Chapter

Improving Mindfulness, Quality of Life, and Controlling Cellular Aging through Meditation

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Abstract

Many people suffer from stress and anxiety due to complex lifestyles. Stress is one of the main causes of various diseases. In addition, it causes a lower level of consciousness, quality of life, and a higher rate of cellular aging. Meditation becomes a trending topic to overcome these problems. Key terms including "Meditation," "Mindfulness," "Quality of life," "Telomere," and "Telomerase" were used to search literature in PubMed, Medline, and Google scholar databases. Meditation is cheap, viable, and simple mental training. Several studies have been conducted on the effects of meditation on well-being, including mindfulness level, quality of life, and cellular aging. Accordingly, many of these studies suggest that meditation practice can improve well-being and may help control cellular aging. Though meditation showed various physiological and psychological benefits, the mechanism behind the meditation and these benefits still remains unclear. However, by reducing a person's stress level, meditation can improve mindfulness, develop quality of life, and reduce cellular aging.

Keywords: mindfulness, quality of life, telomere length, telomerase, (hTERT and hTR) OR (gene expression)

1. Introduction

Mindfulness could be defined as "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" [1]. This includes the awareness of thoughts, feelings, sensations, and surrounding nature. Mindfulness helps to pay attention to thoughts and sensations without judging them and aids to keep the mind in the present moment by avoiding disturbances caused by past memories and future imaginations. The capacity for mindfulness within an individual can be increased or decreased. Mindfulness plays a key role in reducing stress, boosting memory, improving cognition, and producing various other positive psychological outcomes. There are three axioms of mindfulness, that is, intention, attention, and attitude. The intention is the vision of a person, and attention refers to the present-moment awareness of internal and external experiences. Equanimity and acceptance are called attitude [2].

The quality of life of a person is mainly hinged on their physical health, psychological state, level of independence, and social relationships to noticeable characteristics of the environment [3]. According to World Health Organization, quality of life can be defined as "an individual's perception of their position in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" [4]. Wealth, employment, environment, physical and mental health, education, safety, beliefs, recreation, and freedom are some of the examples for standard indicators of the quality of life. Most of the researchers have been developing and/or using different methods such as scales to measure the quality of life. Out of these quality-of-life measuring instruments, the World Health Organization Quality of Life (WHOQOL) can be considered as a broader measure of overall quality of life, which was developed by collaborating a large number of psychologists, including physical, psychological, social relationship, and environment [5]. The physical health domain focuses on pain and discomfort, sleep and rest, energy and fatigue, mobility, activities of daily living, depending on medicinal substances and medical aids, and work capacity. Secondly, the psychological domain considers positive feelings, thinking, learning, memory and concentration, self-esteem, body image and appearance, negative feelings, and spirituality/religion/personal beliefs. The social relationships domain emphasizes on personal relationships, social support, and sexual activity. Finally, freedom, physical safety and security, home environment, financial resources, health and social care accessibility and quality, opportunities for acquiring new information and skills, participation in and opportunities for recreation/leisure activity, physical environment, and transport belong to the environment domain.

Telomeres are biomarkers of cellular aging, which are located at the termini of the chromosomes. They are simple repeat DNA sequence tracts $(TTAGGG)_{n,}$ which functioned as protective end caps of linear chromosomes. When considering the somatic cells, it was reported that telomeres have 5 kb to 15 kb in length. The length of these telomeres gets shorter gradually with each cell division due to the loss of DNA tracts. Telomere length is maintained either enzymatically or by a recombination mechanism. Though the average overall telomere length is partially a hereditary characteristic [6], it depends on various factors, such as a reflective history of the cell lineage, exposure to stress, and oxidative damage. Human telomerase enzyme adds the DNA tracts to the end of the existing DNA tracts, thus control the length of the telomeres. It can be easily found in germ cells while a low amount can be detected in totipotent cells. However, most of the differentiated cells do not contain the telomerase enzyme. Human telomerase enzyme consists of two subunits, that is, hTERT and hTR. hTERT or human telomerase reverse transcriptase is the core protein that has a central catalytic domain and it encodes by the gene *TERT*. hTR is the RNA component of the telomerase enzyme, where it was dependent on the expression of *TERC* gene [7].

There are different types of interventions that are commonly used to improve mindfulness and quality of life and known as the mindfulness scale. In addition to mindfulness interventions, most of meditation interventions are also improving the mindfulness level/and quality of life with a reduce cellular aging [8]. A growing body of research targets on the effects of mindfulness or meditation interventions on reducing aging.

2. Methods

A literature search was carried out for articles published in English in Google scholar, PubMed, and Medline databases from their inception to December, 30, 2022.

"Meditation," "Mindfulness," "Quality of life," "Telomere," and "Telomerase" were used as key terms to search the databases without considering an exclusive study design.

3. Results and Discussion

3.1 What is meditation?

Traditions in both eastern and western cultures are the derivatives of meditation practices [9]. Most of religions own a particular type of meditation practice where the final outcome of practicing that meditation technique is similar among the religions. Mindfulness meditation can be done by sitting, lying down, or by walking. It helps to increase thoughtless awareness [10]. Body scanning meditation basically focuses on body parts and internal and external sensations and loving-kindness meditation spread the love to "I" and "we" [11]. Breathing meditation mainly targets on the own breath and increases attention [12]. In addition to these meditation practices, yoga is also considered a relaxation method. Yoga can be done by obtaining and maintaining different positions to build strength, flexibility, and balance, and it also includes breathing exercises [13].

A human is made up of three different characteristics, that is, physical body, inner faculty, and deep inner self. The physical body is the persistent object that needs a physical space from the world. Inner faculty consists of four aspects, including mind, intellect, ego, and *chitta* (all memories and impressions stored here). It is believed that the deep inner self initiates the inner faculty and which in turn triggers the physical body [14].

3.2 Effects of meditation on mindfulness, quality of life, and aging

There are various benefits of meditation, such as decreased stress, reduced anxiety and depression, improved memory, beneficial effects on blood pressure, metabolism, and heart rate [15]. In addition to these benefits, meditation positively affects mindfulness and quality of life, which in turn reduces the aging rate. Numerous meditation and meditation-based studies also suggest that meditation could have beneficial effects on mindfulness levels and the quality of life of people. A randomized controlled trial showed significantly higher levels of mindfulness and better quality of life after 3 months of meditation follow-up of retreat participants compared to waitlist control participants [16]. Another recent case-control study found that meditators who practiced Zen meditation for more than 10 years, had significantly better results in relation to mindfulness variables and quality of life, such as attention and awareness, observing, describing, non-judging, resilience, self-compassion, and satisfaction with life and subjective happiness [17].

Meditation does not only result in psychological outcomes, but it also positively affects the telomere dynamics, including plasma telomerase level, the relative telomere length, and expression of genes related to telomere regulation, such as *hTERT* and *hTR.* According to some of these studies, meditators have longer telomere lengths when compared with controls who had no prior meditation practice or related techniques [17, 18].

Hoge and his colleagues investigated the association between Vipassana meditation practice and telomere lengths in relation to gender using long-term meditators.

The study findings showed that the median relative telomere length in females was higher in practitioners compared to female controls and this difference was statistically significant. However, no significant difference was observed between the telomere lengths in male practitioners compared to controls. These results suggest that meditation practice may alter relative telomere lengths, especially in women, and this significant finding could potentially be used as a biomarker associated with longevity. In addition, they have shown that the median relative telomere length of the whole practitioners was longer than controls but it was not significant [18]. In addition, the median relative telomere length of the whole practitioners was longer than controls but it was not significant. Another study showed that the expert Zen meditators have a significantly longer median TL compared to the comparison group. Furthermore, they have indicated that the prevalence of short telomeres in the cells of the expert meditation group was significantly lower than that of the comparison group [17]. Studies have developed different interventions, including meditation or meditation-based techniques, where their intervention period has varied from study to study. Le Nguyen et al., recruited meditation-naïve healthy participants and randomly assigned them to three groups, namely the loving-kindness meditation intervention group, the mindfulness meditation intervention group, and the control group that did not receive any form of meditation. The loving-kindness meditation group has a significantly lower decrease in telomere length compared to the control group and the mindfulness meditation group did not show a telomere length difference relative to the control group [19]. Another recent randomized controlled trial has shown that there was a change in every four groups (presence, affect, perspective, and control group) after the 12-week intervention without any significance [20]. Most of the studies have recruited patients with certain diseases, such as cancer patients, infertility patients, diabetes patients, and depression patients, to see the effect of meditation or mindfulness on telomere lengths. One study compared the effectiveness of mindfulness-based cancer recovery (MBSR) and supportive-expressive group therapy (SET) after the breast cancer survivors were exposed to 8 weeks of interventions. However, according to the telomere lengths, there was no significant difference between MBSR and SET groups. When comparing the MBSR and SET groups together with controls, there was also no significant difference [21]. Innes et al., have shown the effect of Kirtan Kriya meditation (KK) and a music listening (ML) program on telomere lengths of Alzheimer's disease patients by giving a 12-week intervention. According to the findings, the KK group and ML group have shown an absolute telomere length change from the baseline. However, the changes in telomere length were not significant either within the group (baseline and after intervention) or between groups [16]. Thimmapuram and colleagues have recruited residents, nurses, and faculty physicians, to seek the effect of heartfulness meditation on telomere lengths after a 12-week intervention. In relation to the results, they have shown that there was a statistically significant increase in telomere length in meditators in the subset of subjects aged 24–33 years [22]. Telomeric DNA is formed *via* binding nucleotides through phosphor-di-ester bonds independently (normal DNA synthesis) using an enzyme called telomerase. It is a specialized cellular ribonucleoprotein (RNP) reverse transcriptase. The main function of telomerase is the synthesis of telomeric DNA using its RNA template [23]. Some studies have looked at the effect of meditation on telomerase activity. Jacobs and his colleagues investigated the immune cell telomerase activity in psychological meditators. They selected two groups—perceived controls and those with neuroticism and used meditation models to test

whether the effects of meditation on telomerase activity could explain changes in the perceived control and the neuroticism group [24].

Thirty individuals from each group who were within the age range of 21–69 years, with 3 months experience of meditation for both groups, and who were matched on demographic variables were recruited. The telomeric repeat amplification protocol was used to quantify the telomerase activity. Telomerase activity was significantly higher in perceived control and lower in the neuroticism group prior to the introduction of the mindfulness of breathing meditation practice, and it increased in both groups after introducing the meditation practices. These results indicate that mindfulness meditation practice could affect telomerase activity directly, and this finding has important implications for immune cell longevity [24]. Daubenmier et al., [25] and Lavretsky et al., [26] have done their studies using patients, overweight, chronic fatigue, and dementia carers to seek the effect of meditation on telomerase, respectively. All these studies have used the same study design, that is, randomized controlled trial [18]. Daubenmier et al., compared the intervention group with the waitlist control group whereas Lavretsky et al., [26] study compared the intervention group with a relaxation group. However, according to their results, Daubenmier has given 4 months of mindfulness meditation intervention and has shown that the telomerase activity was increased in both groups, but 11% greater in the meditation intervention group than the control group [25]. Lavretsky et al., have shown that there was a significant change, that is, improvement in the telomerase activity in the meditation group compared with the relaxation group after 8 weeks Kirtan Kriya meditation intervention [26]. Several studies have also demonstrated the effect of meditation or related techniques on gene expression. Duraimini and colleagues studied telomerase gene expression in hypertensive patients using the study design randomized controlled trial [27]. Forty-eight African-American men and women with stage 1 hypertension were recruited and were introduced to either the stress reduction transcendental meditation technique and a basic health education program (stress reduction (SR) or an extensive health education program (EHE) for 16 weeks. Blood was drawn and RNA was extracted. *hTR* (human Telomerase RNA component) and *hTERT* (human Telomerase Reverse Transcriptase) telomerase gene expression levels were quantified by q-PCR. Results showed that the functional RNA component of telomerase *hTR*, increased in both groups. The catalytic component of telomerase, *hTERT*, increased in both groups. The blood pressure of these individuals was also found to be reduced. Therefore, the telomerase gene expression may serve as a biomarker for reduced blood pressure or explain the mechanism by which stress reduction and lifestyle modifications reduce blood pressure [27].

3.3 Mechanism behind meditation and quality of life, mindfulness, and aging

Though meditation showed various physiological and psychological benefits, the mechanism behind the meditation and these benefits still remain unclear. However, Dasanayaka et al., described the hypothetical mechanism behind meditation, mindfulness, quality of life, and aging (**Figure 1**) [28].

Stress is the main cause of the high rate of aging. HPA axis activates due to acute stress, which in turn stimulates the hypothalamus. Stimulated hypothalamus secrets neuropeptide hormone corticotrophin-releasing hormone (CRH) in high amounts. Then, the adrenocorticotrophic hormone (ACTH) secrets from the activated anterior pituitary gland, where the activation of the anterior pituitary gland takes place due to CRH. ACTH then travels to the adrenal cortex *via* the bloodstream and triggers the release of cortisol. High cortisol level acts to increase stress [29]. Moreover, the expression of NF-ƙB

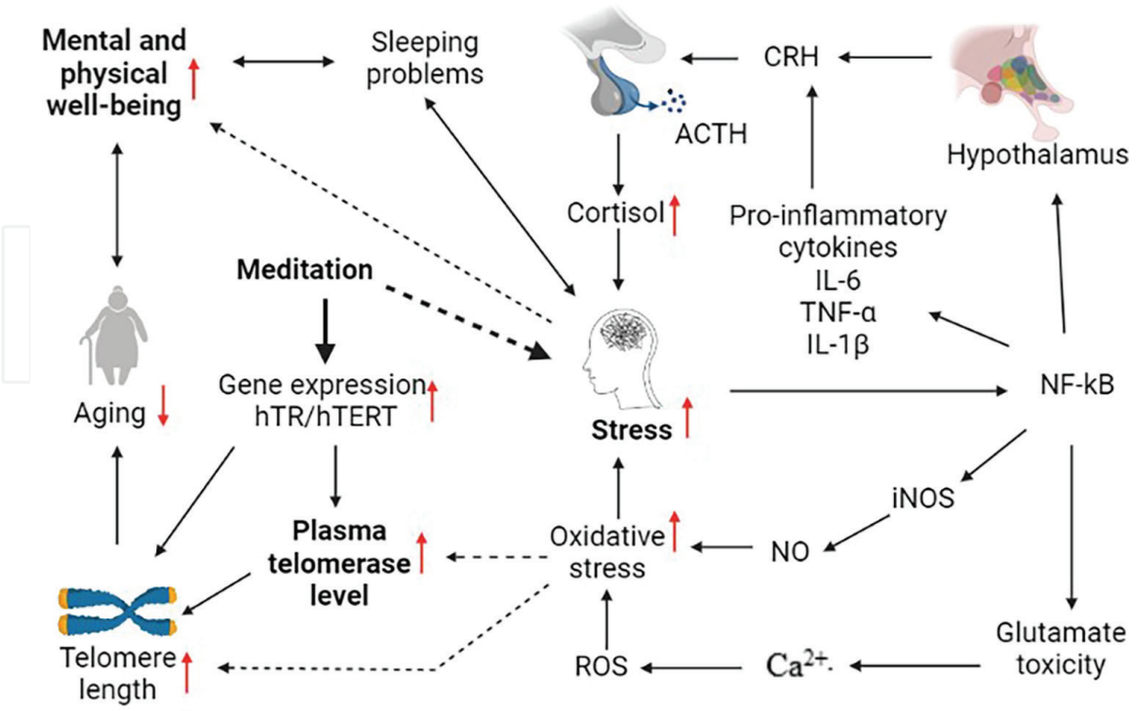

Figure 1.
Schematic diagram of the hypothesized biological pathway of the effects of meditation on mental and physical well-being and aging (adopted from: Dasanayaka NN, Sirisena ND, Samaranayake N. impact of meditation-based lifestyle practices on mindfulness, well-being, and plasma telomerase levels: A case-control study. Front Psychol. 2022; 13 (march)).

increases with respect to the dysregulation of the HPA axis and is involved in the secretion of proinflammatory cytokines, such as IL-1β, IL-6, and TNF-α. These pro-inflammatory cytokines combine with the aforementioned pathway by increasing CRH.

Further increased expression of NF-ƙB activates glutamate toxicity and sequentially increases calcium concentrations. Elevated calcium concentrations result from mitochondrial damage and generate free oxygen radicals, which increase oxidative stress and thus stress [30]. In addition, reactive nitrogen species are formed according to the highest expression of NF-ƙB. Due to loss of mental and physical well-being, including quality of life and mindfulness of a person, cause sleep problems and higher levels of stress [31]. However, it was known that sleeping problems or less number of sleeping hours also assist to have higher stress levels and worsens mental and physical well-being. Further, lowered mental and physical well-being aids to increase aging. Cellular aging mainly depends on the telomere lengths, which are located at the end of chromosomes and telomerase activity [32]. Plasma telomerase level encodes by the *hTERT* and *hTR* genes [23]. High levels of oxidative stress decrease plasma telomerase levels, thereby increasing aging [33]. Empirical evidence suggests that meditation can directly reduce the stress level and up-regulates the expression of *hTERT* and *hTR* genes [28, 29], which in turn increase the plasma telomerase level and maintain the telomere length. Hence, meditation indirectly controls the aging of a person.

4. Conclusion

This study suggests that meditation practice is a simple, cheap, and doable method that has several benefits. It is a complementary and alternative medicine that helps to

reduce the stress level of a person, which indirectly resulted in an improved mindfulness level, better quality of life, and reduced cellular aging.

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