E-ISSN: 2654-9182
Sport and Fitness Journal
Volume 10, No.2, May 2022: 85-96

THE EFFECT OF YOGA AND MINDFULNESS MEDITATION ON ALPHA-AMYLASE LEVEL

Brigitta[1*], Latisha Lubianca[1], Jessica[1], Tania Rosa[1], Eka Diah[1], Nila Wahyuni[2,] I Putu Gede Adiatmika[2]
[1] Magister Program of Biomedical Science Anti Aging Medicine Medical Faculty Universitas Udayana, 80234, Denpasar, Indonesia
[2]Physiology Department Medical Faculty Universitas Udayana, 80234, Denpasar, Indonesia
Email : brigittaclar@gmail.com

ABSTRACT

In recent years, a lot of behavioral studies have shown that physical exercise and yoga have a positive impact on one's physical and mental health. Yoga, which is increasingly used in the clinical setting of various mental and physical health problems, especially stress-related illnesses and concerns, has shown promising effects. The purpose of this study was to investigate the effects of mindful meditation and yoga in reducing salivary alpha-amylase levels, as a stress biomarker. This research is focused on evaluation of the stress levels in one's body by measuring the levels of salivary stress marker alpha-amylase in accordance with yoga and mindful meditation. This study will focus on literature review using Boolean operator with databases from ScienceDirect, Pubmed, and Cochrane.

Keywords : alpha-amylase; yoga; meditation; mindfulness; stress ; biomarker; exercise

INTRODUCTION

Stress is a ubiquitous phenomenon that is found in the daily lives of humans and animals. The longer stress persists, the more likely it is to have harmful effects, eventually leading to negative health consequences, including but not limited to cardiovascular, immune, nervous, and endocrine systems[1]. In this respect, stress has been shown to cause, exacerbate and prolong psychological and physical illnesses[2].

Mindfulness meditation and yoga have been long considered as alternatives to traditional mental health support. These are very popular tools for reducing stress and improving productivity and overall mental health[3,4]. Mindfulness meditation is one of two traditionally identified forms of meditation. Mindfulness meditation, which is also known as "insight meditation" or "Vipassana meditation," plays an increasingly important role in defining how meditation can contribute to therapeutic growth and self-development. While all meditations develop the ability to focus and focus, mindfulness meditation is primarily non-judgmental to the subject of attention rather than a single subject-focused consciousness such as words or mantras[3].

Different forms of yoga have different goals and focal points. Meditation Yoga (Hatha Style) focuses on careful breathing techniques, flexibility, and meditation[5], while Power Yoga (Vinyasa Style) focuses on maintaining strong poses and muscular endurance[6]. It has been shown to achieve metabolic intensity similar to that of a moderately intense exercise. Both meditation yoga and power yoga have been reported to reduce stress levels over time[7].

Alpha amylase is a non-invasive biomarker that can be used to study stress in the body. It is the most abundant enzyme in human saliva and is responsible for breaking down carbohydrates and starch. Alpha amylase has been shown to be secreted in response to sympathetic nervous system stimuli and increased in response to psychological stressors, which may be a useful parameter for measuring stress[1].

This article aims to investigate the effectiveness of yoga and mindfulness meditation interventions to reduce the individual stress biomarker alpha amylase, thus building the lead up to further studies to find how much it really prevents and reduces stress. The purpose of this article is to

look at and examine whether mindful meditation can be an alternative and complementary approach for managing stress.

METHODS

a. Methodology

Literature search related to the effect of Yoga and meditation on alpha amylase was performed on March 16th until 17th, 2022. Three databases are searched using Boolean operator (*Science Direct, Pubmed,* and *Cochrane).* Inclusion criteria includes trial in human, meta-analysis, systemic review, randomized controlled trial, observational study and articles within 10 years. Exclusion criteria on journal that is more than 10 years, animal subject and Non – English paper.

Table 1. Search Strategy

Database	Search Strategy	Hits	Selected
Pubmed®	(Yoga OR Meditation OR * OR Stress*) AND Alpha Amylase	1782	18
Science Direct®		28950	29
Cochrane®		455	10

b. Material and procedure

Based on the database search, 31178 papers have been obtained. Inclusion and exclusion criteria were then applied. The paper will be filtered for doubles and full-text availability. The process is illustrated in the figure below.

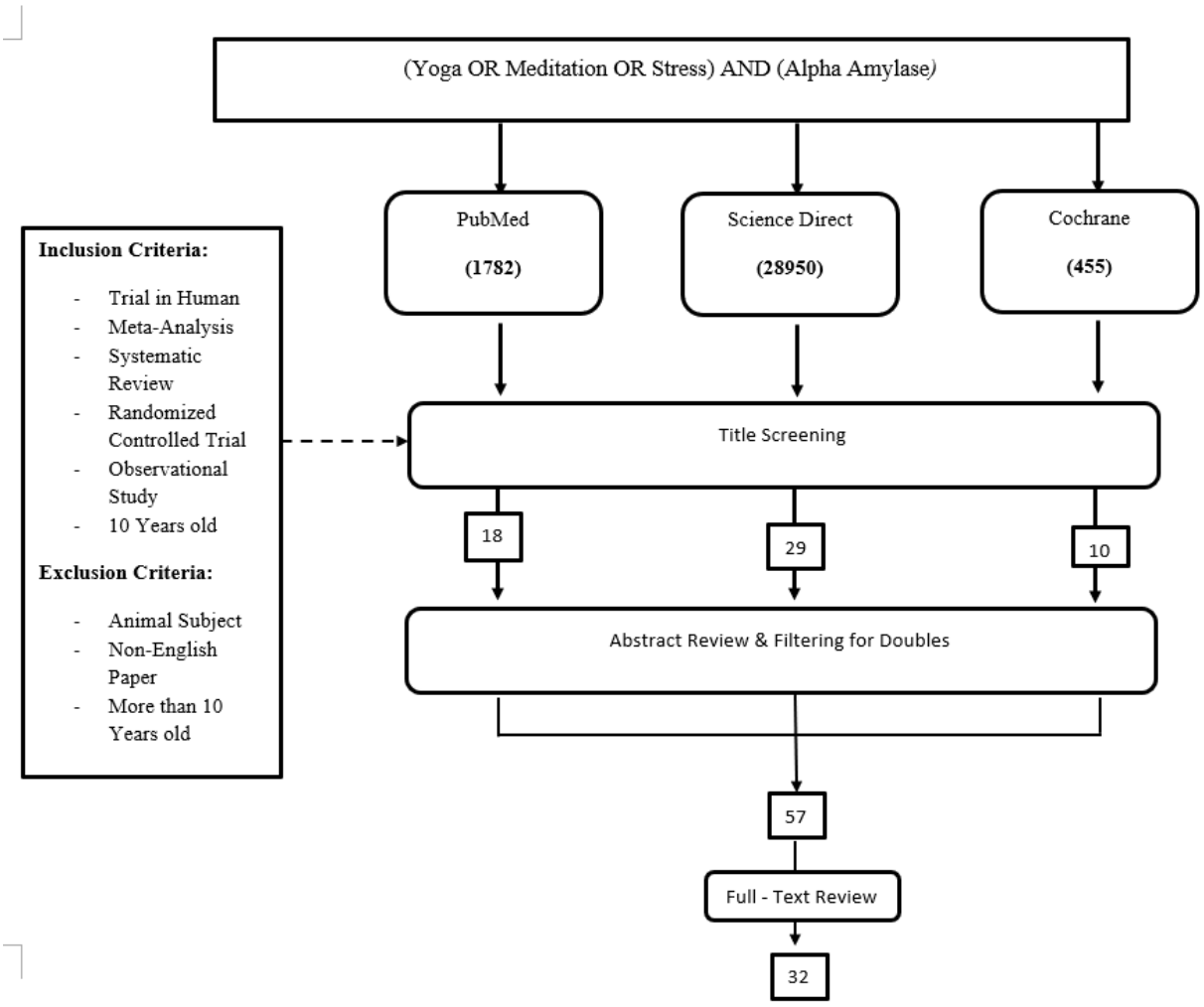

Figure 1. Search Strategy

A total of 31178 journals were found. The application of inclusion and exclusion criteria narrowed the article to 57. Final articles obtained for review were 32.

RESULTS

The data extraction of the eight journals is presented in Table 1.

Table 1. Data Extraction of Literature Review Results

No	Author, Year of Research	Participant/ Research Groups	Outcomes	Intervention and Research Purpose	Duration (weeks or months)	Frequency	Research Methods	Research Result
1.	Garcia-Sesnich et al., 2017 [8]	26 volunteers from the North campus of University of Chile	sAA and sCort	Kundalini yoga (KY) practice Research purpose: to determine the KY effect, immediate and after 3 months of regular practice, on the perception of psychological stress and the salivary levels of cortisol and alpha-amylase activity.	3 months	Twice a week 90 minutes of KY practice for 3 months	Randomized control trial	The study showed KY practice had an immediate effect on salivary cortisol. The activity of alpha-amylase did not show significant changes.
2.	Anguilar et al., 2021 [9]	74 medical students (third semester), at the end of the term, were about to take their first major exam	sAA and sCort	Mindfulness-based interventions (MBI) Research purpose: examines the effects of MBI on stress, sAA and sCort in daily life.	3 months	A one-day theoretical introductionfour three-hour evening sessions every two weeks and a final two-hour-session at the end of the intervention period.	Randomized controlled trial	The study showed MBI can reduce psychobiological stress markers, assessed via repeated measures of sAA and sCort in daily life.

3.	Fakharirad et al., 2020 [21]	20 post CABG patients in Shahid RajaieHeart Center in Tehran	sAA and sCort	Yoga-cardiac rehabilitation Research purpose: to investigate the effects of rehabilitation and yoga practice on salivary levels of alpha-amylase and cortisol in patients after CABG.	8 weeks	60 minute per sessions, 3 sessions per week for 8 weeks	Randomized controlled trial	The results showed that combined yoga and rehabilitation training had a significant effect on salivary cortisol but these interventions did not show a significant effect on salivary alpha-amylase.
4.	Siederves et al., 2014 [22]	28 students from science and math charter school in Charleston	BP, sAA and sCort	Hatha yoga (HY) practice Research purpose: to determine the effects of Hatha Yoga on salivary alpha-amylase among normotensive and prehypertensive youth.	3 months	90 minute sessions on alternating days (cycles of two sessions 1 week followed by three sessions the next week) throughout 12-week period	Randomized controlled trial	The results showed no statistically significant group differences were observed with changes of salivary cortisol or alpha-amylase levels but the HY practice demonstrated potential to decrease resting BP, particularly among prehypertensive youth.
5.	Kukihara et al., 2022 [28]	44 care workers who worked for elderly care facilities in rural Fukuoka.	sAA	Mindful meditation and yoga Research purpose: to investigate the effects of mindful meditation and yoga on reducing burnout and stress in care workers who assist elderly individuals	6 weeks	60-minute each week for six weeks	Randomized controlled trial	The results indicate that practicing mindful meditation or yoga for 60 minutes once a week for six weeks can reduce care workers' burnout, as well as reducing bomarker of stress (sAA), but both are not significantly different.

6.	Haslam et al., 2017 [29]	77 mindfulness-based stress reduction (MBSR) instructors	sAA	Mindfulness Meditation Research purpose: characterize sympathetic activity by using waking salivary alpha-amylase (sAA) concentrations and and to examine the association between meditation (depth, dose and duration) and the waking alpha-amylase response	Cross Sectional	Questionnaire (the number of years participans spent meditating, the average number of days per week and the amount of minutes per day)	Randomized controlled trial	Greater depth of meditation appears to be associated with a healthier sAA awakening slope, years of meditation was not associated with the awakening sAA slope.
7.	Mehrsafar et al., 2019 [31]	26 male elite Wushu athletes	sAA and sCort	MBI Research purpose: examines the effects of MBI on competitive anxiety, self-confidence, mindfulness, and autonomic and biomarkers stress responses to a competition in elite athletes	8 weeks	Weekly one-hour workshop sessions, daily 30 minutes home meditation practice, and weekly group-based mindful-Wushu sessions	Randomized controlled trial	The mindfulness group lower sCort daily levels ($p = 0.001$) but unaffected in daily sAA ($p = 0.742$) 8-week MBI was associated with decreased competitive anxiety, stress-related biomarkers, and enhanced self-confidence and competitive mindfulness in elite Wushu athletes, but could not rely on one stress biomarker only.
8.	Ducheni m et al., 2015 [32]	32 workers from a surgical intensive care unit (SICU) that work in high-	sAA	MBI Research purpose: to determine if a workplace stress-	8 weeks	Once per week with 60 minute every sessions except for week 5 that lasts 2	Randomized controlled trial	Levels of sAA were significantly decreased in the intervention group but with no changes in the control group. There was a positive correlation between sAA levels and

stress settings	reduction intervention decreases reactivity to stress among personnel exposed to a highly stressful occupational environment	hours and includes mindful eating	burnout scores.

DISCUSSION

a. Association between Stress dan Alpha-amylase (α-amylase)

Stress is the word we use to describe an organism's automatic process or mechanism in reaction to real or perceived demands from the environment. Stressors can be biological, environmental, social, emotional, or psychological, to restore balance[5]. Dysregulation of the neurobiological stress system can occur if there is permanent exposure to a stressor but there is a failure to recover from that stressor[6,10]. In stressful situations, the body's physiological and psychological reactions are given warning signs to help our bodies adapt to the current situation. At the physiological level, there is activation and harmonization between the central and peripheral nervous systems[11]. Activation of the hypothalamus and brainstem on the central nervous system when there is an outflow from the hypothalamic-pituitary-adrenal (HPA) axis and the autonomic nervous system (ANS) including the medullary sympathetic adrenal (SAM) and the parasympathetic system are part of the peripheral nervous system[12].

As a stress biomarker, cortisol has been extensively studied, but it is clear that the ANS is also important in biological stress processes and also in stress-related diseases[2]. Stress studies suggest that salivary alpha-amylase (sAA) has emerged as a viable and reliable marker of ANS activity. Alpha-amylase (α-amylase) is a non-invasive biomarker to stress in our body[1,13]. An easy, fast and non-invasive measurement that can be done by collecting participants' saliva, this method is often used in the acute stress literature, especially because it makes research easier because samples can be easily collected from home[2,14]. The enzyme in human saliva and has been shown to be secreted in response to sympathetic nervous system stimuli and increased in response to psychological stressors, which may be a useful parameter for measuring stress[1]. The character of salivary alpha-amylase is that there is a decrease in sAA levels in the first 30 minutes after waking up and then persists even progressively increases throughout the rest of the day, there is a difference with cortisol levels which immediately reach peak values within half an hour after waking up[2,15].

b. Association between Yoga and Alpha Amylase

Yoga is an ancient type of stress management that aims to bring the mind, body, and spirit together[7,8]. It has grown increasingly popular in many countries in recent years[7,18]. There are many forms of yoga and each form has its own theoretical underpinnings and methodologies, even though there are similar aspects such as regulated breathing, meditation practices, and physical postures[8,9].Yoga has been demonstrated in studies to reduce mental stress and negative moods, as well as to alleviate psychological symptoms by reducing anxiety and anger level[7]. Long-term yoga training also lowers stress-related psychological symptoms including anxiety and rage[8,10].

A case control study was conducted by Garcia-Sesnich et al in 2017 to seek the immediate and after 3 month effect of Kundalini Yoga (KY) on the sense of psychological stress, as well as salivary cortisol and alpha-amylase activity on 26 individuals (age ranging from 18 to 45 years-old). KY focused on the practice of kriya and meditation, as well as mantra chanting. Participants were divided into two groups namely, 1) study group consisting of beginners in KY practices and 2) not doing KY at all. Participants will be observed for 3 months. To assess immediate and longitudinal effects, four samples were taken from the yoga group in the beginning, middle, and end of the first and last classes. Two samples were taken from the control group at the start of the trial and after three months. The study group alpha-amylase activity was 34.03±21.68 U/mL at the start of the study and 38.01±20.14 U/mL after three months of yoga classes, whereas the control group values were 43.82±18.24 U/mL compared to 41.02±19.95 U/mL. Comparison between group values showed no significant changes (P=0.25 and P=0.72) even after three months in the study group (P=0.37) nor control group (P=0.67). The activities before and after the first and last classes were used to determine the immediate effect. The alpha-amylase value from before the first class were 34.03±21.68 U/mL and after 40.73±20.44 U/mL, whereas before the last class 38.01±20.14 U/mL and after 37.68±23.71U/mL. We found no immediate effect of yoga practice on salivary alpha-amylase activity before or after the first and last classes (P=0.26 and P=0.85). The results showed there are no major changes either in longitudinal or immediate effect of alpha-amylase activity between the KY group

and the control group. However, this study has several limitations, one of which, the small number of population it was conducted[8].

A recent randomized controlled clinical trial in 20 post coronary artery bypass grafting (CABG) patients revealed combining yoga and rehabilitation had a positive impact on salivary levels of the stress markers investigated. As a result, this sort of workout is suggested for secondary prevention of cardiovascular disease (CVD). In this study all of the participants ranging in age from 45 to 75 years-old were randomly assigned to one of two groups: 1) yoga-rehabilitation group and 2) rehabilitation group. Participants in the trial after a minimum of 12 hours of nocturnal fasting, saliva samples were obtained and will be monitored for 8 weeks and. According to the findings, the combined intervention of rehabilitation and yoga had a noticeable effect on salivary cortisol levels (P = 0.028). However, there was no major impact of these therapies on the sAA levels (P = 0.193). In this study, long-term rehabilitation and yoga training did not have a significant effect on alpha-amylase changes in coronary artery disease patients after surgery. Alpha-amylase has been shown to have a circadian rhythm, and the interaction of time of day (morning and evening) and exercise activity had an effect on sAA levels; this variable might have been influenced by distinct surface reactions in this study[21].

On the other hand, a pilot trial study by Siederves et al in 2014 to see the effects of Hatha Yoga on salivary alpha-amylase among normotensive and prehypertensive youth[22]. This type of yoga is a combination of physical postures with breathing and/or meditation activities[5]. There are 28 individuals participating in this trial with a mean age of 12.3 ±0.4 and divided into, 1) Hatha yoga program (HYP) and 2) attention control (AC) that will be assigned to a music or art program. Participants will be observed for 12 week and the saliva samples were collected at night, at awakening and at 30 and 60 minutes after waking up. The results showed salivary alpha amylase levels of the HYP group dropped significantly from pre- to post-intervention (Cohen d = 0.34; prehypertensive d = 0.20) but the prehypertensive AC group alpha amylase level rose (prehypertensive Cohen d = 0.30). The findings in this study suggest reductions of alpha amylase levels leading to reduced sympathetic nervous system (SNS) activation may have partially contributed to reductions in blood pressure (BP). Salivary alpha-amylase is a biomarker of SNS activation, a reduction in the markers infers a shift in SNS regulation toward parasympathetic dominance that relates to decreased BP[22].

c. Association between mindfulness meditation and Alpha Amylase

Meditation is a practice in contemplation or reflection which promotes general mental well-being and development[23], such as expanding tranquility, physical relaxation, improving psychological balance, accomplish an intellectually clear and stable state[3,24]. Mindfulness is defined as self-observation that trains focus on the present moment while accepting and acknowledging all physical thoughts, emotions, and feelings[25]. Mindfulness leads to decrease the negative impact associated with the fact that stress factors are not automatically assessed as threatening[9]. Meditation is closely related to the concept of mindfulness, therefore it is regularly alluded to as "mindfulness meditation"[23]. Mindfulness meditation has been shown to reduce psychological stress in many populations, including eldery[26,27,28].

The collective previous studies suggest a beneficial effect of mindfulness meditation on stress[29,30]. Recent longitudinal study with 74 medical students at the end of third semester showed the Mindfulness-Based intervention group can reduce psychobiological stress markers, including sAA and saliva cortisol compared to the control group. The students in the mindfulness group showed statistically significant results in lowering sAA levels (b = −0.361, p = .043, M = −6244.69, SD = 44,386.82)[9].

Similar previous research conducted by Haslam et al in 2016, with 77 mindfulness-based stress reduction (MBSR) instructors examined the relationship between meditation (dose, depth and duration) and the alpha-amylase. sAA samples were taken four times (right away upon waking, 15 minutes, 30 minutes, and 45 minutes intervals after waking. In this study, the population with deeper meditation was related with steeper decline in awakening sAA (p = 0.02) compared to the population who meditated less profoundly. Whereas years of meditation (p = 0.15) and dose (p = 0.24) were not related to reduced awakening sAA[29].

But on the other hand, a pilot study conducted by Mehrsafar et al in 2019 on 26 elite Wushu athletes during a competitive event. Competition has been associated with increased sAA and serum

cortisol (sCort). The experimental group participated in a 8 week mindfulness program that included weekly one-hour workshop sessions, in-house meditation practice, and weekly group-based mindful-Wushu sessions. The mindfulness group lower sCort daily levels (p = 0.001) but unaffected in daily sAA (p = 0.742) This study indicated that mindfulness intervention may be associated with attenuation of physical and psychological responses to stress during competition, but could not rely on one stress biomarker only[31].

d. Effect of yoga and meditation to Alpha Amylase

Both yoga and mindfulness mediation interventions can reduce stress biomarker alpha amylase, but both are not significantly different[28]. The combination of yoga and mindfulness meditation showed significant changes in sAA levels[32].

A randomized control trial conducted by Kukihara et al in 2021 on 44 eldery care workers who were randomly divided into three intervention groups: control vs yoga, control vs mindfulness, and yoga vs mindfulness. Yoga group practiced hatha yoga, mindfulness group trained in mindful meditation, both yoga and meditation sessions took approximately an hour, once a week for six weeks. Level of alpha amylase was measured using NIPRO: T-110-N. The result showed no significant difference between alpha amylase in the yoga group (M=36.86, SD=23.44) and the mindfulness group (M=35.53, SD=22.68, P= ns). On the other hand, there were significant differences between the yoga group (M=11.57, SD=3.06) and the control (M=75.75, SD=38.78, P=0.004), and between the mindfulness group (M=35.53, SD=22.68) and the control (M=75.75, SD=38.78, P=0.002). This research concluded that practicing yoga or mindful meditation for an hour once a week for six weeks can reduce biomarkers of stress[28].

A randomized pilot study conducted by Duchemin et al in 2015 investigated a work related stress intervention that reduces stress reactivity in 32 workers from a surgical intensive care unit (SICU) that work in high-stress settings. Participants were divided randomly into two groups namely, 1) study group participated in 8 week mindfulness based intervention (MBI) consisting of mindfulness meditation, gentle yoga and relaxation music 2) control group. The saliva samples were taken in the workplace during work day between 1 till 3 PM to represent the impact of work-related stress on the salivary alpha-amylase level. At the beginning of the study, results showed there was no difference between the two groups (p = 0.6812, t = 0.4152) and the average salivary alpha amylase levels for all participants were 93.6±15.9 units/ml (mean±SEM). The MBI group sAA levels from the beginning until after 2-month were lowered by 40% (p = 0.026, t = 2.562) compared with 4% of the control group. According to the findings, MBI can reduce stress reactivity among SICU personnel[32].

The results indicate that practicing mindful meditation or yoga, or both can reduce the biomarker of stress[28,32]. It is strongly recommended and encouraged people, especially those who work in a stressful environment to practice mindful meditation or yoga[12]. As health professionals, we should advise people to practice yoga and mindfulness as holistic therapy for stress in order to enhance their quality of life. Perhaps most importantly, yoga and mindfulness is available to anyone at any time or place, making it a cost-effective, flexible, and psychologically beneficial holistic practice from occupational stress and burnout[23].

CONCLUSION

There is a positive correlation between yoga and meditation on the level of alpha amylase. Kundalini and Hatha style Yoga have shown greater outcome compared to other types of Yoga. Deeper meditation was related with steeper decline in awakening sAA, whereas years of meditation and dose were not related to reduced awakening sAA. The fall in alpha amylase in turn reduces stress and improves overall productivity and mental health status. Practicing yoga and mindfullnes are beneficial in reducing occupational stress and burnout thus improve quality of life.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Cooper K, Wojcik J. The Effects of Physical Activity Classes on Stress in College Students. Winthrop McNair Res Bull. 2018;4:2018.
2. Ali N, Nater UM. Salivary Alpha-Amylase as a Biomarker of Stress in Behavioral Medicine. Int J Behav Med. 2020;27(3):337–42.
3. Breedvelt JJF, Amanvermez Y, Harrer M, Karyotaki E, Gilbody S, Bockting CLH, et al. The effects of meditation, yoga, and mindfulness on depression, anxiety, and stress in tertiary education students: A meta-analysis. Front Psychiatry. 2019;10(APR):1–15.
4. Erdoğan Yüce G, Muz G. Effect of yoga-based physical activity on perceived stress, anxiety, and quality of life in young adults. Perspect Psychiatr Care. 2020;56(3):697–704.
5. Vollbehr NK, Bartels-Velthuis AA, Nauta MH, Castelein S, Steenhuis LA, Hoenders HJR, et al. Hatha yoga for acute, chronic and/or treatment-resistant mood and anxiety disorders: A systematic review and meta-analysis. PLoS One. 2018;13(10):1–28.
6. Cahn BR, Goodman MS, Peterson CT, Maturi R, Mills PJ. Yoga, meditation and mind-body health: Increased BDNF, cortisol awakening response, and altered inflammatory marker expression after a 3-month yoga and meditation retreat. Front Hum Neurosci. 2017;11(June):1–14.
7. Marshall M, McClanahan M, Warren SM, Rogers R, Ballmann C. A comparison of the acute effects of different forms of yoga on physiological and psychological stress: A pilot study. Int J Environ Res Public Health. 2020;17(17):1–8.
8. García-Sesnich J, Flores M, Ríos M, Aravena J. Longitudinal and immediate effect of Kundalini Yoga on salivary levels of cortisol and activity of alpha-amylase and its effect on perceived stress. Int J Yoga. 2017;10(2):73.
9. Aguilar-Raab C, Stoffel M, Hernández C, Rahn S, Moessner M, Steinhilber B, et al. Effects of a mindfulness-based intervention on mindfulness, stress, salivary alpha-amylase and cortisol in everyday life. Psychophysiology. 2021;58(12):1–12.
10. Francis AL, Beemer RC. How does yoga reduce stress? Embodied cognition and emotion highlight the influence of the musculoskeletal system. Complement Ther Med [Internet]. 2019;43(January):170–5. Available from: https://doi.org/10.1016/j.ctim.2019.01.024
11. Eda N, Ito H, Akama T. Beneficial effects of yoga stretching on salivary stress hormones and parasympathetic nerve activity. J Sport Sci Med. 2020;19(4):695–702.
12. Arrant K. The Effects of a Yoga Intervention The Effects of a Yoga Intervention Author : Karen Arrant , PhD , RN. 2019;1(1).
13. Arrant KR, Stewart MW. The Effects of a Yoga Intervention. … J Interprofessional Heal … [Internet]. 2020;2(2). Available from: https://repository.ulm.edu/ojihp/vol2/iss2/7/%0Ahttps://repository.ulm.edu/cgi/viewcontent.cgi?article=1028&context=ojihp
14. Cozma S, Dima-Cozma LC, Ghiciuc CM, Pasquali V, Saponaro A, Patacchioli FR. Salivary cortisol and α-amylase: Subclinical indicators of stress as cardiometabolic risk. Brazilian J Med Biol Res. 2017;50(2):1–8.
15. Ameri M, Ghazalian F, Shakeri N, Akhoond MR. Effect of exercise with mental stress on cortisol and alpha-amylase changes in young men. Middle East J Rehabil Heal Stud. 2020;7(1):1–6.
16. Penman S, Stevens P, Cohen M, Jackson S. Yoga in Australia: Results of a national survey. Int J Yoga. 2012;5(2):92.
17. Yoshihara K, Hiramoto T, Oka T, Kubo C, Sudo N. Effect of 12 weeks of yoga training on the somatization, psychological symptoms, and stress-related biomarkers of healthy women. Biopsychosoc Med. 2014;8(1):1–10.
18. Hopkins LB, Medina JL, Baird SO, Rosenfield D, Powers MB, Smits JAJ. Heated hatha yoga to target cortisol reactivity to stress and affective eating in women at risk for obesity-related illnesses: A randomized controlled trial. J Consult Clin Psychol. 2016;84(6):558–64.
19. Pascoe MC, Thompson DR, Ski CF. Yoga, mindfulness-based stress reduction and stress-related physiological measures: A meta-analysis. Psychoneuroendocrinology [Internet]. 2017;86:152–68. Available from: http://dx.doi.org/10.1016/j.psyneuen.2017.08.008
20. Riley KE, Park CL. How does yoga reduce stress? A systematic review of mechanisms of change and guide to future inquiry. Health Psychol Rev. 2015;9(3):379–96.
21. Fakharirad F, Ghazalian F, Nikbakht H, Lotfian S, Nikpajouh A. The effect of 8 weeks of combined yoga and rehabilitation training on salivary levels of alpha-amylase and cortisol in patients after coronary artery bypass grafting. Res Cardiovasc Med. 2020;9(1):16.
22. Sieverdes JC, Mueller M, Gregoski MJ, Brunner-Jackson B, McQuade L, Matthews C, et al. Effects of hatha yoga on blood pressure, salivary α-Amylase, and cortisol function among normotensive and

prehypertensive youth. J Altern Complement Med. 2014;20(4):241–50.
23. Green AA, Kinchen E V. The Effects of Mindfulness Meditation on Stress and Burnout in Nurses. J Holist Nurs. 2021;39(4):356–68.
24. Strehli I, Burns RD, Bai Y, Ziegenfuss DH, Block ME, Brusseau TA. Mind–body physical activity interventions and stress-related physiological markers in educational settings: A systematic review and meta-analysis. Int J Environ Res Public Health. 2021;18(1):1–24.
25. Fahmi AY, Dwidiyanti M, Wijayanti DY. Effectiveness of Mindfulness on Decreasing Stress in Health Professional Students: A Systematic Review. Holist Nurs Heal Sci. 2018;1(1):1.
26. Dada T, Mittal D, Mohanty K, Faiq MA, Bhat MA, Yadav RK, et al. Mindfulness meditation reduces intraocular pressure, lowers stress biomarkers and modulates gene expression in Glaucoma: A randomized controlled trial. J Glaucoma. 2018;27(12):1061–7.
27. Lemay V, Hoolahan J, Buchanan A. Impact of a yoga and meditation intervention on students' stress and anxiety levels. Am J Pharm Educ. 2019;83(5):747–52.
28. Kukihara H, Ando M, Yamawaki N. The effects of yoga and mindful meditation on elderly care worker's burnout: a CONSORT-compliant randomized controlled trial. J Rural Med. 2022;17(1):14–20.
29. Haslam A, Wirth MD, Robb SW. Relationship Between Meditation Depth and Waking Salivary Alpha-Amylase Secretion Among Long-Term MBSR Instructors. Stress Heal. 2017;33(3):298–306.
30. Hoge EA, Bui E, Palitz SA, Schwarz NR, Owens ME, Johnston JM, et al. The effect of mindfulness meditation training on biological acute stress responses in generalized anxiety disorder. Psychiatry Res [Internet]. 2018;262(May 2016):328–32. Available from: http://dx.doi.org/10.1016/j.psychres.2017.01.006
31. Mehrsafar AH, Strahler J, Gazerani P, Khabiri M, Sánchez JCJ, Moosakhani A, et al. The effects of mindfulness training on competition-induced anxiety and salivary stress markers in elite Wushu athletes: A pilot study. Physiol Behav [Internet]. 2019;210(August):112655. Available from: https://doi.org/10.1016/j.physbeh.2019.112655
32. Duchemin AM, Steinberg BA, Marks DR, Vanover K, Klatt M. A small randomized pilot study of a workplace mindfulness-based intervention for surgical intensive care unit personnel: Effects on salivary α-amylase levels. J Occup Environ Med. 2015;57(4):393–9.