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Gubbels, J.; van der Stouwe, T.; Spruit, A.; Stams, G.J.J.M.

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# Martial arts participation and externalizing behavior in juveniles: A meta-analytic review



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## ABSTRACT

Martial arts are very popular among juveniles all over the world, but the relation between martial arts and externalizing behavior in juveniles remains unclear. The current multilevel meta-analysis of 12 studies, including 94 effect sizes and  $N = 5949$  juveniles, was conducted to examine the relation between martial arts participation and externalizing behavior in juveniles, and to examine factors with a possible moderating effect. Results showed that there was no overall relation between martial arts participation and externalizing behavior in juveniles. However, a trim-and-fill procedure implicated publication bias of studies reporting that juvenile martial artist showed more externalizing behavior than non-martial artists, suggesting that the current overall outcomes might underestimate externalizing behavior in martial artists. Moderator analyses showed that studies published in higher impact factor journals, and studies with a higher training intensity in martial arts found more externalizing behavior in martial artists. Furthermore, karate was found to be less related to externalizing behavior than judo. Finally, in comparison with non-athletes and team sport athletes, martial artists showed similar levels of externalizing behavior, but they showed more externalizing behavior when compared to individual sport athletes. Implications for future policy and research are discussed.

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Martial arts (e.g., karate, judo, taekwondo, and boxing) are very popular among children and adolescents all over the world. In several countries martial arts are even the most popular extracurricular sports practiced by children between 10 and 15 years old (De Knop, Engström, Skirstad, & Weiss, 1996). In the Netherlands, approximately 50% to 56% of those who practice martial arts in a club setting are juveniles (Breedveld, Kamphuis, & Tiessen-Raaphorst, 2008), and in Finland percentages even range from 64% to 86% (Tammelin, Näyhä, Hills, & Järvelin, 2003). In light of the popularity of martial arts, it is noteworthy that some controversy exists about the practice of martial arts by juveniles. Proponents of martial arts consider them as valuable sports with an important function for society. Through martial arts, juveniles would learn to deal with rules and to have respect for others (Van Koolwijk, Langendijk, & Van Egdome, 2014). On the other hand, the practice of martial arts raises ethical concerns because of the possible harmful effects on the personal and social well-being of young participants in terms of aggressive and violent behavior (Endresen & Olweus, 2005).

In previous research, multiple theories about the relation between martial arts participation and externalizing behavior have been discussed. For example, according to the social learning theory of Bandura (1973), martial arts would increase externalizing behavior by modelling, rehearsing, and rewarding aggression. This theory has been tested in several experiments, including the 'bobo doll experiment', which shows that when children watch others punching a large bobo doll, they are likely to imitate this behavior (Bandura, Ross, & Ross, 1961). On the other hand, the catharsis theory claims that sports participation, including martial arts participation, will vent off negative energy (Breuer & Freud, 1974) and thus reduce externalizing behavior outside the sports context. With most martial arts being explosive sports, these are likely to vent off more negative energy than less explosive sports. However, the catharsis theory lacks empirical evidence (Bushman, 2002; Shields & Bredemeier, 1995; Wann et al., 1999) and has been contradicted by research showing that engaging in socially acceptable forms of aggression, like martial arts, in fact increases aggression (Bushman, 2002; Geen, Stonner, & Shope, 1975). In sum, these theories show contradictions regarding the relation between martial arts and externalizing behavior.

Several researchers have studied and reviewed the relation between martial arts and behavioral outcomes in juveniles (Vertonghen & Theeboom, 2010). Martial arts have been associated with higher self-esteem (Finkenbergh, 1990; Trulson, 1986), more emotional stability (Konzak & Boudreau, 1984), assertiveness (Konzak & Boudreau, 1984) and less anxiety (Kurian, Caterino, & Kulhavy, 1993). Moreover, several studies have examined the influence of martial arts on externalizing behavior, and have found that martial arts participation was associated with less externalizing behavior (e.g., Daniels & Thornton, 1990, 1992; Lamarre & Nosanchuk, 1999; Nosanchuk, 1981; Rutten et al., 2011; Steyn & Roux, 2009).

An earlier review on the relationship between martial arts and aggressive behavior concluded that in general longer martial arts training was associated with lower levels of aggressiveness (Vertonghen & Theeboom, 2010). However, not all studies have found a positive relation between martial arts and externalizing behavior. Higher levels of externalizing behavior among martial artists have also been reported (Endresen & Olweus, 2005; Kreager, 2007; Lotfian, Ziaee, Amini, & Mansournia, 2011; Mutz, 2012; Reynes & Lorant, 2001, 2002a,b, 2004; Ziaee, Lotfian, Amini, Mansournia, & Mernari, 2012).

The inconsistent research findings on the influence of martial arts on externalizing behavior may be explained by several contextual factors. First, the type of martial art has been associated with differences in aggression. Several authors have found that those who practiced modern martial arts training (e.g., boxing) showed more aggression than traditionally trained martial artists (e.g., karate) (Graczyk, Hucinski, Norkowski, Peczak-Graczyk, & Rozanowska, 2010; Nosanchuk & MacNeil, 1989; Trulson, 1986). Additionally, some studies showed that the length of the martial arts training was indicative of less externalizing

behavior (Lakes & Hoyt, 2004; Skelton, Glynn, & Berta, 1991), and others found less externalizing behavior for specific target groups, such as middle or elementary school juveniles at risk (Edelman, 1994; Zivin et al., 2001).

Inconsistencies may be explained by some important limitations in the existing research. First of all, a comparison group is often lacking (Kellogg, 2003; Skelton et al., 1991) so that levels of externalizing behaviors in martial artists could not be compared to athletes in other sports or in non-athletes. Moreover, studies that have used a comparison group often lack description of the type of sports practiced in the comparison group (e.g., Endresen & Olweus, 2005), or have implemented martial arts as an intervention (e.g., Delva-Tautiliili, 1995; Palermo et al., 2006). As martial arts are often exercised for a short amount of time in intervention studies, the results cannot be generalized to all martial artists.

Despite the popularity of martial arts among juveniles, it remains unclear to what extent martial arts participation is associated with externalizing behavior. It has been suggested that the relation between martial arts participation and externalizing behavior is influenced by several contextual factors. However, existing research on these factors is limited. A previous narrative review on the relation between martial arts participation and externalizing behavior aimed to provide more insight into this relation (Vertonghen & Theeboom, 2010), but was limited in explaining between study differences and could not provide an estimation of the strength of the relation. By conducting a meta-analysis it is possible to estimate the effect size of the association between martial arts participation and externalizing behavior, and to account for between study differences. Consistent with the previous review by Vertonghen and Theeboom (2010), we therefore included externalizing emotions and behavior and excluded substance use and attention problems, similar to the DSM-V classification of disruptive, impulse control and conduct problems. Moreover, a meta-analysis can assess the influence of context factors as advised in the review by Vertonghen and Theeboom (2010). Furthermore, by including a smaller age range (i.e., excluding adults), and excluding studies without a comparison group, the current meta-analysis provides a better understanding of the relation between martial arts and externalizing behavior in juveniles specifically, and gives insights into the impact of possible moderators on this relation. The following research questions will be addressed: 1) What is the relation between martial arts and externalizing behavior? 2) Which study, design, sample, comparison group and outcome characteristics have a moderating effect on the outcomes?

## 1. Method

### 1.1. Selection of studies

To select all the relevant studies for this meta-analysis, two searches were conducted. The first search included all reports until 2014 addressing the relation between martial arts and externalizing behavior for juveniles. Multiple computerized databases have been searched to identify relevant studies: PiCarta, ProQuest Sociological Abstracts, Google Scholar, EBSCOhost Academic Search Premier, Wiley Online Library, OvidSP (including PsycINFO, and PubMed through Medline), National Academic Research and Collaboration Information System (NARCIS), ScienceDirect and Web of Science. The following keywords were used: 'combat sport', 'fight sport', 'martial art', aikido, bojutsu, boxing, capoeira, dambe, eskrima, fencing, gatka, grappling, hapkido, jiu-jitsu, judo, jujutsu, kalaripayattu, karate, kendo, kenjutsu, kickboxing, kobudo, 'krav maga', 'kung fu', kyudo, 'muay thai', pankration, sambo, sanda, sanshou, savate, self-defense, shootboxing, silat, sumo, taekwondo, 'thai chi', 'vale tudo', 'wing chun', wrestling, and wushu. Keywords that could also have another meaning besides a combat sport (e.g., 'fencing') were combined with the keyword 'sport' to reduce the number of unqualified search results. In July 2015 a second search was carried out. The same databases and keywords have been used as noted before, but this time the

keywords were combined with several outcome variables (i.e., aggression, antisocial behavior, conduct behavior, delinquent behavior, and juvenile delinquency). To obtain possible unpublished and non-reported data on study and sample characteristics and outcomes, several authors were contacted. Finally, the references of relevant studies were examined to include all research on the relation between martial arts and externalizing behavior in juveniles.

Despite the broad search for studies investigating externalizing behavior, only studies examining aggression, anger, hostility, violence, conduct problems and antisocial behavior were found. Studies including constructs like delinquent behavior were not found, and could therefore not be included in the current meta-analysis.

### 1.2. Inclusion criteria

To be included in the current meta-analysis, studies had to meet the following criteria: (1) the study had to report about the relation between martial arts and externalizing behavior, (2) only studies with a comparison group consisting of non-athletes or other sports athletes were included, (3) the sample had to consist of children and adolescents up to the age of 20. In case a study reported insufficient information to calculate an effect size, authors were contacted for additional information to be able to include the study in the present meta-analysis.

The search yielded 43 relevant studies of which 12 studies (with #ES = 94 effect sizes,  $N = 5949$  participants, and 9 independent non overlapping samples) met the inclusion criteria for the meta-analysis. Appendix A shows the characteristics of the included studies.

### 1.3. Coding the studies

A detailed coding scheme was used to record all study, design, sample, comparison group and outcome characteristics that could moderate the relation between martial arts and externalizing behavior. The impact factor of the journal was considered a *study characteristic*. For *design characteristics*, the type of study (cross-sectional or longitudinal), whether the participants were self-selected or assigned to their sports, and whether or not the effect size could be corrected for pre-existing differences between martial arts participants and other (sports) participants. The coded *sample characteristics* included type of martial arts (judo, karate or other martial arts, including taekwondo, aikido, kempo, boxing and wrestling), experience in martial arts in years, intensity of martial arts training in hours a week, gender, age and the style of martial arts (traditional, modern or both). The *comparison group characteristics* included the type of comparison group (individual sport athletes, team sport athletes or non-athletes). Finally, for the *outcome characteristics*, the construct category was coded (anger versus aggressive/antisocial behavior).

Inter-rater agreement was based on a double-coding of all studies by two coders. An inter-rater agreement of 87% was found between the two coders.

### 1.4. Data analysis

In order to establish the overall relation between martial arts and externalizing behavior and to examine which factors moderate this relation, a multi-level meta-analysis was conducted. Through a multi-level meta-analysis multiple effects within studies can be included to generate more statistical power and to fully exploit all possible factors that may moderate the relation between martial arts participation and externalizing behavior in the available research. The outcomes of the studies were transformed into the correlation coefficient effect size ( $r$ ). We calculated the effect size based on analyses correcting for demographic or pretest measures if the study provided sufficient information to do so. In addition, we corrected effect sizes for pre-existing differences between groups by subtracting the pre-sports effect size from the post-sports effect size. A positive effect size indicated that martial artists

show more externalizing behavior than athletes in other sports or non-athletes, whereas a negative effect size can be interpreted as martial artists showing less externalizing behavior than athletes in other sports or non-athletes. These effect sizes have been calculated using formulas from Wilson (2010), mostly based on means and standard deviations. If the results were reported to be non-significant, without measures to calculate an effect size, an effect size of zero was assigned (Durlak & Lipsey, 1991). This procedure has been applied to one study, for two effect sizes. Because the variance of the coefficients  $r$  depends strongly on the correlation, the coefficients  $r$  were recoded into Fisher's  $z$  values (Lipsey & Wilson, 2001).

Continuous variables were centered on their mean, and categorical variables with more than two categories were recoded into dummy variables. Extreme values of the effect sizes ( $>3.29$  SD from the mean; Tabachnik & Fidell, 2007) were corrected by winsorizing these outliers. Only one effect size was found to be an outlier ( $r = -.839$ , from Reynes & Lorant, 2002b), and this effect size was reduced to the nearest effect size in the normal range ( $r = -.645$ ). Standard errors and sampling variance of the effect sizes were computed using formulas by Lipsey and Wilson (2001). Furthermore, because two studies provided the majority of the effect sizes (i.e., #ES = 32: Lotfian et al., 2011; #ES = 30: Reynes & Lorant, 2002a), and two studies consisted of a substantially larger sample than the other studies (i.e.,  $N = 1415$ : Endresen & Olweus, 2005;  $N = 2879$ : Kreager, 2007), sensitivity analyses were conducted to test if the inclusion of these studies changed the overall results.

Because the data of most studies resulted in more than one effect size, a traditional random effects model was extended to a three-level random effects model (Van den Noortgate, López-López, Marín-Martínez, & Sánchez-Meca, 2013). Within this model three forms of variations were taken into account: the random sampling variation of observed effect sizes (level 1), the variance between outcomes within studies (level 2), and the between-study variance (level 3) (Wibbelink & Assink, 2015). To compare the outcomes of the full model and the models excluding the variance parameters of level 2 or 3, likelihood ratio tests were used. This makes it possible to determine whether significant variance is present at the two levels (Wibbelink & Assink, 2015). In case there was significant variance on these two levels, the distribution of effect sizes was considered to be heterogeneous. This indicates that the effect sizes could not be treated as estimates of a common effect size, and moderator analyses were performed. The program R (version 3.2.0), with the metafor-package, was used to conduct multi-level meta-analysis, using a random effects model that allows for the hierarchical structure of the data. The model was extended by including study, design, sample and outcome characteristics as moderators in order to investigate their influence on the relation between participation in martial arts and externalizing behavior problems.

### 1.5. Publication bias

A common problem in conducting a meta-analysis is that studies with non-significant or negative results are less likely to be published than studies with positive and significant results. The studies included in this meta-analysis may therefore not be an adequate representation of all studies that have been conducted. This phenomenon is called the 'file drawer problem' (Rosenthal, 1995). In this meta-analysis, the publication bias was examined by testing the asymmetry of the funnel plot, according to Egger's method, (Egger, Davey Smith, Schneider, & Minder, 1997). A funnel plot is a scatter plot of the effect sizes against the effect size's precision (the inverse of the standard error). In case of publication bias, a gap in the effect size distribution would be present, showing an asymmetrical funnel plot and a significant Egger's test. After this, a trim and fill procedure was performed (Duval & Tweedie, 2000a,b). The trim and fill procedure corrects for funnel plot asymmetry by imputing estimated missing effect sizes that are calculated on the basis of existing effect sizes, which shows the influence of the estimated missing data on the overall effect of the meta-analysis. Finally, the skewness

of the effect size distribution was calculated in SPSS, because a skewed distribution of the effect sizes would be expected if a publication bias is present (Begg & Mazumdar, 1994).

## 2. Results

The current meta-analysis consists of  $k = 12$  studies (with 9 non-overlapping samples), #ES = 94 effect sizes, reporting on  $N = 5949$  juveniles of whom  $n = 1169$  participated in martial arts and  $n = 4780$  constituting the comparison group.

### 2.1. Overall relation

Table 1 presents the results of the multilevel meta-analysis. Cohen's (1988) guideline was used to interpret the effect sizes, with effect sizes of  $r = .10$  considered small,  $r = .25$  medium and  $r = .40$  large. No significant association was found between participation in martial arts and externalizing behavior ( $CI = -.150-.112$ ), indicating that there is no overall relation between practicing martial arts and externalizing behavior in juveniles.

Sensitivity analysis excluding the studies with the substantially larger samples than other studies had little effect on the overall relation ( $r = -.066$ ; 95%  $CI = -.215-.084$ ;  $p > .05$ ). The sensitivity analysis excluding the studies with the largest number of effect sizes did not affect the overall relation between martial arts participation and externalizing behavior either ( $r = -.041$ ; 95%  $CI = -.222-.139$ ;  $p > .05$ ).

When checking for publication bias, Egger's method indicated funnel plot asymmetry, since the intercept was significant ( $t = -3.455$ ,  $p = .001$ ). Furthermore, the trim and fill plot showed that there were some missing effects with positive correlation coefficients (see Fig. 1), which could indicate publication bias. Table 1 therefore includes an overall effect size after a trim and fill procedure was conducted (Duval & Tweedie, 2000a,b). After the missing effect sizes were filled within studies, a positive overall effect was found (see Table 1). This indicated that, when controlling for possible publication bias, there is a positive relation between martial arts participation and externalizing behavior in juveniles. Finally, the skewness test was significant ( $Z = -4.000$ ,  $p < .05$ ), indicating that the effects size distribution was skewed to the left. This showed that small studies with outcomes favoring martial arts practice were more often reported; also suggesting that publication bias was present in the current meta-analysis.

**Table 1**  
Overall and moderator effects relation martial arts and externalizing behavior.

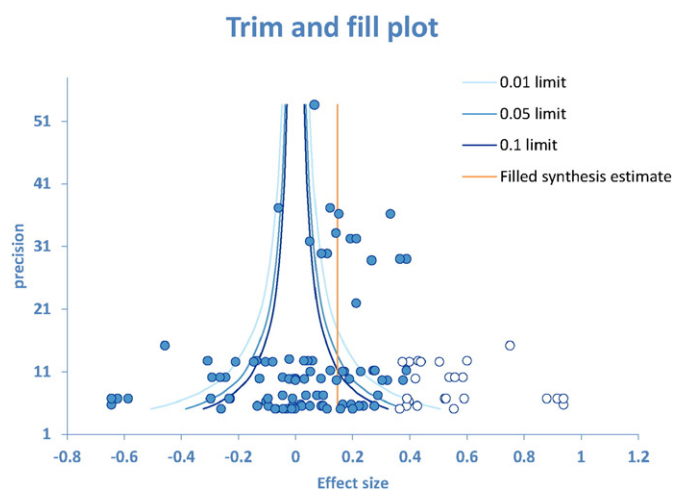
	# studies	# ES	$\beta_0$ (mean $r$ )	$t_0$	$\beta_1$	$t_1$	$F(df_1, df_2)$
Overall relation martial arts and externalizing behavior	9	94	-.019	-.289			
Overall relation after trim and fill procedure	14	118	.185	2.072*			
Moderator variables							
Study characteristics							
Impact factor (continuous variable)	9	94	.000	.008	.057	2.079*	$F(1, 92) = 4.324^*$
Design characteristics							
Type of study	9	94					$F(1, 92) = 1.604$
Cross-sectional (RC)	7	48	-.069	-.935			
Longitudinal	2	46	.106	.906	.175	1.267	
Self-selection	9	94					$F(1, 92) = .017$
Yes (RC)	7	91	-.015	-.202			
No	2	3	-.040	-.230	-.024	-.129	
Pre-existing differences	9	94					$F(1, 92) = .914$
Uncontrolled (RC)	4	59	-.080	-.865			
Controlled	5	35	.049	.497	.129	.956	
Sample characteristics							
Type of martial arts	9	94					$F(2, 91) = 5.272^{**}$
Judo (RC)	2	31	.111	.828			
Karate	2	31	-.036	-.264	-.147	-3.204**	
Other	5	32	-.041	-.509	-.152	-.971	
Experience in martial arts	4	65	.028	.667	-.025	-1.453	$F(1, 63) = 2.111$
Intensity of training in martial arts	4	65	.041	.706	.048	2.751**	$F(1, 63) = 7.566^{**}$
Gender	9	94					$F(1, 92) = .042$
Male sample (RC)	7	70	-.022	-.316			
Female sample or mixed sample	2	24	-.010	-.123	.012	.204	
Age	9	94					$F(1, 92) = .190$
12 and younger (RC)	4	35	-.044	-.497			
Older than 12	6	59	-.012	-.166	.032	.436	
Style of martial arts	9	94					$F(2, 91) = 2.462^+$
Traditional (RC)	7	80	-.046	-.718			
Modern	2	11	.105	1.248	.151	2.043*	
Both	2	3	-.038	-.347	.009	.084	
Comparison group characteristics							
Type of comparison group	7	48					$F(2, 45) = 21.127^{***}$
Individual sport athletes (RC)	2	17	.189	2.199*			
Team sport athletes	2	6	-.145	-1.373	-.334	-3.590***	
Non-athletes	6	25	-.086	-1.091	-.275	-6.246***	
Outcome characteristics							
Construct category	9	94					$F(1, 92) = .519$
Anger (RC)	3	34	.027	.288			
Aggressive/Antisocial behavior	8	54	-.031	-.447	-.057	-.721	

Note. # studies = number of independent studies; #ES = number of effect sizes;  $t_0$  = difference in mean  $r$  with zero;  $t_1$  = difference in mean  $r$  with reference category; mean  $r$  = mean effect size ( $r$ );  $F(df_1, df_2)$  = omnibus test; (RC) = reference category.

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .



**Fig. 1.** Trim-and-fill plot. Graph from Bax (2011). MIX 2.0—professional software for meta-analysis in Excel. Version 2.0.1.4. BiostatXL, 2011. Retrieved from: <http://www.meta-analysis-madeeasy.com>.

The likelihood ratio test comparing models with and without between-study variance (level 3) showed that significant variance was present at the between-study level ( $\sigma^2_{\text{level } 3} = .029, \chi^2(1) = 25.086; p < .0001$ ). The variance between the effect sizes within studies (level 2) was significant as well ( $\sigma^2_{\text{level } 2} = .019, \chi^2(1) = 246.858; p < .0001$ ). About 7% of the total effect size variance was accounted for by the sample variance (level 1), 37% by the variance between effect sizes within studies (level 2), and 56% by the variance between studies (level 3). Since the variance was significant on the second and third level, moderator analyses of study, design, sample, comparison group and outcome characteristics were conducted to assess the strength of the relation between martial arts participation and externalizing behavior.

2.2. Moderator effects

2.2.1. Study characteristics

The only study characteristic examined in the current meta-analysis was the impact factor of the journal in which the study was published. This factor significantly moderated the relation between martial arts and externalizing behavior: studies with a higher impact factor reported more externalizing behavior in martial artists.

2.2.2. Design characteristics

The design characteristics included in the moderator analyses were the type of study (cross-sectional or longitudinal), whether or not martial arts were implemented as an intervention, and whether or not the effect size was controlled for pre-existing differences. None of these characteristics were significant moderators.

2.2.3. Sample characteristics

The type of martial arts practiced had a moderating effect on the relation between martial arts and externalizing behavior. The strength of the relation between karate and externalizing behavior differed from the strength of the relation between judo and externalizing behavior, indicating that karate was less related to externalizing behavior than judo. However, the individual categories did not show significant correlations with externalizing behavior. A moderating effect was also found for the intensity of the training in martial arts, indicating that more frequent training in martial arts was associated with more externalizing behavior. A marginal significant moderating effect was found for the martial arts style, indicating that modern style martial artists show more externalizing behavior

than traditional style martial artists, although both styles showed no significant effects. No moderating effects were found for experience in martial arts, gender, and age.

2.2.4. Comparison group characteristics

The type of comparison group had a moderating effect on the relation between participation in martial arts and externalizing behavior in juveniles. Martial artists showed significantly more externalizing behavior compared to individual sports athletes. However, when compared to team sport athletes and non-athletes, martial artists showed less externalizing behavior, although these effects were non-significant.

2.2.5. Outcome characteristics

The construct used to measure externalizing behavior (anger, aggressive/antisocial behavior), did not moderate the relation between martial arts participation and externalizing behavior.

2.3. Multivariate analysis

A multivariate analysis was conducted including all significant moderating variables (see Table 2). Unfortunately, training intensity could not be included in the multivariate analyses, because this was only reported for traditional style martial artists and not for any comparison with team sport athletes. We have conducted these analyses with and without the marginal significant moderator of style of martial arts. Because the results including this moderator were similar to the results excluding this moderator, we chose to only report about the multivariate analyses with significant moderators.

The multivariate analysis revealed unique moderating effects for type of martial arts and for a comparison with team sport athletes and non-athletes. That is, when controlling for the influence of all other moderator variables in the model, significant differences in the relation of martial arts and externalizing behavior were found for comparisons with individual athletes versus team sport athletes and non-athletes, and for comparisons of karate versus other martial arts. Based on the previous moderator analyses, this indicated that martial artists show significantly more externalizing behavior than individual sports athletes, while they do not differ significantly from team sport athletes or non-athletes. Furthermore, karate shows more favorable results than other martial arts when investigating the relation between martial arts and aggression. The impact factor did not retain its moderating effect when controlling for the influence of all other variables in the model.

3. Discussion

The aim of the current meta-analysis was to examine the relation between martial arts participation and externalizing behavior in juveniles.

**Table 2**  
Results for the multivariate model with the significant moderators.

Moderator variables	$\beta$ (SE)	Z	$F(df_1, df_2)$
<i>Sample characteristics</i>			$F(5, 42) = 19.329^{***}$
Impact factor	.069 (.239)	.942*	
<i>Type of martial arts</i>			
Karate	-.165 (.035)	-4.708 <sup>***</sup>	
Other	.084 (.296)	.283 <sup>**</sup>	
<i>Comparison group characteristics</i>			
<i>Type of comparison group</i>			
Team sport athletes	-.319 (.075)	-4.249 <sup>***</sup>	
Non-athletes	-.280 (.034)	-8.212 <sup>***</sup>	

Note. SE = standard error; Z = significance of moderator;  $F(df_1, df_2)$  = omnibus test.  
\*  $p < .05$ .  
\*\*  $p < .01$ .  
\*\*\*  $p < .001$ .

Overall, no relation was found, suggesting that there was no difference between the level of externalizing behavior for martial artists and athletes in other sports or non-athletes. However, after controlling for possible publication bias by a trim-and-fill-procedure, a positive relation between martial arts participation and externalizing behavior was found. Small studies with outcomes favoring martial arts practice were more often reported, suggesting that the current overall outcomes might underestimate externalizing behavior in martial artists. There was variation between the effect sizes within and across studies that could be explained by moderator effects. Therefore, we conducted moderator analyses to examine the influence of study, design, sample, comparison group, and outcome characteristics.

Moderator analyses showed that studies published in journals with higher impact factors found larger positive correlations (i.e., martial artists showed more aggression) than studies from lower impact journals. Furthermore, there were significant differences between types of martial arts (i.e., karate, judo or other martial arts) in the relation between martial arts and externalizing behavior. Although karate seemed less related to externalizing behavior than judo, none of the separate types of martial arts showed a significant correlation with externalizing behavior. Moreover, the relation between participation in martial arts and externalizing behavior was moderated by the intensity of training in martial arts. Martial artists training more hours a week showed significantly more externalizing behavior. Additionally, the type of comparison group moderated the relation between martial arts participation and externalizing behavior. When compared to team sport athletes and non-athletes, martial artists showed equal levels of externalizing behavior, and when the comparison group consisted of individual sports athletes, martial artists showed more externalizing behavior. No moderating effects were found for the type of study, whether participants were self-selected, had experience in martial arts training, whether effect sizes were controlled for pre-existing differences, gender, age, the style of martial arts (traditional versus modern) and the outcome category (anger versus aggressive/antisocial behavior). In the multivariate analysis, only the type of martial arts and the type of comparison group contained their unique moderating effects.

The lack of an overall relation between martial arts and externalizing behavior is not in line with a previous review on the relationship between martial arts participation and externalizing behavior, which concluded that in general martial arts training was associated with less aggression (Vertonghen & Theeboom, 2010). However, this review also noted that inconsistency existed between studies, especially when it comes to juveniles. The present meta-analysis is only partially able to explain these inconsistencies, particularly given the outcomes of the trim-and-fill analyses. The overall effect size after trim and fill showed more externalizing behavior in martial artists. Studies reporting on unfavorable outcomes in martial artists may be less likely to be published, than studies reporting on favorable outcomes in martial artists. This could indicate that there is a general lack of solid, independent research on the relation between martial arts and externalizing behavior.

Vertonghen and Theeboom (2010) noted that the type of practiced martial arts could be an important factor in the relation between martial arts participation and externalizing behavior. This factor indeed moderated the relation between martial arts and externalizing behavior. Karate was less associated with externalizing behavior than judo. Previous research pointed out that karate can be viewed as a 'hard' martial art, as it emphasizes blocking, punching and kicking, and judo as 'soft', as it emphasizes throws and holds rather than strikes (Lamarre & Nosanchuk, 1999). According to the catharsis theory, participation in karate will therefore lead to less externalizing behavior outside a sport context compared to participation in judo, because it will vent off more negative energy. This would explain the results of the current meta-analysis. However, as noted before, this theory is lacking empirical evidence (Bushman, 2002;

Shields & Bredemeier, 1995; Wann et al., 1999), and when considering other theories, like the social learning theory of Bandura (1973), 'hard' martial arts like karate would have opposite effects on externalizing behavior. Therefore, it remains unclear why, in the current meta-analysis, karate was less associated with externalizing behavior than judo. Moreover, only a marginally significant moderating effect was found for the style of practiced martial arts (traditional versus modern). This hardly substantiates results from previous studies, indicating that traditional martial arts were less associated with externalizing behavior than modern martial arts (Graczyk et al., 2010; Nosanchuk & MacNeil, 1989; Trulson, 1986).

Finally, the relation between martial arts participation and externalizing behavior was moderated by the type of comparison group (sports). Martial artists showed similar levels of externalizing behavior than non-athletes and team sport athletes, and more externalizing behavior in comparison with athletes from individual sports. The individual sports in the comparison group consisted of swimming and athletics. In previous research, these sports have both been defined as non-contact sports and have been associated with less externalizing behavior than contact sports like martial arts (Bredemeier, Shields, Weiss, & Cooper, 1986; Conroy, Silva, Newcomer, Walker, & Johnson, 2001). However, the differences in behavioral outcomes between contact sports, such as martial arts and non-contact sports like swimming, could be due to an aggressive predisposition by martial artists. Previous research, for example, showed that children starting martial arts training were more aggressive to begin with, than children starting other sports (Reynes & Lorant, 2001). This influence of self-selection bias seems unlikely, given the fact that the present meta-analysis found no differences in effect size between studies that did or did not control for pre-existing differences, nor between studies investigating self-selected versus randomly assigned martial artists.

### 3.1. Limitations

There are some limitations of this study that need to be addressed. First, only a small number of studies could be included in the present meta-analysis, which is due to the limited amount of research on the relation between martial arts and externalizing behavior in juveniles. However, a large number of 94 effect sizes could be analyzed by conducting a multilevel meta-analysis. Furthermore, none of the included studies examined the construct delinquency, whereby not all externalizing behaviors were included in this meta-analysis. Second, the results of the trim and fill procedure indicated that studies with outcomes unfavorable to martial arts practice were underrepresented in the present meta-analysis. Several simulated meta-analyses have showed that in case of between-study heterogeneity, the trim and fill analysis may produce an inappropriate adjustment for publication bias, where in reality no bias exists (Peters, Sutton, Jones, Abrams, & Rushton, 2007; Terrin, Schmid, Lau, & Olkin, 2003). Therefore, differences between the adjusted and the observed overall effect size in the current meta-analysis should be interpreted as indicative of publication bias, but should be interpreted with great care. Third, we could not control for self-selection bias, which means that the results of the current study could be influenced by a selection of the martial artists of the individual studies for their sport consistent with their personal externalizing tendencies. Vertonghen and Theeboom (2010) argued that this bias could be particularly problematic with cross-sectional designed studies and advocated the use of longitudinal studies. However, the current meta-analysis showed that controlling for pre-existing differences as well as randomly assigning juveniles to the sports condition did not moderate the relation between martial arts and externalizing behavior. This could be indicative of only a small influence of self-selection bias on the present outcomes. Fourth, the included studies did not always provide enough information about the coded characteristics to be used as a moderator, and some relevant moderators, such as the

coach–athlete relationship (Rutten et al., 2011), and the type of guidance (Vertonghen & Theeboom, 2010), could not be examined at all. Finally, most studies included a male only sample, so that differences between male and female martial artists could not be examined.

3.2. Strengths and implications for the future

Despite these limitations, the present meta-analysis has several strengths. A three-level random effects model was used, which increased statistical power and facilitated a more extensive analysis of factors that may moderate the relation between martial arts and externalizing behavior. Furthermore, the findings of the current meta-analysis yield some important implications for future research and policy. Overall, no relation was found between martial arts and externalizing behavior in juveniles. This finding contradicts existing policies for martial arts participation in juveniles. Some local authorities choose to limit martial arts participation because of the assumed association with violence, whereas others choose to fund martial arts clubs because of the assumed positive effects on juveniles (Van Koolwijk et al., 2014). The trim-and-fill outcomes do, however, point to a general lack of robust, independent research on the effects of martial arts participation. To rule out any negative effects of martial arts participation, and to determine under which conditions these effects (may) occur, further research is warranted.

The current lack of association is not really surprising, given the fact that sports or other leisure activities are not or only weakly associated with juvenile problem behavior (Bakker, Bakker, Van Dijke, & Terpstra, 1998; Fredricks & Eccles, 2006; Spruit, Van Vugt, Van der Put, Van der Stouwe, & Stams, 2015). However, sports, including martial arts, could be combined with other interventions in order to gain

positive effects on externalizing behavior (Draper, Errington, Omar, & Makhita, 2013). Moreover, previous research has shown that martial arts (and sports in general) may serve other purposes that have not been examined in the present study, such as increasing self-esteem or emotional stability in juveniles (Crews, Lochbaum, & Lander, 2004; Finkenbergh, 1990; Konzak & Boudreau, 1984). In addition, martial arts may constitute a context where juveniles with behavior problems may learn how to cope with challenging social problems situations, such as competition, dealing with authorities and perceptions of disadvantage, through targeted treatment (Kirkcaldy, Shephard, & Siefen, 2002; Weiser, Kutz, Kutz, & Weiser, 1995).

4. Conclusion

In sum, the present study showed that there is no overall relation between martial arts and externalizing behavior in juveniles. The trim-and-fill outcomes did, however, indicate that studies with outcomes unfavorable to martial arts practice were, pointing to a general lack of robust, independent research on the effects of martial arts participation. Our findings reveal that participation in karate was less associated with externalizing behavior than participation in judo. Furthermore, more externalizing behavior was related to a more intense training in martial arts. In addition, martial artists showed similar levels of externalizing behavior compared to non-athletes and team sports athletes and more externalizing behavior compared to individual sport athletes. Independent, robust research with more detailed information on sample, sports and comparison group characteristics is needed to rule out any negative effects of martial arts participation, and to determine under which conditions these effects (may) occur.

Appendix A. Characteristics of included studies

Study	Secondary article		Study characteristics				Design characteristics			Sample characteristics			
	Year	N	# r (M)	Impact-factor	Type of study	Self-selection	Pre-existing differences	% male	Age (# r)	Experience	Intensity training		
Lotfian et al.	Ziaee et al. (2012)	-	2011	492	32 (.049)	3.736	CROSS	Yes	Uncontrolled	50	>12 (32)	3.837	6.310
Delva-Tauiiili	-	-	1995	42	1 (-.104)	.658	CROSS	No	Controlled	100	≤12 (1)	.050	3.750
Reynes	Reynes and Lorant (2002b)	Reynes and Lorant (2004)	2002a	64	30 (.031)	.658	LONG	Yes	Controlled	100	≤12 (30)	1.333	3.000
Zivin et al.	-	-	2001	96	2 (0)	.790	CROSS	No	Controlled	100	>12 (2)	.210	2.250
Rutten et al.	-	-	2011	427	3 (-.262)	1.382	CROSS	Yes	Uncontrolled	100	>12 (3)	-	-
Steyn and Roux	-	-	2009	48	8 (-.340)	0	CROSS	Yes	Uncontrolled	43.1	>12 (8)	-	-
Endresen and Olweus	-	-	2005	1415	16 (.176)	5.669	LONG	Yes	Uncontrolled	100	≤12 (4), >12 (12)	-	-
Kreager	-	-	2007	2879	1 (.066)	4.045	CROSS	Yes	Controlled	100	>12 (1)	-	-
Mutz	-	-	2010	486	1 (.213)	1.314	CROSS	Yes	Controlled	100	>12 (1)	-	-

Study	Sample characteristics						Comparison group characteristics				Outcome characteristics	
	Type of martial arts (# r)			Style of martial arts (# r)			Type of sport in comparison group (# r)			Construct category (# r)		
	Judo	Karate	Other martial arts	Traditional	Modern	Both	Individual sport	Team sport	No sport	ANG	BEH	
Lotfian et al.	16	16	0	32	0	0	16	0	16	32	0	
Delva-Tauiiili	0	0	1	1	0	0	0	0	1	0	1	
Reynes	15	15	0	30	0	0	-	-	-	6	24	
Zivin et al.	0	0	2	2	0	0	0	0	2	0	2	
Rutten et al.	0	0	3	3	0	0	1	2	0	0	3	
Steyn and Roux	0	0	8	8	0	0	0	4	4	2	6	
Endresen and Olweus	0	0	16	4	10	2	-	-	-	0	16	
Kreager	0	0	1	0	1	0	0	0	1	0	1	
Mutz	0	0	1	0	0	1	0	0	1	0	1	

Note. N = number of participants; # r (M) = number of effect sizes (mean); Impact factor = impact factor of journal in 2013; Type of study = cross-sectional or longitudinal; Self-selection = martial artists were self-selected (yes) versus assigned to sport (no); Pre-existing differences = effect sizes are controlled for differences prior to sports participation; % male = proportion of males in sample; Age (# r) = mean age of sample (number of effect sizes); Experience = the average experience of martial artists in years; Intensity training = the average intensity of training martial arts in hours a week; ANG = anger; BEH = Aggressive/Antisocial behavior; CROSS = cross-sectional; LONG = longitudinal; > 12 = mean age above 12 years old; ≤ 12 = mean age of 12 years old or below 12 years old.



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