



REVIEW: LITERATURE REVIEW

Cognitive function and exercise training for chronic renal disease patients: A literature review



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KEYWORDS

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Summary Objective: Cognitive impairment is very often noted in patients with Chronic Kidney Disease (CKD). Even though, exercise is considered to be a quantifiable activity that improves cognition in animals and humans, it seems that few studies have examined the relationship between cognitive function and CKD from the perspective of physical activity and cognitive performance. Thus, this evidence based review summarizes the present level of knowledge regarding the effects of exercise training on cognitive function in CKD patients. **Data sources:** A comprehensive literature search was conducted in PubMed and Scopus from May 2014 through June 2014, by using the Cochrane and PRISMA guidelines.

Review methods: Eligibility of the studies based on titles, abstracts and full-text articles was determined by two reviewers. Studies were selected using inclusion and exclusion criteria. We included only those studies that: assessed cognitive function in humans and animals using validated neuropsychological methods in chronic renal diseases patients; used exercise training protocols; addressed randomized control trials or controlled trials or clinical trials designed to evaluate cognitive impairment; and articles that were written in English. Studies were excluded when they concerned behavioral approaches and underpowered studies.

Results: According to the current review only a few studies have examined the issue of cognitive function in CKD patients. These studies indicate that these patients often exhibit cognitive impairment, which is highly associated with poor outcomes. It has been supported that exercise training can induce positive changes in brain metabolism favoring better scores in cognitive function in Chronic Kidney Disease patients although the physiological

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mechanisms, which explain the influence of physical activity on cognition, have focused on changes in neurotransmitters, neurotrophins and vasculature.

Conclusion: Systematic exercise training seems to improve cognitive function in Chronic Kidney Disease patients but further research is warranted to further clarify the mechanisms involved.

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Introduction

Cognitive function is a multidimensional concept that describes the domains resulting from healthy brain performance, namely attention and concentration, executive function, information processing speed, language, visuo-spatial skill, psychomotor ability, learning, and memory (Jansen et al., 2005). Moreover, cognitive functioning refers to abilities such as perception, memory, verbalizing, and thinking (Bai et al., 2012) and includes the processes by which an individual perceives, registers, stores, retrieves, and uses information. Due to dramatically increase of the aging of our world's population, cognitive impairments are diagnosed more often. Since the incidence of Chronic Kidney Disease (CKD) is increasing with advancing age, the connection between CKD and cognitive impairment is possible and expected. Consequently, both conditions needed greater healthcare as they are associated with poorer quality of life (QoL) and increased mortality (Levey et al., 2003; Plassman et al., 2007).

Data collection

A comprehensive literature search was conducted from May 2014 through June 2014. We used PubMed, ScienceDirect and Scopus or Google Scholar to search for studies that investigated the relationship among i) cognitive function and exercise in experimental animals models and ii) cognitive function exercise and CKD patients. Eligibility of the studies based on titles, abstracts and full-text articles was determined by two reviewers. Studies were selected using inclusion and exclusion criteria. We included only those studies that met the following criteria: they assessed cognitive function in humans and animals using validated neuropsychological methods in CKD; they used exercise training protocols; they addressed randomized control trials or controlled trials or clinical trials designed to evaluate cognitive impairment; and articles were written in English. Studies were excluded when they concerned behavioural approaches and low quality studies, namely studies with methodological flaws, underpowered or missing information. Totally 94 studies reviewed.

Cognitive function in chronic renal failure patients

According to the literature only few studies have examined the issue of cognitive function in CKD patients. These studies indicate that these patients often exhibit cognitive impairment, which is highly associated with poor outcomes

(Sehgal et al., 1997; Kurella et al., 2006; Murray et al., 2006; Tamura et al., 2011; Drew and Weiner, 2014). It has been reported that only a minority of patients on hemodialysis (HD) have normal cognitive function when assessed by specific tests for different aspects of mental fitness (Dahbour et al., 2009). In a study by Stringuetta-Belik et al. (2012) who assessed the association between physical activity and cognitive function in CKD patients on HD, the highest level of physical activity was positively associated with better cognitive function.

The outcomes of the National Cooperative Dialysis Study associated the high levels of urea clearance during dialysis with better overall cognitive performance (Teschan et al., 1983). However, Tamura et al. (2013) who evaluated cognitive function in 218 participants in the Frequent Hemodialysis Network (FHN) Daily Trial and 81 participating in the FHN Nocturnal Trial, found no benefit of 1 year of frequent HD in either trial for any cognition outcome. This study suggested, in contrast with earlier reports, that in well dialyzed patients, uremia is not primarily responsible for the low cognitive performance.

Previous studies approached the prevalence of cognitive impairment in HD patients by poor performance on the Mini Mental State Examination (MMSE) that was present in 40%–60% (Fazekas et al., 1995; Sehgal et al., 1997; Kutlay et al., 2001). In the study of Sehgal et al. a 22% of the studied HD patients were found to exhibit mild mental impairment (MMSE score 18–23) while 8% of the patients experience moderate to severe (Sehgal et al., 1997). Further, another study evaluated the cognitive function of 338 HD patients indicating severe cognitive impairment in the 37%, moderate impairment in the 36%, mild impairment in the 14% while only the 13% of the examined population were diagnosed with normal cognition suggesting that cognitive impairment is common in HD patients (Murray et al., 2006). Finally, a more recent study reported a prevalence rate of 20% among 236 veterans with ESRD participating in a homocysteine lowering clinical trial (Brady et al., 2009). However, Sarnak et al. (2013) who investigated the frequency of and risk factors for poor cognitive performance in 314 HD patients using detailed neurocognitive testing, concluded that compared with population norms, HD patients had significantly poorer executive function but not memory performance. Importantly, the above finding persisted in the subgroup with a MMSE score of 24 or higher, a level considered consistent with normal cognitive performance. These results showed that the MMSE is an insufficient screening test for cognitive impairment in dialysis patients, likely due to the inefficiency in evaluating executive functioning parameters (Sarnak et al., 2013).

Despite the fact that cognitive impairment is a common symptom in the dialysis population, the underlying

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