SUPPLEMENTARY FILES

Efficacy of School-based interventions for improving muscular fitness outcomes in children: A systematic review and meta-analysis

Supplementary file 1. Electronic search for the intervention studies including database, number of references found, and terms included.

The electronic search was conducted including all the years until 12 December 2020. Three categories of search terms were identified: 1) age, 2) type of physical exercise, and 3) interventions. Relevant publications that contained at least one term from each of the 3 categories in the full text, were identified. Moreover, use of the search term, ***school*** *or physical education,* was restricted to title and abstract to avoid its inclusion in the author's affiliation. The following terms were used for each category:

a) **Web of Science: 555 references**

TI= (child OR children OR youth OR student* OR pupil* OR young* OR infant*) AND TI= (resistance training OR resistance activity OR resistance exercise OR strength OR Muscle Strengthening OR Bone Strengthening OR Strength Training OR Strength Exercise OR Weight Training OR Weight Lifting OR Weight Bearing Exercise OR Bodyweight Exercise OR Bodyweight Training OR plyometric) AND TS= (trial OR intervention* OR program OR implement* OR evaluat* OR change OR pilot OR project OR encourage* OR planning OR impact) AND TS= (school OR physical education)

b) **SPORT DISCUS: 96 references.**

TI (child OR children OR youth OR student* OR pupil* OR young* OR infant*) AND TI (resistance training OR resistance activity OR resistance exercise OR strength OR Muscle Strengthening OR Bone Strengthening OR Strength Training OR Strength Exercise OR Weight Training OR Weight Lifting OR Weight Bearing Exercise OR Bodyweight Exercise OR Bodyweight Training OR plyometric) AND AB (trial OR intervention* OR program OR implement* OR evaluat* OR change OR pilot OR project OR encourage* OR planning OR impact) AND AB (school OR physical education)

c) **Scopus: 401 references.**

(TITLE-ABS-KEY (child OR children OR youth OR student* OR pupil* OR young* OR infant*) AND TITLE-ABS-KEY (resistance AND training OR resistance AND exercise OR strength AND training) AND TITLE-ABS-KEY (trial OR intervention* OR program OR implement* OR evaluat* OR change OR pilot OR project OR encourage* OR planning OR impact) AND TITLE-ABS-KEY (school OR physical AND education))

d) **Google Scholar: 500 references***

*First 500 results from Google Scholar were used as per the guidance of Haddaway et al (2015).

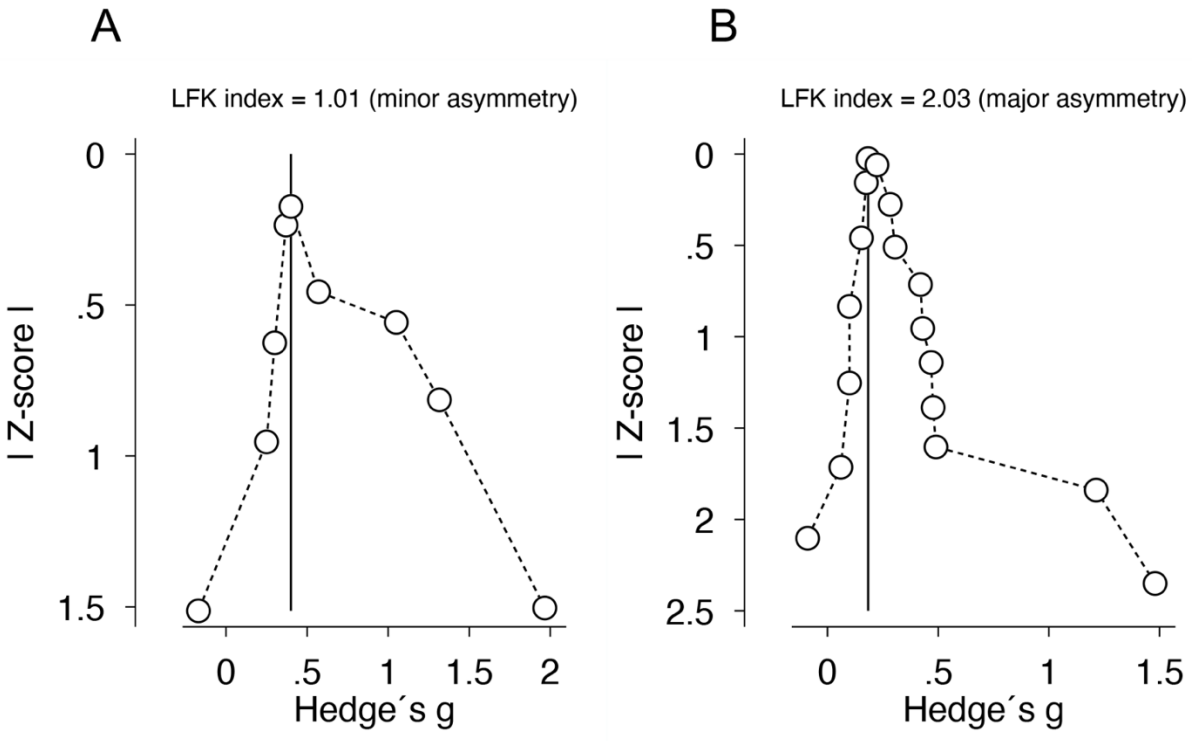
Haddaway, N. R., Collins, A. M., Coughlin, D., & Kirk, S. (2015). The Role of Google Scholar in Evidence Reviews and Its Applicability to Grey Literature Searching. PLoS ONE, 10(9), e0138237. http://doi.org/10.1371/journal.pone.0138237

e) CENTRAL (Cochrane Central Register of Controlled Trials)

Limiters Applied

Narrow by language: - English
Search modes – find all my search terms

Supplementary file 2. Doi plot for local muscular endurance (A) and muscular strength and power (B).



Supplementary table 1. PRISMA 2020 Main and Abstract Checklist.

Topic	No.	Item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	p.1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	p.3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	p.4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	p.4
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	p.5
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	p.5
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	p.5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	p.9

Topic	No.	Item	Location where item is reported
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	p.9
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	p.9
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	p.6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	p.7
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item 5)).	p.7-8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	p.7-8
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	p.7-8
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	p.7-8
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	p.7-8
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	p.7-8
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	p.7-8
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	p.7-8
RESULTS			

Topic	No.	Item	Location where item is reported
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	p.8
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	p.8
Study characteristics	17	Cite each included study and present its characteristics.	p.8
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	p.10
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	p.10
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	p.11-13
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	p.11-13
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	p.11-13
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	p.11-13
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	p.13
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	p.13
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	p.13-17
	23b	Discuss any limitations of the evidence included in the review.	p.13-17
	23c	Discuss any limitations of the review processes used.	p.13-17
	23d	Discuss implications of the results for practice, policy, and future research.	p.13-17

Topic	No.	Item	Location where item is reported
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	p.4
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	p.4
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	p.4
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	p.19
Competing interests	26	Declare any competing interests of review authors.	p.19
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	-

PRISMA Abstract Checklist

Topic	No.	Item	Reported?
TITLE			
Title	1	Identify the report as a systematic review.	Yes
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	Yes
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	Yes

Topic	No.	Item	Reported?
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	Yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	Yes
Synthesis of results	6	Specify the methods used to present and synthesize results.	Yes
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	Yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	Yes
DISCUSSION			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	Yes
Interpretation	10	Provide a general interpretation of the results and important implications.	Yes
OTHER			
Funding	11	Specify the primary source of funding for the review.	No
Registration	12	Provide the register name and registration number.	Yes

Supplementary table 2. Quality Assessment of Controlled Intervention Studies.

	Alves et al. 2016	Arabatzi et al. 2018	Engel et al. 2019	Faigenbaum et al. 2015	Faigenbaum et al. 2013	Faigenbaum et al. 2014	Grainger et al. 2020	Granacher et al. 2011	Granacher et al. 2011	Larsen et al. 2016	Lucertini et al. 2013	Marta et al. 2019	Qi et al. 2019	Sadres et al. 2001	Siegel et al. 1989	Viciana et al. 2013
1. Was the study described as randomised, a randomised clinical trial, or a RCT?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
1.1 Or did they describe it as cluster randomised?	NA	NA	NA	Yes	Yes	Yes	Yes	NA	NA	Yes	NR	Yes	NR	NR	No	Yes
2. Was the method of the randomisation adequate (i.e., use of randomly generated assignment)?	Yes	NR	NR	NR	NR	NR	Yes	NR	NR	Yes	NR	Yes	NR	NR	No	NR
3. Was the treatment allocation concealed (so that assignments could not be predicted)?	Yes	NR	NR	NR	NR	NR	Yes	NR	NR	Yes	Yes	Yes	NR	NR	NR	Yes
4. a) Were study participants blinded to the treatment-group assignments?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4. b) Were providers blinded to the treatment group assignments?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4.1 In case of cluster-randomisation: Was the recruitment of participants conducted by an individual independent of the trial?	NA	NA	NA	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Were the people blinded to the participant's group assignment?	No	NR	No	Yes	Yes	Yes	NR	Yes	Yes	Yes	NR	No	No	No	NR	NR
6. Were the groups similar at baseline on important characteristics that could affect outcomes (i.e., demographics, risk-factors, co-morbid conditions)?	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No	Yes
6.1 In case of cluster randomisation: Did they use stratification or matched-pairs before randomisation to reduce baseline-imbalances?	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
7. Was the overall drop-out rate from the study at endpoint 20% or lower of the number allocated to treatment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. Was the differential drop-out rate (between treatment groups) at endpoint 15 percentage points or lower?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

9. Was there high adherence to the intervention protocols for each treatment group?	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	NR	NR	NR	NR	NR	NR
10. Were other interventions avoided or similar in the groups (e.g., similar background treatments)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11. Were outcomes assessed using valid and reliable measures, implemented consistently across all study participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12. Did the authors report the calculation of a sufficiently large sample size to be able to detect a difference in the main outcome between groups with at least 80% power?	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No
12.1 a) In case of cluster-randomisation: Did they take clustering effects into account in their statistical analysis?	No	NA	NA	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
12.2 b) In case of cluster-randomisation: Did they consider intra-class-correlation regarding sample size calculation?	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No
13. Were outcomes or analysed subgroups which were reported prespecified? (i.e., identified before analyses was conducted)?	Yes	No	Yes	Yes	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NR	Yes
14. Were all randomised participants analysed in the group to which they were originally assigned, i.e., did they use an intention-to-treat analysis?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quality rating: (good, fair or poor)	poor	poor	fair	**good**	**good**	**good**	poor	**good**	**good**	poor	poor	poor	poor	fair	poor	**good**

*CD, cannot determine; NA, not applicable; NR, not reported

Fatal flaws: If a study has a "fatal flaw"., i.e., NO response in any of the 14 items, then risk of bias is significant, and the study is of poor quality.

Supplementary table 3. Quality Assessment for Before-After Studies (Pre-Post) Studies with No Control Group).

	Annesi et al. 2005
1. Was the study question or objective clearly stated?	Yes
2. Were eligibility/selection criteria for the study population prespecified and clearly described?	Yes
3. Were the participants in the study representative of those who were eligible for the test/service/intervention in the general or clinical population of interest?	No
4. Were all eligible participants that meet the prespecified entry criteria enrolled?	Yes
5. Was the sample size sufficiently large to provide confidence in the findings?	No
6. Was the test/service/intervention clearly described and delivered consistently across the study population?	Yes
7. Were the outcome measures prespecified, clearly defined, valid, reliable and assessed consistently across all study participants?	Yes
8. Were the people assessing the outcomes blinded to the participants' exposure/interventions?	NA
9. Was the loss to follow-up after baseline 20% or less? Were those lost to follow-up accounted for in the analysis?	Yes
10. Did they use statistical methods that examined changes in outcome measures from before to after the intervention? Were statistical tests done that provided p values for the pre-to-post changes?	No
11. Were outcome measures of interest taken multiple times before the intervention and multiples times after the intervention (i.e., did they use an interrupted time-series design)?	NR
12. If the intervention was conducted at a group level (e.g., a whole hospital, a community, etc.) did the statistical analysis take into account the use of individual-level data to determine effects at the group level?	No
Quality rating: (good, fair or poor)	poor

NA, not applicable; NR, not reported

Fatal flaws: If a study has a "fatal flaw," (NO response), then risk of bias is significant, and the study is of poor quality.