Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings
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CRD summary
This review found preliminary evidence for the benefits of mindfulness meditation practices on cognition and identified a need for further higher quality research. The review had some methodological problems that impacted on reliability. Most studies were in healthy populations so generalisability to clinical populations was unclear. The included studies differed to such an extent that drawing meaningful conclusions was problematic.

Authors' objectives
To review the evidence of the effects of mindfulness meditation practices on objective measures of cognitive function.

Searching
The authors searched MEDLINE, Web of Science, PsycINFO, unspecified Cochrane databases, Google Scholar and references of retrieved articles for papers published in English up to May 2010. Search terms were reported.

Study selection
Eligible studies needed to compare formal mindfulness meditation practice (with or without focused attention meditation training) with an active or inactive control condition in participants aged at least 18 years. Studies had to report quantitative data for at least one of the outcomes: attention, memory, executive functions and miscellaneous measures of cognition. Studies of both clinical populations and healthy participants were eligible.

Various meditation practices were included (such as mindfulness-based stress reduction, mindfulness-based cognitive therapy, Vipassana meditation, Zen meditation and intensive retreats). Most studies compared mindfulness meditation to a waiting list or no treatment. Most studies were with healthy participants aged 18 to 75 years; the review also included participants with various types of chronic pain, traumatic brain injuries and depression. Prior meditation experience ranged from none to 29 years of practice. Most of the case-control studies included experienced meditators. Study duration varied from one day to six months. Meetings ranged from a single session of 20 minutes up to 30 sessions of 10 to 12 hours. Various types of daily practice were involved. Neuropsychological assessments were made immediately following the training and up to 52 weeks using a wide range of assessment tests/measures.

The authors did not state how many reviewers were involved in the selection of studies for the review.

Assessment of study quality
The authors did not state that they assessed study quality.

Data extraction
The results of tests for the outcomes of interest were extracted (attention, memory, executive functions and miscellaneous measures of cognition). Attention and memory were further divided into sustained attention, selective attention, executive attention, attention switching and miscellaneous measures of attention. Memory was subdivided into working memory, memory specificity and miscellaneous measures of memory. Miscellaneous measures of cognition involved collecting data outcomes unrelated to attention, memory and executive functions such as meta-awareness and general intelligence.

These data were extracted by two authors independently. Any disagreements were solved through discussion or reference to a further reviewer.

Methods of synthesis
The authors conducted a narrative synthesis that divided studies according to neuropsychological outcome.

Results of the review
Twenty-three studies (1,577 participants) were included in the review: seven randomised controlled trials, eight non-randomised controlled trials and eight case-control studies.

**Attention:** Two trials found benefits from mindfulness training on sustained attention and five trials did not. All three case-control studies found significantly higher performances from meditators in tasks involving sustained attention. One trial found benefits from mindfulness training on selective attention and three trials did not. All four case-control studies found that meditators had significantly higher levels of selective sustained attention. Two trials found benefits from mindfulness training on executive attention and three trials did not. Evidence from four case-control studies was mixed. None of the three trials that investigated attention switching found statistically significant improvements of mindfulness training over control groups. One case-control study found some improvements in attention switching.

**Memory:** Three trials showed mixed results for effects of mindfulness meditation on working memory. Three trials found a range of positive results in terms of memory specificity in healthy and depressed patients. Two studies found no significant benefits on general measures of memory.

**Executive function:** All three trials found some benefits from mindfulness training on executive function.

Further results were reported in full in the paper.

**Authors' conclusions**
There was preliminary evidence for the benefits of mindfulness meditation practices on cognition. Further higher quality research was needed.

**CRD commentary**
This review had broadly defined inclusion criteria for population, intervention, outcome and study design. Searching encompassed several databases. The search was limited to studies published in English and this risked language and publication biases. Studies were not formally quality assessed and observational studies at greater risk of bias were eligible for the review. It was not clear how many reviewers were involved in study selection and this raised the possibility of selection bias and error in a complex topic. Procedures to ensure rigour in data extraction were reported.

A narrative synthesis was appropriate given the diverse populations, intervention styles and duration and outcome measures. The reliability of this review was uncertain due to the methodological issues highlighted and the fact that positive results were often based on studies at greater risk of bias. There was huge variation in the delivery of the mindfulness interventions. The level of clinical and methodological heterogeneity in this review made drawing meaningful conclusions very challenging. Questions remain on whether the interventions work and if so what method of delivery was effective and in what populations this was the case. It is important to note that most of the studies were in healthy populations so results cannot be generalised to diverse clinical populations.

**Implications of the review for practice and research**

**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that further higher quality research with standardised mindfulness protocols was needed given the limitations of the available research. Inclusion of different patient populations (such as clinical and non-clinical populations) should be considered. The effects on different domains of memory and on further executive functions such as problem solving should be investigated.

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.