Reducing aggression with martial arts: A meta-analysis of child and youth studies

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Article history:
Received 9 May 2016
Received in revised form 1 March 2017
Accepted 1 March 2017
Available online xxxx

Martial arts are becoming a mainstream sport for energetic youth and their popularity extends globally. Following a comprehensive search of martial arts research, a critical review of the field and the psychological implications was conducted. The resulting meta-analysis examined the effect of martial arts on problematic externalizing behavior (aggression, anger, and violence). The final meta-analysis included twelve studies, with 507 participants (ages 6 to 18), where study type was a moderator. For nine intervention and longitudinal studies, there was a homogenous effect size of 0.65 (95% CI: 0.11, 1.03) indicating a medium effect, where martial arts improved aggression amongst the practicing youth. The other three one-time comparisons studies did not yield a homogenous effect size. Based on these analyses, it appears that martial arts has a potential to reduce externalizing behaviors in youth, although further research is needed to determine the mechanisms of change and specify the most relevant population groups for targeted interventions.

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Keywords:
Martial arts
Meta-analysis
Externalizing behavior
Aggression
Adolescent
1. Introduction

Over the past half century, martial arts have gained increasing popularity in the west, as their physical and mental health benefits have been demonstrated (Weiser, Kutz, Kutz, & Weiser, 1995). Far from their negative connotations once exposed in the media (Fuller, 1988), martial arts are now seen in a much more positive light with both participation and research into their effects steadily increasing (Vertonghen & Theeboom, 2010).

Martial arts, the general term for those combat arts developed in the East, have a development shrouded in secrecy with techniques and practices initially designed for combat and to create a warrior who has spiritual, physical, and mental wellbeing. As these combat arts began to permeate the West (particularly through increased travel to Eastern regions and the stationing of US troops in Japan and Korea), they adapted to suit the needs of the participants while retaining the Eastern philosophy (Burke, Al-Adawi, Lee, & Audette, 2007). The philosophy which permeates traditional martial arts is one of attaining the Zen state of mushin, or “no mindedness,” a state whereby the participant is capable of fighting to their fullest extent but without aggressive feelings. This is carried out through ritualization of combat moves (katas), the requirement of respect to the teacher (sensei), to the practice space and to one another, and also by highlighting the importance of meditation and philosophies such as peace, benevolence, humanity, and self-restraint (Nosanchuk & MacNeil, 1989).

Research into martial arts focuses on those elements which are most valuable to the targeted population. Research with adolescents and young adults examine the benefits of martial arts in teaching self-control, enhancing self-esteem, teaching a more positive response to physical challenges, and inducing greater emotional stability, self-confidence, and assertiveness. Martial arts provide an outlet for participants to channel energy into a productive and self-enhancing activity (Twemlow & Sacco, 1998). They have also been demonstrated to improve concentration and self-awareness in children (Lakes & Hoyt, 2004) and tentatively aid executive functions (Diamond & Lee, 2011), including self-monitoring and awareness (Haydicky, Wiener, Badali, Milligan, & Ducharme, 2012; Lothes, Hakan, & Kassab, 2013) and cognitive-regulation (Lakes & Hoyt, 2004).

Of current interest is the effect of martial arts on externalizing behaviors. Externalizing and antisocial behaviors amongst youth are of pressing concern and considered a major public health problem (Krug et al., 2002). Birth-CoHORT studies carried out internationally demonstrate close links between youth delinquency and adult crime (Farrington, 2000; Laubacher et al., 2014; Moffitt, 1993). It appears that while a minor level of delinquency and antisocial behavior increases gradually through adolescence and decreases in adulthood, youth who show serious and persistent antisocial behaviors are at the greatest risk of becoming lifelong offenders (Hoge, Vincent, & Guy, 2013; Moffitt, 1993).

Treatments for externalizing behaviors in youth include interventions at an individual level such as cognitive behavior approaches (Barnes, Smith, & Miller, 2014; Cornet, De Kogel, Nijman, Raine, & Van Der Laan, 2015), at a family level such as systemic therapy (Smith et al., 2004), and community interventions (Marans & Schaefler, 1998). Other more novel approaches include dietary changes, such as increasing fish oil consumption (Raine, Portnoy, Liu, Mahomed, & Hibbelen, 2015) and overhauling classroom teaching methods (Hawkins, Catalano, Kosterman, Abbott, & Hill, 1999). While treatment success rates vary, current guidelines highlight the necessity of matching the most suitable intervention for the cultural and social needs of the relevant community (Krug et al., 2002).

Martial arts provide a novel intervention both because of the comparatively low cost of implementation (just one martial arts instructor for a group as large as 15) and also because of the novelty and ‘street-cred’ associated with the sport. As cognitive functions, specifically executive functions, improve with training (Diamond & Lee, 2011), so too do externalizing behaviors (Zhou et al., 2007). The more advanced a student becomes in the traditional martial arts, the lower his or her aggression levels are reported on a range of measures (Nosanchuk & MacNeil, 1989). While martial arts appears to attract those children who have higher aggressive tendencies, it seems that throughout the training process, both aggressive and non-aggressive tendencies are reduced (Krug et al., 1999). Indeed learning to understand one’s boundaries, developing self-control, and physically integrating mind and body can have deep psychological benefits (Weiser et al., 1995).

Recent, school-based martial arts programs have shown promising results in the reduction of school-based aggression for troubled youth, with participants demonstrating significantly less violent behavior, as well as reductions in rule breaking and impulsive behaviors. Additionally, participants reported a more positive emotional state following training and demonstrated significant improvement in attentional self-control (Zivin et al., 2001). Smaller scale studies have also indicated the positive effect of martial arts in at-risk youth on aggression levels (Palermo & Forno, 2006; Theeboom, De Knop, & Wylleman, 2008).

A previous review of the effect of martial arts on socio-psychological variables (Vertonghen & Theeboom, 2010) demonstrated the variability of research pertaining to the effect of martial arts on externalizing behaviors and highlighted the need for more extensive research. They emphasized the positive outcomes of martial arts in a host of studies but also drew attention to those studies demonstrating negative outcomes. A simple review of the studies these authors include in their analysis highlights the lack of segregation in this field of research, with half the studies on aggression including mixed adult and youth samples. This proves problematic when attempting to ascertain whether there are age effects within the field. Likewise the majority of the research is with a male sample, although when females are included they either show little (Lakes & Hoyt, 2004) or negative effects (Bjorkqvist & Varhama, 2001).

The goal of the current review is to estimate the effect size of martial arts training in youth on externalizing behaviors. In light of the large variability in the relevant studies, as discussed above, we will first review the sources of variability and potential moderators, when considering the effect of martial arts on externalizing behaviors.

1.1. Martial arts types

Current research does not distinguish between different forms of martial arts. Studies that include two types of martial arts generally combine them together for final analysis (Daniels & Thornton, 1992, 1990). The martial arts studied mostly conform to the ancient practices and include an internal reflection, ancient philosophies, and breathing practices. When these aspects are contrasted with modern, fight-heavy martial arts, the traditional martial arts have superior effects, while modern martial arts may even be harmful (Trulson, 1986). Introducing traditional, internally focused techniques, such as controlled breathing, can mediate this effect (Hernandez & Anderson, 2015).

1.2. Movement type

It has been hypothesized that the repetitive movements in martial arts can act as a container for destructive aggression and a vehicle for embodiment of the mind (Twemlow, Sacco, & Fonagy, 2008b). This effect may be similar to the synchronized and unifying effect of movement expression in dance and movement therapies (Levy, 1988; Ritter & Low, 1996), although there is little to no research to this effect in other fields (i.e., sports, educational interventions, and crinomology).

1.3. Gender

Current studies indicate that greater effects of martial arts practice for males than for females (Lakes & Hoyt, 2004; Twemlow et al.,...
This could be due to the overwhelmingly larger proportion of males demonstrating externalizing behavior problems, as opposed to females (Krug et al., 2002), but may also be due to the male dominated nature of the sport.

1.4 Age

The majority of the studies on martial arts have been carried out on youth or university age adults, with no intervention studies performed on a purely adult population. Externalizing behavior problems are generally not studied in elderly populations, but there is evidence demonstrating an improvement in emotional functioning following a karate intervention (Jansen & Dahmen-Zimmer, 2012). Given the heightened risk of violence amongst youth and young adults (Dahlberg & Potter, 2001), it follows that interventions designed to reduce violence would show the greatest impact when levels are at their peak. Likewise, executive functions are demonstrated to develop from early childhood (Baddeley, 1996), only reaching maturity in adulthood and demonstrating periods of rapid development occurring during adolescence (Satterthwaite et al., 2013). Given the heightened potential for improvement during this period, interventions targeting executive function improvement and reduction of aggression generally target school age children (Diamond, 2013).

1.5 Training/intervention duration

The effects of martial arts have been studied from as short as a two and a half week intervention (Delva-Tauiliili, 1995), although the majority of examine programs lasting at least ten weeks. Shorter interventions appear to have smaller effect sizes, and there is evidence to demonstrate that the longer time spent in martial arts practice, the lower aggression levels demonstrated (Daniels & Thornton, 1992; Skelton, Glynn, & Berta, 1991).

1.6 Location of training

Intervention programs can be divided into those taking place in school and outside of school settings. School based intervention programs are wider reaching and target much larger samples of children (Lakes & Hoyt, 2004; Twemlow et al., 2008a; Zivin et al., 2001). While other intervention studies target those already demonstrating severe disruptive problems (Palermo & Forno, 2006), the advantage of school-based programs is that they target those at-risk but not yet demonstrating criminal levels of anti-social behaviors and externalizing problems. Likewise, those studies taking place in a martial arts sports clubs show a wider range of results given the selection bias effects of participants choosing martial arts over less aggressive sports (Delva-Tauiliili, 1995; Lamarre & Nosanchuk, 1999; Reynolds & Lorant, 2002b).

1.7 Health or illness of participants

There is not enough information concerning martial arts with patient populations, although preliminary studies demonstrate a potential improvement in externalizing behaviors amongst sufferers of schizophrenia (Hasson-Ohayon, Kravetz, Roe, Rozencwaig, & Weiser, 2006), autism (Brahmi, Movahedi, Marandi, & Abedi, 2012), and epilepsy (Conant, Morgan, Muzykewicz, Clark, & Thiele, 2008). Of course, externalizing behaviors may have different neurological causes in different disorders.

This current meta-analysis is intended to collate those studies providing usable data on martial arts and externalizing behaviors amongst children and adolescents and generate a picture of the current state of the field. If martial arts do appear to demonstrate beneficial outcomes in reducing externalizing behaviors, then this will provide a platform on which to base future intervention studies.

2. Method

2.1 Literature search

The first step in conducting the meta-analytical review involved a selective literature search for papers published from 1980 until November 2015. We used the PsychNET, Google Scholar and Web of Science databases. Literature was also sourced from published literature reviews including the aforementioned 2010 literature review (Vertonghen & Theboom, 2010). Our key search term was “martial arts” with the limitation that manuscripts were written in English.

2.2. Selection criteria

2.2.1 Inclusion criteria

1. Studies evaluating the effect of martial arts on externalizing behaviors (i.e. Aggression, anger, violence, hostility).
2. Effect of martial arts evaluated with a validated cognitive or behavioral measurement.
3. The study analysis included data or statistical information which could be used to generate an effect size (d-value).
4. The existence of either a control group or comparison group.
5. The study sample is composed of youth (up to and including 18 years).

2.2.2 Exclusion criteria

We did not include studies evaluating the effect of martial arts on physiological or neurological functions which were unrelated to psychological functioning such as fitness or vision. We did not include studies which only dealt with an elderly population nor did we include studies which only had a female sample.

2.3. Extraction of the outcome measures

Statistical data including means and standard deviations, t-test/F Anova/P values and number of subjects/df were extracted from each study. In cases there were several reported effect sizes for various measures in one study, we extracted only the larger effect size for the most relevant measure. Analysis Effect sizes were calculated according to Rosenthal (1991). In order to assess homogeneity/heterogeneity, we examined the data using Q test (Sanchez-Meca & Fulgencio, 1997; Shadish & Haddock, 1994) and I² (Higgins & Thompson, 2002).

Accordingly, if the Q value is not significant, then the effect sizes are considered to be homogeneous, and the mean effect size is the best estimation for the data; however, if the Q is significant, moderators should be suggested as the effect sizes are considered to be heterogeneous.

All studies were coded and the data extracted by the first author and a random subsample of papers were coded independently by the second author. Inter-rater reliability was 100%. All data was extracted from papers and if there was a lack of sufficient information to calculate effect sizes, the authors were contacted (for standard deviations).

3. Results

3.1 Studies retrieval

From the initial, broad, search criteria, 312 studies in English were retrieved. Forty-nine publications which reviewed the psychological effects of martial arts were identified and carefully reviewed. Many of these studies were eliminated due to the inclusion and exclusion criteria. The majority of the eliminated studies focused on psychological characteristics other than externalizing behaviors, also other reasons for exclusion included inability to access relevant data (Nosanchuk & MacNeil, 1989; Rothpearl, 1980; Theboom et al., 2008). Twelve studies were deemed to fulfill inclusion and exclusion criteria (from unique publications). From each study, we took out the most significant results.
for behavioral measures; if the result was not significant, we treated it as a zero effect size and included in the meta-analysis (see Table 1).

3.2. Meta-analysis results

We included twelve effect sizes. In the first step, the Q value was calculated based on all effect sizes and revealed a Q value of 28.57, df = 11 (p < 0.01) and I² = 61.5, which reflect the presence of a moderator or several moderators. We assumed that type of study could be a moderator thus effect sizes were split into two groups: nine studies derived from intervention and longitudinal studies and three studies which were a one-time comparison of martial arts participants with other sports on a number of behavioral and psychological measures. Homogeneity tests for intervention and longitudinal studies yielded Q = 15.50, df = 8 (p > 0.05) and I² = 41.99, indicating that there is no need to search for another moderator and that the results are homogeneous. A funnel plot of included studies did not show any asymmetry, an indication that significant publication bias was not likely (Fig. 1).

The final analysis of these studies revealed an average effect size of 0.65 (95% CI: 0.11, 1.03) indicating a medium effect size. These nine studies contained 507 participants between the ages of 6 and 18 and were a combination of longitudinal, cross-sectional and intervention studies. They were mainly comprised of normative youth or University age students but they also included those with epilepsy (Conant et al., 2008), learning disabilities (Haydicky et al., 2012) and social or behavioral problems (Palermo & Forno, 2006; Zivin et al., 2001).

The three comparison studies in the second group were not homogeneous (Q = 10.96, df = 2 [p < 0.01], I² = 81.75) and while they yielded a small effect size (d = 0.38, 95% CI: −0.35, 0.82), the small number of such studies limits concluding analysis. Of the studies included in the final analysis, four were deemed to be as close to randomly controlled trials as possible within this field of research. These studies were found to be homogeneous (Q = 4.81, df = 3 [p > 0.05], I² = 37.6) and yielded the greatest average effect size of 0.73 (95% CI: 0.37, 0.79). The remaining studies remained homogeneous (Q = 7.88, df = 4 [p > 0.05], I² = 49.26).

4. Discussion

The present meta-analytic study found support for the relationship between martial arts and reduced aggression amongst a range of youth populations. 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.

There was no need for further moderator analysis following the removal of comparison studies of martial arts participants with other sports participants. The studies based on a martial arts intervention were found to be homogeneous. Thus, based on studies including over 500 youth, it is reasonable to conclude that the beneficial effects that martial arts have on reducing externalizing behaviors do not depend on martial arts of participant type, location of practice, or duration of the program. That said, age may still be a potential moderator, as this study only included youth.

The research on martial arts is sparse and many studies lack the statistical integrity to include them in a robust meta-analysis. Vertonghen & Theeboom's, 2010 literature review was the most comprehensive on this topic (Vertonghen & Theeboom, 2010). Unfortunately, of those studies which included a solely youth and young adult populations, studies such as Nosanchuk’s (1981) and Edelman’s (1994), non-inclusive usable statistical data that could be used in a meta-analysis. This left the current meta-analysis with a dearth of papers to be analyzed, and rather than subdivide the martial arts research into definitive categories, the resulting analysis included the compilation of a wide range of martial arts in a variety of settings and populations.

The studies included in the current analysis varied in their scope and quality. The smallest effect was found, predictably, when youth participated in just two and a half weeks of training, albeit daily (Delva-Tauiliili, 1995), and the largest effect was generated in the longest intervention of 10 months (Palermo & Forno, 2006). When the youth taking part in various martial arts were deemed to be at risk and demonstrated significant behavior problems, the effect of martial arts varied dramatically (0.3 to 1.53, Palermo & Forno, 2006 and Zivin et al., 2001, respectively), and this variance is testament to both the varying techniques and externalizing behavior presentations. The analysis of such externalizing behaviors also varied with some studies having aggression and aggressive behaviors as the key measure (Reynes & Lorant, 2002a; Zivin et al., 2001), whereas others extracting the analysis of externalizing behaviors from broader behavioral and temperamental measures.

![Fig. 1. Funnel plot showing effect sizes for martial arts meta-analysis delineated by sample size.](http://dx.doi.org/10.1016/j.avb.2017.03.001)
(Conant et al., 2008; Twemlow et al., 2008a) and novel, though rarely used, observation methods (Lakes, 2012; Lakes & Hoyt, 2004). While studies such as Haydicky et al. (2012) used naturally formed experimental groups comprised of those eligible for the intervention and those eligible but on a wait list others were self-selected participants (Conant et al., 2008; Reyes & Lorant, 2002a; Skelton et al., 1991).

Just one study used full random assignment to the martial arts or physical activity intervention (Lakes & Hoyt, 2004) though Palermo and Forno (2006) and Zivin et al. (2001) randomly assigned children referred to the martial arts program to either the test group or wait list (the later added participants to the test group at the school’s and parent’s request thus reducing the level of randomization) and Twemlow et al. (2008a, 2008b) used a sample taken from a school using the martial arts component from a wider RCT (Fonagy et al., 2009). When taken together, these studies produced an even larger effect size than when all intervention studies were calculated.

A limitation of all the included studies is that where attrition was documented, it was primarily as a result of absence from final testing (Lakes & Hoyt, 2004; Zivin et al., 2001) and no study reports on the dosage or number of classes participated in from those offered during the study period. It seems improbable that especially during large scale studies taking place in schools with at-risk youth, that there would not be greater dropout or unwillingness to participate (indeed in Fonagy et al., 2009, the full RCT had just a 75% participation rate and 25% of the data was missing and computationally estimated).

The question of whether martial arts increases or reduces externalizing behaviors is crucial when planning interventions and attempting to further research into lowering criminogenic behaviors. While the current meta-analysis included only one study with a negative result (Reynes & Lorant, 2002a), it should be noted that the same sample was used for two additional publications reporting negative findings that were not included in the present analyses (as outlined above, one effect size was taken from each study; Reyes & Lorant, 2002b, 2004). Similarly, of the three comparison studies not included in the final analysis, Ziae and colleagues found martial arts participants to demonstrate greater anger (Ziaee, Loftian, Amini, Mansournia, & Memari, 2012), although the other two studies reported less hostility and aggression compared to other sports participants (Daniels & Thornton, 1992; Roux & Steyn, 2009).

A recent meta-analysis was published on the foundation of detangling whether these negative effects were more significant than the positive effects cited (Gubbels, van der Stouwe, Spruit, & Stams, 2016). Although the findings were overall positive, as in the current meta-analysis, the resulting effect size was relatively small in stark contrast to the current result. Further investigation revealed a number of questionable inclusions into their analyses, including a study which did not appear to include traditional martial arts (Kreager, 2007) and another whereby martial arts was grouped with boxing and other combat sports (Mutz, 2012). The authors also did not include their self-generated effect sizes, making their analyses impossible to replicate. These questionable inclusions highlight the dearth of research in this field, which helped the current meta-analysis. Nonetheless, as there are very few studies in the field of martial arts and crime prevention, and yet more and more schools and youth clubs are introducing them and citing beneficial effects, it is critical to stimulate additional rigorous research that accurately reflects the state of the field.

While psychologically oriented programs often receive the bulk of the scientific interest (James, Stams, Asscher, De Roo, & van der Laan, 2013; Zagar et al., 2013), troubled youth often do not cooperate with these traditional approaches. Martial arts, it has been suggested, may both complement and form a basis for further cooperation in psychological therapies (Weiser et al., 1995). Further research is needed to substantiate the tentative claims of this meta-analysis and also provide a more thorough examination of why martial arts training appears to be a beneficial intervention. It does not appear to matter which specific martial arts are used, but rather the common themes of repetitive movements, controlled behaviors, and respect are present in all the studies outlined above. Furthermore these positive effects have also been documented in reducing stereotypy in autism (Bahrami et al., 2012), improving quality of life in schizophrenia (Hasson-Ohayon et al., 2006), and increasing emotional mental state in the elderly (Jansen & Dahmen-Zimmer, 2012), thereby adding further evidence to the wellbeing enhancing mechanisms of martial arts across a range of populations. Understanding the specific mechanisms of change in martial arts with at-risk youth will aid future program development and encourage the proliferation of this cost-effective, fun, and normative intervention.

Acknowledgements

This research was supported by the Ministry of Science, Technology & Space, Israel (Grant #3-13631). This study was carried in the course of the PhD research conducted by Anna Harwood at Bar Ilan University, Ramat Gan, Israel. No conflicts of interest exist for any of the authors nor was any specific funding supplied for this study. Anna Harwood is a recipient of the Presidential Scholarship Award from Bar-Ilan University.

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