR "mindfulness" OR "reverse aging" OR "telomere" OR "telomerase enzyme" OR "oxidative stress." A total of 17 papers are set in this review for evaluation through PUBMED database search. This review shows that Yogapositively affects length of telomeres and telomerase enzyme activity. Yoga is critical in reversing the ageing process by reducing the signs or symptoms of ageing.. According to the studies reviewed in this paper, the practice of Yoga seems to facilitate reverse aging through increasing telomere length, telomerase activity. However, studies in this field are limited and with no Yogic text references and physiology. There is a need for additional research on reverse aging is needed to authenticate its application and to find a simple, convenient

and costless alternative to improve longevity and to reduce side effects induced by any other treatment. Yoga is one of a simple, convenient, and costless alternatives to relieving human beings naturally from all sufferings of life.

Keywords---yoga, reverse aging, healthspan, longevity, telomere length, telomerase enzyme.

Introduction

The global population continues to expand at a breakneck pace. Seniors are indeed a rapidly growing segment of the global population. Today, 8.5 percent of the world's population is elderly.. As reported by "An Aging World": 2015, the percentage will be about 17 percent of the world's population by 2050. In 1996, the elderly founded more than 13% of the population and reported that it would double by 2030[1,2]. A challenge in front of is the rapid aging of the population. People live longer but not healthier as disability and illness are connected with an aged population and contribute the largest in the spectrum of chronic disorders[3]. Various therapies have been studied to determine their effect on longevity or healthspan.Nonetheless, ageing experts are focusing there own studies on strategies and solutions it against natural progression of a ageing process in an attempt to delay it, and the outcomes and adverse effects of the these procedures are unknown.. The prevalence of age-related problems in older adults is extremely high (cardiovascular disease, lung disease, stroke, malignancy, osteoporosis, and musculoskeletal disorders). The expenditures of aging have also gone up exceedingly. Recent research powerfully directs that proper lifestyle interventions such as exercise, stress reduction, and diet help reverse aging,[4,5] as phenotype results from the genotype and environmental factors like diet and lifestyle.[6] Approaches that reduce oxidative stress and psychosocial stress and promote homeostasis may be essential for achieving successful aging. Aging is the progressive physical, mental, and social changes in an individual that weaken biological functions, adapt to the environment and create metabolic stress.[7] Old age is the continuous weakening of bodily structure and functions (cardio-pulmonary functions, diabetes, vision, postural defects, and reproductive functions) over time [8,9,10,11,12] with increased risk of mortality.[13]

Changes Induced During Aging

As aging is the progressive decline in bodily structure and functions. There are various types of changes that occur from cellular to organ level and physical to mental level during an aging process like molecular changes, pathological changes, psychological changes, but there is no clear evidence of which molecular, cellular, or physiological changes are the most important cause and how they influence one another is usually uncertain[14].

Molecular Changes

Most changes in adults' lifespan are due to genetic variation or variation in DNA sequence like mutations, deletion, translocation, duplication, inversions, etc.

which causes alterations in human anatomy and physiology,such as immune system, endocrine, and neurological system dysfunction, which results in a variety of disorders. A healthy immune system, endocrine system, and nervous system all contribute significantly to survival in advanced or old age.[15]

Pathological Changes

Various changes such as the changes in structure and functions of the brain and other neurodegenerative disorders have also been shown with Aging.[16] various types of cancer, cardiopulmonary diseases, diabetes, metabolic diseases, osteoporosis, stroke, arthritis, and Parkinson's disease as the elderly population is contributing the largest to the spectrum of chronic diseases.

Psychological Changes

Age-related psychological changes occur, such as the improper functioning of cognitive processes such as (attention, concentration, problem-solving, perception, imagination, and memory) and variations in sleep patterns .[17] Elderly people also associated with various mental health problems like stress, anxiety, depression to schizophrenia.

Factors that Encourage Biological Aging

Various factors encourage abnormal and pathological aging.Nine hallmarks of ageing have been identified, such as genomic instability, telomere attrition, epigenetic changes, lost opportunity of proteostasis, dysregulated nutrition sensing, mitochondrial dysfunction, cellular senescence, and stem cell depletion.[19] Aging has been associated with molecular cross-linking,[18] the existence of ageing genes in DNA, free radical-induced damage, immune function alterations, and telomere length shortening due to decreased telomerase enzyme activityROS (reactive oxygen species) generation results throughout oxidative oxidative dna Damage, proteins, and lipids...[29,30,31,32,33.] There are several free radicals in DNA, and mitochondria cause oxidative damage.[34] With age, DNA methylation levels decreases which cause DNA damage and result in aging.[35] To prevent oxidative damage tablets or pills of antioxidants should not prefer. It should be supplemented only in our diet.[36]

The endocrine system has also been viewed as associated with human Aging Because Growth hormone & insulin-like growth factors are depleted as people age, resulting in Aging..[24,25,26.] Various studies put that proteasome activity is reduced with aging, which causes the gathering of oxidizing proteins, aggresome, and age pigment (lipofuscin). Additionally, advanced glycation end products (AGEs) cause oxidative damage to proteins, lipids, or DNA in the cell.[41].

With aging, cell membranes become more rigid, which decreases the ability to communicate with other cells and decreases intracellular potassium content, leading to aging. Hence, aging is related to decreased cells' ability to communicate.[44] The most acceptable theory of aging refers to telomere shortening[42]Telomere length decreases with every cell division if telomerase is not

present to maintain it. Telomerase has been shown in recent experimental work to protect against accelerated ageing.[43].

Rather than all these causes of aging, scientists have reported that reverse aging could be initiated by reducing cellular replication[27] through antioxidant balance [28] and activation of "longevity genes." It has been shown that the rising interruption of protein homeostasis influences the cell's longevity[39]. The longevity of cells can be enhanced by activating the proteasomal system[40]. The proteasome in the eukaryotic cells is mainly responsible for removing oxidized proteins and inhibiting their accumulation[38] It is reported that signal transmission control also plays a vital role in maintaining human longevity.[37]

Aging Therapies

- Caloric Restriction: Aging is the loss of homeostasis and the accumulation of damaged cells.[45] It has been known that caloric restriction can extend lifespans by increasing free radicals in the cells[46], which improve the defense system of the body[47], and also suggested that the less obtainability of nutrients leads to the optimization of metabolism.[48] Due to their various adverse outcomes like maladaptations and several other deficiency diseases yet its positive effects are not clear on humans.
- Stem Cell Therapy: Additionally, it has been demonstrated that stem cells may be used to treat ageing and repair illnesses. Stem cells have the ability to divide and form new cells called as daughter cells.become stem cells or specialized cells. So, their regeneration capacity is used in repairing diseased or dead cells or tissue[49]. Stem cell therapy has various ethical challenges with a high risk of tumour.
- Breaking AGE Barriers (Advanced glycation end-products): AGEs are naturally occurring modified proteins found in food and created by the human body throughout the metabolic process. There amount of AGEs in food is dependent on the nutrient makeup, the cooking temperature, and the technique of cooking. Non-vegetarian or fast food (dry-heat processed foods) contain a higher concentration of AGEs as vegetarian or simple carbohydrate foods. Numerous intervention studies have established that a high AGE consumption results in tissue damage via inflammation and oxidative stress. [50,51] There are medications available to prevent the formation of AGEs, but their complete impact and negative effects are unknown. [52]
- Hormonal Therapy: Hormones are used as a anti-aging medication in the modern era.,[54] such as human growth hormone, testosterone, phyto-oestrogen, and dehydroepiandrosterone (DHEA). With aging, the endocrine system declines, decreasing the level of hormones like thyroid hormone, renin, insulin-like growth factor, testosterone, and angiotensinogen which causes various abnormalities with aging results in decreasing healthspan and longevity. However, it has adverse side effects such as abnormal metabolism, high blood and gastrointestinal diseases, diabetes, and cancer.[55,56,57,58.]
- Antioxidant Therapy: Numerous antioxidants, including as vitamins A, C, or E, have been heavily promoted in anti-aging cosmetics.[59]. However, these antioxidants in tablets and any cosmetic products are not proven effective

or helpful. The deficiency of antioxidants should be fulfilled through our diet and through naturally built in our body only.[60,61,62]

- Telomere Therapy: Various products are available as a natural telomerase activator,[63,] but they failed to prolong the lifespan with healthspan .[64] Overactivation of telomerase may increase the risk of cancer and tumour development.[65]Drug Therapy: Resveratrol is a sirtuin stimulant that has been shown to increase animal longevity, however its impacts are unknown. [66,67] Metformin, a diabetes medication, was shown to prolong animal life, & resveratrol is currently undergoing clinical trials to determine if it is efficient at postponing the effects of aging in humans. [67,68] Even though the method is unknown, both acarbose and basic aspirin extend the lifespan of mice. They do, however, inhibit chronic inflammation rather than the underlying cause..[69]
- Therapies to Come: The use of rapamycin is an immunosuppressant.[70]Apart from extending life, rapamycin has an astoundingly broad variety of benefits in mice, including the prevention of cancer as well as other cardiovascular diseases. diseases.[71,72,73.]This compound also has shown Nephrotoxicity, platelet deficiency, and elevated lipid levels are all possible side effects. [74,75,76]. It has been demonstrated that cellular nicotinamide adenine dinucleotide (NAD+) prolongs life. [77,78] Nanotechnology is an upcoming anti-aging treatment. [79]

One marker of individual agedness is the telomere length of chromosomes and telomerase activity.[80] The enzyme telomerase contributes pointedly to the maintenance of the protective effect of the telomeres. On the other hand, excessive telomerase activity can increase cancer risk.[81] A shelterin contributes to telomere maintenance. Shelterin is directly linked with telomere protection.[82]It has been established that cellular nicotinamide adenine dinucleotide (NAD+) prolongs life. [77,78], stress can boost the earlier arrival of age.[83]Various diseases with aging cause continuous telomere shortening in humans.[81,84]

Need of the Study

For thousands of years, man has been trying to stop aging, avoid death, and make himself immortal. Today is a desire in the mind of every human being that his old age should not come and always remain in such a body that does not have any diseases. There are several aging therapies like Caloric restriction, Stem cell therapy, Breaking AGEs, Hormonal therapy, Drug therapy, Plastic surgery, Oxygen therapy, and forth. The marketing and demand for anti-aging products are highest in China, Australia, India, and South Korea, progressively increasing day by day in the world.

Various therapies (Antioxidant's therapy, Telomere-based therapy, Drug therapy, and Physical therapy) have been studied to determine their effect on longevity or healthspan. However, no single therapy is fully effective, safe, and economical. All studied therapies failed to meet the expectations because their effect and side effects on the human body are still unknown.[52] These therapies also have shown side effects such as nephrotoxicity, a decrease of platelets, abnormal metabolism, increased blood pressure or intracranial pressure, elevated levels of lipids, diabetes, and cancer [74,75,76,55,56,57,58.]

It has been reported through various studies of mind-body therapy or mindfulness showing a positive impact on age reversal. However, there is no single study with ancient yogic text references. As stated inside the ancient Yoga literature, Yoga's ancient concepts and practises are intended to promote health, prevent disease, raise immunity, heal, and reverse ageing. There is a wealth of research demonstrating Yoga's efficacy in chronic conditions such as hypertension and diabetes.[85,86,87,88,89] Therefore, there is a need for further research on reverse aging to find a simple, convenient and costless alternative to improve longevity and side effects induced by any type of other treatment. *Yoga* is a simple, convenient, and costless alternative to relieving human beings from all sufferings of life.In modern parlance, an attempt to integrate the western medical system as well as psychology with the ancient principles and practises of Yoga for the purpose of promoting health, preventing disease, boosting immunity, healing, as well as reversing the ageing process. Yoga activities are relatively effective and safe.

Yoga for a Successful Life Span

Distinct from the modern medicine method of looking for tablets and pills or plastic surgery and botox to look young or extend lifespan,Yoga is a comprehensive programme that incorporates lifestyle, behavioural, nutritional, and psychological interventions to help people live longer and healthier lives. Yoga intervention reestablishes the balance of all systems and functions simultaneously on the physical, mental, and emotional levels..Yoga is a 3000-year-old health and healing practise that is now widely recognisedas a complementary and alternative form of medicine. Yoga is regarded as a form of mind-body exercise.practise by the national supplementary and integrative health centre. Yoga is a practise that combines a focused concentration on self-awareness as well as the breath with muscular activity. Yoga views the human body as a holistic organism that is unique to each individual. It believes in self-healing in accordance with an individual's quality or state of mind. 88 Yoga, as defined by eminent current Yoga teacher Aurobindo, is indeed a practical discipline comprised of a variety of mind-body-spirit practises aimed at achieving optimal psychosomatic wellbeing, followed either by union of individual life with universal or transcendent existence..[90]

Yoga is a 5,000-year-old practise that focuses on optimising the four components of human existence: physical, mental, emotional, & spiritual. 91 Nowadays, modern therapies use elements of the western medical system, psychology, and the ancient concepts and practises of Yoga to promote holistic health. Through the application of Yoga concepts, methods, and techniques, YT aims to provide holistic care of a variety of psychophysical issues ranging as backache to emotional discomfort. According the international association for yoga therapists, YT is really the process for empowering individuals to enhance their health and well-being through the application of Yoga theory and practise. [92] Physical, emotional, and psychological aspects all contribute to ageing, as do metabolism, immunity, cellular metamorphosis, and hereditary variables. [93] Aging is a series of decaying and degenerative processes. Despite the fact that these alterations are natural. [94,95] Nonetheless, despite the fact that individuals, their choices, or activities are to blame for accelerated biological ageing. Anomalies of the mind

and body disrupt homeostasis, resulting to uncontrolled ageing. [93,94] Yoga is a comprehensive approach to maintaining homeostasis, the state of balance among anatomical, biochemical, physiological, psychological, and spiritual well-being. 96 Thus, a body in balance results in an increase in healthspan and lifespan..[97]

It is noted that mind-body intervention aids in the reduction of oxidative stress, which is critical for reducing the ageing process of cells.[98,99]Yoga practise on a daily basis helps to slow the ageing process. The results of a meta analysis clearly demonstrate that yoga practises promote general health (body strength and flexibility, cardiovascular or respiratory function, addiction recovery, anxiety, stress, depression, sleep patterns, and pain management), as well as quality of life. 100,101 Yoga activities aid in the delivery the oxygenated blood to all cells and the elimination of wastes from them. Yoga activities improve the body's control and coordination, as well as the balance of a physical, mental, & emotional bodies, resulting in a longer life span..[102,103] It has been shown that mind-body medical techniques help reduce stress and attain positive behavior.[84] By practicing mind-body practice, the proper regulation of catecholamine and cortisol hormone positively affects telomeres[84]. Mind-body medical therapies can have a defensive effect on telomere length.[104,98]

Herbert Benson has described the relaxation response (RR). These relaxation responses lead to physiological changes that comprise reduced metabolism (lower oxygen consumption or carbon dioxide removal) and optimize heart rate, respiratory rate, and arterial blood pressure.[105] The Relaxation response induces changes that have an advantageous positive effect on telomeres and increases health span or longevity through opposing stress-induced genes [99] because stress and anxiety induce a typical gene expression pattern, which causes proinflammation, and leads to a reduction of the immune response.[83] Moreover, studies have often reported that mind-body interventions (Meditation, *Yoga*, and tai chi) can cause down-regulation of the proinflammatory transcription factors [106] even demonstrated a direct association between mind-body intervention with altered gene expression. For example, it decreases inflammatory markers (IL-6, C-reactive protein, lymphocytes, and IL-10) and increases IgA, T-cells, and NK. cells[107,83].

Method

A search was done by using the electronic database PubMed following the PRISMA format. In this review, the search focused on telomere length and telomerase activity to *Yoga* intervention. The literature search was done by using keywords such as: " *Yoga* OR asana OR pranayama OR meditation OR mindfulness OR reverse aging OR telomere OR telomerase enzyme OR oxidative stress."

Literature Search Sheet

Figure 1

History

Download history Clear history

Search	Add to builder	Query	Items found	Time
#26	Add	Search ((((yoga OR asana OR pranayama OR meditation OR mindfulness)) AND (aging OR telomere OR telomerase enzyme or oxidative stress)) AND ("has associated data"[Filter] AND "open access"[filter]))	1750	04:30:08

Figure 2

History

Download history Clear history

Search	Add to builder	Query	Items found	Time
#11	Add	Search ((yoga[Title] OR asana[Title] OR pranayama[Title] OR meditation[Title] OR mindfulness[Title])) AND (reverse aging[Title] OR telomere[Title] OR telomerase enzyme[Title])	7	02:34:38
#10	Add	Search ((yoga OR asana OR pranayama OR meditation OR mindfulness)) AND (reverse aging OR telomere OR telomerase enzyme)	1705	02:32:21
#9	Add	Search (((((("yoga" OR asana OR pranayama OR ("meditation" OR "mindfulness") AND (("reverse aging" OR "aging" OR ("telomere" OR ("telomerase enzymes" OR) OR ("oxidative stress") AND ("has associated data"[Filter] AND "open access"[filter]))))	7241	02:28:53
#8	Add	Search ((((("yoga"[MeSH Terms] OR "yoga"[All Fields]) OR asana[All Fields] OR pranayama[All Fields] OR ("meditation"[MeSH Terms] OR "meditation"[All Fields]) OR ("mindfulness"[MeSH Terms] OR "mindfulness"[All Fields])) AND ((reverse[All Fields] AND ("aging"[MeSH Terms] OR "aging"[All Fields])) OR ("telomere"[MeSH Terms] OR "telomere"[All Fields]) OR (("telomerase"[MeSH Terms] OR "telomerase"[All Fields]) AND ("enzymes"[MeSH Terms] OR "enzymes"[All Fields] OR "enzyme"[All Fields])) OR ("oxidative stress"[MeSH Terms] OR ("oxidative"[All Fields] AND "stress"[All Fields]) OR "oxidative stress"[All Fields]))) AND ("has associated data"[Filter] AND "open access"[filter]))	621	02:23:05

(1750 Records + 7 records+1705 records+621 records) were identified through database searching, and then through title and abstract screening, only 29 records were selected; out of 29 papers, only 14 relevant records were selected for narrative review. Additionally, three records were selected from cross-references. This review examined a total of 17 research conducted up until April 2021, using human participants..

Inclusion Criteria

1. Paper associates the effect of *Yoga* (within eight limbs of *Yoga*) on reverse Aging about DNA damage markers (telomere length, telomerase enzyme, oxidative stress, total antioxidant status, some hormonal status). Concerning the *Yoga* tradition.
2. Mindfulness-based stress reduction program (mental practice).
3. Qi-Gong studies.

4. Tai- chi
5. Different Meditation techniques.
6. Any mind-body training.
7. Above all practices are -body practices synchronized with breath and awareness.

Exclusion Criteria

Those studies were not showing an association between *Yoga* (mind-body practice) and reverse aging.

Table 1
Scientific evidence

Effect of *Yoga* on reverse aging (telomere length, telomerase activity)						
Reference	Sample Size	Intervention	Result	Conclusion	Measures	Comments
1. (Innes et al., 2018)[108]	N=53 participants age: 50–84 years old An Exploratory Randomized Clinical Trial	12-week meditation practice for 12 minutes/day	-increase in TL and TA. (*p*s<0.006) - Improvements throughout psychological and cognitive parameters have been demonstrated.(*p*s ≤0.05), -reductions in stress and improved life quality were more pronounced inside the meditation group.	Mind-body therapies may have a beneficial effect on TL and TA..	-peripheral blood mononuclear cell. -TL. -TA.	-Smaller sample size -No long term effects -lacked a non-active control group,
2. (Lengacher et al., 2014)[109]	N=142 participants This randomized, wait-listed, controlled study,	Six weeks and 12 weeks, Mindfulness-based stress reduction (MBSR)	TA at 12 weeks in comparison with the control group, ($p < .01$)	MBSR (Breast Cancer) also increases TA in this population.	-TA. -TL. - Psychological measures	-No, long-term effect. -Sample was heterogenous
3. (Daubenmier et al., 2012)[110]	(n = 47) obese females. a pilot study with a randomised waitlist	mindfulness-based intervention	Over a four-month period, there was an increase in the mean telomerase activity.($p < 0.001$)	psychological and metabolic stress had shown a direct link with telomere length.	-Telomerase activity. - psychological factors. -metabolic factors. -eating behavior.	Telomerase activity increased across both groups.
4. (Cheung et al., 2019)[111]	N=247 of 271 (intervention group, 120;	22-week qigong intervention	Telomerase activity is not significantly different. Wait-list control	No significant benefit of qi-gong on telomerase	-telomerase activity -TNF -IL-6	-No Long-term effect is known. -may influence

	wait-list control group, 127).A single-blind randomized clinical trial		group; *P*= .66). In the intervention group- -telomerase activity was marginally significant stress and depressive symptoms were significantly stressed.	activity was found in women. Mental health enhanced.	-mental wellbeing, -perceived stress (PSS scores) -depressive symptoms (BDI-II scores).	biased psychological outcomes. -limit generalisability
5. (Shravya Keerthi et al., 2015)[112]	*Yoga* group n=15 control group (n=18) a prospective case-control study a pilot cross-sectional study	Continual Yoga practise (asana, pranayama, and meditation).	-LTL was significantly shorter inside the comparison group than the Yoga group.(p<0.001). -Total antioxidant oxidative stress was reported in the *Yoga* group. -balanced MDA and Homocysteine levels were found in the *Yoga* group (p<0.001).	-well-preserved LTL in regular *Yoga* practitioners. -lower systemic oxidative stress - *Yoga* practice seems to obstruct replicative cellular aging.	-LTL -TAOS -MDA -Homocysteine	-Without further investigation. -is incapable of examining inter-individual variability Additional research must be conducted to determine the effect and duration of Yoga, as well as the types of practises, on LTL over period.
6. (Tiwari et al., 2014)[113]	N=240 women (treatment condition, n = 120) (control condition, n = 120). This randomized, wait-list controlled study	Qigong training sessions were given twice a week for six weeks.	–	–	-telomerase activity -TNF-alpha -IL-6 -PSS -PCS -BDI-2 score	–
7. (Ho et al., 2012)[114]	N=64 participants (Chronic fatigue or chronic fatigue syndrome.) A	4-month qigong intervention.	Improved Fatigue symptoms and mental functioning were reported. Increased TA in the qi-gong group s ($p < 0.05$). Statistically	Qi-gong exercise helps in reducing chronic fatigue and chronic fatigue syndrome.	-activity of the telomerase -symptoms of exhaustion -mental health	-neither double-blind nor comprised a control group. -possible chronic disorders

	randomized controlled trial.		significant.			might have confounded results. -This finding needs to be replicated in more carefully designed randomized controlled trials.
8. (Lavretsky et al., 2013)[115]	N=39 family dementia caregivers A pilot study	kirtana kriyä or relaxation music for 12 minutes per day for eight weeks.	The experimental group showed improvement in telomerase activity as compared to the control group (p=0.05).	Improvement in mental and cognitive functioning was reported with lower depressive symptoms. An increase in telomerase activity. A	-mental health -depressive symptoms -telomerase activity.	-small sample size. -a significant difference by chance due to a large number of the assessment instrument.
9. (Thimmapuram et al., 2017)[116]	N=35 enrolled as meditators and N=12 as controls. a prospective cohort trials	12-week 'Heartfulness Meditation' program	statistically significantly increased TL in younger meditators.	increased telomere length	-emotional wellness scores. -telomere length	-Lack of randomization. - increase telomere length in the younger samples but not comment in older samples.
10. (Tolahunase et al., 2017)[117]	N=96 individuals in good health. A hypothetical open-label. An exploratory study with a single arm.	12-week, (YMLI) *Yoga* and Meditation-based lifestyle intervention.	Significant progress was shown in both the cardinal biomarkers and the metabotropic biomarkers of aging. Significantly lower mean levels of 8-OH2dG, ROS, cortisol, and IL-6.	YMLI helps in cellular age-reversal.	-8-OH2dG, -ROS, -cortisol, -IL-6 -TAC, -telomerase activity, -β-endorphin, -BDNF, and -sirtuin-1	-not include controls
11. (Alda et al., 2016)[118]	($N = 20$) from the Soto Zen Spanish Buddhist community. Control group	Zen meditation experts	longer telomeres in the cells of the expert meditators group The meditators group had a longer MTL ($p = 0.005$)	In the cells of the meditators group, the frequency of short telomeres was less.	-psychological variables. -telomere length	-Small sample size. -no randomization, so causality is unclear.

	(*N* = 20)		than those in the control group.			
12. (Mendioroz et al., 2020)[119]	A group of long-term mindfulness meditators (N = 17) control group (N = 17) a cross-sectional study	A group of long-term mindfulness meditators was practicing 60 min/day.	Longer Telomere length in meditators group compared to controls (p = 0.061).	Telomere length and DNA methylation levels were interlinked in the meditation group.	-telomere length -DNA Methylation level.	-limited sample size
13. (Jacobs et al., 2011)[120]	N= 30 experimental group control group (N= 30) a longitudinal wait-list controlled design.	Six h daily meditation for three months	was significantly greater Telomerase activity in the experimental group than in controls (p< 0.05).	Telomerase activity enhanced.	- Telomerase activity - Neuroticism	- lack of a pre-test telomerase measure, -small sample size,
14. (Kumar et al., 2015)[121]	A man in his thirties (class I obesity) A single case report. A prospective study is currently being conducted.	*Yoga*, group discussions, lectures, and individualized advice were given. 90 days	Telomerase activity, -endorphins, plasma cortisol, & IL-6 levels were increased, while ROS and 8-hydroxy-2-deoxyguanosine levels were decreased.	*Yoga* helps reverse aging by maintaining oxidative stress, telomerase activity, and oxidative DNA damage.	- telomerase - β-endorphins - plasma cortisol - interleukin-6 -oxidative stress markers -reactive oxygen species -8-hydroxy-2-deoxy-guanosine level.	
15. (Dhawan et al., 2018)[122]	N= 30 couples with recurrent pregnancy loss. a prospective ongoing exploratory study	*Yoga*-based lifestyle intervention (YBLI) end of YBLI (21 days).	Significant changes have seen a decrease in ROS levels, improvement in motility and count of sperm, and a decrease in DNA fragmentation index.	*Yoga*-based lifestyle intervention (YBLI) helps normalize sperm transcript levels.	-seminal -oxidative stress (OS.) -DNA damage - spermatozoal transcript levels	
16. (Qu et al.,	N=14	*Yoga*(Sudarshan	Immediate effects of	Immediate	- PBMCs	

2013)[123]		Kriya) compared with a control group (nature walk and relaxing music)	*Yoga* practices at the molecular level may form the basis for the long-term stable effects.	effects at the molecular level in circulating immune cells were shown.		-needs to conduct systematically more experimental studies.
17. (Glaser et al., 1992)[124]	Two hundred seventy men and 153 women. Control group 5-year age grouping to799 male and 453 female	Transcendental Meditation (TM).	The effect of TM practice was also p = .0001 for men and p < .0001 for women]. TM participants showed higher levels.	TM prevents deterioration in DHEA-S.	- DHEAS levels	

Abbreviations used in this review.
Deoxyribonucleotide deoxyribonucleotide acid
ROS oxygen radicals
AGEs advanced glycation end-product
NAD+ nicotinamide adenine dinucleotide
YT *Yoga* therapy
RR response relaxation
IL interleukins
IgA immuonoglobuline A
NK cells natural killer cells
TL telomere length
TA telomerase enzyme
MBSR Mindfulness-Based Stress Reduction
TNF tumor necrosis factor
PSS perceived stress scale
BDI Beck depression inventory
LTL leucocyte telomere length
TAOS total antioxidant oxidative stress
MDA malondialdehyde
PCS perceived coping scale
YMLI Yoga and meditation-based lifestyle intervention
TAC total antioxidant capacity
8-OH2dG 8-hydroxy-2'-deoxyguanosine
BDNF brain-derived neurotrophic factor
MTL median telomere length
YBLI Yoga based lifestyle intervention
OS oxidative stress
PBMCs peripheral blood mononuclear cells
DHES serum dehydroepiandrosterone sulfate
TM Transdental Meditation

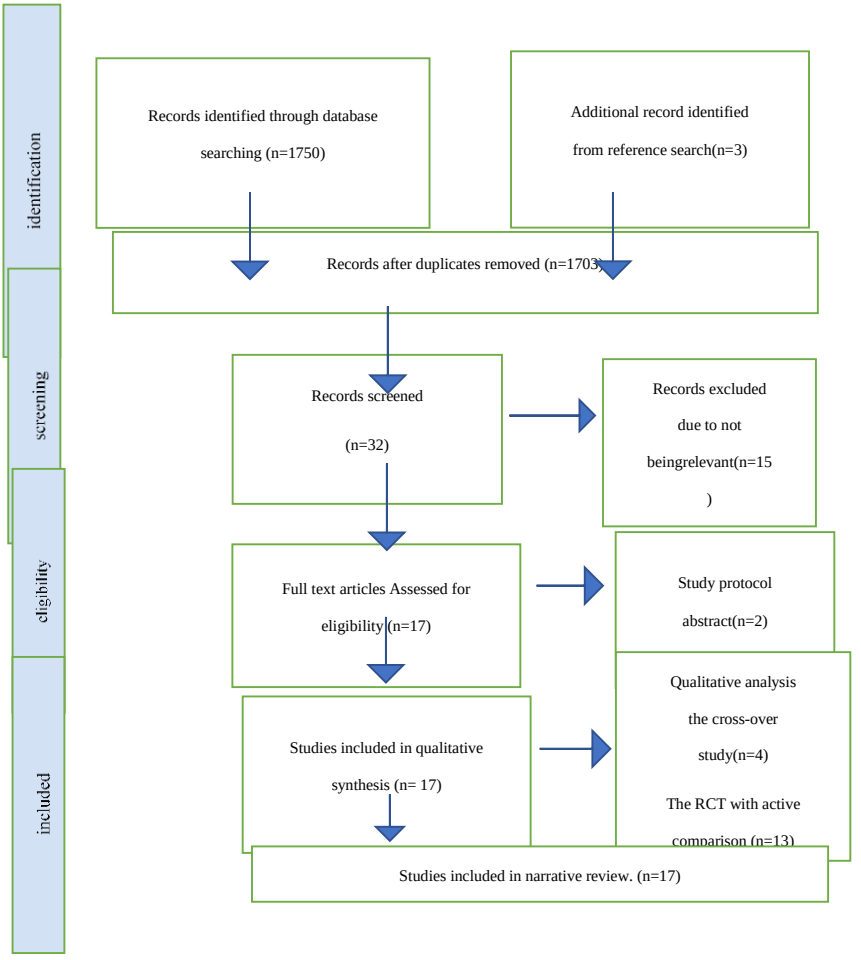
HP Hatha Pradipika
GS Gherand Samhita
HR Hatha Ratnavali
SS Shiva Samhita

Scriptural Shreds of Evidence

In Hatha pradipika hatha yogic text verse 1/47Meaning: The prana (air) should be brought down through the gut by lifting the apana (air). Due to this, the *Yoga* practitioner becomes free from old age and becomes like a young man of sixteen years. Verse 1/28 Meaning: Practice of this mahavedha gives excellent benefits to the seeker. It removes hair whitening, wrinkles, and tremors; that is why sadhak practices it. Verse 1/29 Meaning: These three (mahavedha,mahabandha mahamudra) should be kept very secret. Which removes old age and death, ignites the gastric fire, and bestows siddhis like anima. Verse 1/39 Meaning: Who keeps the tongue up even for half a moment, the seeker becomes free from poison, disease, death and old age, and so forth. Verse 1/43 Meaning: The seeker who does sompana with the tongue upwards while remaining still conquers death within half a month. There is no doubt about it. Verse 1/57 Meaning: If an older man always practicesuddiyaan bandh naturally by following the path prescribed by the guru, he becomes like a young man. Verse 1/58 Meaning: By practicing pulling the upper and lower part of the navel, a sadhaka conquers death in six months, no doubt about it.Verse 1/64 Meaning: the unity of apanaand pranaby continuously practicing mulbandha. There is a shortage of stool and urine, and the older man also becomes a young man. Verse 1/69 Meaning: By constricting the throat, apply the chibouk firmly in the heart. This bandha named jalandra bandha removes growth and death. Verse 1/81 Meaning: Wrinkles and white hair do not appear after six months of practice. One who regularly practices for oneYama (three hours) a day conquers death. In Gherand Samhita hatha Yogic textVerse 16 Meaning: This mahabandhais the best of all postures and is a little-death-destructive. The offerings of this bandha fulfil all desires.In shvetashvar Upanishad Verse 12 Meaning: Yoga becomes possessed of a body made of the fire of *Yoga*, and he will not be touched by diseases, old age, or death.In Yogatattvopnishad Verse 5Meaning: Cutting the web of this happiness and sorrow in the form of *mäyä*, which paves the way for salvation to them (all living beings) and gets rid of birth-death, old age, and disease.In Hatharatnavali hatha Yogic text verse 2/1 Meaning: The wise men are blessed with miraculous accomplishments and longevity; they must be practiced for attainment. In Shiva Samhita verse 4/75Meaning: IfYogipractices it for six months, he will surely conquer death. His gastric is ignited, and digestive juices increase.

Results

Figure 3
This evaluation reviewed a number of 17 studies conducted between April 2016 and April 2021 that involved human subject.



Discussion

The above review explains the impacts of yoga on telomere duration telomerase enzyme reverse ageing. In a potential case-control study, Keerthi Shravya reports that daily Yoga practitioners have better-preserved LTL and less oxidative stress than that of the control group. Some other single-arm explorative study enrolled 96 healthy individuals in a lifestyle intervention based on yoga and meditation. Following data gathering, a significant improvement in cardinal and metabotropic biological markers of cellular ageing is observed. It has also been reported in a prospective ongoing study that a man of 31-year-old with class one obesity after

90 days of accepting a*Yoga* /meditation-based lifestyle found oxidative balance stress, increased telomerase activity, and reduced oxidative damage of DNA. which shows that *Yoga* is a natural and comprehensive therapy that helps in attaining a natural state. Dhawan also reported in 2018 that YBLI helps reduce oxidative damage of DNA and balance oxidative stress. *Yoga*practices also result in rapid gene expression in healthy people. It was reported in 2013, which improves healthspan and longevity. Glaser in1992 reported a higher level of Serum dehydroepiandrosterone sulfate (DHEA-S) by the adrenal cortex in trained practitioners of the Transcendental Meditation. Which reduces age-related deterioration and helps is slow down the aging processJacob establishes a link between meditation or positive psychological change and telomerase activity, which might also aid in immune cell longevity, in a study. In 2020, Maite Mendioroz discovered that telomere length has been unrelated to age in a collective of long-term meditators. The results indicated that meditators had longer telomeres than the control group..Alda, in 2016 reports that in the cells of the expert meditators group, the prevalence of short telomeres was significantly lower than non-meditators.In 2017, Jayaram Thimmapuram demonstrated the impact of such a 12-week' Heartfulness Meditation' on exhaustion in a prospective cohort study, demonstrating the beneficial effects of meditation on emotional health and telomere length. Daily meditation, according to a pilot study, could indeed enhance mental functioning and alleviate stress or depression by increasing telomerase activity, implying a reduction in cellular ageing. It was reported that people with chronic fatigue who practised qi-gong demonstrated a significant increase throughout telomerase activity when compared to a control group.

Cheung published a single-blind randomised clinical trial in 2019 that demonstrated increased mental health yet did not have a beneficial effect overall telomere length, which subsequent research should validate. In a randomised controlled pilot study, 47 obese women who received a mindfulness-based stress management demonstrated a significant increase in telomerase activity. However, the intervention's effect on telomerase activity was unclear. A randomised controlled trial was done upon 142 breast cancer patients to analyze the influence of 6-week MBSR on TA and TL. Assessments of TA and TL, as well as psychological dimensions, revealed a significant rise in TL and TA, as well as better psychological aspects, when compared to a control group. Innes (2018) reported inside an exploratory Randomized Clinical Trial that TL and TA may affect my kéartana kriyä meditation and music listening programme.

Telomere length has an inverse association with Aging and chronic health issues (including cardiovascular disease, obesity, and diabetes). This review shows that *Yoga* positively affects telomere length, telomerase enzyme activity, total antioxidant status and reduces oxidative stress. Based on the studies reviewed in this paper, we found that the practice of *Yoga* seems to facilitate reverse aging through increased telomere length telomerase activity. *Yoga* and meditation positively affect cellular aging. Studies in this field are limited to *Yoga* practices (meditation, asana, and pranayama), without any *Yoga* text references or as per appropriate *Yoga* protocols mentioned in the ancient yogic text. The ancient *Yoga* text has already described that yoga practitioners can remain away from all suffering and old age (whitening of hair, wrinkles, and tremors) through

practicingKumbhaka, Mudra, andBandha. These practices involve breath-retention (breath-hold). Various researches support that breath-hold helps activate dormant parts of the brain and lungs, such as neurogenesis, angiogenesis, vasodilation, telomerase activation, preventing DNA damage, and balancing total oxidative stress with decreasing inflammatory markers are the potential biomarkers of reverse aging. There is a need for further research on reverse aging is needed to validate its application and to find a simple, convenient and costless alternative to improve longevity and reduce side effects induced by any other treatment. *Yoga*is a simple, convenient, and costless alternative to relieving human beings from all sufferings of life, but how and which specific practice help in improving longevity and healthspan is a question of research.

Limitation

Although the impacts of Yoga on telomere duration but also telomerase enzyme were positive, Yoga protocols were not used appropriately, and studies are limited by small sample sizes, lack of long-term effects, and lack of follow-up. Yoga's role in age reversal is still debated and thus requires further systematic investigation. Until now, the designated findings must be viewed as positive but circumscribed. Additional research should be conducted to determine the effect and duration of Yoga, this same type of practise described in ancient texts as effective at reversing ageing or extending life.

Conclusion

Based on the studies reviewed in this paper through PubMed central database, we found that the practice of *Yoga* seems to facilitate reverse aging through increased telomere length telomerase activity. *Yoga* and meditation positively affect cellular aging. Studies in this field are limited and with no *Yoga* text references or lack of proper *Yoga* protocol. There is a need for additional research on reverse aging required to validate its application and to find a simple, convenient and costless alternative to improve longevity and side effects induced by any type of other treatment. *Yoga* is a simple, convenient, and costless alternative to relieving human beings from all sufferings of life.

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There is also no conflict between both the authors of such a work.

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