The Effects Of Physical Exercise In Children With Attention Deficit Hyperactivity Disorder: A Systematic Review And Meta-analysis Of Randomized Control Trials

A. J. Cerrillo-Urbina, A. García-Hermoso, M. Sánchez-López, M. J. Pardo-Guijarro, J. L. Santos Gómez and V. Martínez-Vizcaíno

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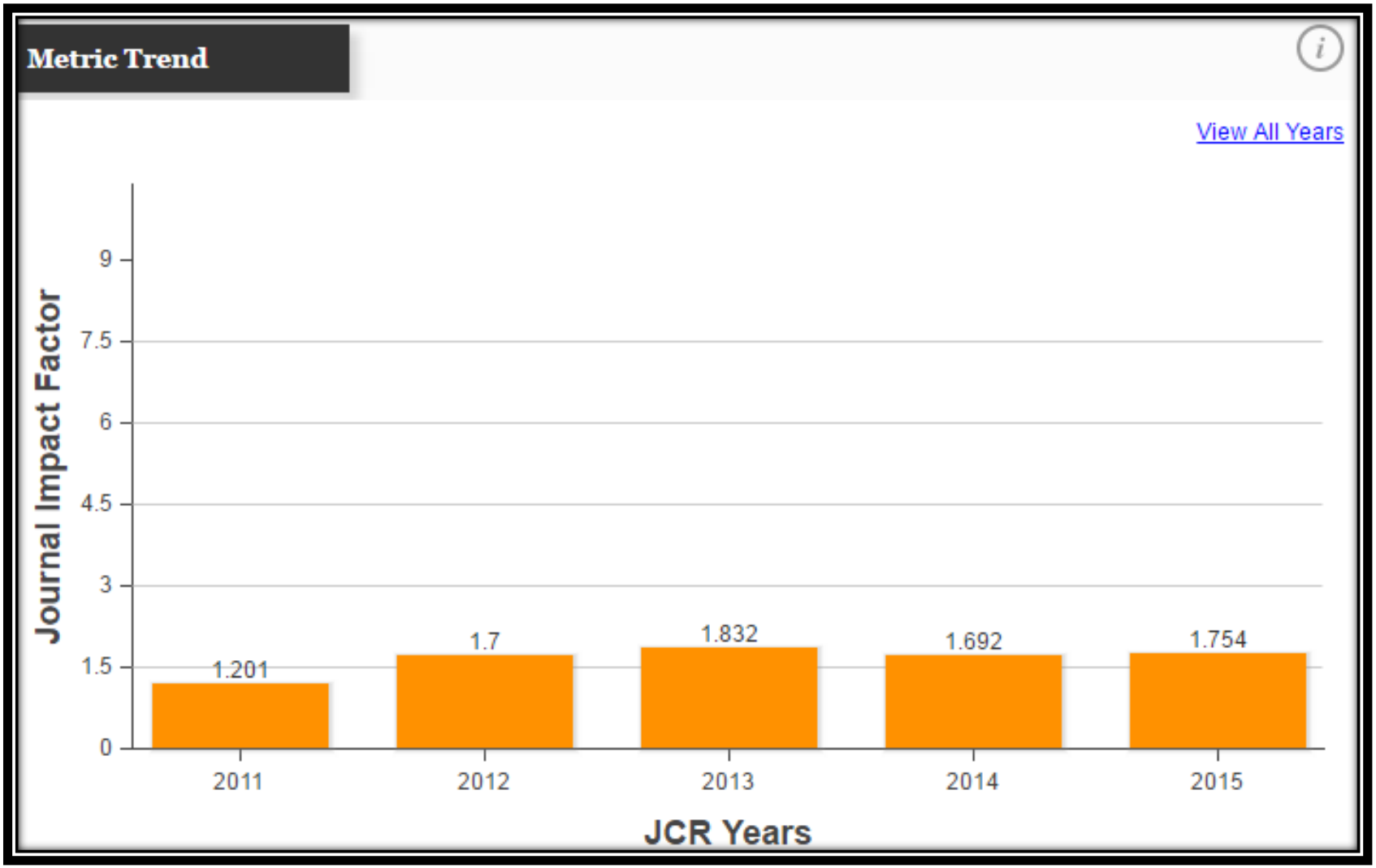
Impact factor

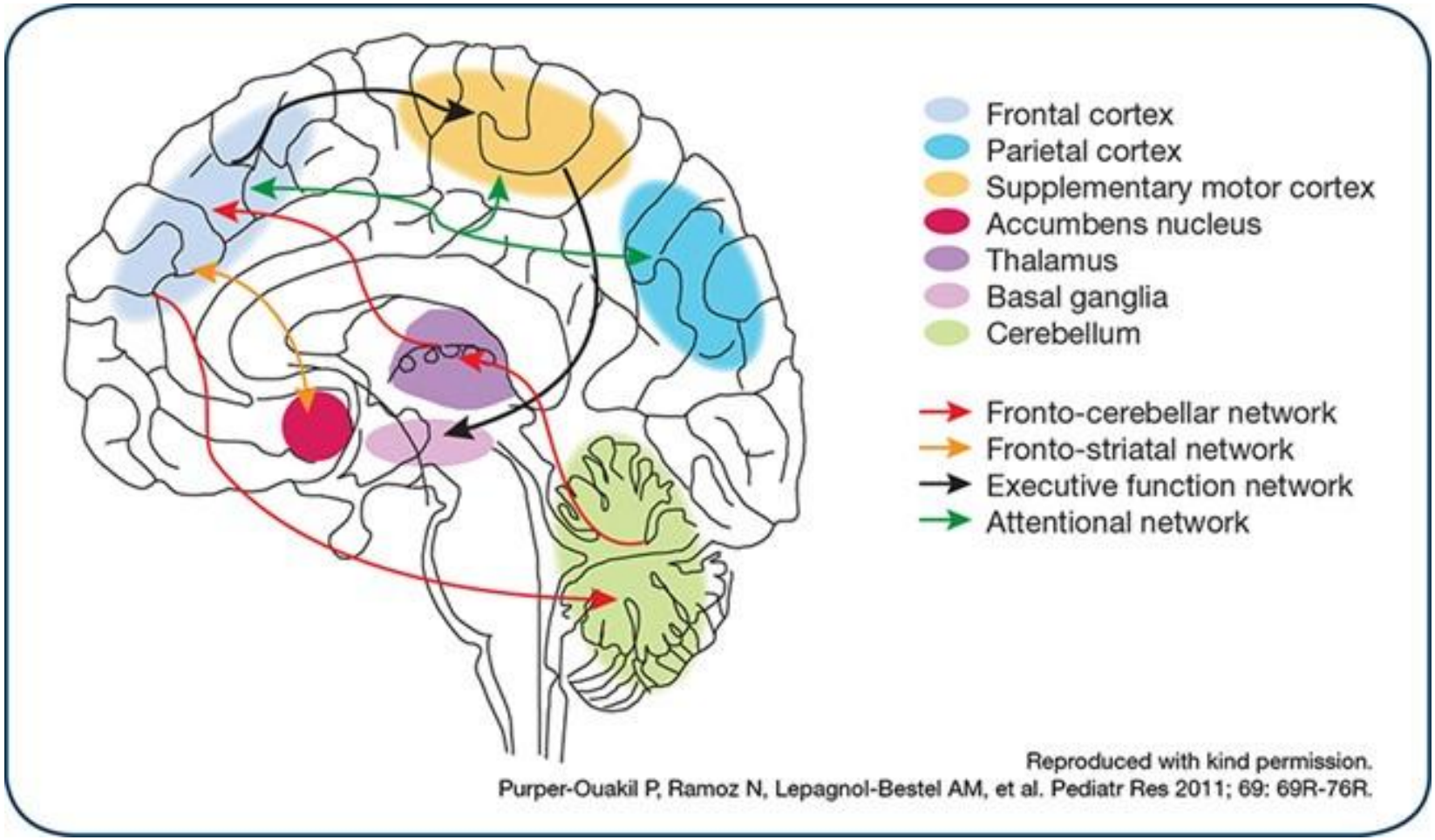


背景資料 background knowledge

- ADHD成因
  - 目前尚無定論
  - 可能原因
    - 大腦神經傳導物質失衡(多巴胺過少)
    - 腦部結構異常(前額葉功能失調)
    - 腦組織器質性損害
    - 遺傳
    - 環境

背景資料 background knowledge

- ADHD的腦部構造



背景資料 background knowledge

- Dopamine releases in the prefrontal cortex and basal ganglia during sports activities.
  - (Foley and Fleshner et al., 2008)
  - (McMorris et al.,2009)

背景資料 background knowledge

根據DSM-V診斷 (符合6/9項，超過6個月，12歲以前出現)

- **注意力不集中**
  - 無法注意細節、容易粗心犯錯
  - 工作/遊戲有維持注意力的困難
  - 對話時常好像沒在聽
  - 無法遵循指示完成功課或工作
  - 組織工作與活動上有困難
  - 逃避或討厭要持久心力的工作
  - 常遺失東西
  - 容易因外在刺激而分心
  - 日常生活中常忘東忘西
- **過動或衝動**
  - 手腳不停的動/敲或在座位上蠕動
  - 在應該要坐著時常常離席(坐不住)
  - 在不合宜的場所跑來跑去/爬上爬下
  - 無法安靜地玩或從事休閒活動
  - 經常處在活躍狀態(身上裝馬達)
  - 經常話太多，不適合的情境音量大
  - 常在問題尚未問完時插嘴說出答案
  - 無法等待排序(不喜歡輪流排隊)
  - 常打斷他人進行的活動(未問就拿)

背景資料 background knowledge

- 目前治療方法
  - 藥物治療
    - 中樞神經活化劑(methylphenidate, MPH)
    - 非中樞神經活化劑(atomoxetine)
  - 行為管理
  - 認知行為治療
  - 親職訓練
    - 日常生活安排、學習環境與教育...
  - 其他治療
    - Eg. 感覺統合訓練、運動介入、生理回饋訓練...

《衛生福利部心理衛生專輯　注意力不足過動症 》

目前職能治療介入方向

- **感覺統合訓練**
  - ADHD
    - 感覺調節障礙
      (觸覺防禦、平衡/前庭問題、聽覺不敏感...)
    - 動作控制不佳
      (雙側肢體運用、手眼協調、身體改念較差)
  - 介入
    - 提供本體覺/前庭覺刺激輸入，以增進警醒程度

- **運動介入** (折返跑、籃球、跳跳床)

- **親職教育**
  - 認識ADHD症狀、治療方式
  - 協助孩童與家長建立關係
  - 規律生活作息安排、明確目標(Eg. 時間表)

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The effects of physical exercise in children with attention deficit hyperactivity disorder: a systematic review and meta-analysis of randomized control trials

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Appraisal sheets(FAITH)

- **Appraisal Tool**
  - [統合分析 Meta-analysis]
  - 步驟1：研究探討的問題為何 (PICO)
  - 步驟2：研究的品質如何 (內在效度)
  - 步驟3：研究結果之意義為何 (效益)

步驟1：研究探討的問題為何 (PICO)

- **研究族群/問題 (Population/Problem)**
  - Children diagnosed with ADHD (DSM-III or IV)
- **介入措施 (Intervention)**
  - Physical exercise (aerobic/ yoga programmes)
- **比較 (Comparison)**
  - [Physical exercise+ medication] and [medication+(education)]
- **結果 (Outcomes)**
  - Attention, hyperactivity, impulsivity, anxiety, executive function, social disorders
    - Conners' Parent Rating Scale, CPRS
    - State-Trait Anxiety Inventory for Children, STAI-C
    - Wisconsin Card Sorting Test, WCST
    - The Stroop Test
    - Child Behavioral Checklist, CBCL
    - Social Skills Rating System, SSRS

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F- 研究是否找到(Find)所有的相關證據

最好的狀況是？
良好的文獻搜尋至少應包括二個主要的資料庫(如：Medline, Cochrane 考科藍實證醫學資料庫, EMBASE 等)，並且加上文獻引用檢索(參考文獻中相關研究、Web of Science, Scopus 或 Google Scholar)、試驗登錄資料等。文獻搜尋應不只限於英文，並且應同時使用 MeSH 字串及一般檢索詞彙(text words)。

Literature search

Five databases covering the period up to November 2014 (PubMed, Scopus, EMBASE, EBSCO [E-journal, CINAHL and SportDiscus] and The Cochrane Library) were searched. In addition, the reference lists and related links of retrieved articles were examined to detect studies' potentially eligible references for inclusion. Grey literature search was conducted in congress articles, university research and other electronic media. We developed a sensitive search strategy for each individual database (Supporting Information File 1).

評讀結果：☑是 ☐否 ☐不清楚

A- 文獻是否經過嚴格評讀(Appraisal)

- 說明所使用的文獻品質評讀標準
  - Asessment of **Risk of Bias** in Included Studies

Quality assessment

Two review authors (A. J. C. and A. G.) independently assessed the risk of bias of each included study in accordance with methods recommended by The Cochrane Collaboration (Higgins *et al.* 2011). The quality assessment was performed using the Review Manager program (Update Software, Oxford) for assessing the risk of bias in RCT (Higgins *et al.* 2011; Savovic *et al.* 2014).

A- 文獻是否經過嚴格評讀(Appraisal)

- 說明所使用的文獻品質評讀標準

Methodological quality of studies

The overall quality of the studies that met the inclusion criteria is low; two studies that have quality indicators that are all 'low risk' or 'unclear' bias are considered as average quality (Chang *et al.* 2012; Choi *et al.* 2015), and the remaining six studies that have some quality indicators that are 'high risk' are considered as low quality (Tantillo *et al.* 2002; Mackune *et al.* 2003; Jensen & Kenny 2004; Kang *et al.* 2011; Verret *et al.* 2012; Pontifex *et al.* 2013). Table 2 and Supporting Information File 2 outline the risk of bias assessments in domains for the included studies.

Support for judgments is provided in Supporting Information File 3. Only four studies reported a process of randomization (Jensen & Kenny 2004; Kang *et al.* 2011; Chang *et al.* 2012; Choi *et al.* 2015). Blinding is unknown in all studies, and this may be an important bias; a recent study showed that effective non-pharmacological treatments for ADHD are influenced significantly by the nature of the evaluator so that unblinded interventions are not effective (Sonuga-Barke *et al.* 2013). In one study (Mackune *et al.* 2003), the number of result data was insufficient. In four studies (Kang *et al.* 2011; Chang *et al.* 2012; Pontifex *et al.* 2013; Choi *et al.* 2015), other inconveniences that might pose a risk of serious bias is not found.

A- 文獻是否經過嚴格評讀(Appraisal)

Table 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study

Study	Random sequence generation (selected bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Aerobic programmes							
Tantillo and colleagues (2002)	High risk	Unclear	Unclear	Unclear	Low risk	High risk	Unclear
Kang and colleagues (2011)	Low risk	Unclear	Unclear	Unclear	Low risk	High risk	Low risk
Chang and colleagues (2012)	Low risk	Unclear	Unclear	Unclear	Low risk	Low risk	Low risk
Verret and colleagues (2012)	Unclear	Unclear	Unclear	Unclear	Low risk	Unclear	High risk
Mackune and colleagues (2003)	High risk	Unclear	Unclear	Unclear	Unclear	High risk	High risk
Pontifex and colleagues (2013)	High risk	Unclear	Unclear	Unclear	Low risk	High risk	Low risk
Choi and colleagues (2015)	Low risk	Unclear	Unclear	Unclear	Low risk	Low risk	Low risk
Yoga programmes							
Jensen and Kenny (2004)	Low risk	Unclear	Unclear	Unclear	Low risk	High risk	High risk

隨機分派

分派順序的保密

受測者設盲

結果數據完整性

評讀結果：☑是 ☐否 ☐不清楚

I- 文獻是否指納入(included)具良好效度文章

- 納入與排除標準

Study selection

The criteria for inclusion were as follows: (i) patients (children and/or adolescents aged 6–18 years diagnosed with ADHD and regular medication); (ii) type of study (RCT, in which the control group received no PE intervention); (iii) type of intervention (PE programmes); (iv) main outcome (we selected those studies evaluating ADHD symptoms, taking into account primary outcomes, such as inattention, hyperactivity and impulsivity, and secondary outcomes that include related ADHD symptoms such as anxiety, executive function, social disorders and cognitive performance); (v) diagnostic criteria (Conners or DSM in any of its editions); and (vi) language (alllanguages were accepted). Because of the intensity and type of exercises, we decided to categorize programmes in aerobic and yoga (considered as complementary and alternative medicine) (Barnes *et al.* 2008). Finally, no restrictions on frequency or duration of training were imposed. The exclusion criteria were as follows: (i) interventions in which exercise was part of a multicomponent therapy involving a combination of exercise and alternative therapy; (ii) studies with a low quality (four or more high-risk bias points); and (iii) those studies that were limited to testing the effect of exercise on improving physical ability or aerobic or gross motor. The search was conducted between 20 and 30 November 2014.

Two authors (A. J. C. and A. G.) independently screened the titles and abstracts of retrieved studies identified by the search strategy; in a second step, these potentially eligible studies were re-evaluated in the full text. In case of disagreement, a third author (M. S.) proceeded to read the entire article and resolved the discrepancy.

評讀結果 : ☑是 ☐否 ☐不清楚

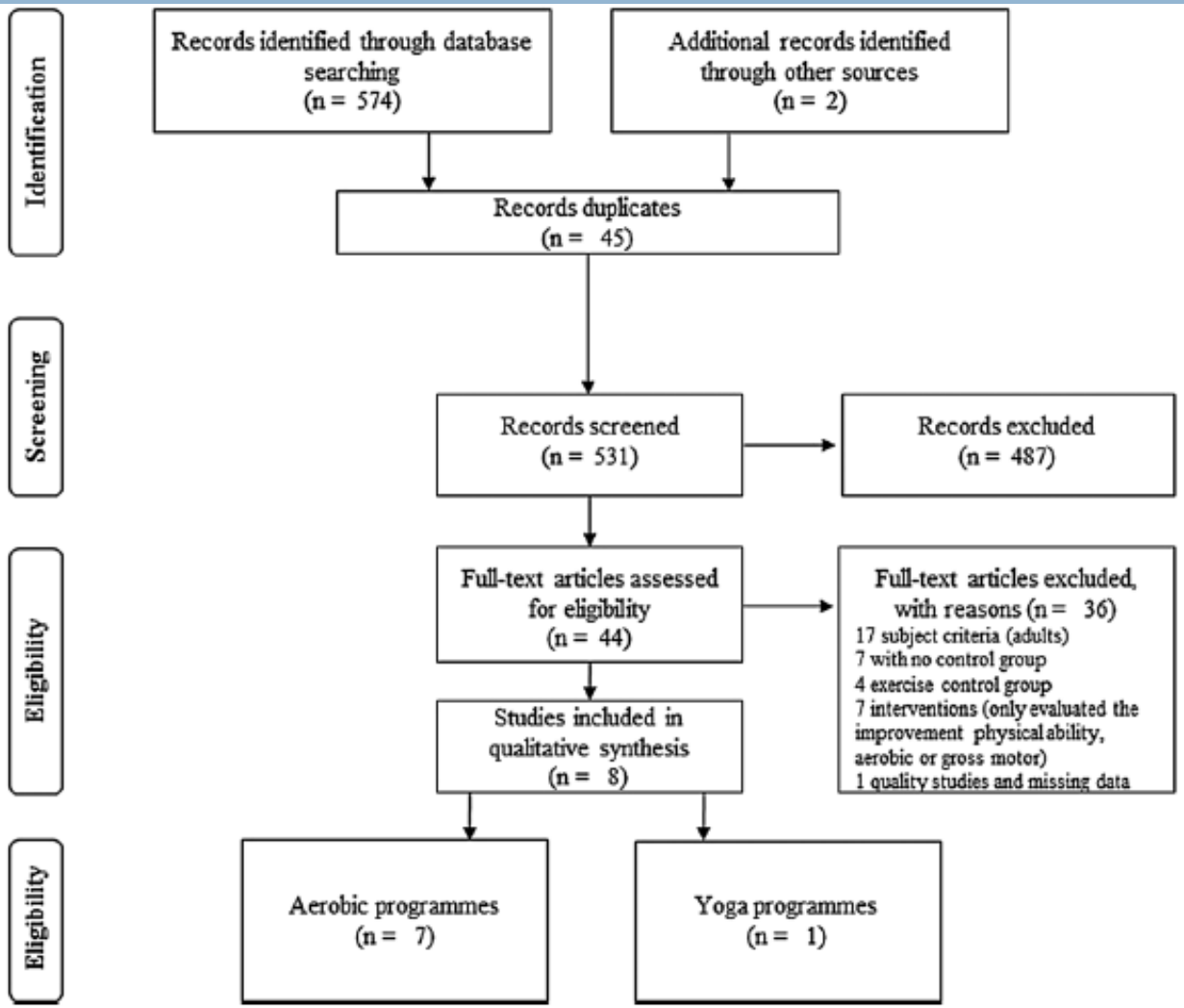
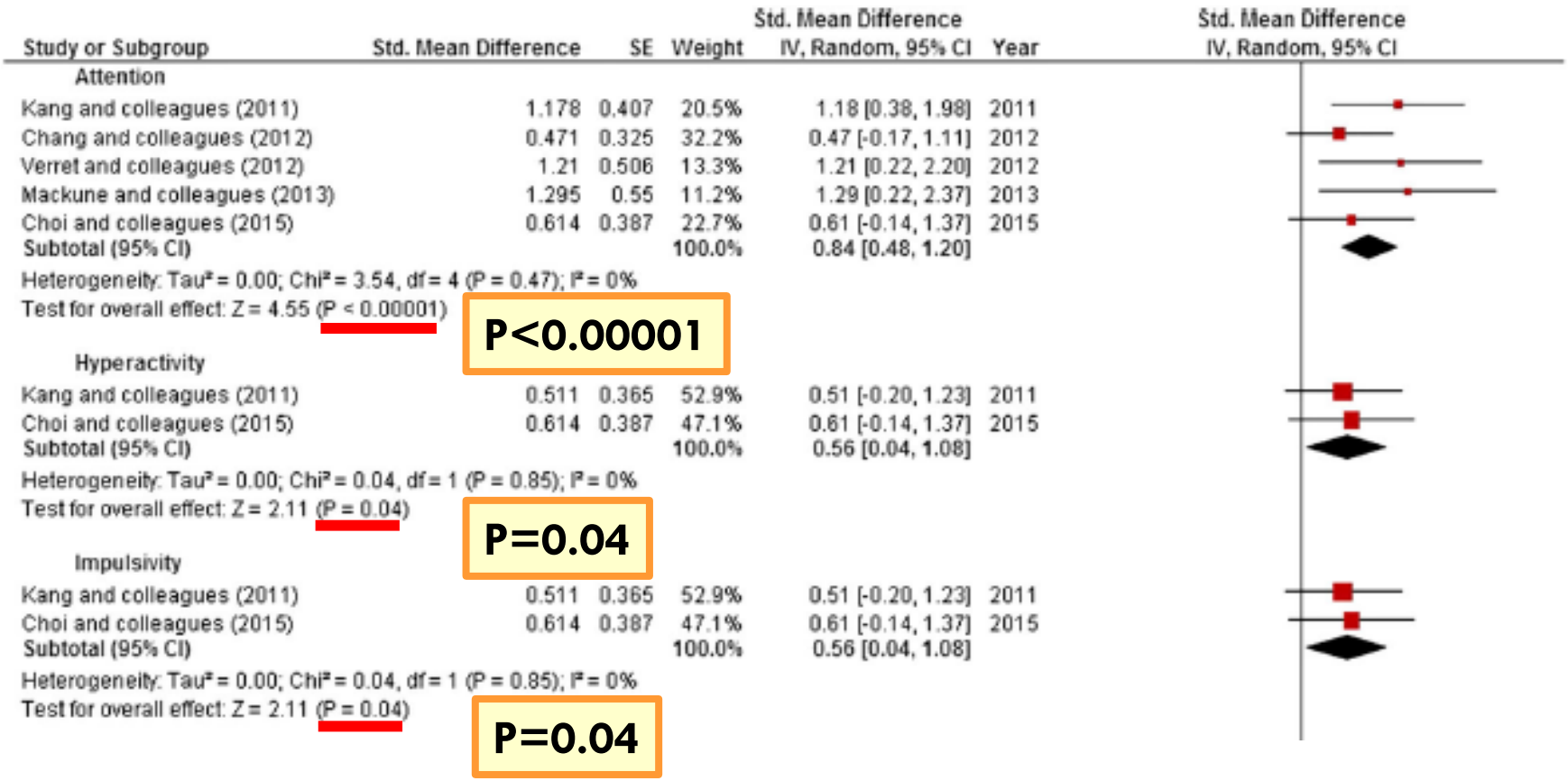


Figure 1. Flowchart for the selection of studies.

T- 作者是否以表格和圖表「總結」(total up)試驗結果

- 以森林圖呈現各項outcome經過統合分析的結果



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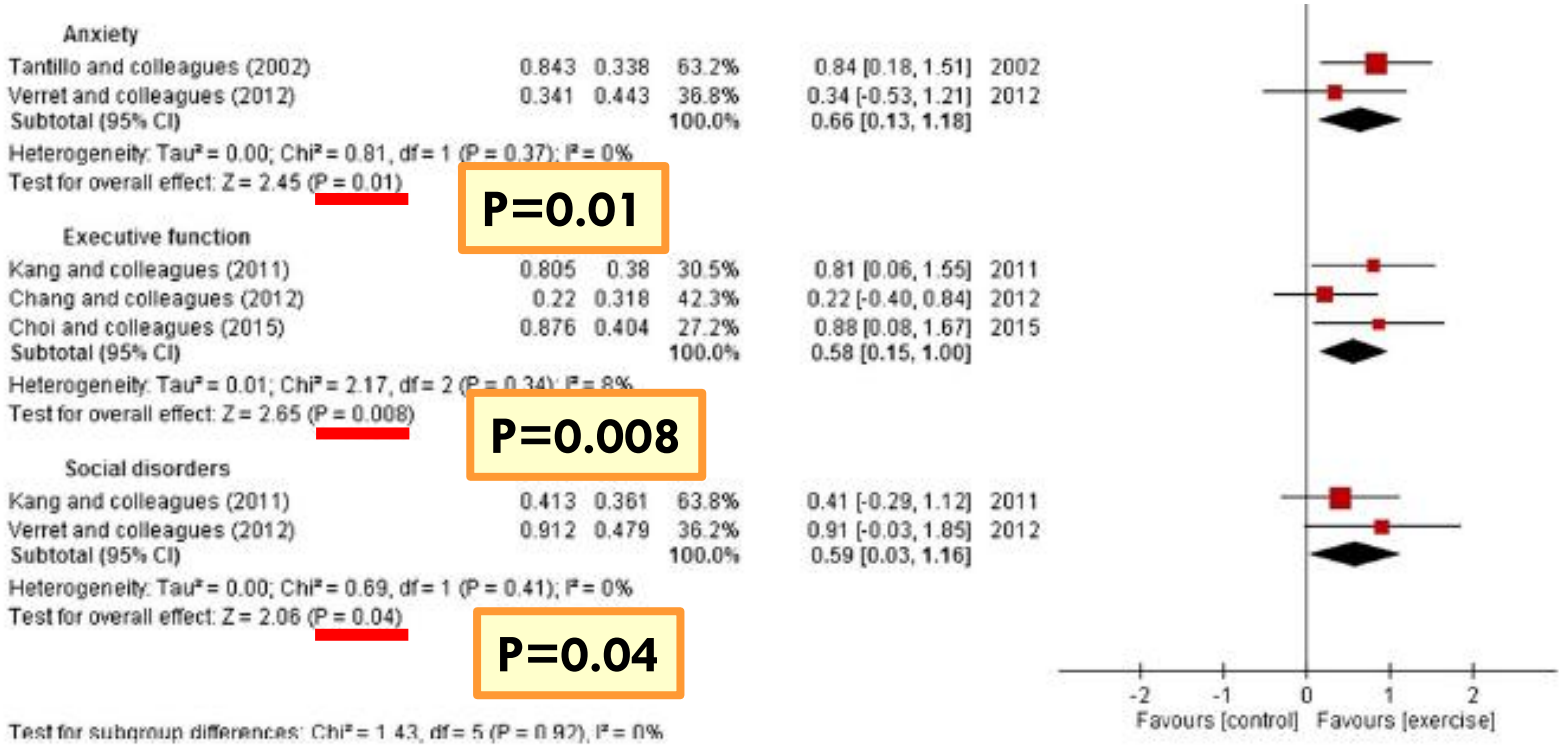


Figure 2. Effects of the aerobic exercise programmes on symptoms and/or problems.

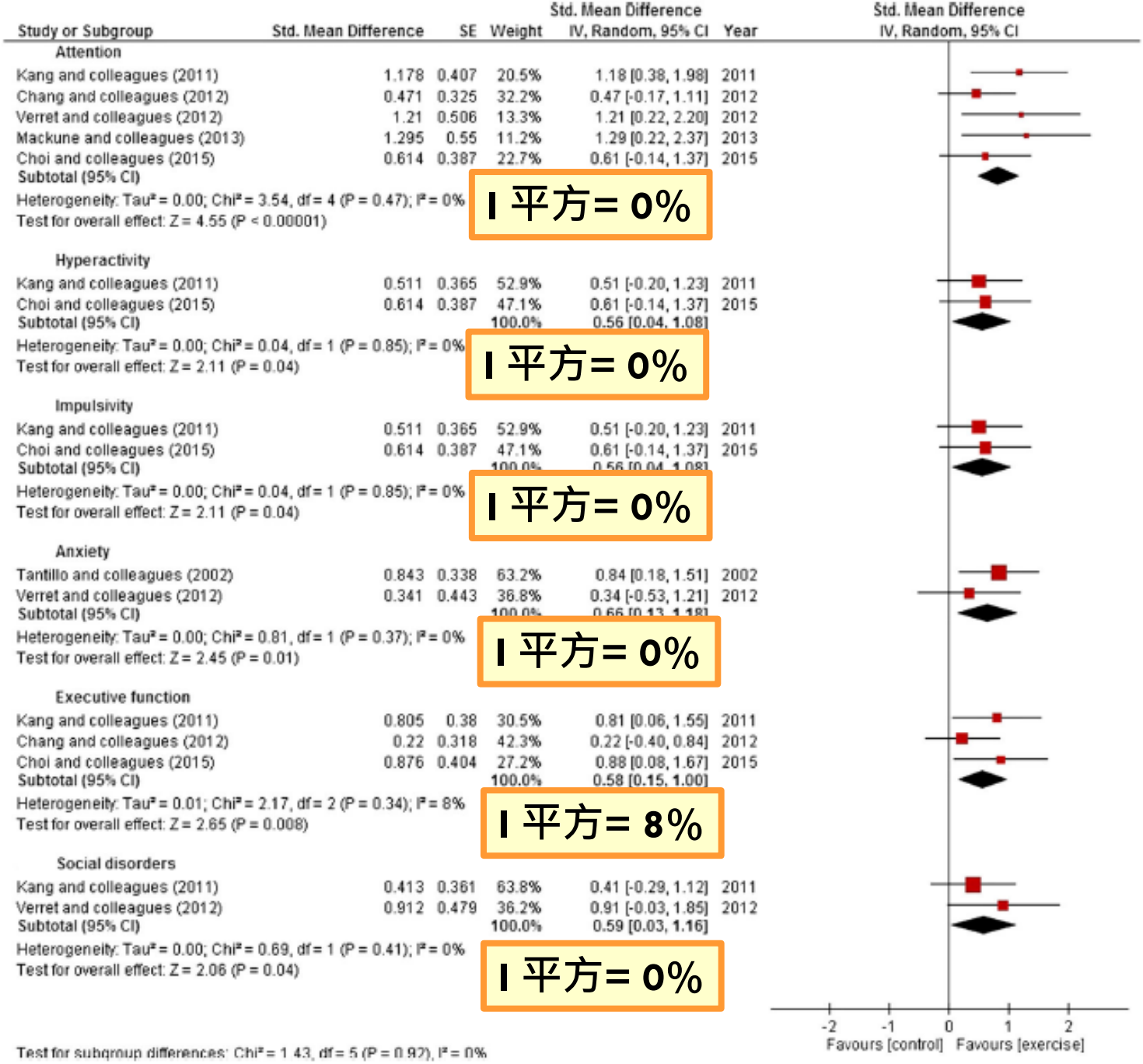
評讀結果：☑是 ☐否 ☐不清楚

H- 試驗的結果是否相近-異質性(heterogeneity)

Assessment of heterogeneity

The heterogeneity of the studies was assessed using Cochran's *Q*-statistic applied to the SMD (Higgins *et al.* 2003) and χ^2 test. The percentage of total variation across the studies due to heterogeneity was determined using I^2. The magnitude of the inconsistency was assessed as follows: small if $0 \leq I^2 \leq 25\%$, medium if $25\% < I^2 \leq 50\%$ and large if $I^2 > 50\%$ (Higgins & Thompson 2002).

評讀結果：☑是 ☐否 ☐不清楚



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結果為何?

- Aerobic exercise had a moderate to large effect on
  - core symptoms such as attention (SMD = 0.84),
  - hyperactivity (SMD = 0.56)
  - impulsivity (SMD = 0.56)
  - anxiety (SMD = 0.66)
  - executive function (SMD = 0.58)
  - social disorders (SMD = 0.59)
- Yoga exercise suggests an improvement in the core symptoms of ADHD.

討論 (Discussion)

Frequency: 2~5 times/week
Duration: 20~90 mins/time, 6~10 weeks
Intensity: moderate aerobic exercise (50~75%* maximal HR)

Table 1.

Study	Intervention features: Duration (weeks)	Frequency (Se/week)	Se duration (min)	Intensity (MHR) (%)	Adh (%)	Diagnostic criteria: ADHD
Aerobic programmes						
Tantillo and colleagues (2002)	1	2	MET‡	65–75§	100	DSM III-R
Kang and colleagues (2011)	6	2	90	NR	87.50	DSM IV
Chang and colleagues (2012)	1	1	30	50–70¶	100	DSM IV
Verret and colleagues (2012)	10	3	45	77	85.71	DSM IV
Mackune and colleagues (2003)	5	5	55	50–75	100	DSM III-R
Pontifex and colleagues (2013)	1	1	20	65–75	100	DSM IV
Choi and colleagues (2015)	6	3	90	60	85.71	DSM IV
Yoga programmes						
Jensen and Kenny (2004)	20	1	60	NR	73.68	DSM IV

前後測比較

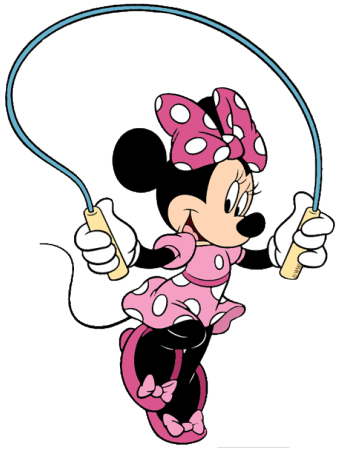
討論 (Discussion)

- 研究收納樣本數過少
- 採用的ADHD診斷標準有所不同
- 運動介入設計的變項太多
  - 運動形式、環境...
- 某些研究只針對單次前後測比較
- 介入的期間短暫，未能預測長遠的影響
- 未能排除研究對象在實驗時間外從事其他運動

→ More studies are required.

結論(Conclusion)

有氧運動最佳劑量仍不明，建議...	
頻率	至少2~5次/週，20~90min/次 持續 6~10 週
強度	至少50%~75 最大心跳率(maximal HR)
形式	跑步、籃球、跳躍、足球、游泳...



Q&A 交流和討論時間

- 有氧運動是否能夠有效改善ADHD孩童之症狀(注意力、衝動性、執行功能)?

同意：10人
需考慮：30人
不同意：0人


Thank you!