Review Article

Screening of Cognitive Impairment in the Dialysis Population: A Scoping Review

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Keywords

Dialysis · Cognitive impairment · Cognitive screening · Scoping review

Abstract

Background: Cognitive impairment in end-stage kidney disease patients on dialysis is increasingly common. This study aimed to review the practice of screening and to evaluate the evidence on cognitive impairment prevalence in this population. **Methods:** This scoping review of studies summarises the evidence on cognitive impairment in dialysis populations. The search included the Medline, CINAHL, Embase, PsycINFO, PubMed, and Cochrane Library databases for English-language articles published between 2000 and 2015. A total of 46 articles were reviewed. **Results:** The studies were of prospective observational design, with the majority conducted in the haemodialysis population. The reported prevalence of cognitive impairment ranged from 6.6 to 51%. Three screening tools were consistently used. **Conclusion:** While cognitive impairment is recognised in the dialysis population, there is paucity of screening data. The design of prospective comparisons ideally includes established screening instruments, particularly the Montreal Cognitive Assessment, to determine the optimal results for this population. Translation of established screening tools to increase the inclusion of people from other cultural and language groups is required. Regular screening can enhance the timing to introduce home-based care support and advance care planning discussions.

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Introduction

Globally, developments in medicine and greater understanding of human behaviour have led to significant progress in reducing mortality and increasing the average life expectancy in developed countries. Despite improvements in healthcare and longevity, there is very little reduction in the overall effect of non-fatal diseases on population health [1]. This trend has resulted in end-stage kidney disease (ESKD) being increasingly a disease of the elderly. According to the Australia and New Zealand Dialysis and Transplant Registry (ANZDATA), in 2015, approximately two-thirds of prevalent dialysis patients were ≥ 65 years old, and one-third were ≥ 75 years old [2].

Based on published international studies, internationally the prevalence of dementia is between 5 and 9% of the population [3]. The prevalence of dementia in patients with ESKD, who are on dialysis is largely unknown as studies of cognition in this population have excluded patients with dementia. The reported prevalence of cognitive impairment among patients with ESKD, as assessed using neuropsychological tests, varies from 16 to 38% [4]. In a recent systematic review, people treated with haemodialysis were found to have more cognitive impairment than the general population in most cognitive domains [5].

There is international agreement that population-based screening of people aged ≥ 65 years for mild cognitive impairment should not be undertaken, primarily on the grounds that progress from mild cognitive impairment to dementia is uncertain [6–8]. Routine screening, however, may have value in ESKD populations, with reported rates of cognitive impairment approximately three-fold higher than in the general population. Cognitive impairment in this population may interfere with capacity for self-care and informed decision-making, which puts individuals at risk for poor outcomes. If cognitive impairment is recognised early, potentially reversible causes such as delirium and depression can be identified and treated. Early recognition may provide an opportunity for care planning before the dementia becomes advanced [4].

A scoping review was conducted to provide insight into the practice of screening for cognitive impairment in people with ESKD on dialysis. The review focused on optimal timing and valid instruments for screening for cognitive impairment in patients on dialysis. The prevalence of cognitive impairment using a screening tool in the studies was also determined. The purpose of the review was to identify the gaps in what is known to guide future research.

Materials and Methods

The methodology framework for scoping reviews as described by Arksey and O'Malley [9] was used. A scoping review was selected to rapidly review the literature on screening for cognitive impairment in dialysis patients to identify gaps in the evidence base, and to identify whether a full systematic review is feasible or relevant.

Identification of Research Questions

Through an initial review of the literature on cognitive impairment in dialysis patients, the following research questions were identified: (1) What are the validated tools for screening for cognitive impairment in dialysis patients? (2) What is the prevalence of cognitive impairment in the dialysis population when a screening tool is administered? (3) What are the optimal conditions and timings in relation to haemodialysis sessions to screen for cognitive impairment?

Identification of Relevant Studies

The Medline, CINAHL, Embase, PsycINFO, PubMed, and Cochrane Library databases were searched for English-language articles published between 2000 and 2015. All peer-reviewed prospective observational trials that used a screening tool for cognitive impairment in haemodialysis and peritoneal dialysis populations were included. The search strategy is reported in Table 1. Studies on patients with non-dialysis chronic

Table 1. Search concepts and keywords

Concept	Controlled and natural keywords
Cognition	“dementia” OR “dementia”[tw] “delirium”[mh] OR “delirium”[tw] “cognition”[mh] OR cognition[tw] OR “cognition disorders”[mh]
Dialysis	“renal dialysis”[mh] OR “dialysis”[mh] OR dialysis[tw] OR hemodialy*[tiab] OR haemodialy*[tiab] OR dialy*[ti] OR peritoneal dialysis[tw] OR dialysis patient*[tiab] OR end-stage renal[ti] OR dialysis therapy[tiab] OR “Hemofiltration”[majr] OR “Renal Replacement Therapy”[majr:noexp] OR esrd[ti] OR renal replacement[ti]
<i>Databases</i>	
Medline (Ovid)	
Embase	
CINAHL (Cumulative Index to Nursing and Allied Health)	
Cochrane Library	
PsycINFO	
PubMed	
<i>Limits</i>	
2000–2015; English	

kidney disease, paediatrics studies, animal studies, case reports, and review articles were excluded. Other exclusion criteria included dialysis dementia or aluminium toxicity, uremic encephalopathy, dialysis disequilibrium, acute kidney injury, intensive care unit dialysis, and other secondary causes for cognitive impairment such as subdural haematoma.

Study Selection

Studies were selected for review in a two-step process. The study authors worked in pairs to review the titles and abstracts in step 1 and then the articles in step 2. When a review pair disagreed about inclusion or exclusion, the team met to discuss and agree. The process of selection through stepwise exclusion is shown in Figure 1.

Charting of Data

Initially, data were catalogued and sorted using Endnote XV and Microsoft Excel. Two investigators reviewed each article, with rotation of each pair of reviewers to enhance reliability. Data were summarised and entered into the Excel spreadsheet and organised by author, year of publication, study location, intervention type and comparator (if any), duration of the intervention, study populations, aims of the study, methodology, outcome measures, and important results.

Summarising and Reporting of Results

In contrast to a systematic review, the scoping study identifies a broad range of studies irrespective of study design and quality to present an overview of all the material selected for review [9]. Description of the geographic source of studies, purpose and types of cognitive assessment tools, and prevalence of cognitive impairment in the renal dialysis population was undertaken. In reporting the prevalence of cognitive impairment, the cut-off used by the study authors was noted. The type of research methods adopted was also described.

Results

A total of 334 articles were found through the database searches. There were 46 studies meeting the inclusion criteria for final analysis [10–55]. An overview of the reviewed articles is presented in Table 2.

Fig. 1. PRISMA flow diagram showing the studies included and excluded.

The included studies were conducted across 17 countries, and 13 out of the 46 studies were conducted in the USA. Of note, none of the included studies were from the United Kingdom, Canada, or Australia.

All of the studies were prospective observational studies, with 21 studies including a control group for comparison. The focus for the majority of the studies was to assess the prevalence of risk factors for, and correlates of, cognitive impairment in the dialysis population. Thirty-five out of the 46 studies were conducted in the haemodialysis population, 9 studies in both the peritoneal dialysis and haemodialysis population, and 1 in the peritoneal dialysis population. Most studies included patients aged ≥ 65 years, and only 2 studies were conducted focusing on a younger population, with a mean age of <40 years [35, 55].

Table 2. Extracted data displaying the timing of assessment, the screening tools used, and the prevalence reported in the studies

Reference (first author) and country of study	Study groups	Sample		Exclusion criteria of interest				Screening tools	Prevalence based on screening test	Assessment timing
		size	age, years	gender, M/F	advanced dementia	cerebro-vascular disease	psychiatric disease			
Abdelrahman [10], 2014, Egypt	HD	94	67.26±4.95	39/55	NR	E	E	MMSE	normal (MMSE 30); 26 (28%); mild CI (MMSE 26–29); 32 (34%); early dementia (MMSE 21–25); 21 (23%); moderate dementia (MMSE 11–20); 8 (8%); severe dementia (MMSE 0–10); 7 (7%)	NR
Bossola [11], 2012, Italy	HD	90	group I: 58.8±15.7; group II: 67.9±12.9; group III: 72.1±10.1	group I: 30/13; group II: 10/12; group III: 14/11	E	E	E	MMSE	group I: MMSE 24.7±0.4; group II: 23.2±0.7; group III: 22.5±0.9	NR
Bossola [12], 2014, Italy	HD	72	62±15	45/27	NR	E	E	MMSE	MMSE <24: 37 (51%)	during midweek HD session
Condé [13], 2010, Brazil	HD PD predialysis HBP	30 37 32 30	57.4±10.7 59.1±13.6 60.7±13.7 56.8±11.5	18/12 12/15 17/15 10/20	NR	NR	NR	MMSE	presented only in graphical form; proportion of patients with altered MMSE was worst in HD group, but not statistically significant	NR
Costa [14], 2014, Germany	HD C	47 40	57.3±14.4 57.6±11.9	24/23 18/22	NR	E	E	MoCA and MMSE	NR; excluded from individual-based statistical analysis due to low reliability	day before HD and directly after HD session; C: twice within 24 h
Cukor [15], 2013, USA	HD PD (C)	25 6	50±12.1 47.9±11.6	9/16 1/5	NR	NR	NR	MMSE	Mean MMSE: HD: 27.4±1.7; PD: 28.2±1.2	HD: immediately before and after PD; two measures at 4-h gap
Dahbour [16], 2009, Jordan	HD C	54 54	46±15.2 47.3±12.5	36/18 38/16	E	E	NR	MMSE	MMSE: before HD: 26.5±2.7; after HD: 26.4±3.3; C: 28.4±1.6	before scheduled dialysis and repeated 2–4 weeks later after they had finished dialysis
Drew [17], 2013, USA ^a	Group I Group II	21 19	58.1±18.0 59.8±16.4	15/6 9/10	E	NR	NR	MMSE	mean MMSE 26.7±2.6 with the first test; mean MMSE 27.0±2.6 with the second test	randomised crossover design; 21 patients tested 1 h before dialysis, then crossed over 1 month later to be tested during the 1st h of dialysis; the second group of 19 patients followed the reverse sequence
Fadili [18], 2014, Morocco	HD	108	60.94±7.5	57/51	E	NE	E	MMSE	MMSE <24–27 (25%)	first hour of HD
Gad [19], 2012, Egypt	HD C	50 50	48.2±4.8 reported to be matched to HD patients	25/25	NR	NR	NR	MMSE	HD MMSE <24–33 (66%)	NR
Hain [20], 2008, USA	HD	63	72.71±7.75	35/22	E	NR	depression NE	3MS	3MS <80–25 (40%)	30 min after start of dialysis

Table 2 (continued)

Reference (first author) and country of study	Study groups	Sample		gender, M/F	Exclusion criteria of interest			Screening tools	Prevalence based on screening test	Assessment timing
		size	age, years		advanced dementia	cerebro- vascular disease	psychiatric disease			
Harciaresk [21], 2012, Poland	HD C	49 30	47.9±12.01 47.23±10.21	27/22 22/8	E	E	E	MMSE	MMSE HD: baseline: 28.57±0.98; 1st follow-up: 28.59±0.99; 2nd follow-up: 28.56±0.96	24 h after the last dialysis
Huang [22], 2008, Taiwan	HD	147	group I: 68±8.46; group II: 57.51±12.64	61/86	NR	NR	NR	MMSE	MMSE scores NR	shortly before dialysis session
Ishihiki [23], 2014, Japan	PD C	18 60	67.5±6.9 71.5±8.3	12/6 28/32	NR	E	NR	MMSE	MMSE 27 or more: 14 (78%); 24–26: 3 (17%); 25 or less: 1 (5%)	not applicable
Jung [24], 2013, South Korea	HD PD C	29 27 12	55.8±8.7 52.4±11.6 44.7±10.7	13/16 14/13 11/1	E	NR	E	MMSE	MMSE <24: HD: 7 (24.1%); PD: 3 (11.1%)	off dialysis, minimum 1 h from last dialysis treatment
Kalaitzidis [25], 2013, Greece	HBP CKD I, II CKD III CKD IV HD PD	96 ^b 160 ^b	53±1.51 50.2±11.8 63.1±9.4 64.1±12.2 60.4±13.8 58.6±15.7	62/35 ^b 15/4 ^b 20/9 ^b 33/14 ^b 17/14 ^b 20/13 ^b	NR	E	E	MMSE	NR	on HD patients before dialysis session middle of the week
Kalirao [26], 2011, USA	PD HD C	51 338 101	57.5±14.8 71.2±9.5 68.5±9.6	34/17 183/155 44/57	NE	NE	E	3MS	3MS raw scores: PD: range 93–100, SD 6.7; HD: range 83–100, SD 8.6; C: range 94.3–100, SD 5.7	during off-dialysis time, with an interval of at least 2 h from the time of last dialysis
Kang [27], 2012, USA	HD PD CKD	70 17 82	52.6±14.6	110/59	E	E	E	3MS	3MS: total: 91.7±7.4; SDB: 90.5±7.9; non-SDB: 92.8±6.8	HD: morning of a non-dialysis day at home
Kato [28], 2012, Japan	HD CKD C	57 26 17	69.4±3.8 66.6±14.7 66.6±4.1	29/28 18/8 5/12	NR	NR	NR	MMSE	HD: 27.4±2.4; CKD: 25.8±2.4; C: 28±2	NR
Kiraguchi [29], 2011, Japan	HD	37	68.9±4.1	16/21	NR	NR	NR	MMSE	MMSE 27.1±2.4	NR
Kobayashi [30], 2014, Japan	HD	54	67.8±11.3	33/21	NR	E	NR	MMSE	MMSE 28 or more: 34 (63%); 25–27: 13 (24%); 24 or less: 7 (13%)	NR
Kutlay [31], 2001, Turkey	HD	84	mean: 42	47/37	NR	NE	NE	MMSE	mild impairment (MMSE 18–23): 18 (21%); moderate to severe impairment (MMSE <18): 9 (11%)	at various times: before, during, after, and at intervals; immediate beginning and termination of dialysis avoided
Leinau [32], 2009, USA	HD	109	61±10	71/38	NE	NR	NR	MMSE	CI reported to be present in 41 (38%); breakup of the scores not provided	midweek, after the dialysis treatment was underway

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Table 2 (continued)

Reference (first author) and country of study	Study groups	Sample		Exclusion criteria of interest			Screening tools	Prevalence based on screening test	Assessment timing
		size	age, years	gender, M/F	advanced dementia	cerebro-vascular disease	psychiatric disease	lack of language fluency	
Li [33], 2014, China	HD C	20 20	37.1±8.6 38.3±6.5	15/5 15/5	NR	E	E	NR	NR
Lux [34], 2010, Germany	HD C	12 12	45±11.5 44.7±10	11/1 11/1	NR	E	E	NR	end of their long dialysis interval for HD patients
Martins [35], 2011, Brazil	HD	86	<35 years: 11; 35–60 years: 47; >60 years: 28	41/45	NR	NR	NR	NR	first hour of HD
Murray [36], 2006, USA	whole HD cohort random HD sample C	338 101 101	71.2±9.5 70.4±9.4 68.5±9.6	183/155 57/44 45/56	NR	NR	NR	E	one of three times: 1 h before, 1 h after, the day after last run
Murray [37], 2007, USA	HD	28	66.7±9.5	10/18	E	NE	E	E	MMSE mean (SE): T1: 26.6 (0.51); T2: 26.5 (0.51); T3: 27.1 (0.50); T4: 27.6 (0.51)
Nasser [38], 2012, Egypt	CKD HD AKI C	50 50 20 20	median 45 (range 22–60) with no significant difference between groups	patients with kidney disease: 64/56	NR	E	E	NR	MMSE HD: MMSE 26.5±1.5
Odagiri [39], 2011, Japan	HD C	154 852	65.1±13.3 57.8±12.2	88/66 314/38	NR	NE	NR	NR	MMSE
Pipkin [40], 2010, USA	HD group I HD group II	54 33	54±14 50.9±13	34/20 23/10	NR	NR	NR	E	NR
Post [41], 2012, USA	HD C	50 26	63±10 64±10	all male patients in both HD and C	E	E	E	E	all subjects scored 26 or more on MMSE
Sarnak [42], 2013, USA	HD	314	63±16	168/146	E	NE	NR	E	MMSE <24–78 (22%) during the selection process
Sithinamsuwan [43], 2005, Thailand	HD PD	60 30	53.67±15.84 55.67±14.18	33/27 21/9	NR	NR	depression NE	NR	MMSE <24: HD: 5 (8.3%); PD: 1 (3.3%)
Soykan [44], 2005, Turkey	HD	43	41.53±11.48	25/18	NR	NR	E	NR	NR
Soysal [45], 2014, Turkey	group I group II group III	121 188 270	73.1±7.1 72.2±8.1 72.7±8.3	68/53 76/112 106/164	NE	E	E	NR	only mean values provided; significantly lower than C

Table 2 (continued)

Reference (first author) and country of study	Study groups	Sample size	age, years	gender, M/F	Exclusion criteria of interest			Screening tools	Prevalence based on screening test	Assessment timing
					advanced dementia	cerebro-vascular disease	psychiatric disease			
Kurella Tamura [46], 2010, USA	HD	383	51.6±13.3	238/145	NR	NE	depression NE	3MS	median 3MS score: 90 (IQR 83–94); score <80–61: 16% (74 [19%]) had isolated impairment in executive function on Trails B)	midweek predialysis or non-dialysis day
Kurella Tamura [47], 2012, USA	group I group II	80 46	55±15 55±14	50/30 34/12	E	NE	E	3MS	3MS score: group I: 89.7±7.7; group II: 2.2±1.5 (multivariable-adjusted)	in a quiet room prior to midweek dialysis session
Tholen [48], 2014, Germany	HD	26	65.81±16.11	17/9	NR	E	NR	MMSE and MoCA	only mean values provided; MoCA scores best before HD in a single/separate room	MoCA before HD group/separate room, 2 h into HD, after HD group/separate room; MMSE during HD
Tiffin-Richards [49], 2014, Germany	HD C	43 42	58.3±13.9 57.9±11.8	25/18 20/22	NR	E	E	MMSE and MoCA	MoCA (24 or less): 59% (26); MMSE: 46.3% (19)	non-dialysis day
Tilki [50], 2004, Turkey	HD PD C	25 17 25	37.3±2.7 44.2±3.9 41.2±3.5	13/12 7/10 14/11	NR	NR	NR	MMSE	MMSE scores: C: 30±0.2; PD: 29±0.3; pre-HD: 26±1.5; post-HD: 28±0.3	2 h before and after a standard HD session
Tyrrell [51], 2005, France	HD PD	25 26	NR	35/16	NR	NR	depression NE	MMSE and BEC 96	median (range): MMSE: 24 (16–28), CI 24 (47%); BEC 96: 82 (56–94), CI 15 (29.4%); both normal: 25 (49%); both abnormal: 12 (24%); abnormal MMSE only: 12 (24%); abnormal BEC 96 only: 2 (4%)	during individual appointment with psychologist
van Doorn [52], 2004, Belgium	HD	70	range 19–92; median 70.5; mean 67.9	predominantly female	NR	NR	NR	MMSE	MMSE <23: 17 (22%)	NR
Wolfigram [53], 2014, USA	HD	38	65.9±9	33/5	E	E	NR	MoCA	59% HAD 2 SD below mean	following dialysis (92%), before dialysis, or off days (8%)
Yavuz [54], 2000, Turkey	HD	112	mean 39.89 (range 19–75)	63/49	NR	NR	NR	3MS	only 102 had 3MS test; the article reports maximum score as 26 as opposed to 100 in other articles; minimum score 2, mean 14.03, SD 5.97	NR
Zhang [55], 2015, China	HD C	26 28	34.6±7.3 33.7±12.5	12/14 13/15	NR	E	E	MMSE	MMSE scores significantly lower in HD patients compared to C	NR

Age and cognitive test scores are presented as mean ± SD where not otherwise specified. Prevalence is presented as n (%). AKI, acute kidney injury; 3MS, Modified Mini-Mental State; BEC 96, Batterie d'Evaluation Cognitive; C, controls; CI, cognitive impairment; CKD I–IV, chronic kidney disease stage I–IV; E, excluded; HBP, high blood pressure; HD, haemodialysis; IQR, interquartile range; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment; NE, not excluded; NR, not reported; PD, peritoneal dialysis; SDB, sleep-disordered breathing. ^a A substudy of the Cognition and Dialysis Study of Sarnak et al. [42]. ^b Discrepancies noted between total number of participants and gender-specific breakdown.

The Mini-Mental State Examination (MMSE) [56] as the screening tool, alone or in combination with other tools such as the Montreal Cognitive Assessment (MoCA) [57] or the Batterie d'Evaluation Cognitive (BEC 96) [58], was used in 35 out of the 46 studies. The Modified Mini-Mental State (3MS) test [59] as the screening tool was used in 9 studies. Only 1 out of 4 studies using the MoCA utilised it as a sole screening tool. Trained researchers or research assistants administered the cognitive screening tools, where reported.

A battery of detailed neuropsychological testing, in addition to the use of a screening tool, was done in 17 out of 46 studies. Only 1 study out of 17 compared the performance of the two screening tools, MMSE and MoCA, with the neuropsychological battery of tests [49]. In this study, the authors reported that there was a greater incidence of detection of cognitive impairment with the neuropsychological test battery (70%) compared with the MoCA (59%) and the MMSE (46.3%). The MoCA for a cut-off value of ≤ 24 out of 30 was found to be more sensitive and specific in screening for cognitive impairment, with a sensitivity of 76.7% and a specificity of 78.6%, compared to the MMSE for a cut-off value of ≤ 24 out of 30, with a sensitivity of 55.2% and a specificity of 75.0%. In one study, 66% of haemodialysis patients had moderate to severe cognitive impairment based on neuropsychological testing, and 59% of patients scored two standard deviations below the mean on the MoCA [53]. A cross-sectional study of cognitive function in 374 haemodialysis patients aged ≥ 55 years found a prevalence of cognitive impairment in 87.3% based on neuropsychological testing and in 40.5% based on the 3MS [36].

The prevalence of cognitive impairment could not be estimated in 14 out of 28 studies using a screening tool alone to assess global cognitive function. The purpose of these studies was to assess the risk factors for, and correlates of, cognitive impairment and not to estimate its prevalence. The test scores were reported as a continuous variable in their statistical tests. One of the studies, reporting the cognitive scores in the context of detecting early cerebral regional homogeneity changes in neurologically asymptomatic patients, found that none of the 20 patients aged < 50 years had an abnormal MMSE [33]. In the remaining 13 studies, the prevalence of cognitive impairment varied from 6.6% [43] to 51% [11] with MMSE as the screening tool and from 16% [46] to 39.7% [20] with 3MS as the screening tool. In two of the studies that compared the prevalence of cognitive impairment in haemodialysis and peritoneal dialysis patients, the difference was not statistically significant [24, 43].

There was only 1 study assessing the variation in cognitive performance using a screening tool alone. The study administered MoCA before and after the dialysis session in two different settings, in a group room and in a separate room. It was found that the cognitive performance based on MoCA scores were best when assessed before the dialysis session in a separate room [48]. Three studies on samples of < 100 participants investigated the timing of cognitive assessment using neuropsychological tests rather than simply screening. However, the results were conflicting. Cognition was best immediately before haemodialysis in one [14], immediately after haemodialysis in the second [15], and 24 h after haemodialysis in the third [37]. One crossover randomised controlled trial of timing for assessment of cognitive performance using MMSE and detailed neuropsychological tests found no difference in scores between the 1 h before haemodialysis and the first hour, concluding that assessment before dialysis was appropriate [17].

Discussion

The most common screening tool administered in the reviewed studies was the MMSE followed by the 3MS and the MoCA. The BEC 96 was only used in 1 study. Since the BEC 96 is hardly known outside the French scientific community, its usefulness as a screening

instrument was difficult to assess when only English-language articles were reviewed. The MoCA and the MMSE are brief tests, taking <10 min to administer, whereas the 3MS is a more detailed test [60].

The MoCA was specifically designed to detect mild cognitive impairment [57]. It is more sensitive to detecting visuospatial and executive functional deficits than the MMSE and is a better screening test for patients with subcortical vascular cognitive impairment [61]. While Alzheimer disease accounts for up to 80% of cases of dementia in the general population [62], the high burden of cardiovascular disease in dialysis patients means that the pattern of cognitive impairment is subcortical in nature [63]. In the study by Tiffin-Richards et al. [49], the MoCA with a cut-off value of ≤ 24 was more sensitive and specific in screening for cognitive impairment in dialysis patients than the MMSE with a cut-off value of ≤ 24 . There were 16 more studies that administered a screening tool as part of a battery of neuropsychological tests for assessment of cognitive dysfunction in dialysis patients. None of these 16 studies assessed the performance of the screening tool used against the battery of neuropsychological tests, which was a lost opportunity. Based on the single study by Tiffin-Richards et al. [49], the MoCA appears to be a preferred screening tool for cognitive impairment in the dialysis population.

The prevalence of cognitive impairment varied widely in the reviewed studies. The variation may be attributed to differing sensitivities of the screening tools, use of different cut-off scores to define cognitive impairment, variable sample size, age, gender, and education level, as well as cultural differences depending on where the study was conducted. The differences in inclusion and exclusion criteria, depending on the purpose of the study, may also explain the variable prevalence. While the prevalence of cognitive impairment in people on dialysis is not clear, 2 systematic reviews found that people with ESKD with or without dialysis consistently had lower scores, indicating a high likelihood of cognitive impairment [5, 64].

In the recently published Choice of Renal Replacement Therapy (CORETH) project, almost half of the 767 eligible dialysis patients had missing cognitive testing data [65]. The patients with missing data were those with disease-related limitations for cognitive testing such as visual, motivational, or motor difficulties. The authors of this study conclude that the estimates of cognitive impairment in the dialysis population may be biased and that the cognitive testing resources that overcome the above limitations may be useful in the future. Excluding patients with previous stroke and patients with dementia also leads to significant underestimation of the prevalence of cognitive impairment in the population studied [66]. Inability to speak a language, for example inability to speak English in studies from the USA [20, 32] or French in studies from France [51], was one of the exclusion criteria in many studies. This exclusion may have biased the reported prevalence of cognitive impairment in those studies. Rather than excluding such patients, future studies should consider using validated translations of the selected cognitive screening tool in these patients.

There has been limited investigation into the timing of screening for cognition. Based on one study with a small sample ($n = 26$), the best time and place to communicate information to patients on haemodialysis appears to be before dialysis [17, 48] and in a separate room [48]. In practice, the timing of neuropsychological assessment is more likely to be determined by logistics, such as willingness and ability of the patient to participate in a detailed neuropsychological assessment after a haemodialysis session, willingness of patient to come in early for an assessment before haemodialysis session or to visit the hospital or clinic on a non-haemodialysis day, and resources available for a home assessment on a non-haemodialysis day. The timing of cognitive screening in people on dialysis is an area for further investigation.

There is an opposition to screening for cognitive impairment in the general elderly population [67], and routine screening of at-risk populations is not recommended in national

guidelines [6–8]. One of the reasons for the recommendation against routine screening is that the majority of older people with mild cognitive impairment do not progress to dementia or that their cognitive function may even improve. However, there is compelling evidence that cognitive impairment occurs early in ESKD [64] and that people on dialysis have worse cognition than the general population [5, 64]. Further, in a recent study of dialysis patients with cognitive impairment, there is evidence that cognition declines faster, with effects on the decision-making capacity [68].

One of the benefits of early diagnosis of cognitive impairment in the dialysis population is identifying substitute decision-makers and facilitating advance care planning. The main advantage of completing an advance care plan under these circumstances is to clearly document a person's wishes with respect to the timing of treatment withdrawal before the person loses decisional capacity and the ability to give informed consent. In the ANZDATA, in 2014, the cause of death for 1 in 3 dialysis patients was recorded as withdrawal from dialysis [2]. The advance care planning process requires a shared process of decision-making between the patient, the patient's family, and clinicians. When this process begins early, there are opportunities for the patient, family, and clinicians to share their perspectives and negotiate goals of care over several conversations [69]. An early discussion about if and when to withdraw from dialysis therapy can relieve family carers of the burden of responsibility for making the decision on behalf of the person who is cognitively impaired. Currently, the important process of advance care planning remains suboptimal in this population [70].

The Australian Commission on Safety and Quality in Health Care (ACSQHC) "Delirium Clinical Care Standard" recommends cognitive screening at presentation to hospital in patients with key risk factors for delirium such as age ≥ 65 years, known cognitive impairment/dementia, severe medical illness, and current hip fracture [71]. Dialysis patients are older, have a large burden of disease, and have a high rate of hospitalisation compared to the general population [72]. The prevalence of cognitive impairment is higher in the dialysis population in the reviewed studies that recruited a control population for cognitive screening. This underscores the need for cognitive screening in the dialysis population to identify patients with delirium and at risk of delirium early in order to institute appropriate management and preventative measures.

Navigating health services places significant cognitive demand on dialysis patients. At every stage of their healthcare journey they need to process, understand, assimilate, and recall information and to be involved in shared decisions about their care. Cognitive impairment is strongly correlated with poor health literacy leading to reduced capacity to engage in self-care and achieve desirable health outcomes [73]. Adherence with complex medication regimens, treatment regimens, dietary restrictions, and fluid restrictions is a major challenge for dialysis patients [74]. Cognitive impairment is linked to decreased adherence to the complex treatment regimen [75]. Early detection of cognitive impairment in the dialysis population will help with successful interventions to overcome the practical barriers faced by these vulnerable patients and improve adherence.

This scoping review was restricted to studies published in English, potentially leading to underrepresentation of the non-English-speaking population and the usefulness of non-English instruments, such as the BEC 96. Through the exclusion of conference abstracts, we may have missed contemporary research on the prevalence or timing. This may limit the applicability of our conclusions. The study did not address the quality of evidence by design and consequently provides a descriptive summary of available research.

The most common screening tool used in the reviewed studies was the MMSE. Based on a single study, the MoCA is more sensitive and specific compared to the MMSE, and the best time to administer the MoCA appears to be before dialysis in a separate room. The reported prevalence of cognitive impairment in dialysis patients is highly variable and is likely to be

biased due to studies excluding patients with stroke, dementia, and others who could not consent or complete the assessments. There is a need for studies in the dialysis population comparing and validating commonly available cognitive screening tools, including those that are used in culturally and linguistically diverse population.

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