

MARTIAL ARTS: MINDFUL EXERCISE TO COMBAT STRESS

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ABSTRACT

Stress can promote cardiovascular and metabolic responses that may favor the development of a number of diseases, especially when it is experienced chronically. Mindfulness (MF) practices are adaptations from eastern meditative techniques which are utilized in different psycho-social therapies for promotion of physical and mental health. The psychological construct of MF refers to a special form of attention to internal and external phenomena in the present moment, including openness to experience in a non-critical attitude (i.e. without judgments). Mindfulness-based practices and interventions are particularly effective in promoting health for clinical conditions involving chronic stress, anxiety and depressive symptoms. Similarly, regular exercise has multifarious benefits for health, especially activities that strongly integrate both psychological and physiological training. Such is the case for martial arts (MA), the whole of which could be classified as mindful movements. Given that MA requires expenditure of energy done with a high level of concentration, engagement in this form of exercise may provide an interesting and novel strategy for enhancing physical and mental benefits. The regular practice of MA could elevate MF levels of practitioners and thus influence positively on stress management and therefore quality of life and well-being.

Key Words: mindfulness, meditation, exercise, attention, stress, depression

RESUMEN

El estrés genera respuestas cardiovasculares y metabólicas que pueden favorecer el desarrollo de diversas enfermedades, especialmente cuando es experimentado de forma crónica. Las prácticas de atención plena son adaptaciones de técnicas meditativas orientales que son utilizadas en diferentes terapias psicosociales para la promoción de la salud física y mental. El constructo psicológico de la atención plena se refiere a una forma especial de atención hacia fenómenos internos y externos en el momento presente, con una actitud no crítica hacia la experiencia (i.e. sin juicios). Las prácticas y las intervenciones basadas en la atención plena son particularmente efectivas en la promoción de la salud en condiciones clínicas que incluyen estrés crónico, ansiedad y síntomas depresivos. Del mismo modo, el ejercicio regular posee múltiples beneficios para la salud, especialmente aquellas actividades que integran sólidamente tanto el entrenamiento psicológico como el fisiológico. Este es el caso de las artes marciales que podrían ser caracterizadas como ejercicios con atención plena. Dado que las artes marciales requieren de un gasto energético, al mismo tiempo que altos niveles de concentración, podríamos considerar la adhesión a esta modalidad de ejercicio como una estrategia novedosa e interesante para el incremento de los beneficios físicos y mentales asociados. La práctica regular de artes marciales puede elevar los niveles de atención plena e influir así positivamente en el tratamiento del estrés y, por lo tanto, en el bienestar y la calidad de vida de sus practicantes.

Palabras clave: atención plena, meditación, ejercicio, atención, estrés, depresión

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INTRODUCTION

The subtle and silent transition from health to illness occurs with the rupture of homeostasis. Under normal conditions, physical and psychological stressors contribute to complex bodily reactions that promote positive adaptations thus increasing tolerance capacity for adverse situations (Lipp et al., 2002). In contrast, chronic stress is associated with a number of adverse physiological alterations (Demarzo et al., 2014) and worse lifestyle behaviors (Stults-Kolehmainen & Sinha, 2014), which can result in the development of cardiovascular, metabolic and mental pathologies (Hammen, 2005).

Among the diverse contemplative experiences (i.e. focused attention, open monitoring, compassion, loving kindness), the millenarian practice of Mindfulness (MF) is highlighted as a meditative technique characterized by the continuous and wide-attention monitoring to present perceptual experiences with the absence of judgment or value judgment (Kabat-Zinn, 1998). The psychological construct of MF is constituted by two main components: i) attention processing to internal (cognitive, emotional and somatic) and external perceptions (routine and daily life experiences); ii) attitude of open and non-critical monitoring to those experiences (Bishop et al., 2004). In the Western World, MF practice is an adaptation of contemplative Eastern techniques that has gained increasing recognition, and is mainly applied through mindfulness-based interventions by medical and psychosocial therapists (Demarzo et al., 2014; Neale, 2006). Studies suggest that this particular kind of attention, through well-structured practices and programs, may contribute to positive alterations in health, such as better autonomic control of heart rate (Tacón et al., 2003; Mankus et al., 2013) and lower systolic blood pressure (Zeidan et al., 2010), but especially improved control of chronic stress (Chiesa & Serretti, 2009; Ludwig & Kabat-Zinn, 2008; Biegel et al., 2009). Moreover, interventions based on these techniques have demonstrated positive results in clinical populations exhibiting elevated symptoms of anxiety (Hoge et al., 2013; Khoury et al., 2013) and depression (Joo et al., 2010; Sanders, 2010). Further, results from recent studies suggest that expert Buddhist meditators present lower activity of neural structures (e.g., amygdala, insular cortex and orbital frontal gyrus) related to the control of emotional responses to sensations and thoughts (Davidson & Begley, 2012) which in turn control autonomic, endocrine and immunological axes.

Some fundamental practices in MF programs include movements executed with full attention to internal physical sensations, which could help regulate physiological responses to chronic stress (Demarzo et al., 2014). During these activities, the attention is intentionally directed to interoceptive and proprioceptive sensations, such as feeling how much tension each muscle generates while walking, or feeling the breath and heartbeats while breathing

deeply and slowly. Indeed, these techniques have been referred to as mindful movements which have demonstrated various physical and mental benefits (Demarzo et al., 2014; LaForge, 2012). It is well recognized that physical exercise in itself plays an important role in stress regulation and health promotion, because its practice favors the development of physiological regulatory mechanisms for the control of acute and chronic stress, apart from promoting immediate psychological benefits (Huang et al., 2013). Consequently, these practices may be particularly effective at combining both physical and psychological aspects of training.

A martial art (MA) is the combination of physical movements with strategy and a variety of precise and coordinated techniques conducted for combat purposes. Each of these are embedded within a structured philosophy, knowledge-base, system of values and tradition (Green, 2001). Moreover, a MA is a practice that also strives for an aesthetic representation during combat, without focus on its destructive potential. It is common to find in the same MA one modality in which the opponents fight thorough physical contact, and another in which there is an individual simulation of combat without physical contact. In *karatê* they are called *kumite* and *kata*, in *taekwondo* *gyeorugi* and *poomsae*, and in *wushu sanda* and *taolu*. Within *taiji quan*, for instance, it is recognized that the execution of combat movements without physical contact (*taolu*) is an exercise with an important meditative component (Yu, 1996; Abbott & Lavretsky, 2013). This system integrates body and mind because its practice demands constant attention and focus on the execution of movements (Yu, 1996; Diepersloot, 1997). Results from validated questionnaires (Park, Reilly-Spong, & Gross, 2013) suggest that MA practice favors MF in daily tasks and experiences and, consequently, influencing stress control related issues (Caldwell et al., 2010, 2011; Nedeljkovic et al., 2012a; Lothes, Hakan, & Kassab, 2013).

Nowadays, primary prevention health programmes that include meditation practice associated with MA are recognized and promoted by public health systems. However, it is important at the current time to determine precise and evidence-based methodologies and training protocols for healthcare practitioners. Moreover, although meditation with full attention is present in some MA (Abbott & Lavretsky, 2013), little is known about the demands and characteristics of attention systems for each MA, style and technique. This dearth of information limits the validity of exercise prescriptions which focus on this form of physical activity. Therefore, the purpose of this literature review was to search evidence that supports the validity of regular MA practice as a mindful movement for stress management.

METHOD

The search for relevant articles was performed independently by two researchers in May of 2014. This was conducted in the Pubmed database (see Figure 1) and included only articles reporting original data in the English language. The keywords utilized were: (*martial arts OR Asian martial arts OR wushu OR gong fu OR aikido OR karate OR judo OR taekwondo OR taiji OR tai chi*) AND (*mindfulness OR meditation OR mental health OR stress OR stress management*).

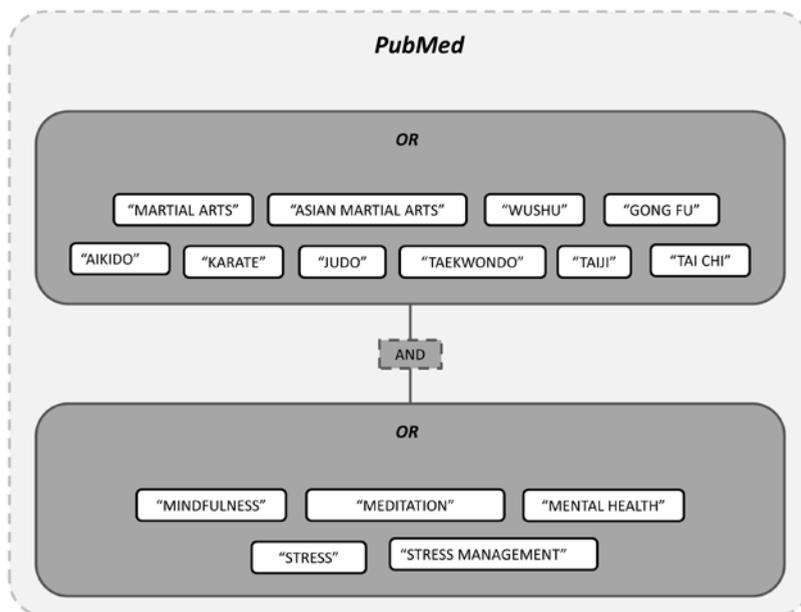


FIGURE 1: Keywords utilized in Pubmed database.

Inclusion criteria for the identified articles included the following: (a) a MA was utilized as a mode of exercise in at least one group of participants; and (b) at least one parameter related to mental health, stress management, dispositional MF or meditation-related indices was evaluated (see Figure 2). Articles focusing on high-level sport were excluded.

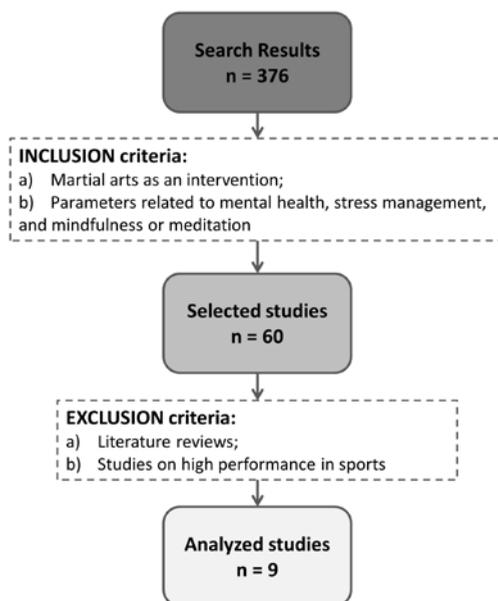


FIGURE 2: Search strategy and selection criteria.

RESULTS

In the initial search, 376 studies were found, from which 60 met the inclusion criteria. From these studies, 51 were excluded when exhibiting one of the following characteristics: (a) being a literature review; or (b) being a study related to injuries and training methodologies in high performance sports. In this regard, some authors did not suggest a link to health promotion in competitive sports and were thus excluded. Nine studies were further evaluated (see Table 1).

TABLE 1
Description of selected studies from Pubmed according to established criteria.

References	Subject characteristics	Purposes	Methods	Assessments	Results	Conclusions
TAYLOR-PILIAE et al., 2006	39 men and women; average age of 66 years old.	To observe changes in psycho-social aspects in persons with cardiac risk factors after 12 weeks of taiji quan (TJ) practice.	60 minute classes, 3 sessions per week over 12 weeks. Data collection before, after 6 and 12 weeks of intervention.	Questionnaires for POMS, PSS, TCSE and session frequency.	Improvement in mood state, ↓ perceived stress. ↑ Self-efficacy to overcome practice barriers.	12 weeks of TJ improves mood and regulates stress and ↑ self-efficacy.
ROBINS et al., 2006	59 men and women HIV patients; age > 18 years old.	To observe the effects of TJ practice on biopsychosocial factors in individuals with different stages of AIDS.	TJ groups of spiritual therapy and stress control based on cognitive behavior. Sessions of TJ with 60 minute duration, 1 session per week over 10 weeks.	Comparisons between the stress level and coping (DIS); psychological stress of patients with HIV (IES) and quality of life related to health (FAHI).	TJ group ↑ quality of life, social welfare and emotional welfare; ↓ psychological stress related to HIV.	TJ helps to control stress in patients with HIV and presents as an alternative therapy for HIV patients.
ESCH et al., 2007	21 men and women; age > 18 years old.	To observe the practice of TJ on the regulation of psychological and physical stress.	90 minute classes, 12 sessions over 18 weeks.	Stress level through blood pressure, heart rate, salivary cortisol (SC) and perceived stress.	↓ SC; ↑ scores at SF-36 questionnaire ..	TJ decreases negative stress and helps with the control of psychological and physiological stress.
WANG, 2008	30 men and women; students with average age of 24 years old.	To observe the effects of TJ on perceptions of the self-rated mental and physical health.	Classes of TJ 2 sessions a week, 60 minutes each over 12 weeks. Data collected before and after intervention.	Physical and mental aspects with SF-36v2 questionnaire .	Improvements in physical and mental health; ↓ body pain; and ↑ emotional and social functions.	TJ improves self-perception of health and may extend benefits to groups different from elderly.

TABLE 1 (Continuation)

CALDWELL et al., 2010	166 men and women with age ranging from 18 and 41 years old.	To observe changes in mindfulness (MF) with Pilates, TJ and GYROKINESIS® and to determine if these are related to changes in perceived stress, mood, self-efficiency, self-regulation and sleep quality.	15 week intervention; Data collection before, during and after intervention through questionnaires.	The MF level was evaluated through FFMQ, sleep quality through PSQI; others instruments were; FDMS, PSS4 e SRE.	TJ↑ MF. ↑ MF improved sleep quality, self-regulation and self-efficiency, mood and perceived stress.	Body motion activities, such as TJ, improve MF, sleep quality, mood, perceived stress, self-efficiency and self-regulation.
CALDWELL et al., 2011	208 men and women with age between 18 and 48 years old.	To determine if TJ classes change levels of MF and if these changes are related to mood, perceived stress, self-efficiency and self-regulation and sleep quality.	Classes of TJ. 2 sessions per week, 50 min each over 15 weeks. Total of 25h intervention. Control group classes, 1 session per week, 150 min or 2 sessions per week, 75 min each. Total of 37 h and 30 min of instructions.	MF level and related variables were assessed with several instruments (FFMQ, FDMS, PSS4, SRE and PSQI)	↑ of MF found only in TJ group. MF ↑ shows relationship with welfare, and sleep quality.	The practice of TJ promotes benefits of MF and personal welfare.
NEDELJKOVIC et al., 2012	70 men and women; students with age between 23 and 50 years old.	To observe the impact of TJ practice on the self-perception of MF and self-compassion.	TJ classes twice a week over 12 weeks. Evaluation before, after and 2 months after intervention.	MF level evaluated with FMI-SF. Self-compassion evaluated with the SCS.	↑ in self-attribution to MF immediately after intervention and 2 months later.	TJ practice can improve self-attribution of MF and self-compassion in healthy individuals.

TABLE 1 (Continuation)

NEDELJKOVI C et al., 2012	70 men and women, with age between 23 and 50 years old.	To investigate the effects of regular practice of TJ to physiological and psychological stress responses in healthy men and women.	Control and intervention groups over 12 weeks. Evaluation during a stress test to verify the stress reactivity (TSST).	Physiological stress measured by levels of SC, heart rate (HR) and alpha-amylase in saliva samples. Perceived psychological stress measured with PSS and VAS; depression with ADS-K and CES-D; mood with MDMQ.	↓ in CS reactivity, HR, alpha-amylase and perceived stress. Positive ↑ in response to psycho-social stress.	TJ practice decreases physiological and psychological stress reactivity.
LOTHES, HAKAN and KASSAB, 2013	STUDY 1: 159 men and women practitioners of Aikido (AK); 20 non-practitioners as control group. STUDY 2: 12 men and women in intervention group; 20 men and women in control group.	STUDY 1: To evaluate changes in MF with AK training. STUDY 2: To determine whether MF is affected by different stages of AK practice.	STUDY 1: Online questionnaires that evaluate the level of MF and notion of self-consciousness (MAAS) in practitioners of AK. STUDY 2: Evaluation of each expertise stage (0, 2, 5 and 9 months of practice). Control group did not participate in any activity and was also evaluated in same periods.	MF was evaluated with specific validated instruments (KIMS and MAAS).	STUDY 1: practitioners and black belts had higher MF than controls and less expertise. STUDY 2: MF ↑ with each expertise level. AK practitioners ↑ MF than control group.	The practice of AK is able to increase MF, being higher as the expertise level increases.

POMS: Profile of Mood States. PSS: Perceived Stress Scale. TCSE: Tai Chi exercise self-efficacy. DIS: Dealing with Illness Scale. IES: Impact of Events Scale. FAHI: Functional Assessment of HIV Infection. SF-36: Short Form Health Survey 36. FFMQ: Five Facet Mindfulness Questionnaire. PSQI: Pittsburgh Sleep Quality Index. FDMS: Four Dimensional Mood Scale. PSS4: Perceived Stress Scale - 4. SRE: Self-Regulatory Self-Efficacy Scale. FMI-SF: Freiburg Mindfulness Inventory – Short Form. SCS: Self-Compassion Scale. TSST: Trier Social Stress Test. VAS: Visual Analogue Scale. ADS-K: Allgemeine Depressionsskala - Kurzform. CES-D: Center for Epidemiological Studies Depression Scale. MDMQ: Multidimensional Mood State Questionnaire. MAAS: Mindful Attention Awareness Scale. KIMS: Kentucky Inventory of Mindfulness Skills

Among the 9 studies analyzed, 8 utilized *taiji quan* as intervention and only one of the studies utilized another MA, i.e. *aikido* (Lothes, Hakan, & Kassab, 2013). Moreover, only two studies (Esch et al., 2007; Nedeljkovic et al., 2012b) also evaluated physiological parameters to evaluate the impact of the interventions for stress management. In others two studies (Caldwell et al., 2010, 2011), participants that practised a MA were compared with others who were involved in another activity, such as Pilates, quiet reading, and/or discussion and learning groups.

The studies showed positive changes in stress perception with programs ranging from 10 to 18 weeks (Robins et al., 2006; Taylor-Piliae et al., 2006; Esch et al., 2007; Wang, 2008; Caldwell et al., 2010, 2011; Nedeljkovic et al., 2012a, 2012b) and 1 study demonstrated that stress management capacity remained stronger at 1 month follow-up post training (Esch et al., 2007). Also, a significant reduction of psychological stress for HIV infected individuals (Robins et al., 2006) and improved perceived stress levels for patients with cardiovascular risk (Taylor-Piliae et al., 2006) were found. The results also showed reduction of cortisol and alpha-amylase levels, helping to control heart rate reactivity during stressful situations (Taylor-Piliae et al., 2006; Esch et al., 2007), which altogether indicate that the practice of MA seems to have a positive effect for the management of chronic stress.

MF levels were elevated more through the practice of MA (Caldwell. et al., 2010; Nedeljkovic et al., 2012a; Lothes, Hakan, & Kassab, 2013) than other activities, such as reading, suggesting that the longer an individual devotes time to such practice, the greater are the improvements (Lothes, Hakan, & Kassab, 2013).

These studies suggested that, in general, MA were able to positively influence both stress management and MF levels as well as to influence health related parameters. Apart from this, MA have been demonstrated to be more effective when compared to others forms of physical activity and leisure. MA practice has resulted in greater improvements for MF levels and for stress management than Pilates (Caldwell et al., 2010) and recreational activities (Caldwell. et al., 2010; Nedeljkovic et al., 2012a, 2012b). Furthermore, studies by Caldwell et al. (2010), Nedeljkovic et al. (2012a, 2012b) and Lothes, Hakan and Kassab, (2013) concluded that *taiji quan* and *aikido* were able to elevate MF levels through MA training. In addition, Lothes, Hakan and Kassab, (2013) suggested that the length of time devoted to training influences MF levels, with experienced individuals demonstrating greater levels compared to novice or moderately trained individuals.

Taiji quan practice resulted in positive changes in stress perception for training programs of 10 weeks (Taylor- Piliae et al., 2006), 12 weeks (Nedeljkovic et al., 2012a, 2012b; Taylor-Piliae et al., 2006; Wang, 2008), 15

weeks (Caldwell et al., 2010, 2011), and 18 weeks duration (Esch et al., 2007). The duration of the sessions in all the studies was between 50 and 60 min, with two sessions per week. As expected, the results did not show important differences when related to time of the sessions.

The benefits achieved through *taiji quan* practice seem to be maintained for a period after the end of the training programs. For instance, Esch et al. (2007) demonstrated that stress management capacity remained stronger at 1 month follow-up post training. Further, Nedeljkovic et al. (2012a, 2012b) suggested from their results that alterations can persist up to 2 months.

The objective of four of the studies analyzed (Caldwell et al., 2010, 2011; Nedeljkovic et al., 2012a; Lothes, Hakan, & Kassab, 2013) was to observe the effect of MA practice on changes in MF levels. The other five studies observed the effects of MA practice on stress and health. Wang (2008) observed that *taiji quan* seems to improve the self-perception of mental and physical health. The study by Robins et al. (2006) found a significant reduction in psychological stress of HIV infected individuals using *taiji quan* as intervention. Taylor-Piliae et al. (2006) observed that *taiji quan* could improve perceived stress levels after 12 weeks of intervention in patients at risk for cardiovascular disease. Another two studies found similar results after similar interventions in healthy students (Caldwell et al., 2010, 2011).

Other parameters related to stress, such as perception in sleep quality, humor, self-regulatory abilities, self-efficacy (Caldwell et al., 2010, 2011), quality of life and social and emotional well being (Robins et al., 2006) also showed significant and positive changes after MA intervention. Meanwhile, positive changes in physiological markers related to stress were recorded in the studies of Nedeljkovic et al. (2012b) and Esch et al. (2007), thus suggesting that *taiji quan* practice was also able to reduce cortisol and alpha-amylase levels, while helping to control heart rate reactivity during stressful situations.

DISCUSSION

The results of the present review suggest that the practice of some MA, like mindful exercise, favorably affects stress management (Demarzo et al., 2014; Brown & Ryan, 2003) and trait MF (Caldwell et al., 2010, 2011; Nedeljkovic et al., 2012a; Lothes, Hakan, & Kassab 2013). MA training can be characterized as meditative movements as it is a performance that simultaneously stimulates both body and mind (Faggianelli & Lukoff, 2006; Waysun, 1990; Wang et al., 2009). Therefore, MA may provide multiple pathways to stress management, which may contribute to a better control of dysfunctional stress (Demarzo et al., 2014) and ultimately physical and mental health.

MA training is capable of promoting physiological adaptations in blood pressure (Esch et al., 2007; Tsai et al., 2003), heart rate and circulating levels of

cortisol and alpha-amylase (Esch et al., 2007; Nedeljkovic et al., 2012b), and psychological adaptations (Zhang et al., 2012) including changes in humour (Caldwell et al., 2010, 2011; Taylor-Piliae et al., 2006), anxiety and depression levels (Caldwell et al., 2010, 2011; Wang et al., 2009; Li, Hong, & Chan, 2001; Chou et al., 2004; Yau, 2008), sleep quality (Caldwell et al., 2010, 2011), and attention processing (Converse et al., 2014). In addition to the aforementioned outcomes, *taiji quan* specifically has been demonstrated to increase bone density (Zhang & Fu, 2008), control glucose (Chang et al., 2008) and lipid levels (Rosado-Pérez et al., 2013), and also has induced a greater antioxidant effect when compared to moderate intensity exercises (Rosado-Pérez et al., 2013). Moreover, Toskovic, Blessing and Williford (2002) suggested that *taekwondo* could be prescribed for cardiovascular conditioning and weight control, while Milanez et al. (2012) showed that regular *karate* training promoted positive adaptations in cardiorespiratory capacity. Overall, these previous findings confirm the positive impact that MA could have on different physiological and psychological health related parameters.

Dermazo et al. (2014) previously suggested that the increase of MF capacity through physical exercise could be associated with a greater perception of somatic sensations, body temperature fluctuations, and changes in respiratory rhythm. Meanwhile, it is worth mentioning that the results of recent studies suggest that individuals with elevated levels of self-perception show a greater activation of the insula and, therefore, an enhanced perception of small changes in heart and respiratory rates, for example, in patients with panic syndrome (Davidson & Begley, 2012). These enhanced perceptions associated with the physiological and hormonal changes have a positive effect on stress management.

Taiji quan and *aikido* are modalities that incorporate important meditative components (Yu, 1996; Gleason, 1995; Hu, 1995; Santos & Coutinho, 2004; Faggianelli & Lukoff, 2006) and, following previous findings, it could be said that these modalities significantly increased MF levels as measured by internationally utilized questionnaires. Moreover, greater practice time was related to greater control of attention. Furthermore, when comparing MA to other intellectual and physical activities, MA practitioners demonstrate more favourable changes across a variety of different outcomes (Caldwell et al., 2010, 2011; Wang et al., 2010; Lakes & Hoyt, 2004) with some studies demonstrating that benefits associated with MA practice may be observed up to 2 months after the end of the activity (Nedeljkovic et al., 2012b; Wang et al., 2010). Thus, it would seem that the practice of mindful movements could further improve stress management and health maintenance in comparison to exercising without a meditative component (Demarzo et al., 2014; Rosado-Pérez et al., 2013). This could indicate that meditative monitoring and concentration during

a simulation of combat, in addition to respiratory control, would demand greater levels of attention. However, this aspect has not been addressed yet and further studies are needed.

Previously, it has been suggested that MF can act as a mediator between physical activity and cardiovascular responses to stress, thus indicating the possibility that higher levels of physical fitness are associated with better MF levels and enhanced stress responses (Demarzo et al., 2014). Based on this assumption, it would be possible to infer the reciprocal activity between: (a) MA vs. Stress; (b) MF vs. Stress; (c) and MA associated with MF, working as a mindful movement, for the physical and psychological regulation of stress (see Figure 3).

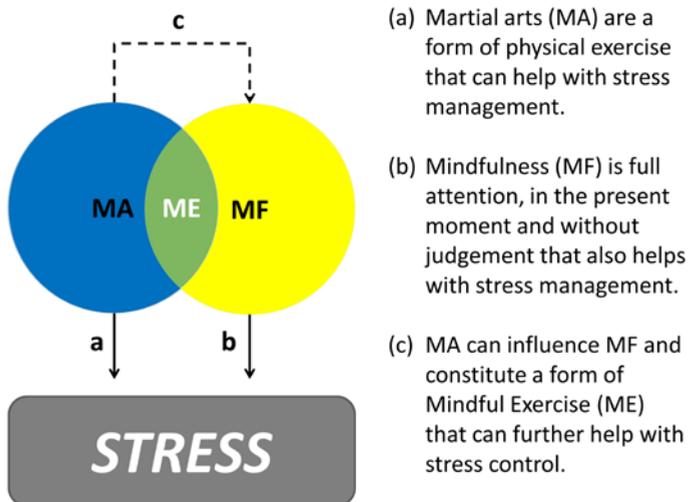


FIGURE 3: Diagram showing the reciprocal activity between martial arts, mindfulness, mindful exercise, and stress.

According to Binder (2007), Asian MA have many aspects in common with other forms of physical activity and exercise; however, MA tend to value self-knowledge and self-control, while performing a form of self-defence that includes ethical and philosophical qualities. Therefore, certain characteristics of MA could help to promote psycho-social changes in addition to physiological and psychological adaptations, and probably MF levels may moderate or mediate this process (Demarzo et al, 2014).

Given that individuals experience greater levels of MF with greater volume of MA practice (Lothes, Hakan, & Kassab, 2013), starting these practices early could be very useful for prophylactic purposes (Chou, 2008). Consequently, focusing on developing MA techniques in formative stages could contribute to

better physical and psychological development for individuals with this exposure. Additionally, these interventions could also mitigate the occurrence of side effects as well potentially help to minimize the dosage of certain medications (Abbott & Lavretsky, 2013; Chan, 2011; Kabat-Zinn, 2003). These avenues of health enhancement should be further investigated to expand the benefits of MA practice for public health.

It should be pointed out that there are a wide variety of MA styles and techniques and that this variation is favourable for individuals with different interests, preferences and physical capacities. Providing individuals with choices and the option to select the most appropriate technique for their own needs may help to enhance motivation and thus adherence. Such programming could be provided in a variety of different settings thus creating opportunities for both personal mastery and collective practice with a number of other participants, magnifying educational objectives and a wide swath of health parameters (Oliveira et al., 2001).

MA practice, which is associated with facets of MF, can promote body consciousness and stimulate body expression, thus improving not only health outcomes but also essential aspects of the school curriculum (Wall, 2005). Therefore, including MA within a school setting may promote the development of cognitive, behavioural and affective abilities (Lakes & Hoyt, 2004; Wall, 2008). In consideration of the potential role of MA for children and adolescents, Lakes & Hoyt (2004) have suggested that *taekwondo* in school can improve children's social behaviour, attention levels and self-esteem. In addition, Converse et al. (2014) concluded that *taiji quan* training seems to reduce deficits in attention and hyperactivity in young adults. Overall, these findings reinforce the potentially important role that MA practice could have, not only in clinical but also in educational settings.

One limitation of the current review is the small number of studies reporting data on the effect of MA on health status (Bu et al., 2010). *Taiji quan* was utilized as the most common intervention therefore limiting the comparison between various MA modalities and styles. Further studies should clarify what MA modalities (e.g. combat vs. simulation) promote greater changes in MF and stress management. Additionally, it should be tested if MA practices alone or combined with other forms of meditation and physical activity could provide more benefits for physical and psychological health when compared to mindfulness-based interventions (e.g., mindfulness-based stress reduction, MBSR) or increases in physical activity levels alone (e.g., walking programs, etc.). Of note, further research would verify if the practice of MA in a periodized fashion may magnify and prolong benefits associated with MA, enhance interest and enjoyment, and accommodate changes in life circumstances (e.g., travelling, holidays).

CONCLUSIONS

The practice of MA appears to provide several benefits for the management of chronic stress. These positive effects could be based on the dual nature of MA which includes the benefits of both PA and meditative/mindful components. Future studies should compare different MA modalities while analyzing different physiological and psychological adaptations for a better understanding of the impact of MA practice on the control of chronic stress and other health related benefits.

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