PARANINFO DIGITAL
MONOGRÁFICOS DE INVESTIGACIÓN EN SALUD
CIBERINDEX CANTARIDA

Paraninfo Digital, 2018; XII(28): e072
http://www.index-f.com/para/n28/e072.php
ISSN: 1988-3439

Indexación: CUIDEN, HEMEROTECA CANTARIDA, CUIDEN CITACION

REVISIÓN

Recibido: 10.07.2018
Aceptado: 08.11.2018

Alternative Exercise and Movement Techniques for Reducing Stress: Integrative Review

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Abstract
Purpose: in recent decades, stress has come to be seen as the evil of the century, with its visible and worrying implications for the human organism. High stress affects general health (physical and mental), revealing the need for strategies to cope with stress, decreasing response and long-term consequences. Exercise has been documented as one of the main non-pharmacological tools in promoting holistic health, and the aim of this study, therefore, is to analyze the scientific evidence available in the databases on using alternative exercise and movement techniques to reduce stress, using the hormone cortisol as the main measure.. Implications: investigate the effect of alternative exercise and movement techniques for reducing stress can be a complementary treatment strategy for patients. Methods: Integrative literature review, guided by Evidence Based Practice in the following databases: PUBMED, LILACS, SCOPUS and SCIENCE DIRECT. Combination of controlled and uncontrolled terms in stress, hormone cortisol, exercise and movement techniques adapted to each database. Results: A total of six publications were selected for this study. Conclusions: it was concluded that exercise and movement could be considered efficacious non-pharmacological, complementary techniques for reducing physiological stress, measured through biomarkers for stress (cortisol and others) as well as other variables.
Key-words: Stress. Cortisol.Exercise movement techniques. Mental health. Integrative review.

Introduction

The negative impact of stress on physical and mental health has been widely documented in the literature. There are two main systems responsible for mediating stress; the hypothalamic-pituitary-adrenal axis (HPA) and the autonomic nervous system (ANS), divided into the sympathetic and parasympathetic systems, which need to be in state of equilibrium. When conditions of stress or threat prevail, specifically, the organism seek to decrease sympathetic and increase parasympathetic activity.[1-8]

Under stressful conditions, the organism undergoes a significant metabolic and endocrine changes, including increased levels of the stress hormone cortisol which, in turn, has a wide range of influences, showing the importance of this glucocorticoid for maintaining systemic homeostasis.[9] Those who do regular physical activity in their daily lives are at lower risk of being affected by mental disorders compared with sedentary individuals, showing the physical and psychological benefits of activity.[10]

Doing physical activity is also related to neuroendocrine alterations and mood changes such as increased levels of adrenaline, noradrenaline, adrenocorticotropic and β- endorphin, and other physiological modulators of mental functions.[11-12] It is also an important mechanism leading to higher BNDF (brain-derived neurotrophic-factor) production, a neurotrophic that maintains function and integrity of glutamatergic primary neurons, acts on brain function and promotes neural plasticity.[13]

Studies suggest that alternative exercise and movement techniques reduce levels of stress. The main objective of such practices is to integrate mind and body, seeking complete equilibrium within the organism, aiming to use the mind to influence physical functioning, as well as promoting the individual's health and well-being.[14-22] Based on the evidence of the effect of such practices on reducing stress, their application is considered an intervention that promotes physical and mental health, as well as preventing diseases triggered by chronic stress.

The aim of this study is to analyze the scientific evidence available in the databases on using alternative exercise and movement techniques to reduce stress, using the hormone cortisol as the main measure.

Methods

This is an Integrative Review (IR) of the literature. The purpose of this IR was to synthesize scientific evidence that support the effectiveness of alternative exercise and movement techniques on reducing stress as measured through corti-

sol hormone levels associated with other measuring techniques.

This research was conducted according to the tools and recommendations for structured IR of literatura.[23] To identify and evaluate the research findings, we adopt a five-stage review process guided by Evidence-Based Practice.[24,25]

- First step: for the research question, we chose PICOT methodology to formulate it. PICOT represents the acronym: P=Patient or Population; I=Intervention or Indicator; C=Comparison or Control; O=Outcomes; and T=Time.[26,27]

In this review, the PICOT strategy was used in the following manner:

P= Adults with stress;

I= Alternative exercise and movement techniques;

C= Does not apply.

O= The use of exercise and movement techniques was an efficacious intervention in reducing stress as measured by cortisol hormone.

T= Duration of intervention

By defining the PICOT strategy in this manner, the database screening was intended to identify the extent to which the literature examines the key research question: what scientific evidence is available in the literature to support that alternative exercise and movement techniques are effective at reducing stress in adults, measured by cortisol hormone?

Search Procedure

The process of reviewing literature included a bibliographic search of databases. The search was completed in July, 30th 2015. The databases that were searched included the PubMed, Latino-American and Caribbean Literature in Health Care Sciences (LILACS), SCOPUS, and SCIENCE DIRECT. A publishing time limit was the past ten years (2009-2015). The descriptors and keywords were selected / adapted for each database.

Articles were included for review if they were published in English, Spanish and Portuguese languages, and researchers had:

a) Studied alternative exercise and movement techniques for reducing stress in adults; b) studies that used cortisol hormone as a variable for measuring stress.

Exclusion Criteria were: review articles, guidelines, grey literature; editorials; manuscripts that researched alternative exercise and movement techniques for reducing stress in individuals with specific pathologies.

After consulting the Medical Subject Headings MeSH Terms and Health Science Descriptors (deCS), the following descriptors were used: Stress; Exercise Movement Techniques; Breathing Exercises; Qigong; Dance Therapy; Tai Ji; Yoga; Hydrocortisone; Cortisol.

The total number of references found in the four databases was 166. After discarding duplicated articles, the eligible references were 97. After reading titles and abstracts, 20 studies were selected to receive a more rigorous review. As a result, six studies that answered the question of this research were selected. A flow diagram illustrates the articles selection process according to PRISMA Statemet[28] (Figure 1) to present the studies chosen, six of which proved useful in answering the research questions.

- Second Stage: extracting data, this stage consists of defining the data to be extracted from the selected studies.[24] Instrument previously validated[29] was used to extract the data.

- Third Stage: the strength of the evidence was classified for different clinical questions.[26]

- Fourth stage: analyzing and synthesizing the results of the review.[25,30]

- Fifith Stage: Presenting the integrative review.[25,30]

Sample

A descriptive summary of the IR was generated, including the six articles selected (Table 1). This summary table was prepared for each primary study included in the review, including the following data: authors, title, country, key-words, source, year, level of evidence, items not contemplated in accordance with the STROBE Statement, objective and method.

All the studies included have level II evidence strength.[26] With the purpose of discussing the quality of each study selected, the STROBE Statement was used. It is a checklist composed of 22 items with recommendations, aiming at providing guidance regarding content to be reported in observational studies, seeking a more complete description and the quality of the scientific article.[31]

A second table was developed describing which technique of exercise and movement was used in each study, period and type of cortisol collection and main results related to the cortisol levels (Table 2).

Analysis and Synthesis

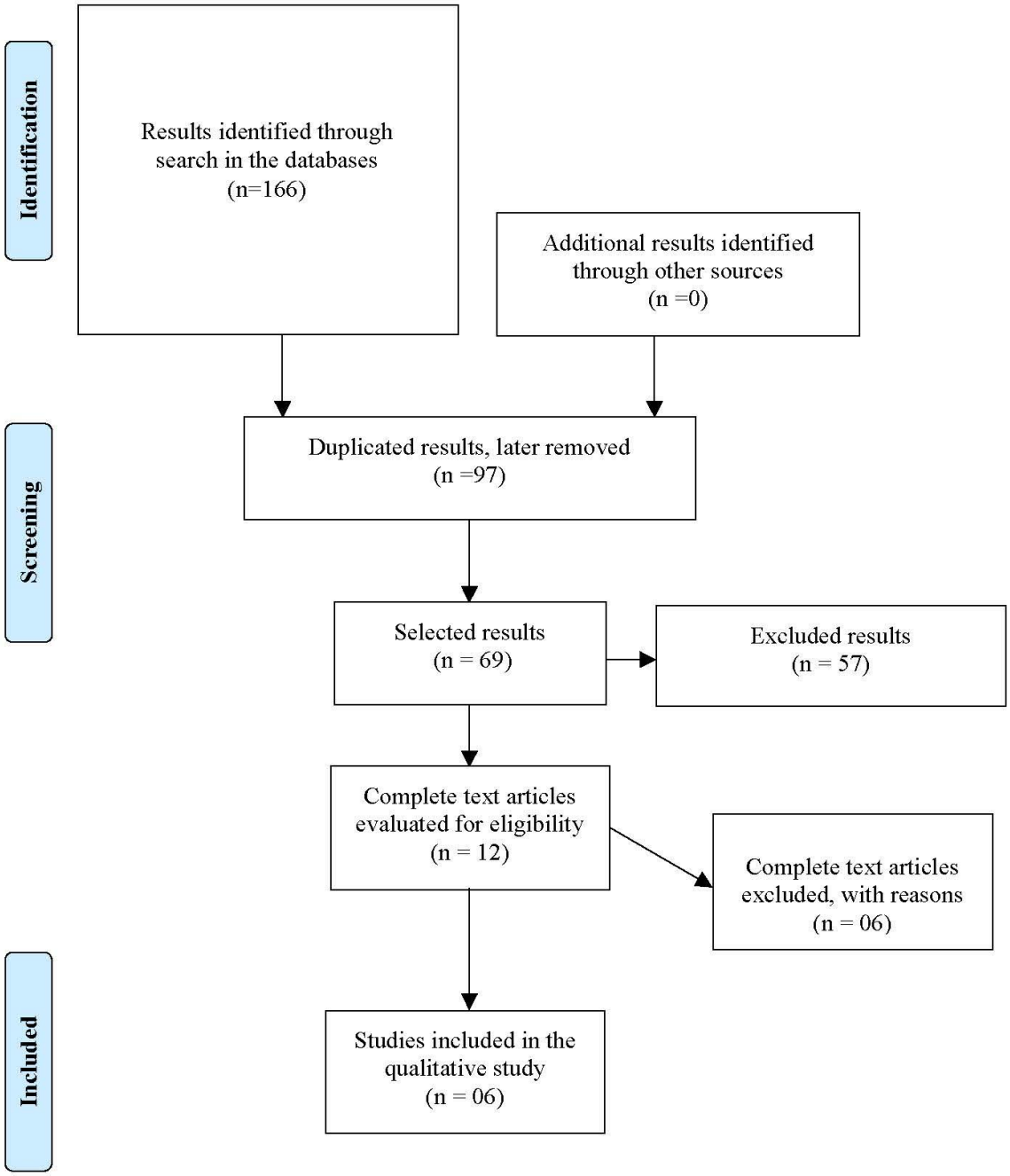
After reading the studies, findings were then synthesized through comparison, interpretation, and classified into categories. The findings from each of these categories will be discussed in four thematics: a) Yoga,[32,33] b) Qigong,[34,35] c) Taiji[36] and d) Mindfulness.[37]

The six articles included were submitted to analysis to verify methods, and then relevant study information (appearance and content validation) was extracted with validated method,[29] which contemplated the identification and methodological characteristics of the studies.

Results

First, we present a general characteristics of the articles included. We then report descriptive features followed by a presentation of the alternative exercise and movement techniques that emerged from the analysis: Yoga, qigong, taiji and mindfulness.

Figure 1. *Identification process flowchart and article selection according to PRISMA Statemet*



General study characteristics

Table 1 shows an overview of the articles referred in this results section. The presentation of the findings summarizes the methods of cortisol collection and the main results of each study showing the duration of the intervention and its effects on cortisol levels.

The articles making up the corpus of this study were written in English. As for origin, three studies were carried out in Asian countries (China, Korea and Japan). It was found that the saliva is the most commonly used sample specimen in cortisol based stress research,[33-36] even more than urine[32] and blood.[37] All interventions brought data on cortisol levels before and after the intervention. All studies were randomized clinical trials, considered standard gold clinical research. In three studies the intervention occurred for 12 weeks,[32,35,36] and only one[32] a significant reduction of the corticotrophic levels was not found. Different duration of the intervention were brought from the other studies, at 8 weeks[37] and at 6 months[33] were effective in relation to the proposed goal. The 4 weeks intervention[34] did not show reduction of the desired hormonal levels (Table 2).

The most studied population of this review were healthy men and women, the alternative techniques of exercise and movement employed were used in a preventive perspective. In addition to this previously mentioned population, a study with military men also used yoga as a prevention to compare if this technique was more or less effective than conventional exercises (running and body building).

Table 1. *Study, Technique, Cortisol Collection and Mains Results*

Study	Technique	Cortisol Collection	Main Results
Yoshihara et al. (2014)[32]	Yoga	**Urinary Cortisol** was collected between 6:00 and 9:00 am. Participants were asked to avoid vigorous exercise and heavy psychological stress for 24 hours prior to urine collection.	After 12 weeks of intervention, there were no significant differences in the urinary cortisol levels between interventions groups (yoga) and the control group.
Kim et al. (2013)[37]	Mindfulness	**Serum cortisol** was measured after morning phlebotomy (unspecified hour).	After eight weeks of intervention, basal serum cortisol concentrations were significantly higher in the experimental (Mindfulness) group in relation to the control group
Hawang et al. (2013)[34]	Qigong	**Salivary cortisol** was collected one hour after awakening, between 7 and 9 a.m. No eating and no drinking except for water was allowed prior to saliva collection.	After four weeks of intervention, salivary cortisol levels not changed in the experimental group (Qiong) and control group.
Rocha et al. (2012)[33]	Yoga	**Salivary cortisol** was collected in the morning (7:00 a.m.) and participants were instructed not to drink or eat anything, nor brush their teeth for at least 2h prior to the testing.	After six months of intervention, salivar cortisol levels of intervention group (Yoga) were significantly lower when compared to control group after the period of practice.
Nedeljkovic et al. (2012)[36]	Taiji	**Salivary cortisol** was collected (10 min (20 min) and 1 min (10 min) prior to the TSST and immediately (+1 min) as well as 10, 20, 30, 45 and 60 min after stress cessation.	After 12 weeks of intervention, Taiji participants exhibited a significantly lower stress reactivity of salivary cortisol than the control group.
Chow et al. (2012)[35]	Qigong	**Salivary Cortisol** was collected in the morning (unspecified hour).	After 12 weeks of intervention, the intervention group (Qigong) showed lower salivary cortisol levels than the control group.

Table 2. *Characteristics of the population and type of intervention*

Study Reference	Population	Country	Age	Characteristic of intervention
[32]	Healthy women	Japan	33 to 36	Prevention
[33]	Military men	Brazil	20 to 40	Prevention
[34]	Men and women with high levels of self-perceived stres	Korea	20 to 60	Treatment
[35]	Healthy men and women	China	21 to 64	Prevention
[36]	Healthy men and women	Switzerland	18 to 50	Prevention
[37]	Nurses with PTSD symptoms	New Mexico	44 to 47	Treatment

Yoga

Yoga is an ancient Indian philosophy that seeks the balance of individuals in every aspect, physical, mental and emotional. The practice has three nuances: Asanas, postures in which the individual has to maintain for a while, with the objective of acquiring flexibility and strength for the body; Pranayamas, breathing exercises focused on the sensations that each body region brings during the practice; Meditation; process of paying attention to the thoughts, physical and emotional perceptions, aimed at improving cognitive functions. Meditation can also be done through mantras, which are repeated phrases.[38,39]

A study with a group of healthy women who had no experience with yoga showed that the 12 weeks of Yoga practice has the potential to reduce the somatization score and the scores related to mental health indicators, such as anxiety, depression, anger, and fatigue. It suggests that yoga can improve somatization and mental health status. However, biologic markers (including cortisol) showed a significant increase compared with that before starting yoga training, and no signi-

ficant changes were observed in the level of urinary cortisol after yoga training.[32]

In a population of military men, for a period of six months, Yoga practitioners showed improvement in the memory performance, as well as improvements in psychophysiological parameters (stress reduction), suggesting that regular yoga practice can improve aspects of cognition and quality of life in healthy individuals.[33]

Qigong

Qigong is a traditional Chinese therapy based on mental control of movements and postures, sustained in concentration and breathing. The goal is to achieve the control state of Qi (vital energy that flows through the meridians or channels of the body and which is totally tied to the regulation of the individual's vegetative functions), which occurs through the control of breathing added to a high state of mind consciousness and focus on the present moment. Recalling that this vegetative regulation also occurs because the mind-body relationship rises, always seeking the state of homeostasis.[40-42]

In one research, fifty participants were randomized into a group receiving a 4-week intervention of a brief Qigong-based stress reduction program (BQSRP) and control group. Compared with the control group, the BQSRP intervention group displayed significantly larger decreases in results of psychometric scales that measure stress, anxiety and increase quality of life, however, cortisol levels were not changed.[34]

Thirty-four healthy middle-aged adults participated in an 8-week qigong program, their outcomes were compared with 31 matched subjects in the wait list control group. The qigong group enjoyed better quality of life, had more positive affect, lower cortisol levels and blood pressure than the control group, supporting that Qigong has a positive effect on reducing stress and anxiety and enhancing body–mind well-being.[35]

Taiji

Taiji (Tai Chi Chuan, Tanjiquan) is an ancient Chinese practice that includes slow body movements based on traditional martial arts, coupled with relaxation and meditation (focus of consciousness at the present moment). There are five main schools or styles of Taiji, named according to the founding family: Yang, Chen, Sun, Wu (Jian Quian) and Wu (He Quin), what differs these styles is the focus of the posture and the center of gravity. However, they all aim at relaxation, mental concentration and coordinated movements associated with pause or not of breathing.[43,44]

In one study[36] the intervention took place over a 12-week period, with classes of one hour, twice a week. Analysis of cortisol and alpha-amylase using immunochemiluminescence showed a significant reduction in these variables in the group that practiced Taiji compared to the control group. Heart rate was measured with an electrocardiogram (ECG) and the group that did Taiji showed a significant reduction in their own basal data when compared with the Control Group. This study suggests that practicing Taiji attenuates psychobiological stress reactivity in healthy subjects.

Mindfulness

Mindfulness can be defined as the awareness that emerges when we pay attention on purpose in the present moment, and without judgment. It has its origins in Buddhist traditions, but it is not based on religious concepts, but on spirituality. Jon Kabat-Zin[45,46] was responsible for unlinking the religious issue from the East and bringing all this knowledge to the West, structuring this practice and making it accessible and interesting to the East, to the extent that it is used as a treatment for patients with chronic pain. The practices are diverse, such as the meditative walk, body scanning and guided breathing, besides these others that compose the framework of exercises brought by mindfulness. The goal is to provide tools for the individual to be fully engaged with the present moment without judgments regarding past and future experiences and thoughts. In addition, opening up new experiences is one of the precepts of the technique.[45-47]

In a randomized controlled trial[37] with twenty-nine nurses (28 female) with post-traumatic stress disorder (PTSD). They realized sixty-minute of Mindfulness sessions conducted semiweekly for 8 weeks. This study demonstrates that participation in 8-week Mindfulness program showed a significant reduction of PTSD symptoms and an increase in serum cortisol in the intervention group compared to the control group.

Discussion

This IR enabled to identify what has been studied and published in terms of applying alternative exercise and movement techniques for reducing physiological stress. The results found in this review will be discussed in categories according to the exercise techniques investigated by the studies analyzed.

Yoga

In this review, different results were shown regarding the practice of yoga, one study[32] showed not change in cortisol levels but in other[33] the levels decreased. However, in a population of healthy men and women who underwent a 6-week yoga program, the results showed a reduction in corticotropic levels of saliva.[48]

A systematic review[49] on effectiveness of yoga in reducing stress measured by biomarkers, including cortisol, presented twenty-five studies in which twenty-four showed that the technique was effective, twelve studies used salivary cortisol as a method of measurement, the average practice of the technique was eight weeks, ranging from at least six weeks to six months.

The study in which the technique was not effective, the practice took five weeks, and the cortisol was collected through blood. Thus, is not possible to affirm, however, in this study as in other reviews which the method of measurement was not saliva that the time of intervention and cortisol levels seems to have some correlation, however, more studies are necessary to pinpoint this information accurately.

In a study[50] conducted with 60 men with high levels of stress, was tested the effectiveness of doing one hour of Yoga, six times a week, for six months. Various stress biomarkers (epinephrine, norepinephrine, serotonin, cortisol, adrenocorti-

cotropic hormone and neurotrophic factor) were measured. Reductions were found in all of the biomarkers, showing that Yoga can be effective in the process of homeostasis in terms of stress.

Qigong

First year nursing students from an university at Brunei Darssulam in Southeast Asia, tested the effectiveness of Qigong for ten weeks, and the results showed that after ten-weeks practice the salivary cortisol levels decreased,[51] corroborating with the results found in this review, specifically regarding the efficacy and method of measurement.[35] The same result were found using 12-week practice in patients with cancer, and with the same type of evaluation regarding cortisol.[52] On the other hand, the five-weeks practice in the same population does not showed any changing in the cortisol levels.[53] Thus, these results suggests that the time of practice may play an important role in the impact on cortisol levels.

In a study[16] with 67 adolescents (both sexes), with high levels of stress, Qigong technique was applied once a week, for 45 minutes, for a period of eight weeks. Psychometric variables and stress biomarkers including cortisol were collected and analyzed. The results showed that in a group that practiced Qigong there were improvements in the psychometric variables, this being more significant in the biological ones, showing the effectiveness of Qigong as an alternative for combatting stress.

Taiji

The findings of this review was corroborated by a study[54] that showed that the effects of doing Taji chi on stress reduction were equivalent to those of moderate physical exercise (walking at around 6 km/h for 1 hour), found through decreased salivary cortisol levels and decreased heart rate and blood pressure, and measurements of catecholamines in the urine.

What differed in the studies[36,54] was the intervention time period, six months and twelve weeks respectively. In addition, it is important to note that in the comparison of efficacy between Taiji and physical exercise, the millenarian technique was not as effective in the first three months, but after six months there was a drastic and much more significant reduction. Similiar results to the ones discussed in this review where found in a study[44] that proposed the practice of Taiji for students who were part of a sporting extension activity in one university from Berlin, Germany. The participants were engaged in a eighteen weeks practice, the measurement was also made through the saliva. At the end, the eighteen weeks practice was effective in reducing cortisol levels.

Mindfulness

The use of Mindfulness in 99 female adolescents showed efficacy in reducing chronic pain. The intervention was applyed for 4 months, the measurement of cortisol was performed through saliva, and as in the present review, the results demonstrated a significant reduction of this biomarker levels.[55]

Using blood as method of measurement, interesting results were shown in a study that sought to know whether mindfulness, walking and education performed for 8 weeks would be effective as treatment for patients diagnosed with diabetes mellitus. Besides the effectiveness of the alternatives, they also made a comparison among them, in order to find which would be more successful. Data demonstrated that all three were effective, but mindfulnnes was the one that reached strong decrease in cortisol levels[56]. Resembling this review, it was demonstrated that the technique is effective, using the same intervention time, but with the different measurement method.[56]

In a study with 40 male soldiers, the aim was to test the effectiveness of the technique for a period of four months, with twice weekly three-hour sessions. The population was divided in control and the Mindfulness (intervention) group. Psychometric and biological variables such as salivary cortisol, were measured. The results showed improvements in the psychiatric scales, although the most significant outcome was in the biological variables, in which the reduction in salivary cortisol stood out in the Mindfulness group. The control group showed worsening scores in the scales and increased salivary cortisol.[57]

We highlight some limitations of the studies reported by the authors like the small sample size and the lack of comparison group (control and intervention)[32] and the composition of the sample, being predominantly female nurses with PTSD symptoms.[37]

Absence of a PTSD diagnosis may also limit the validity of the study and cannot may be limited generalizability of the outcomes to males or individuals with combat-related trauma. Another limitation highlighted was the treatment allocation bias in which the phlebotomy nurses could not be entirely blinded to the group assignment of participants. The absence of exclusion of patients with depression could have contributed to increased cortisol levels in some participants.[37]

Also, limitations was the restriction of result to the immediate post-intervention period.[34] There was a wait-list control, and the contact with the trainer might have influenced the outcomes. The wait-list control subjects were trained for 4 weeks, but the authors could not assess the difference between the two groups over time. The salivary cortisol has a circadian rhythm and is ideally sampled more than twice a day at different time across 2–3 days and it was sampled only once in this study. Investigation of long-term outcomes and further study is warranted.

One study used three types of intervention (pranayamas, meditation or asanas), although without specific protocols for each one. This could be a limitation to possible conclusions of the effectiveness of each intervention and further investigation with protocols focused in each technique would be of great interest.[33]

In another study,[36] results are restricted to a healthy, educated, middle-aged group, and thus cannot be considered for other groups of different health and social status. The results were based on a group of Taiji beginners; long-term effects of the technique are still to be studied. The psycho-biological evaluation does not include approaching responses to stress in certain important physiological systems such as the immune, lipid or coagulation systems. Moreover, with regards physiological systems, certain variables in the HPA system, apart from cortisol, such as corticotrophic and adrenocorticotropic hormones, could have been measured.

One sample was formed by healthy adults, and a larger number of female subjects compared to the male subjects. Moreover, although the Qigong protocol had been evaluated by an experienced instructor, it did not follow a standard with which to quantify participant learning. It is suggested that protocols of Qigong efficacy be standardized in future studies.[35]

Conclusions and implications

In this sense, this article explored what is understood by the knowledge regarding the effectiveness of exercise and movement techniques for stress reduction, and it was shown that these techniques can be used as a health care tool. Yet, additional studies are needed to make progress, but likewise more rigor. It also is essential to take into consideration the duration of the intervention, population and the type of measurement to identify 'best practice' approaches to address health problems and give enough scientific support, so that these techniques can become options consolidated.

Through this integrative literature review, it became evident that better protocols are needed to test the effectiveness of exercise and movement techniques. It should be taken into consideration that although these techniques indirectly influence the condition of the subject, their main objective is to alleviate the effect of reactions to the stressors, offering the subject the opportunity to prepare themselves to cope with and react to stressful situations, increasing their capacity to adapt to them.

Moreover, it should be highlighted that these techniques are alternative and non-pharmacological and, thus, can be used by different health care professionals in treating those suffering from stress. However, recommendations for offering these techniques should consider factors such as personal taste, lifestyle, physical condition and personal motivation. As each technique has its ideas, these should harmonize with personal aspects in order to be effectively incorporated into lifestyle, increasing the chances of benefits to the practitioner.

As for the knowledge produced to advance research on stress and interventions based on alternative exercise and movement techniques, this study provides important results that should be considered when developing research that aims to test the effects of this type of intervention with more accuracy. It contributes to better selection of variables and measuring techniques and drawing up protocols and establishing criteria for selecting participants. This may underline the role of practice for stress prevention.

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