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Effects of martial arts and combat sports training on anger and aggression: a systematic review

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Abstract

Martial Arts and combat sports (MA&CS) are the subject of a dispute. On the one hand, they have been considered an ideal means to acquire emotional self-control. On the other hand, they have been considered aggressive practices which may promote violent behaviors. The current systematic review aims to analyze the evidence of the effects of MA&CS participation in anger and aggression, and the quality of this evidence. The review was conducted according to the PRISMA-P protocol. The studied variables were study type and aims, sample, interventions and procedures, measurements and outcomes. Nine studies (three cohort studies and six randomized controlled trials) were selected for inclusion. The following results should be viewed with much caution, as the volume of studies and the methodological quality of most of them is not optimal. Training in traditional martial arts seems to be an effective means to lower levels of anger and aggression. Regarding the age of subjects, there is a predisposition to reduce anger in the adult population. In addition, young subjects with violent or behavioral problems show a positive response to working with martial arts. However, the available evidence, overall, shows no relationship between MA&CS practice and anger and aggression levels.

Keywords

Martial Arts, Combat Sports, anger, aggression, review.

Abreviattions

Martial Arts: MA

Martial Arts & Combat Sports: MA&CS

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1. Introduction

Aggression is a behavior that aims to physically or psychologically hurt another individual (Berkowitz, 1993). When studying human aggression, Maxwell (2004) proposes to focus on its antecedents. According Novaco (1994), one of these antecedents is the emotion of anger, although this cannot be understood as a necessary and/or sufficient condition for aggression. The relationship between anger and aggression is so close that many authors have included these under a continuum called *Anger-Hostility-Aggression Syndrome* (Spielberger, Jacobs, Russell, & Crane, 1983).

The anger and the ways to cope with anger that each person has are extremely important. Occasionally, cultural reasons that are related to the potential consequences of the expression of anger can make people afraid of getting angry and not wanting to show their anger (Bayansalduz, 2014). In these cases, internal anger can cause negative consequences for the person (Siegman, 1993). It is considered that anger suppression may be associated with many physical diseases such as hypertension, coronary problems and cancer (Arsakay, 2001; Biaggi, Gremigni, Bertolotti, & Zotti, 1995; Edmond, Granberg, Simons, & Lei, 2014; Smith & Furlong, 1998; Spielberger, 1991). Other authors have linked external anger with hypertension and cardiovascular disease (Caska et al., 2009; Eng, Fitzmaurice, Kubzansky, Rimm, & Kawachi, 2003; Ohira, 2010).

Practices that improve anger management and anger reduction will have beneficial effects on their practitioners and should be recommended. Physical exercise is one of these practices, since it has been shown to exert an inducing effect of neurotransmitter synthesis specifically in serotonin, presenting an important role in the inhibition of anger and aggression (Gross, 2015). Despite this, the relationship between sport and anger is not clear. Some authors point out the differences between the many types of sports, linking these closely with the aggressive behavior of the athletes who practice them (Gage, 2008; McCauley et al., 2014; Messner, 2002). Other authors affirm that the aggression exhibited outside the sports field often mirrors the forms of violence in the sport itself (Guilbert, 2006; Pappas, McKenry, & Catlett, 2004). In this way, for example, American football players would be more aggressive due to the violent nature of the sport, which usually includes hitting, running and blocking other players (Steinfeldt & Steinfeldt, 2012). Thus, athletes who practice basketball, karate or shooting normally exhibit more physical violence and aggression due to the nature of their sport (Guilbert, 2006). On the other hand, there are authors who emphasize the

environment. This way, sports surrounded by an aggressive environment (athletes, parents, coaches and spectators) where athletes would be integrated could be associated with aggressive behaviors (Oproiu, 2013). On the contrary, a positive environment in sports can teach positive values and help young people to grow in a developed and emotionally safe way, which would reduce the level of violence in athletes (Passero, 2015). According to this, practices that teach positive values should be promoted in order to reduce these levels of violence.

Martial arts are defined as "systems that blend the physical components of combat with strategy, philosophy, tradition, or other features, thereby distinguishing them from pure physical reaction" (Green & Svinth, 2010, p. xix). Despite this term is commonly applied just to East Asia combat systems, martial arts are universal cultural products (Donohue & Taylor, 1994), including, for example, Japanese aikido, Chinese tai-chi, Korean hapkido, Brazilian capoeira, French savate, English boxing or Nigeria and Niger dambe, to name a few (see Green, 2021; Green & Svinth, 2010). In their evolution, many martial arts have developed a sport side and turned into combat sport, which is the case for the Olympic combat sports of freestyle wrestling, Greco-Roman wrestling, boxing, fencing, judo, taekwondo and karate. Other martial arts, such as tai chi, have mainly developed as mind-body movement practices, also leaving aside the pure martial sphere. Currently, these terms are frequently used in conjunction as *Martial Arts and Combat Sports* (MA&CS) in academic literature.

Due to their specific features, MA&CS have been considered as valuable educational tools. A key feature, which distinguish MA&CS to other physical activities, is the so-called "human target" (Parlebas, 1999). In MA&CS, superiority over the rival is not shown on an object (e.g., a ball) or on a distance (e.g., marathon), but directly on the rival's body by potentially harmful techniques such as kicks, punches, holds, joint-locks, strangles, blows, lunges, etc., according to the specific MA&CS style regulations. This demands for practitioners learn how to apply these techniques efficiently while respecting the other's body and controlling frustration when one's body is successfully attacked (Hortiguela, Gutiérrez-García, & Hernando-Garijo, 2017).

On this logic, MA&CS have traditionally developed philosophies and ethical codes, enhancing values such as "…civility, humility, modesty, chivalry, loyalty, courage and bravery, respect for the self, for the opponent, for the master, and possibly also for all sentient beings" (Martinkova, Parry & Varner, 2019, p. 1). The manifestation of these philosophies and ethical codes can be easily seen in many

MA&CS groups, which may include ritual bows, meditation, forms (a.k.a. *kata*, *poomsae*), specific rules of behavior with the opponent, or short speeches on MA&CS ethics in their regular training. Binder (2007) states that Asian martial arts emphasize the integration of mind and body and have a meditative component through the teaching of self-defense, relating them to philosophical and ethical teachings to be applied to everyday life. The harmonious integration of mind and body through breathing, holistic body movement and mind concentration are the main characteristics of mind-body martial arts such as tai chi (Lan, Chen, Lai, & Wong, 2013). Nosanchuk and MacNeil (1989) point out that in traditional martial arts the philosophy that permeates is that of reaching the zen state of *mushin*, a state in which the participant is able to fight to the fullest but without aggressive feelings. This is carried out through *katas* (ritualization of combat movements), demanding respect for the teacher, the practice space and others, and also highlighting the importance of meditation and philosophies such as peace, benevolence and humanity among others. In this line, Morvey et al. (2019) emphasize the importance of *budo* (the way of the warrior) in some martial arts, as an oriental philosophical background, through a special training environment, the practice of formal exercises and the so-called "*dojo* etiquette", has as an expectation for character development and the pursuit of non-violent conflict resolution, which could help with behavioral self-control. Similarly, Destani, Hannon, Podlog and Brusseau (2014) consider wrestling may promote character development as its practice demands self-control and personal and social responsibility, among other attributes, in the emotionally charged context of individual, face-to-face contest, therefore suggesting its inclusion in physical education. In synthesis, these philosophical, spiritual and moral aspects with which MA&CS have been associated may promote discipline, anger control and taking responsibility of the body of a partner, being usually recommended for children, young people (Tadesse, 2015), and adults (Origua Rios, Marks, Estevan, & Barnett, 2018) with the objective of developing positive aspects in the physical, psychological and socio-affective dimensions.

Nevertheless, this positive vision of MA&CS is opposed to another which relates its practice to aggressiveness, violence and toxic masculinities (Bowman, 2020), considering them practices that seek to cause harm in another individual, which can attract more aggressive people. These people may be drawn to potentially dangerous techniques, depending on the MA&CS style, context and characteristics (Green & Svinth, 2010). The image projected in the entertainment industry and some media

contributes to this negative vision of MA&CS (Binder, 2007; Smith & Furlong, 1998). Furthermore, the use of MA&CS by radical movements (e.g., right-wing extremists, religious extremists, see Ekman, 2014; Ismail, 2013; Perry & Scrivens, 2016) as forms of domination also contributes to this "discourse of violence" which undoubtedly exists in popular consciousness.

It is probably this ambivalence of MA&CS regarding violence which stimulated early studies paying attention to aggression, in the field of sport psychology (e.g., Husbam, 1955; Johnson & Hutton, 1955). In the following decades, and especially since the 1980s, studies on the MA&CS as potential therapies to prevent violent behavior started to arise (e.g., Nosanchuk, 1980; Portuondo & Landy, 1974; Trulson, 1986). This was heavily influenced by the expansion of the styles and philosophies of East martial arts in the West. In recent years, the popularity of MA&CS has continued to grow in the West (Harwood, Lavidor, & Rassovsky, 2017) becoming one of the most practiced sports in many countries, helping to contribute to the growing interest in research in MA&CS. This fact is observed in the increase of scientific literature on MA&CS (Gutiérrez-García, Pérez-Gutiérrez, & Calderón-Tuero, 2011; Gutiérrez-García, 2020) and also of scientific meetings and specific journals on MA&CS (Gutiérrez-García et al., 2018; Vertonghen & Theeboom, 2010). Specifically, the relation between MA&CS and anger, hostility and/or aggression has been object of frequent – but rather disperse – attention to researchers.

In an early narrative review, Cox (1993) pointed out that martial arts training may have a positive impact upon aggression, despite the evidence gathered until that moment could be just considered as preliminary. Basically, the main point under discussion was if martial arts training had this positive impact in the "average" person, or if this was due to a self-selection bias, something that the cross-sectional studies developed to that moment were not able to answer – a cause-and-effect relationship cannot be attributed in these designs. As for clinical interventions, only few, short-term studies involving a low number of participants, had been developed, generally achieving positive outcomes. Years later, Vertonghen and Theeboom (2010) carried out a quasi-systematic review to analyze the social-psychological outcomes of martial arts practice among youth. On the 27 selected studies, all quantitative, up to 16 (10 cross-sectional, 6 longitudinal) specifically referred to hostility, aggression, and/or violent behavior. The authors found that most studies reported positive outcomes, despite studies reporting no

or even negative effects also existed. According to their opinion, several aspects such as the type of guidance, the structural qualities of the sport, the characteristics of the participants and the social context had rarely been considered, something that could be key in untangling the effects of MA&CS training. Recently, van der Kooi (2020) updated Vertonghen and Theeboom's (2010) work, although also including qualitative studies. A total of 17 studies, published between 2010 and 2016 were selected for this quasi-systematic review, eight of them referring to anger, hostility, aggression, and/or violent behavior. As for previous reviews, these studies generally reported positive outcomes. Nevertheless, none of them followed longitudinal, experimental or quasi-experimental designs, but cross-sectional or qualitative. Therefore, stronger evidence on the effects of MA&CS training on the continuum anger-hostility-aggression was still lacking.

In the last years, two meta-analyses on the topic have been published. Gubbels, van der Stouwe, Spruit, and Stams (2016) studied martial arts participation and externalizing behavior in juveniles (up to the age of 20). A total of 12 studies, with nine non-overlapping samples including MA&CS and comparison groups, were selected. Seven followed a cross-sectional design while two were longitudinal, which indeed is a relevant limitation to establish cause-and-effect relationships. The main conclusion on the analysis was that "there is no overall relation between martial arts and externalizing behavior in juveniles" (p. 79), the authors also calling for the need of robust research to be developed. In contrast, Harwood et al.'s (2017) meta-analysis of nine studies on the effects of martial arts on problematic externalizing behavior (aggression, anger, and violence) in children and youth (up to the age of 18) found a medium average effect size of 0.65 (95% CI: 0.11, 1.03), thus concluding that "This result supports the hypothesis that martial arts can reduce aggressive tendencies in a range of populations and is a potentially worthwhile intervention for youth at risk of externalizing behavior problems." (p. 99). Nevertheless, despite the existence of either a control group or comparison group was considered an inclusion criterion, one of the selected studies (Conant, Morgan, Muzykewicz, Clark, & Thiele, 2008) lacked this requirement. Furthermore, the authors also included Haydicky, Wiener, Badali, Milligan and Ducharme's (2012) research, in which the intervention programme not only included MA&CS but mindfulness meditation, cognitive behavioral therapy, behavior modification and martial arts (therefore making it impossible to know the specific effect

of MA&CS), and Skelton, Glynn and Berta's (1991), a cross-sectional study on taekwondo participants' aggressive behavior according their belt rank color.

Finally, Moore, Dudley and Woodcock (2020) conducted a systematic review and meta-analysis on the effects of martial arts training on mental health outcomes, including effects on aggression. A total of seven studies, comprising samples of children, youths and adults, were selected. Results showed an overall, non-significant small effect size of 0.022 (95% CI: -0.191, 0.236; p = 0.839), the confidence interval indicating that MA&CS training may have no effect or small positive or negative effect. For this review, randomized controlled trials, controlled trials or pre-test/post-test designs were eligible. Nevertheless, four of them, which were categorized as controlled trials (Björkqvist & Varhama, 2001; Daniels & Thornton, 1990) and pre-test/post-test designs (Skelton, Glynn, & Berta, 1991; Vertonghen, Theeboom, & Pieter, 2014), are indeed cross-sectional studies in which no clear cause-and-effect relationship should be established.

Given the substantial growth of MA&CS scientific literature during the last decades and the limitations and contrasting outcomes of the aforementioned reviews and meta-analyses, the aim of this systematic review is to synthetize the evidence on the effects of MA&CS training on anger and aggression. We also aim to analyze the methodological designs and procedures followed in the selected studies, as well as the variables considered, in order to provide suggestions for improving further research.

2. Material and Methods

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses Protocols (PRISMA-P) statement (Moher et al., 2015), and the review protocol was registered on the International Prospective Register of Systematic Reviews (PROSPERO), number CRD42018089987. Figure 1 displays the flow chart of the present review, which is explained in detail in the next subsections.

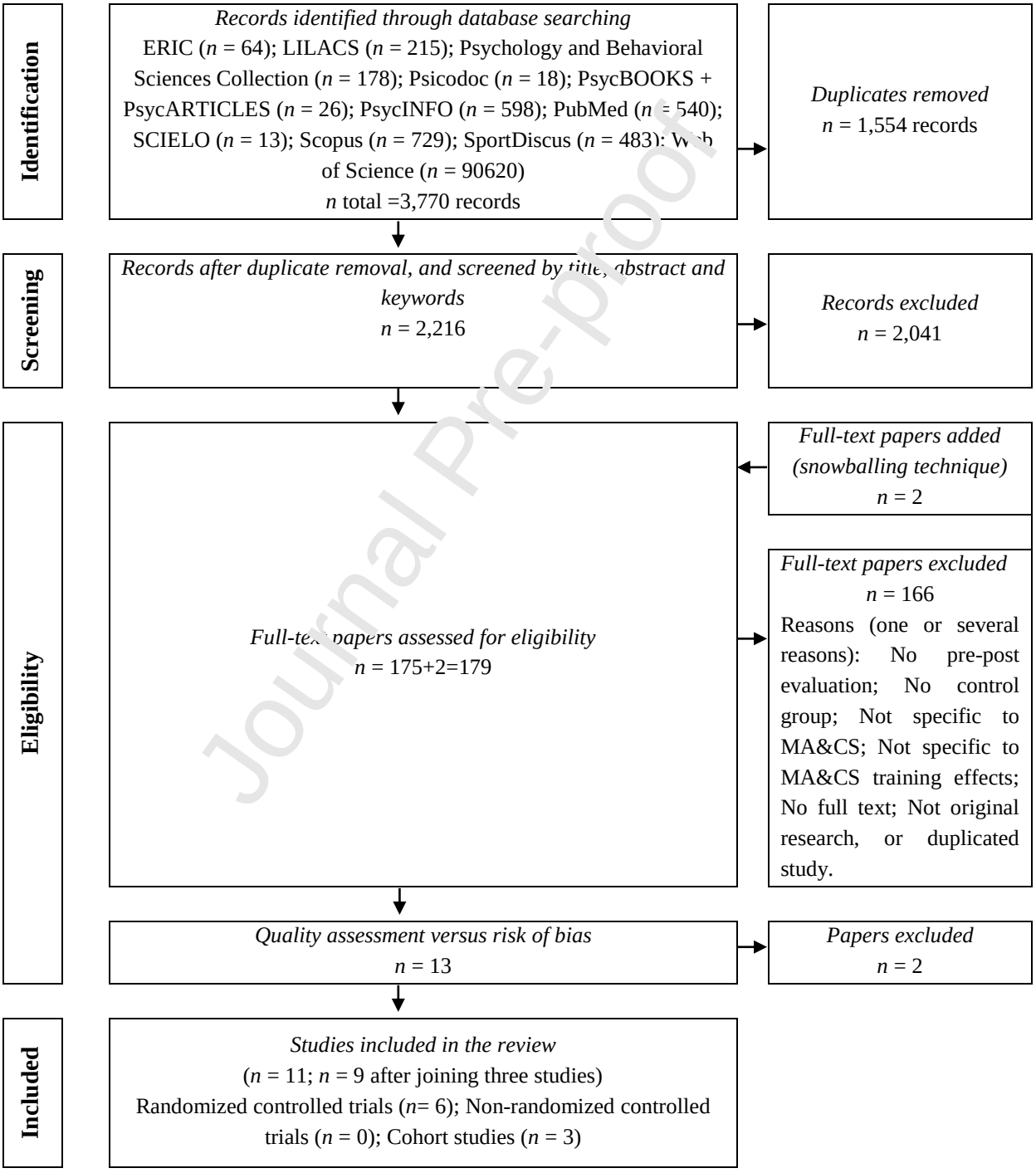

Figure 1. Flow chart of the review process based on PRISMA-P recommendations (Moher et al., 2015).

2.1. Eligibility criteria

Specific studies on groups of MA&CS trainees, regardless the practiced style of martial art or combat sport, age, gender, health status or any other circumstance, were under the scope of this review. These studies had to focus on the effects of MA&CS practice on anger and aggression. Studies on anger and aggression, even if longitudinal, of MA&CS athletes throughout the competitive season, were not considered (e.g., Husman, 1955). Studies were excluded if complementary interventions to MA&CS training were performed (e.g., judo training, community organization, tutoring, and parent training services, see Fleisher et al., 1995). MA&CS training had to be developed in MA&CS clubs, camps, high performance centers, physical education at school, after-school programs, etc., regardless of the duration of the training programs. Evaluations had to include specific assessment on anger and/or aggression using either specific tools (e.g. the State-Trait Anger Expression Inventory, see Menéndez & Fernández-Río, 2015) or more generic psychological assessment tools in which anger and/or aggression assessment is included (e.g., the Minnesota Multiphasic Personality Inventory, see Wargo, Spirrison, Thorne, & Henley, 2007).

Following Grimes and Schulz's (2002) classification, original experimental studies (randomized controlled trials and non-randomized controlled trials) and prospective observational analytical studies (cohort studies) were accepted for inclusion. Observational analytical studies (case-control studies and cross-sectional studies) and observational descriptive studies were excluded due to their limitations to provide cause-and-effect relationships, as well as other types of research (e.g., meta-analyses and reviews). Control/comparator groups were necessary for the study to be included in the review. These groups could be composed of sedentary people, athletes from other sports or trainees in different MA&CS. Comparison within the same MA&CS but varying the sample characteristics or the interventions/procedures were also accepted for inclusion. We have selected studies published as book, book section or article and written in English, French, Portuguese and Spanish, as these are the languages known to the authors. We did not consider any restriction regarding publication date of the studies, but these had to be published in full-length (i.e., brief communications, short papers of less than 500 words or abstracts published in congress proceedings were excluded), and duplications (e.g., publication of the same study in two different languages) and doctoral dissertations were also excluded.

2.2. Information sources

Several multidisciplinary and specific databases were searched for document retrieval. Multidisciplinary databases included Scopus and the Web of Science (all indexed databases). Specific databases included PsycINFO, PsycBOOKS, PsycARTICLES, Psychology and Behavioral Sciences Collection (behavioral and social sciences), ERIC (Education), SportDiscus (Sport Sciences) and MedLine (Medicine). In addition, we explored the more local Literature in the Health Sciences in Latin America and the Caribbean (LILACS), the Scientific Electronic Library Online (SCIELO) and Psicodoc databases, as this strategy has been suggested for retrieving relevant information to include in systematic reviews (Clark & Castro, 2002; Golder, Mason, & Spilsbury, 2008). Finally, search alerts were set in all databases where this option was available and backward and forward snowballing techniques were used to identify additional studies. The backward snowballing technique implied looking in the reference sections of the studies potentially eligible for inclusion, while the forward snowballing technique implied exploring those studies citing the studies potentially eligible for inclusion (Wohlin, 2014). This was possible by using the citation tools provided by several databases such as Scopus, Web of Science or MedLine.

2.3. Search strategy

The search strategy included the terms “anger” and “aggression”, and several terms related to MA&CS. As this is a generic term that embraces a wide variety of martial and combat sports practices, we followed Pérez-Gutiérrez, Gutiérrez-García and Escobar-Molina’s (2011) recommendation of including several known terms and spellings related to MA&CS in database searches in order to improve document retrieval. Therefore, unique search strings were built depending on the operators accepted by each database (e.g., Boolean operators, wildcards, truncation symbols). For example, the search string for the Web of Science was:

> TS=((anger OR aggress*) AND ("martial art*" OR "combat sport*" OR "combative sport*" OR "fighting sport*" OR "martial sport*" OR "budo" OR "martial ways" OR "fighting art*" OR "aikid*" OR "archer*" OR "boxing" OR "boxer*" OR "pugilism" OR "capoeir*" OR "fencing" OR "fencer" OR "savate" OR "hapkido" OR "judo*" OR "jiujit*" OR "jiujit*" OR "jujit*" OR "jujit*" OR "ju jut" OR "jujut*" OR "kalapa*" OR "kalarippa*" OR "karat*" OR "kempo" OR

"kendo*" OR "kickboxing" OR "kung fu" OR "wushu" OR "mixed martial arts" OR "vale tudo" OR "vale todo" OR "Muay Th*" OR "wrestl*" OR "sambo" OR "silat" OR "Soo bahk do" OR "taekwon*" OR "tae kwon*" OR "taekwan*" OR "tai chi" OR "tai ji" OR "taiji*" OR "yongmudo"))

The first database search was conducted from 23 to 27 April 2017, following the doctoral research developed by the first author. We search and placed citation alerts in all databases where this option was available (Scopus, Web of Science, PsycINFO, PsycBOOKS, PsycARTICLES, Psychology and Behavioral Sciences Collection, ERIC, SportDiscus, MedLine, SCIELO). A final search in all databases was conducted on January 25, 2021, in order to include the newest available studies.

2.4. Study records

The selection process of the studies that were included in the review had four phases (see Figure 1). They were all performed independently by two different members of the review team, while the other members helped in resolving any disagreement. In *Phase 1 – Identification*, the basic information (authors, titles, sources, DOI, abstracts, keywords, etc.) for all documents retrieved from the selected databases (n = 3,770) were exported to EndNote (v.X6) reference manager software. A total of 1,554 records were automatically eliminated due to duplication. Interestingly, all the selected databases but PsycBOOKS and PsycARTICLES provided some unique references (i.e., references not included in the other selected databases) in this phase, which reinforce the importance of conducting searches in a wide variety of databases. In *Phase 2 – Screening*, the remaining records (n = 2,216) were screened according to the information provided in title, abstract and keywords fields, which led to the exclusion of 2,041 records. *Phase 3 – Eligibility*, first included the in-depth assessment of 175 potentially eligible studies against eligibility criteria. We applied the backward and forward snowballing techniques during this stage, retrieving two more documents. Next, the quality of the remaining 14 studies was assessed through standard scales (see the subsection "Risk of bias in individual studies" below). Finally, in *Phase 4 – Included*, we used a standardised form for extracting and synthesizing data of the 12 selected studies. This process was also performed independently by two different members of the review team, while the other members helped in resolving any disagreement. Noteworthy is the fact that we did just one analysis for Reynes and Lorant's (2002a, 2002b; 2004) papers,

as they are part of the same study and have overlapping samples (in the same line, see Gubbels et al. 2016; Harwood et al., 2017).

2.5. Data items

This review considered the following variables: (1) study type, (2) study aims, (3) study sample, (4) interventions/procedures (type of MA&CS, training programme, duration), (5) measurements, and (6) outcomes with regard to anger and aggression.

2.6. Outcomes and prioritization

The primary outcomes of interest of this review are: (a) changes in anger and aggression of MA&CS participants from the baseline to the follow-up assessments, in comparison to controls/comparators groups; and (b) the assessment of the methodological designs and procedures followed in published research on the topic.

2.7. Quality assessment

The selected studies were experimental studies (randomized controlled trials and non-randomized controlled trials) as well as observational, analytical studies (cohort studies). Following Zeng et al. (2015) several tools were used in this phase: The PEDro scale (randomized controlled trials), the Methodological Index for Non-Randomized Studies – MINORS (non-randomized controlled trials) and SIGN Methodology Checklist for cohort studies (cohort studies). Two members of the review team independently assessed the quality of the selected studies and a third member helped in resolving any disagreement between the two main reviewers.

2.8. Data synthesis

The findings of this review are presented in a narrative synthesis. We also provide summary tables of the methodological quality assessment and main characteristics for each study.

3. Results

3.1. Quality assessment of eligible studies

Tables 1, 2 and 3 show the results of the selected studies methodological quality assessment. Two studies were excluded in this phase for further analysis. First, Delva-Tauiliili's (1995) study developed a short intervention (two and a half weeks) in order to assess if the practice of aikido would reduce aggressive behavior of preadolescent youth. The sample was composed of 42 boys (21 aikido practice + 21 waiting list control group). Information on inclusion criteria or blind evaluations is not provided, and the administration of a non-validated 12-item scale in measuring aggressive behavior does not guarantee, in our opinion, the validity and reliability of the outcomes. Secondly, Yang, Ko and Roh (2018) developed a pilot study aimed at evaluating the effects of regular taekwondo training on mood state in children from multicultural families. Their sample included 24 participants, eight from non-multicultural families, which were the first control group, and 16 from multicultural families, which were randomly assigned to the second control group or the taekwondo group (n = 8 for each group). In addition to the small sample size, no information of blinding processes is provided. Furthermore, it would have been logical to include a taekwondo group of non-multicultural families, in order to check if belonging to a multicultural family is a relevant variable, or not, to experience the benefits of taekwondo training. Therefore, a total of nine studies were included in the final review synthesis.

Table 1. Methodological quality and risk of bias assessment in cohort studies (SIGN Methodology Checklist for cohort studies)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Focht et al. (2000)	Y	?	N	X	9.1%* 68.9%	N	Y	?	X	Y	Y	N	Y	N	+	N	X
Reynes & Lorant (2002a,b; 2004)	Y	?	N	X	59.1% 37.5%	Y	N	N	X	Y	Y	Y	Y	N	+	N	X
Mickelsson (2020)	Y	Y	N	X	20.2% 20.6%	Y	Y	?	X	Y	Y	N	Y	N	+	Y	X

1) The study addresses an appropriate and clearly focused question; 2) The two groups being studied are selected from source populations that are comparable in all respects other than the factor under investigation; 3) The study indicates how many of the people asked to take part did so, in each of the groups being studied; 4) The likelihood that some eligible subjects might have the outcome at the time of enrolment is assessed and taken into account in the analysis; 5) What percentage of individuals or clusters recruited into each arm of the study dropped out before the study was completed; 6) Comparison is made between full participants and those lost to follow up, by exposure status; 7) The outcomes are clearly defined; 8) The assessment of outcome is made blind to exposure status. If the study is retrospective this may not be applicable; 9) Where blinding was not possible, there is some recognition that knowledge of exposure status could have influenced the assessment of outcome; 10) The method of assessment of exposure is reliable; 11) Evidence from other sources is used to demonstrate that the method of outcome assessment is valid and reliable; 12) Exposure level or prognostic factor is assessed more than once; 13) The main potential confounders are identified and taken into account in the design and analysis; 14) Have confidence intervals been provided?; 15) How well was the study done to minimise the risk of bias or confounding?; 16) Taking into account clinical considerations, your evaluation of the methodology used, and

the statistical power of the study, do you think there is clear evidence of an association between exposure and outcome?; 17) Are the results of this study directly applicable to the patient group targeted in this guideline?

Codes: Y = Yes; N = No; ? = Can't say; X = Does not apply. Only for question 15: ++ = high quality; + = Acceptable; 0 = Unnaceptable – reject; N/A = Not available. * = Only global attrition data are provided.

Table 2. Methodological quality and risk of bias assessment in non-randomized controlled trials (MINORS)

	1	2	3	4	5	6	7	8	9	10	11	12	Total score
Delva-Tauiliili (1995)	2	0	1	0	0	0	0	0	0	2	0	1	6/24

1) A clearly stated aim; 2) Inclusion of consecutive patients; 3) Prospective collection of data; 4) Endpoints appropriate to the aim of the study; 5) Unbiased assessment of the study endpoint; 6) Follow-up period appropriate to the aim of the study; 7) Loss to follow up less than 5%; 8) Prospective calculation of the study size; 9) An adequate control group; 10) Contemporary groups; 11) Baseline equivalence of groups; 12) Adequate statistical analyses.

Scores: 0 = not reported; 1 = reported but inadequate; 2 = reported and adequate. The global ideal score being 16 for non-comparative studies and 24 for comparative studies (Slim, et al., 2003).

Table 3. Methodological quality and risk of bias assessment in randomized controlled trials (PEDro scale)

	1	2	3	4	5	6	7	8	9	10	11	Total score
Trulson (1986)	1	0	0	1	1	n/a	1	1	1	1	0	7/10
Brown et al. (1995)	1	1	0	1	0	n/a	0	0	1	1	1	6/10
Zivin et al. (2001)	0	1	0	1	0	n/a	0	1	1	1	1	6/10
Hsu et al. (2016)	1	1	0	1	0	n/a	0	1	1	1	1	7/10
Oh & Kim (2016)	1	1	0	1	0	n/a	0	0	1	1	1	6/10
Fung & Lee (2018)	1	1	0	1	1	n/a	0	1	1	1	1	8/10
Yang, Ko & Roh (2018)	0	0*	0	1	0	n/a	0	1	1	1	1	5/10

1) Eligibility criteria were specified; 2) Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received); 3) Allocation was concealed; 4) The groups were similar at baseline regarding the most important prognostic Indicators; 5) There was blinding of all subjects; 6) There was blinding of all therapists who administered the therapy; 7) There was blinding of all assessors who measured at least one key outcome; 8) Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups; 9) All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat"; 10) The results of between-group statistical comparisons are reported for at least one key outcome; 11) The study provides both point measures and measures of variability for at least one key outcome.

Codes: 1 = Yes; 0 = No; n/a: not applicable. * Only one of the two primary groups was randomly allocated.

3.1. Findings

Table 4 shows a summary of the analyzed variables for each of the nine selected studies. Four of them aimed at studying the emotion of anger (Brown et al., 1995; Focht, Bouchard, & Murphey, 2000; Hsu, Moyle, Cooke, & Jones, 2016; Oh & Kim, 2016), three focused on aggressiveness (Trulson, 1986; Reynes & Lorant, 2002a, 2002b, 2004; Mickelsson, 2020), one focused on reactive and proactive aggressive behavior (Fung & Lee, 2018) and one focused on violent and inappropriate social behavior (Zivin et al., 2001).

Regarding the effects obtained, it is understood that the decrease in anger or aggression is a positive effect for the subjects who participated in the study, however the increase in these could be a negative effect. Considering this, the results obtained in MA&CS participation showed positive outcomes in four of the investigations (Brown et al., 1995; Fung & Lee, 2018; Oh & Kim, 2016; Zivin et al., 2001). In another three MA&CS participation showed no differences (Focht et al., 2000; Hsu et al., 2016; Reynes & Lorant, 2002a, 2002b, 2004). In these studies, judo showed negative effects after one year or one season of practice, but these were not significant. In one study, Trulson (1986) found positive effects in the group of traditional taekwondo and negative effects in the group of modern taekwondo.

Studies that obtain reductions in the levels of anger or aggression, as the case may be, are carried out through martial arts where philosophical or meditative, aspects typical of traditional martial arts are taken into account (Trulson, 1986; Brown et al., 1995; Zivin et al., 2001;Oh & Kim, 2016; Fung & Lee, 2018).

The MA&CS most used in studies was t'ai chi in three (Brown et al., 1995; Hsu et al., 2016; Oh & Kim, 2016), followed by karate (Focht et al., 2000; Reynes & Lorant, 2002b, 2004) and taekwondo in two (Trulson, 1986). While disciplines only appearing in one studio were judo (Reynes & Lorant, 2002a, 2002b, 2004), Koga Ha Kosho Shorei Ryu Kempo (Zivin et al., 2001), Choy Li Fut (Fung & Lee, 2018) and Brazilian Jiu-jitsu and Mixed Martial Arts (Mickelsson, 2020).

The smallest interval in which measurements were taken was eight weeks (Oh & Kim, 2016), while the longest was two years (Reynes & Lorant, 2004). Samples ranged from 30 to 298 participants. In relation to age we found two investigations that studied children (Fung & Lee, 2018; Reynes & Lorant, 2002a, 2002b, 2004), two studied teenagers (Trulson, 1986; Zivin et al., 2001), one studied youth (between 15 and 24 years old) (Mickelsson, 2020), three adults (Brown et al., 1995; Focht et al., 2000; Oh & Kim, 2016) and a study was conducted exclusively with subjects over 65 (Hsu et al., 2016). Five studies used samples with males and females (Brown et al., 1995; Focht et al., 2000; Fung & Lee, 2018; Hsu et al., 2016; Mickelsson, 2020), three were specific to males (Reynes & Lorant, 2002a, 2002b; 2004; Trulson, 1986; Zivin et al., 2001), while two studies did not specify the sex of the subjects in the sample (Husman, 1955; Oh & Kim, 2016).

Regarding the characteristics of the participants in the sample, two of the studies involved young people with behavior or crime problems (Trulson, 1986; Zivin et al.,

2001). In two other articles an intervention was carried out with subjects with a health problem, hospitalized alcohol-dependent patients (Oh & Kim, 2016) and people who used wheelchairs (Hsu et al., 2016).

In terms of experience, in four of the studies the subjects were novice in MA&CS (Focht et al., 2000; Reynes & Lorant, 2002a, 2002b; 2004; Zivin et al., 2001, Mickelsson, 2020), while in five studies the experience in MA&CS of the subjects was not specified (Brown et al., 1995; Fung & Lee, 2018; Hsu et al., 2016; Oh & Kim, 2016; Trulson, 1986).

The most used assessment instrument was the State-Trait Anger Expression Inventory (STAXI) used in three studies (Brown et al., 1995; Focht et al., 2000; Oh & Kim, 2016). In two investigations have used the Profile of Mood States (POMS) (Brown et al., 1995; Hsu et al., 2016) and the Buss-Perry Aggression Questionnaire (Reynes & Lorant, 2002a, 2002b; 2004; Mickelsson, 2020).

Table 4. Effects reported by selected studies on the effects of MA&CS in anger and aggression.

Reference & Study type	Focus	Population & Sample	Instrument	Groups & Experience	MA&CS	Duration	Outcomes
Trulson (1986) *Randomized controlled trial*	Aggressiveness	Juvenile delinquents n=34 boys (13-17 y/o).	Novaco Anger Inventory and Rosenzweig Picture Frustration Test	G I Tae Kwon Do traditional n=15, G II Modern Martial Arts n=11, G III CG n=9. Experience: N/A	Traditional and modern Taekwondo	6 months SPW: 3 TPS: 60	G I aggressiveness scores that were below average, significant difference is observed (1.7 vs 3.9 initially, $p<0.01$). G II very large increase in aggressiveness, significant difference is observed (7.2 VS 3.9 initially, $p<0.01$). GIII nonsignificant difference. Training in traditional MA decreases aggressiveness.
Brown et al. (1995) *Randomized controlled trial*	Anger	Healthy and sedentary n= 135 (69 women, M= 54.8 y/o) (66 men, M=50.6 y/o).	POMS and STAXI.	Moderate intensity walking n=24, Low intensity walking n=34, Low intensity walking plus the relaxation response n=28, Mindful exercise (taichi) n=18, CG n=31. Experience: N/A	Tai Chi	16 weeks SPW: 3 TPS: 45	Taichi reduced anger in women (significant difference, $p<0.008$).
Focht et al. (2000) *Cohort*	Anger	General n=30 (12 female, 18 males; M=20.6 y/o).	STAXI	Martial Arts n=15, reading classes (control) n=15 Experience: Novice	Karate	14 weeks SPW: N/A TPS:N/A	No significant differences in anger.
Zivin et al. (2001) *Randomized controlled trial*	Violent and inappropriate social behavior	Boys deemed to be at high risk for violence and	Sutter-Eyberg Student Behavior Inventory	Martial arts n=32, CG: n=28 Experience: Novice	Koga Ha Kosho Shorei Ryu Kempo	1 semester SPW: 3 TPS: 45	Significant difference ($p <0.05$) in inappropriate Social Behavior in favor of the martial arts group (focusing, moving meditation and kata).

		delinquency. n=60 boys, (11-15 y/o).					
Reynes & Lorant (2002a,b; 2004) *Cohort*	Aggressiveness	General n=43 boys, (8 y/o).	BPAQ	CG n=27, judo n=28; karate: n=9 Experience: Novice	Judo & Karate	1 year and 2 years SPW: 2 TPS: 90	After 1 year: Judoka had higher Anger scores (F=3.93, p=.051) than the control group. Judoka had significantly higher means on Total Aggression scores (F= 4.60, p <.0.5), the Verbal Aggression score (F=13.06, p < .01), and the Anger score (F= 6.38, p = .01). There is no significant difference between karate and the control group after one year of training. Karate group shows lower values in Total Aggression and Hostility. After 2 years: No positive or negative effects in aggressiveness are clearly shown. Judo group scores higher on the Anger Scale higher than CG and karateka (F=5.83, p<.05, ES=.39 and F=4.48, p<.05, ES=.41).
Hsu et al. (2016) *Randomized controlled trial*	Anger	Older people (+65) using wheelchairs n=60 (38 female, 22 male; CG M=80.73 y/o, CG M=81.77 y/o).	POMS-SF	Experimental n=30, CG: n=30 Experience: N/A	Tai Chi	26 weeks SPW: 3 TPS: 40	No significant differences in anger (p= 1.00).
Oh & Kim (2016) *Randomized controlled trial*	Anger	Hospitalized alcohol-dependent patients n=60 (CG		Experimental n=19, CG n=19 Experience: N/A	Tai Chi	8 weeks SPW: 3 TPS: 50	The experimental group (all sessions has 5 min of meditation and deep breathing) showed a significantly reduction in anger (p=0.001) than the control group. .

		M=48.1 y/o, IG=45.5 y/o).					
Fung & Lee (2018) *Randomized controlled trial*	Reactive and proactive aggressive behavior	General n=298 (66 females, 232 males; M=8.53 y/o).	Reactive-proactive aggression questionnaire, child behavioral checkist- youth self-report.	Skills and philosophy n=79, skills only n=73, philosophy only n=72, physical fitness (placebo) n=74. Experience: N/A	Choy Li Fut	10 weeks SPW: 1 TPS: 90	Combining skill and philosophy significantly reduces aggression. Significant differences were found in aggressive behavior, (p=0.002)
Mickelsson (2020) *Cohort*	Aggressiveness	Youth n=113 (105 men and 8 women; M = 20.23, SD = 2.43)	BPAQ	MMA n=79, BJJ n=66. Experience: Novic	MMA BJJ	5 months SPW: at least 2 TPS: N/A	There was no significant main effect of aggression as a result of training, F(1, 111) = 326.36, p=.1. The interaction between aggression and sport was a significant difference, F(1, 111) = 30.97, p < .001. MMA practitioners slightly increased their levels of aggression, BJJ practitioners reduced theirs

RCT = Randomized controlled trial; NRCT = Non-randomized controlled trial; y/o = years old; G = Group; CG = Control Group; N/A = Not available; SPW = Sessions per week; TPS = Time (minutes) per session; MMPI = Minnesota Multiphasic Personality Inventory; STAI = StateTrait Anxiety Inventory; POMS = Profile of Mood States; STAXI = State-Trait Anger Expression Inventory; POMS-SF = Profile of Mood States Short From; BPAQ = Buss-Perry Aggression Questionnaire ; STAXI-K= The State-Trait Anger Expression Inventory-Korean version; MMA = Mixed Martial Arts; BJJ = Brazilian Jiu-jitsu.

4. Discussion

The aim of the present review was to analyze the evidence of the effects of MA&CS participation in anger and aggression, and the quality of this evidence. The results do not support the idea that MA&CS will reduce or increase anger and aggression, and make it evident a reasonable need to present more and more solid scientific evidence.

The studies used in this review differ greatly from each other in relation to quality and variety at the time of the interventions. This was also indicated by Harwood et al. (2017), in their meta-analysis they found a relationship between the intervention time and the results obtained. In this way the study with less intervention time (Delva-Tauiliili, 1995), reported the least effect, while the greatest effect was generated in the longer intervention, 10 months (Palermo et al., 2006). This relationship was not observed in our study, where although there was a great variety in the time of interventions, the results in the reduction of anger did not seem to be related with time, so the longest intervention, two years, (Reynes & Lorant, 2004) did not show positive or negative effects.

It is important to consider the sample size, Vertonghen and Theeboom (2010) in their 2010 review, noted the small sample sizes of some studies. In our review, a third of the studies have samples with less than 50 subjects (Trulson, 1986; Focht et al., 2000; Reynes & Lorant, 2002a,b; 2004), although all have more than 30 participants. Another problem found in the studies reviewed was that five of them do not specify the experience of the participants in MA&CS (Brown et al., 1995; Fung & Lee, 2018; Hsu et al., 2016; Oh & Kim, 2016; Trulson, 1986). Information on the experience in MA&CS would be important to be show by the studies.

When considering age, studies with adults showed a notable trend. The studies carried out with adults (Brown et al., 1995; Focht et al., 2000; Hsu et al., 2016; Oh & Kim, 2016) showed positive effects, which would indicate a predisposition to the reduction of anger in the adult population. On the other hand, the only two studies that reported a negative effect (Reynes & Lorant, 2002 a, b; 2004; Mickelsson, 2020) were those that used a sample of children or adolescent age. The literature, according to age indicates a decrease in anger levels as people age (Schieman, 2010), this could make the adult population more sensitive to positive effects in interventions with MA&CS to reduce anger.

Two of the studies included in this review were aimed at young people with behavior or crime problems (Trulson, 1986; Zivin et al., 2001). In them the results reported positive effects, which could indicate the benefit of participation in MA&CS for these young people. Ali, Emrah, Fahri, Necmettin, and Gülcan (2010) pointed out how individuals with high levels of aggressiveness may be attracted to combat sports, this motivation and predisposition to work in MA&CS could make the benefits of the practice of MA&CS in relation to aggressiveness greater. In addition to these three studies with young people, another study has been carried out with adult hospitalized alcohol-dependent patients (Oh & Kim, 2016), who showed, according to the author, a genetic vulnerability associated with suicidal behavior, impulses and violence. This study also reported positive effects. Thus, the idea of the benefits of MA&CS in relation to anger is strengthened, not only in young people but also in adults.

As for the MA&CS used, we found a group of Martial Arts (MA) where we would include taichi, aikido, koga Ha Kosho Shorei Ryu Kempo and Choy Li Fut. These four can be considered as "traditional martial arts". According Nosanchuk and MacNeil (1989) the traditional martial arts may include meditation, philosophy or emphasis on the kata. On the other hand, we found two contact sports, boxing and wrestling, which are Olympic sports and that could be considered "modern martial arts". In these, there is no emphasis on the previous elements but competition is more important. Finally, we found karate, judo and taekwondo, which have a martial side and a more competitive side. The inclusion of these within traditional or modern martial arts, would depend on the approach given to them. The training in traditional MA (Lamarre & Nosanchuk, 1999), as well as the philosophical aspects included in these (Lapa, Aksoy, Certel, Özçelik, & Çelik, 2013) and the elements of kata and meditation (Reynes & Lorant, 2004) have been associated with a decrease in aggressiveness.

The results obtained in the review indicate a relationship between traditional martial arts and anger reduction. All studies that had positive effects had used an intervention based on traditional martial arts. In two of the three studies in which taichi was the MA used, positive effects were obtained (Brown et al., 1995; Oh & Kim, 2016), influencing traditional aspects of meditation or mindfulness in them. Zivin et al. (2001) used Koga Ha Kosho Shorei Ryu Kempo, highlighting the properties as traditional martial art, philosophy and meditation in his intervention, also obtained positive effects. Trulson (1986) used taekwondo in his study but giving different approaches, differentiating three groups, a traditional training group, a modern training

group and a control group. Obtaining positive results in the traditional group, negative in the modern group and finding no differences in the control group. In the same line Fung and Lee (2018) performed an intervention with four martial arts groups: skills only, philosophy only, skills and philosophy, and physical fitness (placebo), finding positive effects in the group of skills and philosophy, which was the only one that was considered a traditional martial art. This showed how training focused on traditional martial arts had a positive effect on the aggressiveness of its practitioners as indicated by Piepiora, Szmajke, Migasiewicz, & Witkowski (2016).

The studies included in this review could be classified as randomized controlled trial or cohort (Röhrig, du Prel, Wachtlin, & Blettner, 2009). All the investigations that obtained positive results were of randomized controlled type. In these, the researcher could guide how the intervention should be performed, thus controlling, to a greater extent, a variable that had not been taken into account but which could be even more important than the MA&CS style: the role carried out by the coach (Jones, Mackay, & Peters, 2006). In the selected studies, reference was hardly made to the coach beyond whether he was going to perform a traditional training or not. No investigation talked about the personality or the skill of the instructor, aspects that could vary the experience of the participants (Brown et al., 1995). Vertonghen and Theeboom (2010) observed that the importance of the type of guidance in the practice of MA reported different outcomes in some studies according to the specific guidance. The results obtained in our study indicate the need to control this variable because all the studies with positive effects have been carried out with traditional MA, but also the intervention has been regulated and controlled to a greater extent through experimental studies, in which the influence of the traditional aspects might have been one of the main objectives of the coach.

In general, the selected studies have some limitations: (a) short intervention time, (b) small sizes, (c) loss of participants, or (d) lack of control of potentially relevant variables (such as participation in other physical activities, experience in MA of the participants or style of coach), (e) failure to comply with some methodological requirements (e.g., concealed allocation, blinding of participants and assessors, or follow-up of quitters). Despite this, they can be regarded as valuable contributions that provide insights for further research. In this line, it is necessary to implement solid methodological designs which provide stronger evidence on the relationship between MA&CS training and anger and aggression. Some recent examples (Fung & Lee, 2018;

Mikelsson, 2020; Oh & Kim, 2016) lead us to be optimistic in this regard. This review also has some limitations: (a) only studies published in English, French, Portuguese and Spanish were eligible for inclusion, and (b) the strict eligibility criteria followed, which excluded some types of research designs (e.g., qualitative, case-control, cross-sectional) and procedures (e.g., mixed interventions).

5. Conclusion

The available evidence shows unclear relationship between MA&CS practice and anger and aggression levels. However, training in traditional martial arts, which affects meditation, philosophy or kata, seems to be an effective means to lower levels of anger and aggression. Regarding the age of subjects, there is a predisposition to reduce anger in the adult population. In addition, young subjects with violent or behavioral problems show a positive response to working with martial arts. In any case, these results should be viewed with much caution, as the volume of studies and the methodological quality of most of them is not optimal. Further research on the topic should pay special attention to methodological design and the control of variables that literature has found relevant such as coach style.

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Highlights

- The available evidence shows unclear relationship between MA&CS practice and anger and aggression levels.
- However, training in traditional martial arts, which affects meditation, philosophy or kata, seems to be an effective means to lower levels of anger and aggression.
- Regarding the age of subjects, there is a predisposition to reduce anger in the adult population.
- In addition, young subjects with violent or behavioral problems show a positive response to working with martial arts