YALE JOURNAL OF BIOLOGY AND MEDICINE 89 (2016), pp.91-96.

ORIGINAL CONTRIBUTION

YJBM

The Knowledge of Memory Aging Questionnaire: Factor Structure and Correlates in a Lifespan Sample

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The authors examined the factor structure of the *Knowledge of Memory Aging Questionnaire* (KMAQ) [1] using confirmatory factor analysis in a lifespan sample of 933 individuals who ranged in age from 18 to 101. Participants were college students at Louisiana State University and adults from the community enrolled in the Louisiana Healthy Aging Study (LHAS). A two-factor solution was expected, consistent with the normal and pathological memory aging dimensions that comprise the KMAQ. A bi-factor solution with items loading on a general response bias factor and either a normal or pathological knowledge-specific factor showed good model fit. Knowledge scores were correlated with demographic and cognitive performance variables. Implications of these data for clinical settings and research are considered.

INTRODUCTION

People of all ages experience forgetfulness. The normal memory aging behaviors of later life observed in healthy older adults differ in comparison to pathological memory deficits that may be signaling a serious medical condition. For example, having trouble quickly recalling the name of an acquaintance occurs as part of normal memory aging, whereas forgetting the name of a close friend or relative is non-normative. Distinguishing between normal and pathological cognitive aging has important consequences as early intervention for conditions such as Alzheimer's disease can result in delays in symptom progression [2]. Cognitive changes related to Alzheimer's disease often appear well before individuals seek clinical attention. People with knowledge of normal versus pathological memory aging who interact regularly with an older adult (e.g., family members, health care workers) are well-positioned to notice changes and intervene.

Little research has examined public perceptions of cognitive change across the lifespan [3]. It is important to consider whether the general population has an understanding and awareness of what constitutes normal versus pathological memory aging. Physicians and cognitive scientists know that there is normative change to memory performance as a person ages, but the average person may not be aware of what types of changes are expected and what contextual factors can influence performance. Indeed, past research indicates that people tend to be more knowledgeable of pathological memory changes than of normal change [4,5].

One reason this knowledge may be lacking in the general population [6] is that the majority of information

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†Abbreviations: KMAQ, Knowledge of Memory Aging Questionnaire; LHAS, Louisiana Healthy Aging Study; LSU, Louisiana State University; CMS, Center for Medicare and Medicaid Services; MMSE, Mini-Mental State Exam; WLSMV, Weighted Least Squares Mean and Variance

Keywords: memory aging knowledge, normal and pathological memory deficits, age-associated memory impairment, Alzheimer's disease, subjective memory complaint

Author contributions: MC, data analysis and interpretation, conceptual framing, writing; CR-M, data interpretation, conceptual framing, writing; KEC, data collection and interpretation, conceptual framing, writing; KSH, data collection, scoring, and interpretation; SMJ, writing.

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in the media is about age-related diseases rather than general cognitive health [7]. In one study, many individuals were unaware of the relationship between physical activity and cognitive health [6], and while knowledge is not sufficient to motivate behavior, knowing the value of physical exercise on cognition is an important first step in getting individuals engaged in that activity. Similar to media trends, research on knowledge of memory aging has tended to focus on disease rather than normal aging. As a result, significant gaps remain in our understanding of the knowledge individuals have about normal aging [3].

One measure that addresses these important issues is the *Knowledge of Memory Aging Questionnaire* (KMAQ) [1], which was designed to measure knowledge of both normal and pathological aging for research or educational purposes. Half of the questions address normal memory aging, defined as changes in later life that reflect genuine maturational processes. The other half address pathological memory aging, defined as non-normative changes in older adults' memory due to physiological or psychopathological conditions, pharmacological agents, and/or dementia. Research with the KMAQ indicates that healthy older adults possess greater knowledge of memory aging issues than do high school students [8] and college students [1,9-11]. Past work also documents that health care workers, including mental health professionals [12], social workers [13], caregivers and senior service providers [14], and first responders such as police officers [15], are generally more knowledgeable about pathological than normal memory aging issues.

In this study, we examined the psychometric properties of the KMAQ using confirmatory factor analysis as a method of validating its use as a measure of knowledge of both normal and pathological aging. We extend our earlier work documenting that age group and profession are related to knowledge of memory aging by examining the relationships among knowledge, demographic, and cognitive variables in a large lifespan sample. Brigman and Cherry [9] demonstrate that peoples' knowledge of normal memory aging can be improved with instruction. Other evidence has shown that interventions can successfully change belief in inaccurate age-related stereotypes [16,17]. Thus, identifying who may have incorrect knowledge and would likely benefit from education is an important goal. Furthermore, research has shown that negative aging stereotypes can affect cognitive performance both in experimental [18] and in longitudinal [19] studies. Even after adjusting for covariates associated with memory decline (e.g. age, education, self-reported health), individuals holding negative age-related stereotypes experience greater memory decline over time compared to those without such beliefs [19].

METHOD

Participants

A total of 933 individuals participated in this study: 63 percent were female and 37 percent were male[1]. Participants varied considerably in age allowing for a cross-sectional examination of KMAQ scores across the adult lifespan. Of the 900 people for whom chronological age data were available, there were 305 younger adults (M = 26.35 years, SD = 6.66 years, age range 18 to 39), 270 middle-aged adults (M = 50.38 years, SD = 6.18 years, age range 40-64), 153 older adults (M = 75.94 years, SD = 6.59 years, age range 60 to 89), and 172 oldest-old adults (M = 91.47 years, SD = 1.75 years, age range 90 to 101). Participants also varied significantly in education. Of the 913 for whom educational attainment was reported, relatively few had less than high school: less than 7 years (n = 5), 7 to 9 years (n = 18), and 10 to 11 years (n = 23). The majority reported having completed high school (n = 166), some college or specialized training (n = 392), a bachelor's degree (n = 210), and graduate degree (n = 99).

Participants included 742 individuals from the community in the Louisiana Healthy Aging Study (LHAS)[2], a multidisciplinary study of the determinants of longevity and healthy aging conducted in collaboration with researchers from Louisiana State University (LSU) in Baton Rouge, LSU Health Sciences Center in New Orleans, Tulane University, the Pennington Biomedical Research Center, University of Pittsburgh, and the University of Alabama at Birmingham. LHAS participants were sampled randomly from the Voters Registration 2000 files for those ages 20 to 64 and from the Medicare Beneficiary Enrollment Data file of the Center for Medicare and Medicaid Services (CMS) for participants ages 65 and older who lived within the 40-mile radius of Baton Rouge (surrounding eight parishes) constituting the Greater Baton Rouge community. All scored at least a 25 or higher on the Mini- Mental State Exam (MMSE), which is a 30-item dementia screening measure [20]. Scores of 24 or below typically indicate cognitive impairment. Additionally, 191 individuals were recruited from psychology classes at LSU or were from the community attending a luncheon sponsored by the Life Course and Aging Center at LSU.

Materials and Procedure

The KMAQ consists of 28 true/false/don't know (dk) items. Half of these items cover normal memory aging topics (memory organization/systems, episodic memory phenomenon, encoding/retrieval factors, mnemonics/memory strategies,

[1]For a variety of reasons related to both life expectancy and trends in social science research participation, females are often represented in samples in higher numbers than men. It should be noted that this trend could affect statistical outcomes or interpretations, though we have no reason to suspect this to be the case in the present research.

[2]The total number of participants in the LHAS is 869. The 742 LHAS participants in this study were selected for inclusion here on the basis of having an MMSE score equal to or greater than 25, which is suggestive of cognitive health.

individual difference, and contextual influences), and the other half reflect pathological topics (types of abnormal deficits, identification of abnormal deficits, mental health conditions and memory, physical conditions and memory, and dementia/Alzheimer's disease). Separate proportion scores were calculated for each participant by dividing the number of correct normal and pathological memory aging items by the total in each category [14], minus the number of "dk" responses in each category [10]. All LHAS participants completed the MMSE [20] and a measure of vocabulary knowledge [21]; a subset of LHAS participants completed measures of working memory [22,23] and free recall of words and simple line drawings as a measure of episodic memory [24,25].

Informed consent was obtained according to the protocol reviewed and approved by the Institutional Review Board of Louisiana State University in Baton Rouge. Missing data were present for some demographic and test score variables; given the small amount of missing data and large number of participants, analyses were completed using all available participants for each analysis (i.e., pairwise deletion).

RESULTS

Factor Structure of the KMAQ

As the KMAQ includes items designed to measure knowledge of either pathological or normative aging, we hypothesized that a two-factor solution in which items loaded on either a normal or pathological aging factor would have good model fit. For the purpose of all factor analyses, "don't know" responses were recoded as incorrect. Preliminary exploratory factor analysis showed that items tended to load together both in terms of content (i.e., normal and pathological aging) and the type of correct response (i.e., true or false). This outcome indicates that item responses were influenced both by the type of knowledge being assessed as well as a response bias to answer true or false. Three items (2, 6, and 20)[3] had significant loadings on both true and false response factors and were not included in the confirmatory analysis, as additional analyses showed these items had non-significant or significantly negative correlations with the total score. Of note, exploratory factor analyses treating "don't know" responses as missing data yielded a similar pattern as treating responses as incorrect.

To model normal and pathological knowledge in the context of response bias, a confirmatory bi-factor model was used in which all items were set to load on a general method factor (to capture a general tendency to respond true or false) and one of two specific content factors (i.e., knowledge of normal or pathological aging). Weighted Least Squares Mean and Variance (WLSMV) estimation was used given the dichotomous response options. This model had good fit, supporting the validity of the KMAQ as a measure of both normal and pathological aging ($\chi^2$466.488, $p < .001$; CFI=0.92; RMSEA=0.03). Alternatively, a model including factors for knowledge of normal or pathological aging, but failing to account for response bias, yielded poor model fit (e.g., CFI=0.79), as did a model in which all items were specified to load on only one factor (e.g., CFI=0.78), highlighting the importance of considering response bias and specific content (i.e., knowledge of normal or pathological aging) when assessing the psychometric properties of the KMAQ.

Demographic Correlates of KMAQ Scores

Knowledge scores for normal (n = 11 items) and pathological aging (n = 14 items) were calculated for all of the items retained in the confirmatory factor analysis. For normal aging items, women (M = 6.84, SD = 2.13) did not differ from men (M = 6.76, SD = 2.02), $t = 0.59$, $p > .05$, $d = 0.04$. However, for pathological aging items, women (M = 8.47, SD = 2.45) scored significantly higher than men (M = 7.89, SD = 2.56), $t = 3.37$, $p < .05$, $d = 0.23$).

Knowledge of normal aging decreased with participant age ($r = -.202$, $p < .05$), while knowledge of pathological aging was not associated with participant age ($r = -.05$, $p > .05$). Greater participant education was associated with greater knowledge of both normal and pathological aging to the same degree ($rs = 0.24$, $p < .05$).

Cognitive Correlates of KMAQ Scores

Correlations between cognitive measures and KMAQ scores can be found in Table 1. Correlations with cognitive variables were larger for knowledge of normal aging than knowledge of pathological aging. Correlations were generally small with the exception of moderate relationships between knowledge of normal aging and vocabulary knowledge ($r = 0.30$, $p < .05$) and episodic memory for words ($r = 0.33$, $p < .05$).

DISCUSSION

The primary findings of this study were threefold. First, the psychometric properties of the measure were supported as the predicted factors were identified in both the exploratory and confirmatory factor analyses.

[3]The three items which loaded on both true and false response factors (2, 6, 20) are as follows: (2) Older people tend to have more trouble concentrating than younger people. That is, older people are more likely to be distracted by background noises and other happenings around them. (N-true); (6) Older people remember to do future planned activities (such as returning a book to the library) better than they remember past actions that they have already completed. (N-true); and (20) Immediate memory (such as repeating a telephone number) is about the same for younger and older people, but an older person's memory for things that happened days, weeks, or months ago is typically worse than that of a younger person. (N-true).

TABLE 1

Correlations between Cognitive Measures and Knowledge of Normal and Pathological Aging

	n	Normal Aging	Pathological Aging
Global cognition/intelligence			
MMSE[c]	720	0.18*	0.09*
Vocabulary[d]	715	0.30*	0.26*
Working memory			
FDS[a]	350	0.15*	0.09
BDS[a]	350	0.13*	0.04
SJS[b]	350	0.23*	0.14*
Episodic memory			
Word recall	221	0.33*	0.25*
Picture recall	221	0.24*	0.18*

Notes. [a]Forward Digit Span (FDS) and Backward Digit Span (BDS) from the Wechsler Adult Intelligence Scale-Revised (WAIS-R) [23]. [b]Size Judgment Span (SJS) [22]. [c]Mini-Mental State Exam [20]. [d]Vocabulary [21].
* $p < 0.05$

Second, performance on the measure of knowledge was related to a number of important demographic variables. Last, performance was also related to objective memory performance. These findings and their theoretical and clinical implications are discussed in the sections that follow. We conclude with a brief discussion of future directions for exploring the ways the KMAQ could be used to promote public health.

The KMAQ has been used in many studies to assess knowledge of normal and pathological aging changes in memory. One aim of this study was to provide further psychometric evidence that the KMAQ measures these two separate domains of knowledge given its potential to be a useful measure in a number of contexts (e.g., psychology research, public health research). To accomplish this objective, we used factor analysis, a technique often used to validate measures. The results of our confirmatory factor analysis support the conceptualization of the KMAQ as a measure of two related, but separate knowledge domains (i.e., knowledge of normal aging and knowledge of pathological aging). As discussed subsequently, these two factors differ somewhat in their relationship to demographic and cognitive variables. In addition, this bi-factor model of the KMAQ included a response style factor to account for the tendency for at least a subset of participants to respond in one direction (e.g., true) to items regardless of the specific content of the item. Although the KMAQ includes an equal number of true and false items, if a subset of individuals responds to a large number of items with "true," those items will become correlated with one another. The effect of response biases on true/false knowledge tests has long been studied within psychology [26]. Response bias on various types of measures with different formats has shown to be stable within an individual over time [27] and related to factors such as education [28] and cognitive functioning [29]. Failing to account for response bias can affect the results of a factor analysis [28,29], so we chose to model it in our analyses.

In terms of demographic variables, three findings were of central interest. Gender differences emerged for the pathological memory aging scale, but not the normal memory scale. Women had more knowledge of pathological memory aging than did men, which supports the work of Beier and Ackerman [30], who found that women were more knowledgeable about health in general than men [see also 15]. Although the differences were small, this finding could indicate that men, in particular, may benefit from educational information on the types of non-normative memory change that can occur in late adulthood.

There was also a negative correlation between age and knowledge of normal memory aging, whereas the relationship to age was not present for knowledge of pathological memory aging. This finding is somewhat surprising in that it seems reasonable to expect older individuals to be most familiar with the typical course of memory aging. Lower levels of knowledge of normal memory change in late life may mean that older adults present in clinical settings with memory concerns about change or memory lapses that do not warrant alarm. Incidents of forgetting are highly salient to older adults [31] and people are more likely to attribute memory failures among older adults to a mental difficulty than to the individual effort or contextual factors that may actually be responsible [32]. Further, lower levels of normal memory

aging knowledge may mean that older adults worry about benign instances of forgetting, fearing that they are indicative of an impending dementia diagnosis [33,34]. Last, there was a positive correlation between education and both types of knowledge. This aspect of the data is consistent with previous work [11] and reiterates the need to make sure adults of all educational backgrounds have access to information about cognitive health.

There were a number of correlations between knowledge and cognitive performance variables. Both the normal and pathological memory scales were positively correlated with measures of global cognition, vocabulary, working memory, and episodic memory (free recall of words and simple line drawings). The relationships between knowledge and cognition tended to be stronger for normal than for pathological knowledge. This was especially true for vocabulary ability and word recall. This finding supports the work of Beier and Ackerman [30], who found that health knowledge (broadly defined and measured) was best predicted by cognitive ability and extends their findings by demonstrating the relationship not only for general health knowledge, but also knowledge of memory aging. It also suggests that the language used to convey information about normal memory aging should be understandable to a wide range of audiences, and may indicate that information about normative age-related memory change is not reaching those with fewer verbal skills.

Knowledge of memory aging has clinical relevance because such knowledge may be related to the subjective memory concerns older patients sometimes present. In particular, lower levels of normal memory aging knowledge may mean that some patients are concerned about memory failures that are common experiences, and do not require medical attention. Subjective memory concerns are important considerations because recent evidence indicates their presence can be predictive of mild cognitive impairment or eventual dementia [35,36]. One avenue for future research is a better understanding of the relationship between knowledge, subjective memory complaints, and the course of an individual's cognitive health. An additional clinical implication is that medical students should be exposed to information regarding normal and pathological memory change. As with the study of human development in general, it is sometimes difficult to understand what constitutes atypical memory behavior if one does not have a full understanding of the normative course of development.

The present results and their implications should be interpreted in light of several methodological limitations. For instance, our analyses of demographic factors related to knowledge of memory and aging on the KMAQ focused only on age, education, and gender. As there is evidence to suggest differences in knowledge of memory in aging across various ethnic groups [3], a planned future direction is to explore the issue of cultural differences in knowledge with the KMAQ.

Additionally, occupational status is another important demographic variable that in previous studies has been shown to relate to memory knowledge [12,13]. Future work should also examine the extent to which information regarding normal and pathological memory aging is reaching particular audiences, including those in the medical field, those with relatively low levels of education and cognitive ability, and family members of older adults who are in a position to notice and respond to changes in memory behavior.

All of these groups may benefit from a better understanding of what constitutes normative versus pathological memory development. Additional research is needed to both document current levels of knowledge as well as to investigate how increased levels of knowledge may affect public health outcomes.

Acknowledgments: Emily O. Boudreaux and Jennifer Silva Brown assisted with data collection. Kayla Holland Baudoin, Claire Leerkes, Kelli Broome, Lane Fontenot, Nicole Lowenhaupt, Kyle Ryker, and Brea Manuel helped with data entry.

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