

The psychometric properties of dementia knowledge scales: a systematic review

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Abstract— Dementia prevalence is accelerating internationally commensurate with population aging causing suffering from families as well as society burden because it is generally met with misunderstanding, fear, and stigma. Therefore, it is hoped that efforts to increase awareness, reduce stigma, and clarify misunderstandings of the illness can enable early detection of dementia. There are many different tests that were used to assess dementia knowledge however the use of inferior methods could account for some inconsistent findings related to dementia knowledge. It is important to define robustness of the psychometric properties of dementia knowledge tools. The aim of this study is to provide a systematic overview of what is known from previous research on assessing the reliability and validity of psychometric properties of dementia knowledge scales.

A systematic literature search (2009 - 2017) was performed using the electronic databases PubMed, Web of science and Google scholar in English and Vietnamese. References and citations were tracked to identify additional, relevant studies basing on study eligibility criteria and excluded criteria. Five original studies were recruited from 562 studies in the selected databases for analyzing of the measurement properties of dementia knowledge scales. Quality judgment criteria were formulated and used to evaluate the psychometric aspects of the scales.

Results: This systematic review revealed 4 dementia knowledge scales (ADKS, DKAS, DK-20, DKAT2) in 5 selected researches. Our findings (based on quality judgment criteria relating to validity, reliability, feasibility) demonstrate that ADKS, DKAS show good psychometric qualities, ranging from 15-17 score of psychometric qualities of dementia knowledge scale. The last two (DK-20 and DKAT2) scored 11 and 13 points of a maximum quality score of 20, respectively, so their psychometric quality can be regarded as moderate. Therefore, these tools await confirmation of various aspects of their psychometric properties.

Conclusion: Based on the psychometric qualities, we concluded that ADKS and DKAS are the appropriate scales currently available. Further research should focus on improving these scales by further testing their validity, reliability, and utility.

Keywords-component: Knowledge; Scale; dementia; Alzheimer; reliability; validity.

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I. INTRODUCTION

Dementia is a common psychonervous disorder among elderly that has destructive effects on patients' cognition, perception, language, behavior and emotional abilities[1]. This disease gradually destroys the ability of problem-solving and learning new skills[2]. According to the World Health Organization statistics (2015)[3], there were 47.47 million people around the world currently suffering from this disease, reaching 75.63 million in 2030 and increasing 135.46 million in 2050. There were over half (58%) living in low- and middle-income countries and 7.7 million new patients have added to this number annually. Approximately 2.48 million people with dementia in 2010 within South East Asia (including Vietnam) would increase by 114% to 5.30 million in 2030[4]

Dementia causes suffering from families as well as society burden because it is generally met with misunderstanding, fear, and stigma[5]. Older adults do not know when or why it is necessary to seek memory evaluations [5; 6]. There is a lack of awareness and understanding of dementia, at some level, in most countries, which contributes to fears and to stigmatization[7]. Therefore, it is hoped that efforts to increase awareness, reduce stigma, and clarify misunderstandings of the illness can enable early detection of dementia.

There are many different tests that were used to assess dementia knowledge however the use of inferior methods could account for some inconsistent findings related to dementia knowledge. To our best knowledge, no overview was available of psychometric properties of these assessment scales. Test selection must be driven by the robustness of the measure's psychometric properties[8], therefore it is important to clarify which dementia knowledge tools have the best psychometric properties. The aim of this study is to provide a systematic overview of what is known from previous researches on assessing the reliability and validity of psychometric properties of dementia knowledge scales.

II. METHODS

A. Search strategy

A systematic search was conducted on the databases of PubMed, Web of science and Google scholar (2009-2017), and the keywords "Alzheimer's", "dementia", "Knowledge", "scale", "reliability", "validity", with the limitation of publications in only English and Vietnamese. The reference lists of the included studies were hand-searched to identify additional relevant studies.

The same approach was also performed in Vietnamese journals, which included The Journal of Practical Medicine (Tạp chí Y học thực hành), the Journal of Medical Research (Tạp chí Nghiên cứu Y học), and the Journal of Medicine Hochiminh City (Tạp chí Y học Thành phố Hồ Chí Minh). The same keywords were used in Vietnamese, consisting of "Bệnh Alzheimer", "Bệnh sa sút trí tuệ", and "kiến thức", "thang đo", "độ tin cậy", "tính giá trị". There was no any article on psychometric properties of dementia knowledge scales that resulted from this search.

B. Design

This systematic review was conducted according to PRISMA guidelines[9].

We included full-text original papers based on the following inclusion criterias: (1)audience was intended for, or judged suitable for use with several kinds of population; (2)scope was assessed several knowledge domains of dementia and its subtypes as prevalence, symptoms, course, etiology, diagnosis, treatment, risk factors, and genetic testing, treatment; (3)prior psychometric evaluation and description of test evaluation process (documented by a peer reviewed publication), including measurement quality and the domains validity, reliability of Dementia or its subtypes knowledge scales. Excluded criterias included: (1)the papers did not attempt to evaluate and report the measurement properties of these scales; (2)the studies published in languages other than English and Vietnamese.

Our search yielded a large number of publications (see Table 1). The researchers read the abstracts of all publications identified on the electronic databases, excluding only those that clearly did not meet the aforementioned criteria. In the next stage, the remaining publications were read by either H and T and a consensus was made on those that met all criteria. After the abstracts of 562 publications had been screened, 11 publications remained, 6 studies were excluded after requesting more information on the measurement properties. A total number of 5 original studies met the criteria for recruitment of dementia knowledge scales.

TABLE 1: SEARCH STRATEGY

Keywords used: (Knowledge OR understand) AND (Scale OR assessment OR measure OR test) AND (Elderly OR dementia OR Alzheimer) AND (reliability) AND (validity).

Source	Hits (N =)	Selection based on reading abstracts (N =)	Final selection based on publications (N =)
Databases	PubMed 105 Web of science 30 Google scholar 400	0 3 2	0 1 1
Citation/reference screening	25	5	3
Unpublished manuscripts	2	1	0
Total		11	5

C. Analysis method, data extraction, and synthesis

- Data abstraction criteria used to evaluate behavioral assessment scales (see Table 2) were based on DeVon (2007)[10], Zwakhalen (2006)[11], and Streiner & Norman (2003)[12] for health measurement scales.
- The following data were extracted (if available) to examine the nature and methodological quality of the assessment scales: type of assessment scale (including

items of the scale), source of the items (origin), scoring/scaling response, sample size of participants, construct validity (discriminating between groups, criterion validity in relation to other tool/ convergent validity, construct validity in differentiation/ sensitivity to change content validity), reliability (homogeneity, alternative reliability , test-retest reliability), feasibility. As a quality check was conducted by two reviewers.

TABLE 2: PSYCHOMETRIC QUALITIES OF DEMENTIA KNOWLEDGE SCALES

Aspect	Score
Face and Content validity	
Origin of items	2 if items were developed from existing items/ from older scales and updated literature review, formal theories, Patient experience, clinical observation. 1 if items were developed from at least one way of the list. 0 if no information is provided
Number of participants	2 if N => 100 1 if 50 < N < 100 0 if N < 50
Experts Content validity	2 if scale seems to cover all important items/dimensions (in the reviewers' opinion): 1 if the scale seems to cover important items/dimensions to a moderate extent (in the reviewers' opinion) 0 if the scale does not seem to cover the important items/dimensions (in the reviewers' opinion)
Construct validity	
Discriminating between groups	2 if the scale differentiates well between groups 1 if the scale differentiates moderately well between groups 0 if the scale does not differentiate or no information is provided
Criterion validity in relation to other tool/ convergent validity	2 if correlates with other dementia knowledge measures acceptable to high ($r > 0.60$) 1 if correlates with other dementia knowledge measures are moderate ($0.40 < r < 0.60$) 0 if correlations are low ($r < 0.40$) or no information is provided
Construct validity of differentiation/ Sensitivity to change	2 if the scale differentiates well pre- and post-test 1 if the scale differentiates moderately well pre- and post-test 0 if the scale does not differentiate or no information is provided

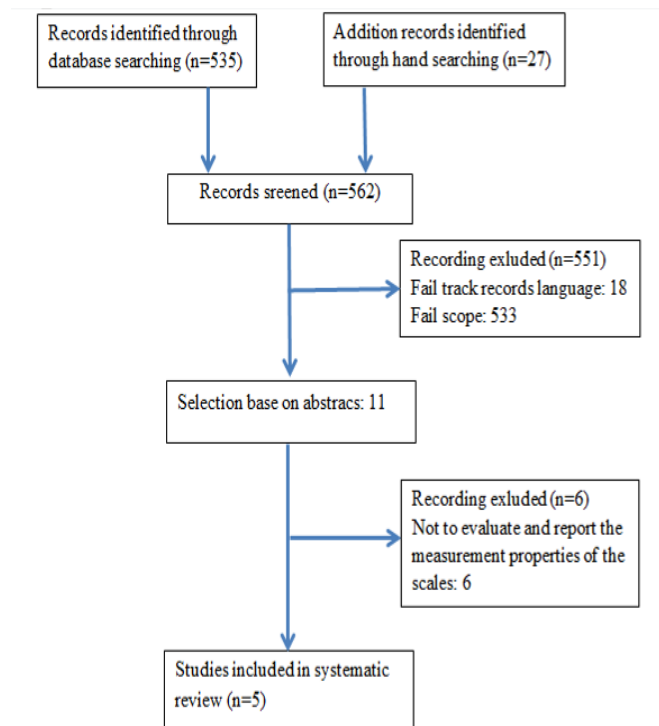
Reliability	
Homogeneity	2 if $0.70 < \alpha < 0.90$ 1 if $\alpha > 0.90$ or $0.60 < \alpha < 0.70$ 0 if $\alpha < 0.60$ or no information is provided
Alternative forms reliability	2 if reliability coefficient > 0.80 1 if $0.60 < \text{reliability coefficient} < 0.80$ 0 if reliability coefficient < 0.60 or no information is provided
Test-retest reliability	2 if reliability coefficient > 0.80 1 if $0.60 < \text{reliability coefficient} < 0.80$ 0 if reliability coefficient < 0.60 or no information is provided
Feasibility	2 if scale is short, manageable with instructions, scoring interpretation 1 if scale is manageable (one format) 0 if scale is more complex

Total score ranges from 0 to 20 with criteria standard such as < 12 scores: fail; 12-14 score: moderate; 15-17 score: good; 18-20 score: very good

III. RESULTS:

A. Study selection

Figure 1. Flowchart of the search strategy



B. Selected study characteristics (see table 3):

C. Synthesis of results and risk of bias across studies

A total number of 562 articles were found. From these 562 articles, only 5 original studies met the criteria for recruitment of dementia knowledge scales. The literature search traced 4 dementia knowledge scales including:

1) *The Alzheimer's Disease Knowledge Scale (ADKS)* was established by Carpenter et al. (2009)[13] who updated the Alzheimer's Disease Knowledge Test (ADKT) which was developed by Dieckmann and colleagues in 1988, in light of a more scientific understanding of AD. The authors first pilot-tested a 57-item tool among various groups and evaluated internal consistency and validity. The final version of the 30-item ADKS consisted of 30 true/false items that addressed prevalence, prevention, risk factors, symptoms, assessment, diagnosis, and management. A convenience sample of students, caregivers, healthcare professionals, researchers, and community-dwelling older adults ($n = 454$) were recruited through an undergraduate pool and a local healthcare agency for a new round of pilot testing with the refined tool. This sample ranged in average ages from 22 to 87 years ($M = 48.9$) and was largely White urban residents. Education as a variable was measured by hours of AD instruction, which ranged an average of 4.49 ($SD = 1.28$) among students to 7.83 ($SD = 1.50$) hours of instruction for healthcare workers. This new sample achieved scores on the ADKS ranging from 19 to 30 ($M = 24.2$, $SD = 2.4$), showing varied knowledge levels. Tests for reliability yielded a coefficient alpha of 0.81, $p < 0.001$ and a split-half reliability of 0.55, $p < 0.001$. Factor analysis was conducted to look for subscales but results were not conclusive and the researchers attributed this to the individuality of the items.

Higher ADKS scores were expected from persons with greater levels of education or experience, such as health professionals or persons attending an AD support group. Knowledge about AD was more extensive among people who had attended a dementia support group ($M = 25.73$) compared with those who had not, $M = 21.11$, $t(755) = 9.53$, $p < 0.001$, and more extensive among people who had attended a class or educational program about dementia ($M = 24.04$) compared with those who had not, $M = 20.57$, $t(756) = 11.10$, $p < 0.001$. Its internal consistency reliability was relatively low. This might be due to the true/false response format and the relatively high item difficulty indexes-testing

TABLE 3: SELECTED STUDY CHARACTERISTICS:

No.	Instrument	Author (year)	Population(s)	Research design/setting	Time and response format
1	The Alzheimer's Disease Knowledge Scale (ADKS)	Carpenter BD, et al (2009)[13], USA	Sample: students, the general public, Healthcare professionals, family and professional caregivers (n = 763). Target population: general	The systematic analysis process, cohort, and quasi-experimental design development guidelines from Clark & Watson, 1995 ; Kline, 2005 ; Streiner & Norman, 1995.	5 – 10 min completion, Response format :true/false format
2	Dementia Knowledge 20 (DK-20)	Shanahan N, et al (2013)[14], UK	Sample: dementia care staff (n = 211). Target population: frontline unqualified dementia care staff	The several - stage development process, cohort study was constructed from Allen and Yen (1979). Residential care homes	15-min completion Response format: Correct, 3x incorrect, I don't know
3	Dementia Knowledge Assessment Tool Version Two (DKAT2)	Toye C, et al (2014)[15], Australia	Sample: Dementia care staff and family carers of people with dementia (n = 104) Target sample: aged care staff and family carers	Cross-sectional research 3 residential aged care settings	15 minutes - completion. Response format: Correct/incorrect/ Don't know
4	Dementia knowledge assessment scale (DKAS)	Annear MJ, et al (2015)[16], Australia	Sample: international respondents and health care provider (N=1,767) Target population: health service workers, aged care staff, family caregiver, general practitioner and students.	The five-stage, systematic scale development process and cohort study; Online environment and during clinical dementia placement.	No information about complete time response format: Adapted Linkert scale (yes/no/I don't know)

with an expanded response format and items that were more varied in difficulty. Over ten language versions of the ADKS are available.

2) *Dementia Knowledge 20 (DK-20)* was published in 2013 by Shanahan and colleagues[14] to measure dementia knowledge aimed at unqualified frontline care staff. The scale consists of twenty items with two dimension (dementia core Knowledge and dementia care knowledge) scored on multiple choice response options. The measure has good utility (15-min administration time) along with established face and content validity by experts, acceptable test-retest reliability ($r=0.73$), and marginal levels of internal consistency (Cronbach's alpha 0.63). Good construct validity was demonstrated, and the scale is also capable of discriminating subgroups based upon expected differences in levels of care staff, and senior staff and professionals, which senior staff attained a higher average score. Value of the concurrent validity of the scale by administering the DK-20 along with the Job Satisfaction Index: $r=0.20$. Further research is required to assess the DK-20 scale's

ability to detect change after education and to assess divergent validity by administrating the DK-20 with a measure of an unrelated construct.

3) *Dementia Knowledge Assessment Tool Version Two (DKAT2)*, was developed by Toye et al.(2014) [15] to evaluate foundation-level knowledge of the dementia trajectory in family carers and aged care staff. This scale was inspired by the DKAT1 with a greater emphasis on late-stage dementia. The scale consists of 21 item such as aetiology, course, prognosis, symptoms, psychosocial, management with three response (Correct, incorrect and don't know) for clearly choosing. The homogeneity of the items (Cronbach's $\alpha =0.79$), discriminating validity of the staff obtained marginally higher scores than families in a small sample. It needs to be further examined validity and reliability to limit ceiling effects from items consistently attracting a high percentage of correct scores in both families and the staff.

Assessment tool/ source	Dimensions/ items Scoring range	Face and Content validity			Construct validity			Reliability			Feasibility	Overall judgment (range 0– 20)	
		Origin of items	Number of participants	Experts Content validity	Discriminati ng between groups	Criterion validity in relation to other tool/ convergent validity	Construct validity of differentiation/ Sensitivity to change	Homoge neity	alternativ e forms reliability	test- retest reliabilit y			
(ADKS)	30 items; 7 domains: risk factors, assessment, and diagnosis, symptoms, course, life impact, caregiving, and treatment and management	modified ADKT, review boarding scales(21 instrument s), pilot	763	The group of investiga tors reviewed	y, evidence of differentiati ng between participants base on their experience	y, ADKT: r=0.65	y, evidence of score improvement post-education.	y, alpha= 0.71	y, ratings of self- reported knowledg e about AD: r=0.50	y, Test- retest from 2- 50 hrs: r=0.81	Short, simple response		
			2	2	1	2	2	1	2	1	2	2	17
(DK-20)	20 items, 2 dimensions: dementia core knowledge (N=11), dementia care knowledge (N=9)	Review scoping literature, review existing scales, focus group	211	y,	y, significant difference	y, ADQ (attitudes towards PWD): r = 0.32	n	y, alpha = 0.63	The Job Satisfacti on Index: r=0.20	y, accepta ble: r=0.73	Multiple choices		
			2	2	2	0	0	1	0	1	1	11	
(DKAT2)	21 items, Content: aetiology, course, prognosis, symptoms, psychosocial, management	modified DKAT1, pilot	104	y, not clear the steps of expert review	y, staff score marginally higher than families	n	n	y, alpha= 0.79	n	y, a Kappa >0.40	Short, simple response		
			1	2	1	2	0	0	2	0	1	2	13
DKAS	27 items, 4 dimensions:	Review scoping	1,767	y	y, t very significant	y, ADKS Pearson	y, t very significant	y, alpha=	n	y, no signific	Short, simple		

Cause and characteristics(N=9), Communication and engagement(N=7), Care needs(N=5), Risks and Health promotion (N=6)	literature, review existing scales, Delphi study	correlation= 0.56 (moderate)	0.89	ant change after 3 weeks	scale	2	2	1	2	1	2	2	0	2	2	15
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y: yes; n: no

TABLE 4: QUALITY JUDGMENT CRITERIA OF DEMENTIA KNOWLEDGE SCALES

4) *Dementia knowledge assessment scale (DKAS)* by Anner et al (2015)[16] is an assessment tool of diverse domain dementia knowledge designed specifically for person-centered care. This tool was based on the five-stage, systematic scale development process by Streiner and Norman in 2008. During the analysis, 13 items were removed (40 items reduced to 27) with specific components of the scale including causes and characteristics (fundamental information relating to pathology and terminality), communication and engagement (information about how a person with dementia engages with the world), care needs (symptoms that are relevant to the provision of care), and risk and health promotion. The DKAS had a high level of internal consistency (Cronbach alpha 0.89), no significant change in test-retest reliability ($t(46) = -0.80$, $P = 0.43$ in members of the health workforce. Face and content validity were achieved through the use of a review of current dementia knowledge measures, a Delphi study with dementia experts. Initial construct validity of the scale indicated that the DKAS was sensitive to change in dementia knowledge with a value of this indicate in an online dementia MOOC: $t(764) = -28.79$, $P < 0.001$, two-tailed) and in medical students who completed a dementia education was $z = -4.57$, $P < 0.001$. Concurrent validity was established through comparison of DKAS and ADKS scores, which were significantly correlated (correlation coefficient = 0.56, $P < 0.001$). A limitation of this study was the purposive sampling approach in pilot tester with high baseline dementia knowledge leading a significant increase in dementia knowledge represented a more-education population. The Japanese version of the DKAS was adjusted by Annear and colleagues (2016)[17] naming DKAS-J with 18 items instead of 27. The DKAS-J shows acceptable reliability (Cronbach's alpha value of 0.73) and validity (discrimination between groups with mean difference 4.94, 95% CI-7.32 to -2.55) when a population of individuals with university training in health-related disciplines in Japan purposely sampled. The measure does not support potential subscales as the English-language DKAS does. The 18-item DKAS-J also provides a balance between positively-worded (11 items) and negatively-worded statements (7 items), which have been reported to improve the reliability of responses. Commensurate with the DKAS, the DKAS-J also overcomes ceiling effects that have been observed in other international measures of dementia knowledge. Further work is indicated to validate the scale to lay populations who were not sampled in these studies.

D. Summary of evidence

The purpose of the present study was to review dementia and its subtypes knowledge scales to evaluate the psychometric quality of these tools. This systematic review revealed 4 dementia knowledge scales with 5 selected researches. Our findings (based on quality judgment criteria relating to validity, reliability, feasibility in **table 4**) demonstrate that ADKS, DKAS show good psychometric qualities, ranging from 15-17 score. The last two (DK-20 and DKAT2) scored 11 and 13 points of a maximum quality score of 20, so their psychometric quality can be regarded as moderate. Therefore,

these tools await confirmation of various aspects of their psychometric properties.

Our review of the studies on dementia knowledge assessment scales identified several general issues and weaknesses that need to be addressed. The first issue is lack of generalizability because of testing and development with narrowly defined populations who had a higher level of education or exposure to dementia. The research participants are generally required to be undergraduate health students and registrants of dementia online course (DKAS), aged care staffs (ADKT, DKAT2, DKAS, DK20), and family carers of dementia patients (DKAT2, ADKT). Therefore, respondents in these studies do not seem to represent. Dementia is an issue of global, national and regional concern, around 47.47 million people around the world suffered from this disease, reaching 75.63 million in 2030 and increasing 135.46 million in 2050 WHO, 2015)[3]. Misunderstanding, fear, and stigma create an additional facet of a burden of dementia disease for families as well as society (Devlin, 2007)[5]. There are great needs for clear, accessible information that gives the public an accurate understanding of dementia. Therefore, studies should include residents of all ages reflective of the general population. Second, items addressing the prevailing limitations of current dementia knowledge measures were their main focus on biomedical domains or particular types or stages of dementia (e.g. Alzheimer's disease). The biomedical aspects of the syndrome (pathology, causes, risk factors, and symptoms) in ADKS, DK-20, DKAT2, and DKAS, or incorporating with the psychosocial issues of care and communication (a manner of viewing the progression of functional limitation through effects on body, personhood, and social interaction) in DKAT2 and DKAS do not totally reflex multiple dimensions of dementia. Robinson et al. (2011) [18] reviewed the literature and concluded that lowered perceptions of susceptibility, cultural beliefs, and lack of knowledge predicted a low use of services for dementia care. The result surmised the need for further investigation with culturally and socially appropriate assessment tools. Thirst, the tools had further limitations relating to simplistic response format and methodological issues. Using dichotomous response format (True/false) in ADKS considered as a potential limitation that reduced observed variability in participant responses lead to ceiling effects, especially in knowledgeable respondents. Related to this, DK-20 with multiple choice response option could identify areas of poor knowledge, misinformation; and the other measurement tools overcome the limitations.

Determining the validity of an instrument often requires building up over time by researchers conducting a variety of studies[19]. More researches related to each tool need to include in this review. Difficult to compare include differences in format/structure and scoring method. Related to this, DK-20 with multiple choice response option could identify areas of poor knowledge, misinformation.

IV. CONCLUSIONS

Based on the psychometric qualities, we conclude that ADKS and DKAS are the appropriate scales currently

available. Further research should focus on improving these scales by further testing their validity, reliability and clinical utility.

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