Mediating Effect of Digital Information Utilization Ability and Interpersonal Contact on the Relationship between Cognitive Function and Depression in Korean Older Adults

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Abstract

Background: As Korea rapidly enters a super-aged society, interest in depression, a change in psychological function that occurs with aging, is increasing. Although previous studies have suggested a relationship between depression and cognitive decline in older adults, they have not clarified how cognitive decline leads to depression. We aimed to examine the mediating effects of digital information utilization ability (DIUA) and interpersonal contact (IC) in the relationship between cognitive function and depression in older adults.

Methods: This descriptive cross-sectional study used data from the 2020 Korean Elderly Survey. The participants were 9,920 seniors aged 65 years and older. Descriptive statistics, *t*-test, and one-way ANOVA correlation analysis were performed using SPSS 24.0 and the dual mediation effect was analyzed using PROCESS Macro for SPSS v.3.5 model 6.

Results: Depression had a negative correlation with cognitive function (r=-.26, *P*<.001), DIUA (r=-.20, *P*<.001), and IC (r=-.13, *P*<.001). Cognitive function was positively correlated with DIUA (r=.40, *P*<.001) and IC (r=.08, *P*<.001). There was a positive correlation between DIUA and IC (r=.10, *P*<.001). Finally, the mediating effect of cognitive function on depression through the dual parameters of DIUA and IC was also statistically significant (B=.-001, 95% CI [-.002, -.001).

Conclusion: The depression caused by cognitive decline can be reduced by improving older adults' ability to use digital information and interact with others. Therefore, social interventions to increase the interpersonal contact of older adults is required, and education programs for improving older adults' ability to utilize digital information may be developed to increase indirect contact using digital devices as well as direct contact.

Keywords: Aged; Cognition; Depression; Mobile applications; Interpersonal relations

Introduction

As Korea is rapidly entering a super-aged society, individual and social interest in the health of older adults is increasing. An increase in depressive tendencies occurs with aging (1). According to data from the 2020 Korean Elderly Survey, 13.5% of older adults reported symptoms of de-

pression, which is higher than those in Western countries (2). Depression in old age is associated with dementia, anxiety disorders, and sleep disorders, along with mental health in old age. It is a major factor that threatens the quality of life, and should be managed (3).

One of the factors found to influence depression in older adults is cognitive decline. Dementia, which is an extreme form of cognitive decline, is a social issue that is not only related to personal happiness and well-being, but also incurs enormous socioeconomic costs (4). The WHO identified dementia as a major factor threatening the mental health of older adults (5). Impairment or decline in cognitive function is a factor that increases the risk of developing dementia, so it must be managed (6). The cognitive decline caused by aging affects older adults' ability to lead active and productive lives (7). In particular, cognitive decline is frequently observed in older adults with depression. Although several previous studies suggest a close relationship between cognitive function and depression in older adults (6,8), it is necessary to examine how cognitive decline leads to depression.

Interpersonal contact, which refers to the frequency with which older adults communicate with people around them, can be considered a variable highly related to cognitive function and depression. In a study on older adults, the frequency of contact with grandchildren was found to be related to cognitive function (9), and contact with children or social participation was also related to depression (10). When older adults experience cognitive impairment, it becomes difficult to use devices such as telephones, and mobility also becomes difficult (11). Because the overall life satisfaction of older adults is affected by spouses, children, relatives and friends (12), if the cognitive decline worsens and contact with people around them decreases, the chances of depression may increase.

In addition, the environment is rapidly changing in the information age owing to the recent developments in technology. The ability to use mobile phones and the Internet is an important factor in the quality of life, affecting not only sharing in-

formation but also various areas of life (13). Those who experience inequality in using digital information do not receive the benefits of using information, leading to digital alienation (14). In particular, this alienation phenomenon is prominent in older adults, and the problem of digital information utilization ability of older adults leads not only to a decrease in information level, but also to negative results such as a decrease in the quality of life, social alienation, and an increase in depression (15,16). Older adults with high digital information usage ability maintained a high level of mental health (17), increased cognitive function (18), and decreased depression and loneliness (19). However, when the cognitive function of older adults decreases, the ability to use digital information inevitably decreases, which can lead to depression.

However, many studies that have identified the relationship between cognitive function and depression in older adults focus only on certain parts such as depression or cognitive function (4,6,7). Additionally, previous studies on digital information utilization ability and interpersonal contact were not conducted well in relation to cognitive function and depression (9,10). In particular, it is difficult to find an empirical study that considers the mediating effect of digital information utilization and interpersonal contact in the relationship between cognitive function and depression in older adults. Because depression in older adults is a psycho-emotional response, it is expected to provide fundamental data for developing a comprehensive intervention method to prevent depression by examining the process that leads to depression through digital information utilization ability and interpersonal contact. Therefore, this study aims to examine the dual mediating effects of digital information utilization ability and interpersonal contact in the relationship between cognitive function and depression in older adults.

Therefore, it was assumed that (a) DIAU has a mediating effect in the relationship between cognitive function and depression; (b) IC has a mediating effect in the relationship between cognitive function and depression; and (c) DIAU and

IC have a dual mediating effect in the relationship between cognitive function and depression.

Materials and Methods

Study design and participants

This secondary analysis study used data from the 2020 Korean Elderly Survey (KES). It was a descriptive correlational study to identify the mediating effect of digital information utilization and IC in the relationship between cognitive function and depression in older adults. The KES received approval for statistical change from the National Statistical Office for the sample design and survey contents (approval number 117071)

The survey was approved by the Institutional Review Board (IRB) of the Korea Institute for Health and Social Affairs (No. 2020-36).

Data collection was conducted through one-on-one direct interviews by 169 interviewers from September 14 to November 20, 2020. The survey was conducted on older adults over 65 years in 969 survey districts, and 10,097 people responded to the final survey. Data from 9,920 people who responded directly, excluding 177 people who responded by proxy, were analyzed.

Study variables

General characteristics consisted of age (65-74, ≥ 75 years), sex (male, female), and education level (≤ elementary school, middle school, high school, ≥ college), household member composition (living alone, couple only, couple and children), economic activity (yes, no), perceived health status (healthy, moderate, unhealthy), number of chronic diseases (0, 1, 2, ≥ 3), visual discomfort (yes, no), and hearing discomfort (yes, no). Economic activity referred to the subject's answer to whether they were currently working, and visual and hearing discomfort comprised responses to whether there was such discomfort in their daily life.

Cognitive function was measured using the Korean version of Mini Mental State Examination for Dementia Screening (MMSE-DS) developed already (20, 21). The MMSE-DS consists of 19 items of orientation, memory, concentration, language ability, execution ability, figure simulation, judgment and problem-solving ability, and the score ranges from 0 to 30 points. In this study, the total score of MMSE-DS was used among the survey data of older adults, and the higher the score, the higher the cognitive function. At the time of development of the Korean version, Cronbach's α was .83, and that of this study was .90.

Depression was measured using the short form of Geriatric Depression Scale (SGDS-K) developed already (22, 23). It is a dichotomous scale with 15 questions, answered with "yes" or "no," with 1 point for "yes" and 0 points for "no." Five items with inverted contents were reverse-coded, and the total score ranged from 0 to 15 points, with higher scores indicating more severe depression. At the time of development of the Korean version of the tool, Cronbach's α was .88, and that of this study was .85.

Digital information utilization ability (DIUA) refers to the ability to utilize various digital information using electronic devices such as smartphones, desktops, and laptops. Based on a study (24), from the 2020 KES data, receiving and sending messages (text, Kakao Talk, Telegram, etc.), information search and inquiry (news, weather, etc.), taking photos or videos, listening to music (MP3, radio, etc.), playing games, watching videos (movies, TV shows, YouTube, etc.), social network services (blog, community, band, Twitter, Facebook, Instagram, etc.), e-commerce (online shopping, reservation, etc.), financial transaction (internet banking, securities, etc.), application search and installation, and others were used. A total of 12 items were coded as 1 point if used, and 0 points if not used.

Interpersonal contact (IC) is the frequency of contact with people over the past year, and the range of people, reflecting the KES questions, is categorized into three categories: i) children who do not live together, ii) relatives including brothers and sisters, and iii) other friends, neighbors, and acquaintances (25). The question measuring the frequency of contact was "How often do you communicate with all your children (including

your child's spouse) and relatives including siblings or friends, and neighbors and acquaintances (through phone calls, text messages, e-mails, letters, etc.)?" and rated according to the following: "little contact" (1 point), "one to two times a year" (2 points), "one to two times in three months" (3 points), "one to two times a month" (4 points), "one to two times a week" (5 points), and "four or more times a week or almost every day" (6 points). A higher score means a higher amount of contact.

Statistical analysis

Data were analyzed using IBM® SPSS® software v.25.0 (IBM Corp., Armonk, NY, USA) and the significance level was set to .05. The general characteristics and the degree of study variables were analyzed with descriptive statistics. The correlation between cognitive function, depression, DIUA, and IC was analyzed with Pearson's correlation coefficient. Hayes's (26) PROCESS Macro for SPSS v.3.5 model 6 was applied to understand the mediating effect of DIUA and IC in the relationship between cognitive function and depression. The bootstrapping method was used to verify the significance of the mediating effect, and 10,000 samples were resampled. For significance test, 95% confidence interval (CI) was used.

Results

General characteristics and descriptive results

Table 1 shows the general characteristics of the participants and the degree of study variables. With regard to age, 60.3% were under the age of 75 years, and women accounted for 60.0%.

Table 1: General characteristics and degree of study variables (N=9920)

Characteristics	Categories	n (%) or M (SD)
Age(yr)	65-74	5977 (60.3)
	≥75	3943 (39.7)
Sex	Male	3971 (40.0)
	Female	5949 (60.0)
Education level	≤Elementary school	4431 (44.7)
	Middle school	2330 (23.5)
	High school	2654 (26.8)
	≥College	505 (5.1)
Household member composition	Living alone	3117 (31.4)
	Couple only	5071 (51.1)
	Couple and children	1602 (16.1)
Economic activity	Yes	3773 (38.0)
	No	6147 (62.0)
Perceived health status	Healthy	4940 (49.8)
	Moderate	3120 (31.5)
	Unhealthy	1860 (18.8)
Number of chronic diseases	0	1678 (16.9)
	1	2922 (29.5)
	2	2712 (27.3)
	≥3	2608 (26.3)
Visual discomfort	Yes	6634 (66.9)
	No	3286 (33.1)
Hearing Discomfort	Yes	7623 (76.8)
	No	2297 (23.2)
Cognitive function		24.43 (5.05)
Depression		3.37 (3.40)
Digital information utilization ability		3.69 (3.12)
Interpersonal contact		12.77 (2.12)

Those with less than elementary school education accounted for the most at 44.7%, and participants who said they were subjectively healthy accounted for 49.8%. Cognitive function scored an average of 24.43 (±5.05) points, and depression scored 3.37 (±3.40) points. DIUA was 3.69 (±3.12) points, and IC was 12.77 (±2.12) points.

Correlation between study variables

Depression had a negative correlation with cognitive function (r=-.26, P<.001), DIUA (r=-.20, P<.001), IC (r=-.13, P<.001). Cognitive function was positively correlated with DIUA (r=.40, P<.001) and IC (r=.08, P<.001). A positive correlation was observed between DIUA and IC (r=.10, P<.001) (Table 2).

Table 2: Correlation among research variables (N=9920)

Variables	Cognitive function	Depression	DIUA	IC
	r (*P*)	r (*P*)	r (*P*)	r (*P*)
Depression	-.26 (<.001)			
DIUA	.40 (<.001)	-.20 (<.001)	1	
IC	.08 (<.001)	-.13 (<.001)	.10 (<.001)	1
DIUA; Digital information utilization ability, IC: Interpersonal contact				

Mediating effect of DIUA and IC on the relationship between cognitive function and depression

As a result of analyzing the mediating effect of DIUA and IC on the relationship between the cognitive function and depression, each model was statistically significant (Table 3, Fig. 1). In Step 1, cognitive function had a significant effect on depression (β=-.151, P<.001), and in Step 2, cognitive function had a significant effect on DIUA (β=.242, P<.001). In Step 3, cognitive function (β=.016, P=.003) and DIUA (β=.061, P<.001) had a significant effect on IC, and in Step 4, cognitive function (β= -.116, P<.001), DIUA (β=-.129, P<.001), and IC (β=-.128, P<.001) significantly affected depression.

Table 3: Mediating Effect of Digital Information Utilization Ability and Interpersonal Contact on the Relationship between Cognitive function and Depression in the Elderly (N=9920)

| No	Variables			β (Coeffect)	SE	P	95% CI	
							LLCI	ULCI
1	Cognitive function	→	Depression	-.151	.008	<.001	-0.167	-0.136
2	Cognitive function	→	DIUA	.242	.007	<.001	0.227	0.257
3	Cognitive function	→	IC	.016	.005	.003	0.005	0.028
	DIUA	→	IC	.061	.008	<.001	0.044	0.078
4	Cognitive function	→	Depression	-.116	.008	<.001	-0.133	-0.099
	DIUA	→	Depression	-.129	.012	<.001	-0.154	-0.103
	IC	→	Depression	-.128	.018	<.001	-0.164	-0.091
DIUA; Digital Information Utilization Ability, IC: Interpersonal Contact, CI=Confidence interval; LLCI=Lower limit confidence interval; ULCI=Upper limit confidence interval								
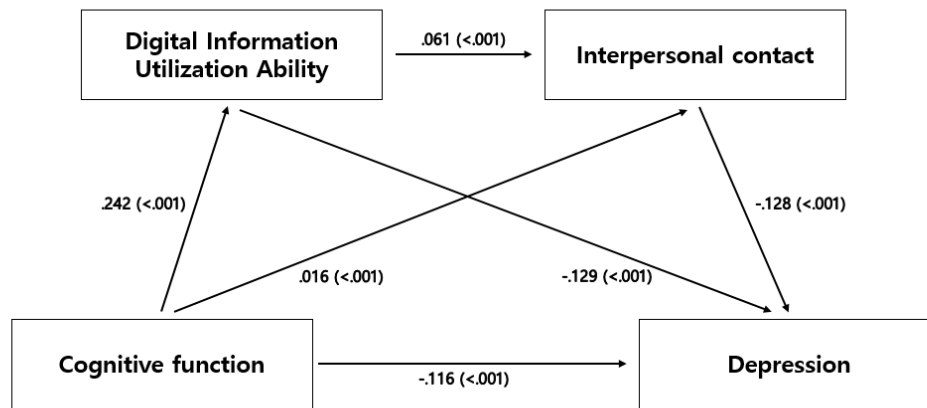
Fig. 1: Mediating effect of variables

Table 4 shows the results of comparing the difference in the effect values for the pathways to understand the significance and magnitude of the double mediation effect. The mediating effect of cognitive function on depression through DIUA (Indirect 1) was statistically significant (B=-.031, 95% CI [-.037, -.025]). The mediating effect of depression through IC on cognitive function (Indirect 2) was statistically significant (B=-.002, 95% CI [-.004, -.001]). Finally, the mediating effect of cognitive function on depression through the dual parameters of DIUA and IC (Indirect 3) was also statistically significant (B=.-001, 95% CI [-.002, -.001). As a result of examining the differ-

ence in mediating effect in the three routes, significant differences were observed between Indirect 1 and Indirect 2 and between Indirect 1 and Indirect 3, and no significant difference was observed between Indirect 2 and Indirect 3. In other words, the mediating effect of cognitive function on depression by increasing DIUA was stronger than the effect of cognitive function on depression by increasing IC or the double mediating effect through DIUA and IC. Through this, it was confirmed that the mediating effect through DIUA was strong in the process of cognitive function affecting depression.

Table 4: Validation of Mediating Effect (Bootstrapping) (N=9920)

Variables		*Effect*	*Boot SE*	*95% CI*	
				LLCI	ULCI
Indirect 1	Cognitive function → DIUA→ Depression	-.031	.003	-.037	-.025
Indirect 2	Cognitive function → IC→ Depression	-.002	.001	-.004	-.001
Indirect 3	Cognitive function → DIUA→ IC→ Depression	-.001	.001	-.002	-.001
Differences	Indirect 1 - Indirect 2	-.029	.003	-.035	-.022
(⊿B)	Indirect 1 - Indirect 3	-.029	.003	-.035	-.023
	Indirect 2 - Indirect 3	-.001	.001	-.002	.001
DIUA; Digital Information Utilization Ability, IC: Interpersonal Contact, CI=Confidence interval; LLCI=Lower limit confidence interval; ULCI=Upper limit confidence interval.					

Discussion

This study was conducted to examine the mediating effects of DIUA and IC in the relationship between cognitive function and depression in

older adults using the 2020 Korean Elderly Survey. DIUA had a mediation effect in the relationship between cognitive function and depression. IC had a mediation effect in the relationship between cognitive function and depression. Finally,

the mediating effect of cognitive function on depression through the dual parameters of DIUA and IC was also statistically significant. The cognitive function of older adults in this study was 24.43, which was similar to the study of Lee and Tak (9) analyzed using data from the 2017 KES. However, for depression, the score of this study was 3.37, which was lower than that of 5.15 in another study (9). This may be attributed to the fact that the proportion of older adults was higher in this study than in the study of Lee and Tak (9). This result is consistent with the findings of a previous study that the depression of older adults tends to increase with age (27). In this study, the DIUA score was 3.56 out of 12, and the IC score was 12.77. The DIUA score is similar to that of 0 to 3 out of 9 in another study (24). However, it was difficult to directly compare the DIUA and IC scores with the previous studies because the scoring and analysis methods were different. In the future, the development of a standardized tool to evaluate the digital information literacy ability and interpersonal contact of older adults is necessary.

The cognitive function of older adults was shown to have a positive effect on DIUA, and increased DIUA was shown to decrease depression. Age, educational level, subjective health, cognitive function, and depression affect the digital informatization level of older adults (24). Among them, cognitive function was confirmed to affect the digital information level of older adults of all ages. In addition, the higher the digital information literacy of older adults, the higher the life satisfaction (24). When the UIDA is high, older adults can easily find the information they want using digital devices, which can increase their self-efficacy due to low dependence on others (28). Therefore, the improved self-efficacy or life satisfaction of older adults can reduce depression in older adults. It is considered necessary to develop a program to improve DIUA in older adults as an intervention to reduce depression in older adults. In addition, a follow-up study to evaluate the disability factors of DIUA in older adults is necessary prior to the development of such a program.

The cognitive function of older adults affected interpersonal contact, and increased interpersonal contact was found to decrease depression. In this study, interpersonal contact was focused on the extent to which people communicated frequently through text messages and e-mails. In older adults, when cognitive function declines, instrumental daily life decreases (29). A decrease in the ability to use phones or computers due to the cognitive decline of older adults may lead to a decrease in interpersonal contact. Additionally, as revealed in previous studies, a decrease in interpersonal contact can lead to an increase in depression because it isolates older adults. In a study (30), the digital information gap among older adults was affected by the motives of using digital information and perceptions of the intelligent information society. Therefore, to improve the interpersonal contact of older adults, education for improving the awareness and accessibility of digital information use is necessary.

In this context, the dual mediating effect shown in this study was significant; cognitive function in older adults was found to increase DIUA. An increase in DIUA increased IC, and an increased IC decreased depression in older adults. In other words, the cognitive function of older adults increases the use of digital devices, and the improvement of digital devices makes it easier to contact people around them, thereby activating communication and expanding social networks (29). Therefore, interpersonal contact can be improved and depression can be reduced accordingly. Improving the ability to use electronic devices improved life satisfaction in older adults and reduced depression (31). Digital literacy and the use of digital devices improved the cognitive function of older adults (9). It was presumed to be an adversarial relationship. Therefore, programs to improve information utilization and IC using digital devices are necessary in an effort to reduce depression in older adults. In addition, there are not enough previous studies that have explored cognitive function and digital information utilization, or cognitive function and interpersonal relationships targeting older adults. Therefore, further studies are needed to explore the relation-

ship between cognitive function, digital information utilization, and interpersonal function in older adults.

This study has several limitations. It had a cross-sectional design, so care should be taken in estimating the causal relationship between variables. Nevertheless, we verified the mediating effect of DIUA and IC on the relationship between cognitive function and depression in older adults using big data. This can minimize bias in our research results. In particular, while previous studies have verified only a single mediating effect of DIUA or IC, this study confirmed that DIUA affects IC and depression. In the future, the results of this study can be used as fundamental data for the development of programs to improve depression in older adults, including elements of DIUA and IC.

Conclusion

The degree of cognitive function affects DIUA and IC, and that improved digital information use and contact with people around can contribute to reducing depression. In particular, it is meaningful, in that, it provided fundamental data for preparing practical measures to improve depression by using digital devices closely related to individuals' daily lives by identifying the effect of reducing depression through digital information utilization ability. To improve the ability of older adults in using digital devices in the future, it is necessary to develop digital devices for older adults and programs to improve their ability to use digital information.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgments

Conflict of Interest

The authors declare that there is no conflict of interests.

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