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Specific Association Between Religiosity and Cognitive Functions in Alzheimer's Disease

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Abstract

Objectives: This study aimed to identify the specific relationship between subdomains of religious variables and cognitive functions in outpatients with Alzheimer's disease (AD). **Methods:** We recruited 325 patients with AD from a psychiatry outpatient clinic. The Korean version of the Consortium to Establish a Registry for Alzheimer's Disease and the Duke University Religion Index were used to assess cognitive functions and religiosity. We performed structural equation modeling and partial correlation analysis after controlling for demographic data. **Results:** The model in which religiosity beneficially affects cognitive functions showed acceptable model fit (root-mean-square error of approximation = 0.076, Tucker-Lewis index = 0.921, comparative fit index = 0.947). In the partial correlation analysis, organizational religious activity demonstrated positive relationships with memory ($r = 0.144$, $P = .010$), language ($r = 0.149$, $P = .007$), and constructional ability ($r = 0.191$ $P = .001$). Nonorganizational religious activity and intrinsic religiosity were positively associated with memory ($r = 0.115$, $P = .040$; $r = 0.140$, $P = .012$) and constructional ability ($r = 0.207$, $P = .000$; $r = 0.136$, $P = .015$). **Conclusions:** The findings suggest that religiosity positively affects cognitive functions and that each religious variable is related differently to the subdomains of cognitive functions in patients with AD.

Keywords

Alzheimer's disease, dementia, cognitive impairment, cognitive functions, religiosity

Introduction

Religion is an important part of our lives. Many studies have shown that religiosity and spirituality have positive effects on physical health outcomes through psychological, social, and behavioral pathways.[1] Religiosity relates to lower risk of hypertension,[2,3] cancer,[4,5] cerebrovascular disease,[6] and reduced risk of all-cause mortality.[7] There are various studies on religion and health, but there are not many that focus on beneficial effects of religion on cognitive functions. In the previous studies, religiosity was positively associated with cognitive functions, as per the evaluation by Mini-Mental State Examination (MMSE) among patients with chronic kidney disease,[8] rehabilitation service patients,[9] and the participants of Chinese Healthy Longevity Survey.[10] Among community-dwelling aged people, those with higher levels of spiritual activity have been observed to have a better composite score for cognitive functions.[11] In a longitudinal study, slower decline in MMSE score related to greater spirituality and individual religious practices among probable patients with Alzheimer's disease (AD).[12] Another study of patients with AD found that higher levels of religiosity appeared to be associated with slower cognitive deterioration evaluated by MMSE.[13] These results suggest that religious affiliation seems to be a protective factor, not only for physical health but also for cognitive functions.[14,15]

However, these studies have a limitation in that they have evaluated cognitive functions based on a single composite

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score or global cognitive function scale (eg, MMSE, the clinical dementia rating).[8-10,12,13] There are various subdomains under cognitive functions such as memory, language, and constructive ability. The limitation for global evaluation of cognitive functions makes it difficult to determine the domains of cognitive functions that religiosity could affect. In addition, most previous studies did not consider various dimensions of religiosity and evaluated only one aspect of religiosity.[8-11] Religiosity has been variously assessed as inner religious belief, frequency of participation in religious meeting, or the time spent on prayer and meditation. Evaluating only one aspect of religiosity makes it difficult to identify the aspects of religiosity that more closely relate to cognitive functions.

To clarify the relationship between religiosity and cognitive functions, a more thorough evaluation of various aspects of religiosity and cognitive functions with qualified tools is required. Additionally, this work was recommended as a future direction of a study on religion.[16] It would enable us to determine which aspects of religiosity could be associated with which subdomains of cognitive functions. As far as we know, there are no studies that verify this specific relationship. Through verifying this relationship, we can understand the beneficial effects of religion on cognitive functions in the elderly patients and apply this understanding in a clinical setting.

In this study, we aimed to investigate the association between religiosity and cognitive functions. We hypothesized that religiosity could affect cognitive functions and that the religiosity shows different pattern of relations with the subdomains of cognitive functions among outpatients with AD.

Methods

Participants

In all, 395 participants older than 60 years were recruited as outpatients of the Geriatric Psychiatric Clinic of Chuncheon Sacred Hospital in Gangwon Province, Republic of Korea, from April 2013 to December 2015. A comprehensive workup including geriatric examinations and neurocognitive tests were performed to exclude participants with major comorbidities (eg, major depressive disorder, organic brain syndrome, vascular dementia). Forty-four participants with major comorbidities were excluded. We excluded 10 individuals classified as practicing a religion other than Christianity or Buddhism (eg, Korean traditional shamanism) owing to the small sample size. Also, 16 participants who scored more than 5 (moderately severe cognitive decline) on the Global Deterioration Scale (GDS) were excluded given the reliability of self-report. After excluding participants with neurocognitive disorders caused by factors other than AD according to the *Diagnostic and Statistical Manual of Mental Disorders*, *Fourth Edition*, the final sample included 325 participants. The study protocol was approved by the institutional review board of Chuncheon Sacred Heart Hospital.

Clinical Evaluation

All participants underwent a structured evaluation that included medical history and neurological examinations by psychiatrists. Detailed cognitive functions were assessed through one-on-one interviews with each participant by skilled clinical psychologists.

Measures

Cognitive functions. The Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet (CERAD) has been widely used in many clinical and research settings to evaluate cognitive functions.[17] It was translated into Korean and was standardized for the Korean population.[18] The CERAD-K consists of a clinical assessment battery and neuropsychological assessment battery that includes the Korean version of the Mini-Mental State Examination (MMSE-KC), verbal fluency test, the Korean version of the Boston Naming Test (K-BNT), word list memory test, word list recall test, word list recognition test, constructional praxis test, and constructional recognition test. The MMSE-KC includes simple questions about orientation for time and place, repetition and memory of words, language comprehension, and fundamental motor skills. In verbal fluency test, participants produce as many words as possible for animals. The K-BNT is a picture-naming test in which participants have to tell the names of 15 pictures. In word list memory, and recall and recognition tests, participants have to remember, recall, and recognize 10 words. Constructional praxis test is a drawing task involving 4 figures suggested on paper and, in a constructional recognition test, participants are asked to recall and draw the figures. The CERAD-K demonstrated equivalence when compared with the original version of the test and its reliability and validity was confirmed. The scores for tasks in the same domain were summed to calculate the score in the cognitive domain. The language score was calculated using the verbal fluency and K-BNT scores. The score for the memory domain was derived from word list memory, word list recall, word list recognition, and constructional recognition, while the score for the constructional ability domain was derived from constructional praxis. The GDS included in this battery is widely used for the purpose of measuring the severity of dementia.[19] It was translated into Korean and standardized for the Korean population.[20] Following deficits in cognition and functions, clinician evaluates the severity from 1 (no cognitive decline) to 7 (very severe cognitive decline).

Religious affiliation. Religious affiliation was defined as the self-identified association with religion, denomination, or subdenominational religious group. Participants reported their religious affiliation through questionnaires, choosing from Christianity (ie, Catholicism and Protestantism), Buddhism, other religion, and no religion. Participants who chose "no religion" were classified as the religiously nonaffiliated group.

The Duke University Religion Index. The Duke University Religion Index (DUREL) was developed by Koenig et al[21] and was

adapted for the Korean population.[22] The 5-item DUREL had a Cronbach α of .80 in this study. In a different study, the 5-item scale had a Cronbach α of .75 and was strongly correlated ($r = 0.85$) with the original 10-item scale.[23] The DUREL is composed of 5 items and 3 subscales: organizational religious activity (ORA; the frequency of attending religious meetings and other group-related religious activity), nonorganizational religious activity (NORA; the frequency of private religious activities such as prayer and meditation), and intrinsic religiosity (IR; the subjective experience about the Absolute, the importance of one's belief, the strong will to carry on one's belief). The ORA and NORA are scored on a scale ranging from 1 (more than once a day) to 6 (never), and the 3 items on the IR subscale are scored on a scale ranging from 1 (definitely true for me) to 6 (definitely not true). Then, we reversed each score and added the score of the 3 items on the IR subscale to calculate the IR score. A higher score on the 3 subscales indicates a higher level of religiosity and spirituality.

Statistical Analyses

Demographic data and clinical data were analyzed using descriptive statistics. Additionally, we analyzed the correlations among the subdomains of cognitive and religious variables. To verify the positive effects of religiosity on cognitive functions, we performed structural equation modeling to estimate latent variables from measurement variables.[24] Age, sex, and years of education were set as control variables for the dependent variable. The standard χ^2 test, Tucker-Lewis index (TLI), comparative fit index (CFI), and root-mean-square error of approximation (RMSEA), as well as the standardized root-mean-square residual (SRMR), were used to evaluate the model fit. If the TLI and CFI are approximately 0.90 or higher, the fit of the model is considered good. In case of the RMSEA and the SRMR, below 0.05 indicates a good fit, from 0.05 to 0.10 indicates a mediocre fit, and greater than 0.10 indicates a poor fit.[25] Since the cross-sectional design makes it difficult to verify the direction of effect, we performed the χ^2 difference test to compare 1 research model and 2 competition models. We set up the research model in which religiosity affects cognitive functions. Next, reversing the direction, we set up competition model 1 assuming that cognitive functions affect religiosity. In competition model 2, it was assumed that cognitive functions and religiosity mutually influenced each other. Finally, we conducted a partial correlation analysis among the religious variables and the subdomains of cognitive functions after controlling for demographic data. Data were analyzed using the Amos and SPSS software statistical package (version 22.0.0, SPSS Inc).

Results

Group Characteristics

A total of 325 participants (religiously affiliated group = 179 and religiously nonaffiliated group = 146) took part in this study. The mean age was 79.15 (±6.47) years, 235 (72.3%) participants were women, and the average years of education was 3.62 (±3.78). Among all participants, the most common religion was Christian (42.2%), followed by Buddhism (12.9%). The religiously nonaffiliated group comprised 44.9% of the participants (Table 1).

Table 1. Group Characteristics.[a]

Variables	Participants, n = 325
Age (years)	79.15 (6.47)
Sex, female (%)	235 (72.30)
Educational duration (years)	3.62 (3.78)
GDS	4.01 (0.77)
Religion	
Christian	137 (42.20%)
Buddhism	42 (12.90%)
No religious affiliation	146 (44.9%)
Religious variables	
ORA	2.80 (2.08)
NORA	2.42 (1.99)
IR	7.99 (4.64)
Cognitive functions	
Memory	12.59 (6.85)
Language	12.24 (4.37)
Constructional ability	6.33 (2.23)

Abbreviations: GDS, Global Deterioration Scale; IR, intrinsic religiosity; NORA, nonorganizational religious activity; ORA, organizational religious activity.
[a]Data are presented in mean (standard deviation; SD) or frequency (percentage).

Correlation Among Subdomains of Cognitive Functions and Religious Variables

In correlation analysis among the subdomains of cognitive functions and religious variables, ORA had significantly positive associations with memory ($r = 0.179$, $P = .001$), language ($r = 0.148$, $P = .008$), and constructional ability ($r = 0.236$, $P = .000$). Additionally, NORA demonstrated a significant relationship with memory ($r = 0.127$, $P = .022$) and constructional ability ($r = 0.232$, $P = .000$), and IR had a significantly positive association with memory ($r = 0.169$, $P = .002$) and constructional ability ($r = 0.191$, $P = .001$; Table 2).

Comparison of the Models Among Religiosity and Cognitive Functions

When the absolute values of the skewness and kurtosis do not exceed 2 and 7, respectively, the assumption of normality is satisfied.[26] As shown in Table 2, the variables used in this study met the assumption of normality. The fit of the research model and the 2 competition models were evaluated through structural equation modeling, controlling for age, sex, and years of education. The fitness of each model is shown in Table 3. The 3 models were in a nested relationship with each other, so we conducted a χ^2 difference test. First, we compared competition model 1 with competition model 2. As a result, competition model 2 was the better fit than competition model 1

Table 2. Correlation Among Subdomains of Cognitive Functions and Religious variables.

Variables	ORA	NORA	IR	Memory	Language	Constructional Ability
ORA	–					
NORA	0.665[a]	–				
IR	0.776[a]	0.724[a]	–			
Memory	0.179[b]	0.127[c]	0.169[b]	–		
Language	0.148[b]	0.045	0.091	0.327[a]	–	
Constructional ability	0.236[a]	0.232[a]	0.191[b]	0.243[a]	0.385[a]	–
Skewness	0.50	0.86	0.22	−0.44	0.39	−0.19
Kurtosis	−1.52	−1.07	−1.51	1.57	−0.18	0.05

Abbreviations: IR, intrinsic religiosity; NORA, nonorganizational religious activity; ORA, organizational religious activity.
[a]$P < .001$.
[b]$P < .01$.
[c]$P < .05$.

Table 3. Comparison of Model Fit Among Research Model and Competition Models.

Model Fit Indices	Research Model	Competition Model 1	Competition Model 2
χ^2	69.289	71.907	66.188
df	24	24	23
RMSEA	0.076	0.078	0.076
90% CI for RMSEA	0.056-0.097	0.058-0.100	0.055-0.098
SRMR	0.069	0.071	0.067
TLI	0.921	0.916	0.921
CFI	0.947	0.944	0.949
AIC	111.089	113.907	110.188

Abbreviations: AIC, Akaike information criterion; CFI, comparative fit index; df, degrees of freedom; RMSEA, root-mean-square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker-Lewis index; 90% CI for RMSEA, confidence interval for the RMSEA.

($\Delta\chi^2$ [1] = 5.719, $P < .05$). When comparing competition model 2 to the research model, the research model showed a better fit ($\Delta\chi^2$ [1] = 3.101, ns). The research model showed the most acceptable fit to the data (χ^2 [24] = 69.289; RMSEA = 0.076; 90% confidence interval: 0.056-0.097; SRMR = 0.069; TLI = 0.921; CFI = 0.947; Figure 1).

Table 4 displays the nonstandardized and standardized coefficient estimates and the standard error for each path presented in the research model supported by this study. The latent factors, religiosity and cognitive functions were well represented by each indicator as all the factor loadings were significant ($P < .001$). This model includes a significant direct effect from religiosity to cognitive functions ($B = 0.420$, $P < .001$). Finally, squared multiple correlations of cognition were 0.578, indicating that this model accounts for 57.8% of the variance in cognitive functions.

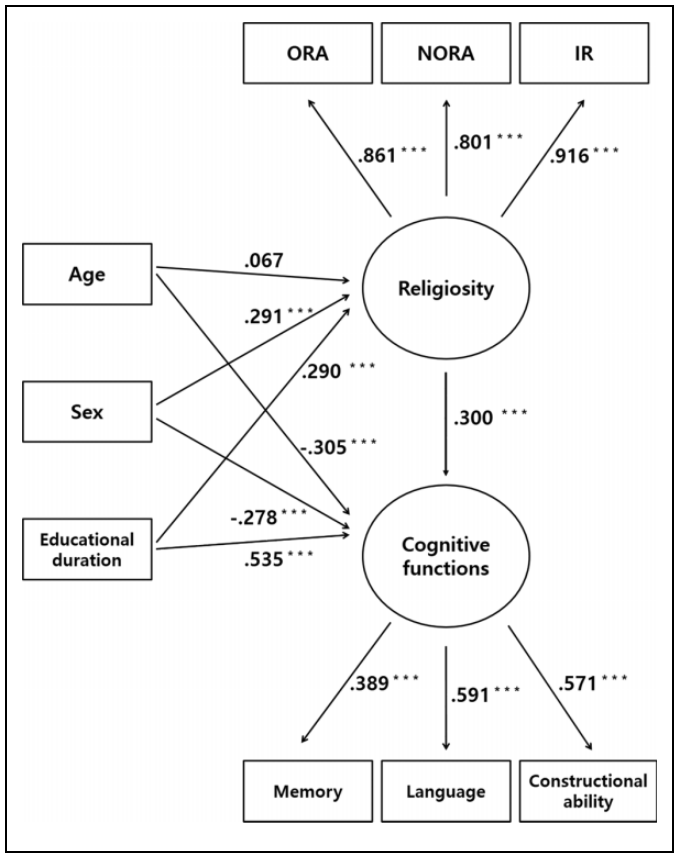

Figure 1. The research model. The coefficients above the arrows are standardized estimates. ***$P < .001$. IR indicates intrinsic religiosity; NORA, nonorganizational religious activity; ORA, organizational religious activity.

Partial Correlation Among Subdomains of Cognitive Functions and Religious Variables Controlling Demographic Variables

After controlling for sex, age, and years of education, ORA was positively related to memory ($r = 0.144$, $P = .010$), language ($r = 0.149$, $P = .007$), and constructional ability ($r = 0.191$, $P = .001$). Both NORA and IR demonstrated a positive relationship with memory ($r = 0.115$, $P = .040$; $r = 0.140$, $P = .012$) and constructional ability ($r = 0.207$, $P = .000$; $r = 0.136$, $P = .015$; Table 5).

Discussion

As we hypothesized, the results of this study show that religiosity has a beneficial effect on cognitive functions in

Table 4. Coefficient Estimates of the Research Model.

Path	*B*	SE	*b*	CR	*P*
Religiosity → cognitive functions	0.420	0.112	0.300	3.751	<.001
Religiosity → ORA	1	–	0.861	–	–
Religiosity → NORA	0.884	0.051	0.801	17.484	<.001
Religiosity → IR	2.368	0.116	0.916	20.331	<.001
Cognitive functions → memory	1	–	0.389	–	–
Cognitive functions → language	0.981	0.140	0.591	7.011	<.001
Cognitive functions → constructional ability	0.484	0.070	0.571	6.922	<.001
Age → religiosity	0.019	0.015	0.067	1.259	.208
Age → cognitive functions	−0.122	0.028	−0.305	−4.317	<.001
Sex → religiosity	1.195	0.224	0.291	5.347	<.001
Sex → cognitive functions	−1.602	0.417	−0.278	−3.84	<.001
Educational duration → religiosity	0.141	0.027	0.29	5.332	<.001
Educational duration → cognitive functions	0.366	0.059	0.535	6.161	<.001

Abbreviations: CR, critical ratio; IR, intrinsic religiosity; NORA, nonorganizational religious activity; ORA, organizational religious activity; SE, standard error.

Table 5. Partial Correlation Among Subdomains of Cognitive Functions and Religious Variables Controlling Age, Sex, and Educational Duration.

Variables	ORA	NORA	IR	Memory	Language
ORA	–				
NORA	0.632[a]	–			
IR	0.750[a]	0.692[a]	–		
Memory	0.144[b]	0.115[b]	0.140[b]	–	
Language	0.149[c]	0.059	0.090	0.220[a]	–
Constructional ability	0.191[c]	0.207[a]	0.136[b]	0.135[b]	0.260[a]

Abbreviations: IR, intrinsic religiosity; NORA, nonorganizational religious activity; ORA, organizational religious activity.
[a]$P < .001$.
[b]$P < .05$.
[c]$P < .01$.

outpatients with AD. In addition, a more specific relationship between the subdomains of religiosity and cognitive functions was also suggested as compared to previous studies. The dimensions of religiosity show different association with the subdomains of cognitive functions in that memory and constructional ability relate to all of the religious variables (eg, ORA, NORA, and IR), but language was associated with only ORA. To the best of our knowledge, this is the first study that suggests a specific relationship among the subdomains of cognitive functions (eg, memory, language, and constructional ability) and various aspects of religiosity.

In our results, only ORA relates to all of the subdomains of cognitive functions. The ORA involves activities demanding comprehensive cognitive ability, such as a series of tasks required to attend religious meeting, singing, sermons, philosophical discussion, voluntary service, and general socializing. We think that social and physical features of ORA are the important characteristics that distinguish it from NORA and IR. We speculate that these features of religious variables make dissimilar relationships with cognitive functions. Many studies suggest that social activity is a protective factor against cognitive decline. Social participation could reduce the risk of cognitive impairment[27] and functional disability in the elderly patients.[28] Further, social disengagement negatively affects cognitive decline because social engagement provides a dynamic environment demanding cognitive efforts.[29] In regard to physical activity, there is evidence that lifestyle activities including household maintenance, domestic chores, social activity, and service to other significantly predict cognitive functions such as language and memory ability.[30] In addition, regular physical activities involving walking is related to better language and memory ability and loss cognitive decline.[31] Meta-analysis study show that cognitive functions is positively affected by physical activity in patients with dementia.[32] Combined with the result of this study and the previous studies, we think that the effect of ORA on cognitive functions includes the positive function of social and physical activities, yet it is needed to study for the other aspect of ORA.

On the other hand, NORA and IR include fewer of these dynamic activities as compared to ORA. Nevertheless, there are findings indicating NORA and IR also relate positively to cognitive functions. There is evidence that the frontal lobe and temporopolar areas are activated when people meditate or pray, which are the components of NORA.[33,34] Meditation could also improve attentiveness and working memory and may relate to a thicker cerebral cortex.[35,36] These studies could explain the beneficial effects of NORA on memory. In a previous study on IR, it was found to be positively associated with cognitive functions and it moderated the relationship between depression and cognitive functions.[37] Interestingly, a recent cohort study has suggested that religious importance involved in IR is associated with thicker cortices in the left and right parietal and occipital areas.[38] Considering the association of constructional ability with the parietal-occipital lobes,[39,40] high levels of IR could beneficially affect constructional ability. Although these studies partially explain the positive effects of NORA and IR on memory and constructive ability, further studies are needed to identify how NORA and IR related to cognitive functions.

In this study, we compared 3 models that reflect different directions of influence between religiosity and cognitive

functions. We set a hypothetical direction for each unidirectional effect and mutual effect in the relationship since cross-sectional design makes it difficult to verify the direction of influence. Consequently, the model in which religiosity affects cognitive functions demonstrated the highest model fit when compared to the other models in this study (Figure 1). This result reflects the beneficial effects of religiosity on cognitive functions, in accordance with previous longitudinal studies that suggest religiosity to be a protective factor against cognitive decline.[8-16]

Using structural equation modeling, we identified the beneficial effect of religiosity on cognitive functions with cross-sectional data. Further, the findings of this study demonstrate that the beneficial effects could vary depending on the subdomains of religiosity. Therefore, future studies and practitioners should consider not only whether the participants have a religious affiliation but also what aspect of religiosity the participants engage in using a multimodal approach. However, our results showed relatively weak relationship between religiosity and cognitive functions. It could be said that the religiosity would play an additive beneficial role in the prevention of cognitive decline. This study has some limitations. As a cross-sectional study, a longitudinal approach is needed to verify the causal inferences of this study, despite the use of statistical methods to overcome this limitation. In addition, the subscale of the DUREL was not suitable to assess IR for people who are non-Christians. The ORA and NORA were simply assessed through the frequency of religious activity, but the subscale of IR could be affected by the cultures and doctrines of each religion.

Conclusion

The results of this study indicate that religiosity positively affects cognitive functions in outpatients with AD. Moreover, each component of religiosity could relate differently to the subdomains of cognitive functions. Specifically, ORA was found to be associated with memory, language, and constructive ability, but NORA and IR only related to memory and constructive ability.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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