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Smartphone Use and Its Relation to Cognitive Impairment and Depressive Symptoms among Elderly People

Entsar A. Abdelsalam[1], Elham Ramzy Elfiky[2] & Esmat Elsayed Ibrahim[3]
[1.] Assistant Professor of Geriatric Nursing, Faculty of Nursing, Menoufia University, Egypt
[2.] Lecturer of Psychiatric Health Nursing, Faculty of Nursing, Menoufia University, Egypt
[3.] Lecturer of Geriatric Nursing, Faculty of Nursing, Menoufia University, Egypt

Abstract:
The accelerating aging process and growing digitalization of society have drawn more focus to the effects of smartphone use on cognitive performance and depression in older adults. **Aim:** To assess the relationship between smartphone use and cognitive impairment and depressive symptoms among elderly people. **Design:** A descriptive research design was used. **Setting:** the elderly club of Al-Taqwa Association, the elderly club of the Family Care Association, and the elderly club in Kafr Al-Maisleh. **Sampling:** A systemic random sample consisting of 270 elderly persons was included in the study (155 users and 115 nonusers of smartphone). **Instruments:** Three instruments were used: the Characteristics of Elderly Structured Interview Questionnaire, the Montreal Cognitive Assessment, and the Geriatric Depression Scale**. Results:** Mean score of total MoCA was higher in mobile users elderly than non-users (25.1 ± 3.6, 23.5 ± 4.7) respectively and the mean score of total depression was lower in mobile users elderly than non-users (4.3 ± 2.1, 5.5 ± 3.01) respectively with statistically significant difference between users and non-users. **Conclusion:** Usage of the smartphone was more associated with better cognitive functions and lower depression scores. Depression symptoms were associated with the elderly over 70 years old, those with a low educational level, widowed, the elderly who live alone, and those who have a low rate of social interaction. **Recommendations:** Providing elderly people with information on smartphone features to promote active smartphone use. Using and maximizing mobile phone features in nursing interventions can benefit senior citizens' health.

Keywords: Cognitive function, Depression, Elderly & Smartphone.

Introduction:
The people aged 60 years and older is growing in both number and proportion. There were 1 billion people 60 and older in the world in 2019. By 2030, there will be 1.4 billion people on earth, and by 2050, there will be 2.1 billion. This growth is happening at an incredible rate and will continue to accelerate in the upcoming decades, particularly in developing countries **(WHO, 2021)**. In Egypt, there are 6.8 million elderly people (60 and over), or 6.7% of the country's total population. In 2052, this proportion is anticipated to increase to 17.9% **(CAPMAS, 2021).**

As the general population ages, smartphone use will increase among older adults, which has been a vital part of their lives for decades **(Wilson et al., 2022)**. Alongside its internet access, a smartphone makes a variety of activities possible, such as gaming, listening to music, and socializing. Smartphones can enable conversation with loved ones, task management, and availability **(Busch & McCarthy, 2021)**.

As average life expectancy rises, the likelihood of illness and frailty among the elderly is rising; notably in the area of cognition **(Pais et al., 2020).** Deterioration of cognitive function is a part of physiological aging and may be sped up by pathological changes brought on by Alzheimer's disease (AD), but it is also present in mild cognitive impairment (MCI), which is a dementia predictor **(Di Nuovo et al., 2020)**. Utilizing smartphones and tablets can enhance memory, executive function, and processing speed. Smartphones are perceived by users as suitable, enjoyable, and stigma-free alternatives to conventional assistive technology devices **(Wilson et al., 2022).**

After retirement, older adults are more likely to feel lonely, depressed, and isolated due to physical decline, decrease in social activities, and less face-to-face interaction. Elderly persons who use mobile phones can better manage their mental, behavioral, and physical health **(Sagong & Yoon, 2022).** The usage of smartphone-based videoconferencing in nursing homes greatly improved the physical health, vitality, and comfort of senior residents as well as decreased their loneliness. Active smartphone use can be encouraged by educating community-dwelling seniors about its features, which strengthens and enhances family ties. As a result, incorporating

mobile phone features into nursing treatments and reaping their benefits can improve the health of elderly people **(Tsai et al., 2020).**

Nurses must be aware of the role smartphones play in health care interventions and be able to use them as beneficial tools, whether they are working with elderly patients at home or in medical facilities. Nurses should be aware of the usage of smartphones by older people in order to maximize positive health outcomes throughout their health interventions **(Sagong & Yoon, 2022).**

Significance of the study:

Cognitive impairment is an aging-related disease that can lead to a variety of health issues, including disability and even death. Older people have a higher-than 40% prevalence of cognitive impairment, which has a significant negative influence on the quality of life, placing a huge economical cost on the community **(Soleimani et al., 2018).** Contrarily, depression is the most common cause of emotional pain in the later years of life and is a mental condition that is extremely common in the older population. Late-life depression is a serious public health issue as it causes physical impairment, functional decline, and increased use of medical services. It has a detrimental effect on one's mental, physical, and overall quality of life **(Muhammad & Meher, 2021).**

The prevalence of smartphone use among Egyptian seniors and its associations with cognitive performance and depressive symptoms have not been the issue of population-based research. In order to better comprehend the association between smartphone use and cognitive function and depression symptoms in seniors, we conducted this study.

Aim: To assess the relationship between smartphone use and cognitive impairment and depressive symptoms among elderly people.

Research questions:

1. Is there a relation between smartphone use and cognitive impairment among elderly people?
2. Is there a relation between smartphone use and depressive symptoms among elderly people?

Subjects and Method:

Design: descriptive research design was used.

Research Setting: This study was conducted at three geriatric clubs in Menoufia governorate: the elderly club of the Al-Taqwa Association, the elderly club of the Family Care Association, and the elderly club in Kafr Al-Maisleh (It is considered the most frequented club for the elderly on an ongoing basis).

Sampling: a convenience sample consisting of 270 elderly persons who regularly visited the mentioned clubs out of a total number of 900 visitors (155 users and 115 nonusers of smartphone) according to the following criteria:

Age of 60 years and above
Both genders
Able to communicate

Sample size:

Population size (for finite population correction factor or fpc) (*N*):	900
Hypothesized % frequency of outcome factor in the population (*p*):	50%+/-5
Confidence limits as % of 100 (absolute +/-%) (*d*):	5%
Design effect (for cluster surveys-*DEFF*):	1

Sample size

$$\mathbf{n = [DEEF^{*}Np(1-P)]/[d^2/Z^2 1-a/z^{*}(N-1)+P^{*}(1-p)]}$$

Instruments of data collection: three instruments were used by the researchers to collect the data.

Instrument one: structured interviewing questionnaire: It was developed by the researchers based on the review of the related literature, which includes personal data as age, sex, marital status, education level, income, socialization frequency, if they have a chronic disease and mobile device use. Mobile devices refer to smartphones or tablets. The elders were asked whether they have a mobile device and for what they used it. They were categorized as "users of mobile devices" if they used the device's smart features and internet access for communication, entertainment, and information search. They were categorized as "non-users" if they lacked a device or if they did but utilized a smartphone similar to a feature phone.

Instrument two: Montreal Cognitive Assessment (MoCA): The Montreal Cognitive Assessment (MoCA) was adapted by **Nasreddine et al., (2005).** It is a widespread and concise screening tool for the assessment of cognitive impairment that has had a significant impact on the evaluation of age-related cognitive decline. The MoCA checks different types of cognitive or thinking abilities. These include: orientation, short term memory, executive function/Visuospatial function, Language, Abstraction, Animal naming, clock drawing test and attention.

Scores on the MoCA range from zero to 30. A score of 26 and higher is considered normal. The following ranges may be used to grade severity: 18-25 = mild cognitive impairment, 10-17= moderate cognitive impairment and less than 10= severe cognitive impairment.

The scoring breakdown is as follows:

Visuospatial and executive functioning (5 points), **animal naming** (3 points), **attention (**6 points), **language** (3 points), **abstraction** (2 points), **delayed recall (short-term memory)** (5 points), **and orientation** (6 points) so total is 30 points.

Noticeable: adding 1 point to the test-takers score if they have 12 years or less of formal education.

Instrument three: Geriatric Depression Scale (GDS) by **DiNapoli & Scogin (2017):** The GDS is a succinct, self-report test of depression symptoms that are frequently used in investigations. For elderly people who are physically unwell as well as people with mild to moderate dementia, the GDS's abbreviated version is more suitable. Given their propensity for swiftly becoming tired, the shortened selection of questions makes it possible to finish the evaluation in 5 to 7 minutes.

Scoring:

One point is awarded for each response that mentions depression. Give one point, for instance, if the response to question 1 is "no." Question 2 will not receive a point if the response is "No," so go on to the next one. After responding to each of the 15 questions, the final score will be calculated (total: 15). The following is the cutoff and interpretation for the geriatric depression scale:

- No depression if total score is less than 5.
- Need follow up assessment if the total score is 5 to less than 10.
- Indicate depression if total score is 10 or more.

Validity and reliability of the instruments:

The instruments were tested for their content validity by five experts in the field of Geriatric and Community Health Nursing, the Faculty of Nursing, Menoufia University. Modifications were done accordingly. Cronbach's α of the MoCA-CS was 0.884, and test-retest and interrater reliability of the MoCA-CS were 0.966 and 0.926, respectively. The values of Cronbach's alpha and test-retest correlation coefficient for the Geriatric Depression Scale (GDS) were 0.88 and 0.66 ($p < .001$) respectively.

Pilot study: A pilot study was conducted in order to evaluate the clarity of the study instruments and establish the amount of time needed to complete the questionnaire. It was carried out on 10% (27 subjects) and then excluded from the study participants.

Ethical considerations:

Official approval was obtained from the research and ethics committee of the Faculty of Nursing, and then the researchers obtained official approval from the relevant authorities after explaining the goal of the study and the methods used to gather data for the current study. Then, oral consent was obtained from the study's participants after being informed of the study goals and receiving assurances regarding the confidentiality of the information collected .The study participants were informed that they could withdraw from participating in the study at any time they desired.

Procedure:

Data for the study was collected from the beginning of June to the end of August 2022 at the geriatric club where the senior members go. The researchers collected the data three days per week from 10 AM to 1 PM; whereas each geriatric club was assigned a specific day of the week. The waiting hall was selected as a comfortable, confidential location for the interview.

Orientation was accomplished by stating the name of the researcher and outlining the significance and goals of the study. In addition to structured interviewing questionnaire, the Montreal Cognitive Assessment (MoCA) and the Geriatric Depression Scale (GDS) were used by the researchers to gather assessment data. To ensure anonymity, each participant was interviewed separately, which took around 30 minutes. The Geriatric Depression Scale is a self-reported scale. The Montreal Cognitive Assessment (MoCA) scale checks different types of cognitive or thinking abilities. It was a one-page, 30-point test administered in approximately 10 minutes. The Montreal test is performed in seven steps that include short-term memory, orientation, executive function/visuospatial function, language, abstraction, animal naming, a clock drawing test, and attention.

- The delayed recall portion of the short-term memory recall task (5 points) involves two learning trials of five nouns.
- Drawing a clock (3 points) and copying a three-dimensional cube (3 points) are the two tasks used to evaluate visual-spatial skills (1 point).
- An alternation task derived from the trail-making B test (1 point), a phonemic fluency task (1 point), and a two-item verbal abstraction task are used to evaluate different facets of executive function (2 points).
- A sustained attention task (1 point), a serial subtraction exercise (3 points), and digits forward and backward are used to assess attention, concentration, and working memory (1 point each).
- A three-item confrontation naming task with uncommon animals (lion, camel, rhinoceros (3 points), and repetition of two syntactically complicated words) is used to evaluate language.
- Finally, Education level: 1 point is added to the test-taker's score if they have 12 years or less of formal education

Throughout the interview, the study's participants received guarantees that all information would be kept confidential and that their participation was voluntary.

Statistical Analysis

Following data gathering, the information was coded and put into a specially designed form that was appropriate for computer entry. The SPSS (Statistics Package for Social Science) statistical package, version 22, was used to enter and analyze the data. The Excel application was used to create the graphics. the quantitative data were reported as mean and

standard deviation (XSD) and were then examined using independent sample t-test. To assess qualitative data presented as numbers and percentages, the Chi-square test (X^2) for a 2 x 2 table was utilized. For the purpose of elucidate the results of tests of significance, the significance threshold was established at a P value of 0.05.

Results:

Table (1): Elderly sociodemographic characteristics Frequency distribution according to mobile device use (n=270).

Sociodemographic characteristics	Mobile use				X^2	P- value
	User (n=155)		Non user (n=115)			
	No.	%	No.	%		
Age (Mean± SD)	66.2 ± 5.3		65.7± 5.9		-	-
Sex:						
Male	75	48.4	45	39.1	2.29	.130
Female	80	51.6	70	60.9		
Education						
Illiterate	18	11.6	18	15.7	27.2	.001*
Read & write	29	18.7	26	22.6		
Secondary education	65	41.9	67	58.3		
High education	43	27.7	4	3.5		
Marital status						
Married	113	72.9	80	69.6	.361	.548
widowed	42	27.1	35	30.4		
Income						
Enough	65	41.9	34	29.6	4.35	.037*
Not enough	90	58.1	81	70.4		
Chronic diseases						
Present	62	40	67	58.3	8.82	.003*
Not present	93	60	48	41.7		
Living:						
Alone	8	5.2	19	16.5	9.46	.002*
with family	147	94.8	96	83.5		

**statistical significant differences*

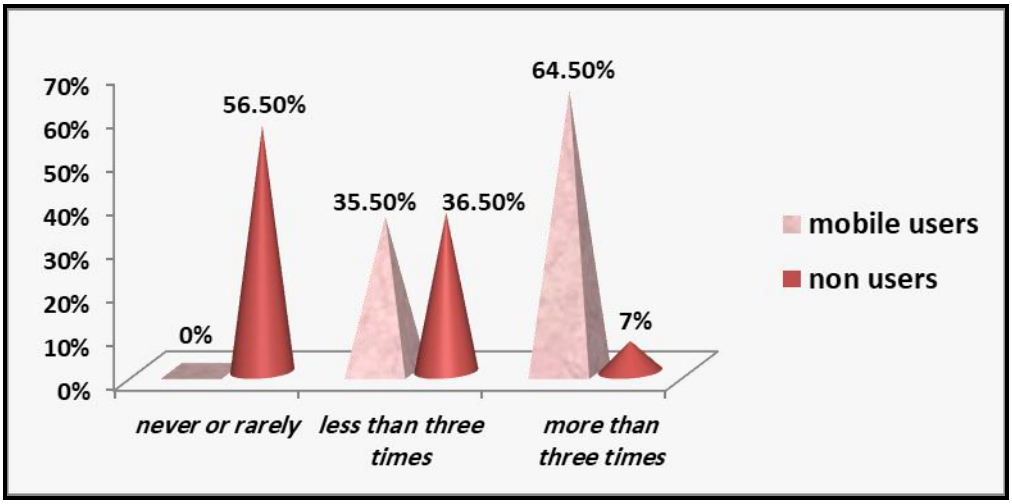

Figure (1): Distribution of elderly socialization frequency according mobile use (n=270)

Table (2): Total mean scores for Montreal Cognitive Assessment and Geriatric Depression Scale for mobile users versus non-users (n=270).

Items	Mobile use		t	P- value
	Users	Non users		
Total MoCA mean score	25.1 ± 3.6	23.5 ± 4.7	3.26	.001*
Total depression scale mean score	4.3 ± 2.1	5.5 ± 3.01	-3.64	.001*

**statistical significant differences*

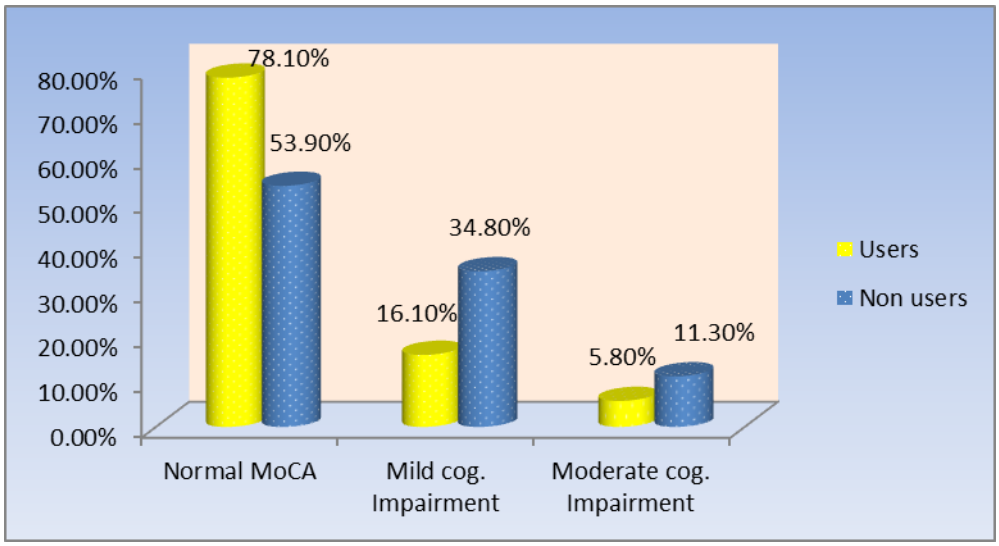

Figure (2): Percentage distribution of Montreal Cognitive Assessment categories according to mobile use (n=270)

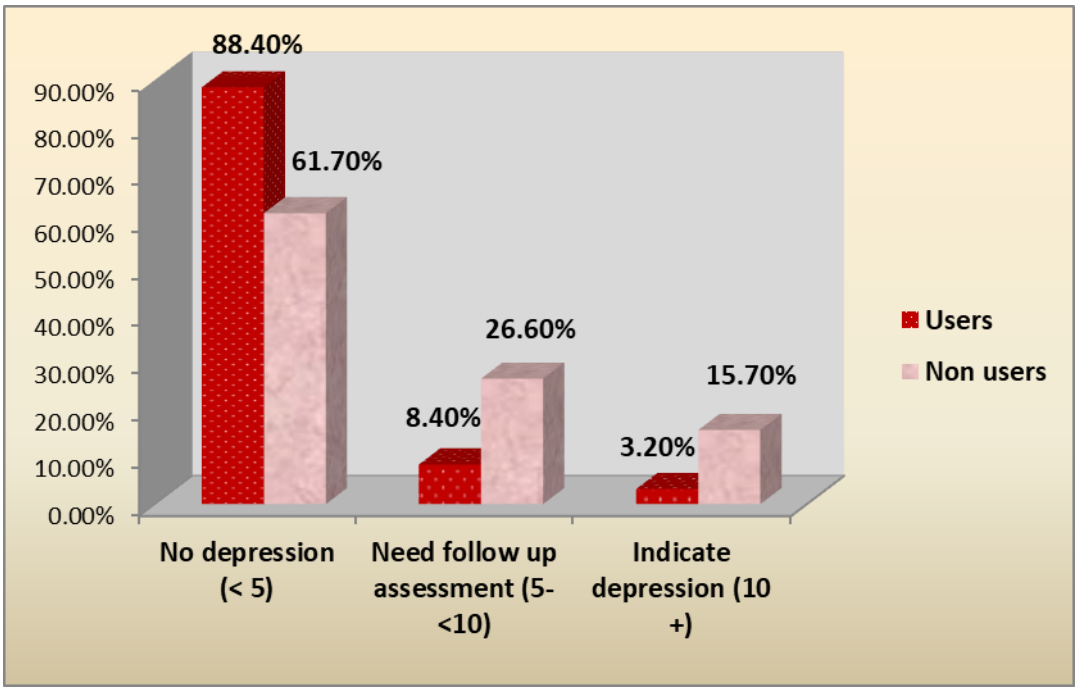

Figure (3): Percentage distribution of depression categories according to mobile use (n=270)

Table (3): Relation between depression categories and socio- demographic criteria among the studied elderly (n= 270).

Socio demographic criteria	Depression Categories						X^2	p- value
	No depression (n=208)		Need to follow up assessment (n=39)		Indicate depression (n=23)			
	No.	%	No.	%	No.	%		
Age:								
60- < 70	162	77.9	26	66.7	8	34.8	20.14	.001*
70 and more	46	22.1	13	33.3	15	65.2		
Sex:								
Male	95	45.7	12	30.8	13	56.5	4.4	.109
Female	113	54.3	27	69.2	10	43.5		
Education:								
Illiterate	17	8.2	14	35.9	5	21.7	100.45	.001*
Read & write	24	11.5	13	33.3	18	78.3		
Secondary education	120	57.7	12	30.8	0	0.0		
High education	47	22.6	0	0.0	0	0.0		
Social status:								
Married	167	80.3	17	43.6	9	39.1	34.6	.001*
Widowed	41	19.7	22	56.4	14	60.9		
Income:								
Enough	90	43.3	0	0.0	9	39.1	26.5	.001*
Not enough	118	56.7	39	100	14	60.9		
Chronic disease:								
Present	116	55.8	8	20.5	5	21.7	23.2	.001*
Not present	92	44.2	31	79.5	18	78.3		
Living:								
Alone	9	4.3	4	10.3	14	60.9	73.6	.001*
With family	199	95.7	35	89.7	9	39.1		
Social interaction frequency:								
Never or rare	34	16.3	17	43.6	14	60.9	32.3	.001*
Less than 3 times	84	40.4	9	23.1	4	17.4		
Greater than 3 times	90	43.3	13	33.3	5	21.7		

**statistical significant differences*

Table (1): Illustrates the personal characteristics of the elderly according to how they utilize mobile devices. For mobile users the mean age is 66.2 ± 5.3 years, compared to 65.7± 5.9 years for non-users. There is no statistically significant difference between users and non-users regarding sex and marital status, but there is a statistically significant differences between users and non-users regarding education, income, presence of chronic illness, and living. Females constituted more than half of the sample.

Figure (1): Illustrates the frequency of social interaction among the elderly varies depending on whether they use mobile devices. Of the elderly who engage in social interaction more than three times per week, 64.5% use mobile devices, compared to 56.5% of the elderly who do not use mobile devices.

Table (2): Shows that mobile users have a higher mean total MoCA score than non-users (25.1 ± 3.6 and 23.5± 4.7, respectively). Mobile users had a lower mean score of total depression than non-users (4.3 ± 2.1, 5.5 ± 3.01, respectively), with statistically significant difference between users and non-users.

Figure (2): Shows how the percentage distribution of mobile users and non-users differs regarding the MoCA categories, with 78.1% of mobile users having a normal MoCA score compared to 53.9 % among non-users. Mild cognitive impairment presents in 16.1 % of mobile users but increased to 34.8 % among non-users. In addition 11.3% of non-users have moderate cognitive impairment compared to only 5.8 % among mobile users.

Figure (3): Shows the difference in percent distribution between mobile users and non-users

regarding categories of depression symptoms where 88.4% of mobile users do not have depression symptoms compared to 61.7 % among non-users. This figure also shows that 26.6 % of non-users require extra follow-up assessment compared to 8.4 % among mobile users. Only 3.2 % of mobile users their scores indicate presence of depression compared to 15.7 % among non-users.

Table (3): Displays depression categories concerning the sociodemographic characteristics of the studied elderly. It is clear from this table that depression symptoms are often associated with the elderly over 70 years old, those with a low educational level, widowed, the elderly who live alone, and those who have a low rate of social interaction. But on the other hand, depression symptoms are less associated with the elderly, who have chronic diseases and don't have enough income.

Discussion:

Smartphone technologies can assist seniors in their daily living activities while they are at home. Seniors should be fully informed about the significance of the newly introduced technology so they can appreciate its potential benefits **(Haan et al., 2021).** Using a smartphone can also improve mental health, mood, independence, and lowering loneliness and depression rates, and lessen the risk of decline in overall cognitive, attention, and memory performance in older people **(Barbosa et al., 2019)**. Therefore the purpose of the current study was to assess the relationship between smartphone use and cognitive function and depression symptoms among elderly people.

Regarding socialization frequency among the elderly according to mobile use, the present study revealed that about two thirds of the elderly who have a high frequency of socialization are mobile users, while over half of the sample of non-mobile users had either never or hardly interacted with others. This may be explained by the fact that many elderly people are using technology to avoid social isolation and its negative long-term effects. This was congruent with **Liu et al., (2022)**, who studied "the association between social support, smartphone usage, and loneliness among the migrant elderly." They found that more frequent usage of smartphones by the elderly was associated with higher levels of social support. Additionally, older adults use smartphones for a variety of social and non-social purposes, with news reading and social networking being the most popular ones. **(Busch et al., 2021).** On the other hand, this result was incongruent with **Wang et al., (2022),** who discovered that being sociable was linked to more face-to-face social interaction, which was then linked to less loneliness.

Regarding MoCA mean score current study found that the mean score of total MoCA was higher in mobile users than non-users and the mean score of total depression was lower in mobile users than non-users, with a significant difference between users and non-users. This finding can be explained by the fact that smartphone applications appear to be a valuable tool for cognitive training in older adults because they can strengthen cognitive skills. Internet use reduces depression scores by increasing the frequency of family interaction and the significance of enjoying life.

This finding was congruent with **Lin et al., (2020)** who studied "Mobile device use and the cognitive function and depressive symptoms of older adults living in residential care homes." He reported that users of mobile devices had a significantly higher total MoCA score and a significantly lower GDS score than non-users. This was also consistent with **Yang et al., (2021)** who investigated "Internet Use and Depressive Symptoms among Older Adults in China." They discovered that older internet users experienced lower levels of depression, and that this depression decreased the more frequently they used the internet. Also, this result is in line with **Qi et al., (2021)** who studied "Mobile Phone Use and Cognitive Impairment among Elderly Chinese" and stated that a strong correlation was found between mobile phone use and better cognitive function. Additionally, the usage of smartphones and tablets may improve executive function and processing speed in older persons without cognitive impairment **(Scullin et al., 2022).**

Regarding the difference between mobile users and non-users percent distribution in relation to MoCA and depression categories, the results of the current study revealed a statistically significant difference between mobile users and non-users, where more than three quarters of mobile users fall into a normal MoCA category and most had no symptoms of depression. This might be due to the desire among older adults to use digital technology in healthy manner to regain their mental health through techniques of diversion, normalization, and facilitated expression of mental feeling. Likewise, it has been shown that using smartphones and tablets improves executive function and processing speed in older persons without cognitive impairment.

This finding was congruent with **Lin et al., (2020)** who discovered that the use of mobile devices was found to associated with the normal MoCA category. Additionally, this result was in accordance with **Scullin et al., (2022)** who studied "Using smartphone technology to improve prospective memory functioning." and found that by adopting smartphone-based memory strategies, the independence and

memory of older adults with dementia or moderate cognitive problems were improved. On the other hand, this finding was in contrast with **Al-Khlaiwi et al., (2020)** who studied "The association of smart mobile phone usage with cognitive function impairment in the Saudi adult population." They claimed that excessive mobile phone use can impair cognitive performance.

The current study illustrated that depression symptoms are often associated with the elderly over 70, less educated, widowhood, living alone, and being less socially interacting. This could be because older adults are more likely to suffer from depression due to their increased susceptibility to chronic diseases. Also, people with low education may have fewer economic and social resources and employment opportunities, which lead to depression. On the other hand, after the bereavement of the spouse, their only source of income is lost, which increases their economic hardships and decreases their social interactions, leading to an adverse impact on their psychological well-being.

This finding was on the same line as **Liang et al., (2021)** who studied "Precautionary Behavior and Depression in Older Adults during the COVID-19 Pandemic." They found that elderly people who were divorced or widowed and lived alone experienced significantly higher levels of depression than those who were married and lived with their spouse, partners, and children. In addition, **Srivastava et al., (2021)** who studied "the association of widowhood and living alone with depression among older adults in India," revealed that older adults who were widowed and living alone were more likely to experience depression compared to older individuals who were currently married and shared a residence. Furthermore, older adults who were less educated and single had a higher incidence of depression **(Ma et al., 2021)**. On the other hand, it was found that more than half of the elderly with a low degree of depression suffered from chronic diseases, and their income was insufficient. This result may be because people in Eastern societies have the belief in "Praise be to God" and contentment with what God has granted them or prevented them from. This result was in contrast with **Liang et al., (2021)** who stated that the depression level was significantly lower for participants who had higher household income relative to those with poorer socioeconomic status.

Conclusion:

Usage of the smartphone was more associated with better cognitive functions and lower depression scores. The proper use of mobile devices help to maintain and improve cognitive functioning, reduce social isolation and enhance social interaction, and prevent the occurrence of depressive symptoms. Depression symptoms were associated with the elderly over 70 years old, those with a low educational level, widowed, the elderly who live alone, and those who have a low rate of social interaction.

Recommendations:

Providing elderly people with information on smartphone features to promote active smartphone use. Using and maximizing the capabilities of mobile phone features in nursing interventions can benefit older individuals' health. Further research is required to determine how older people use smartphones for cognitive support both prior to and following the emergence of cognitive impairment.

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Conflict of Interest – No conflict

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