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Smartphone Usage and Cognitive Function in Older Adults Living in Beijing: A Cross-sectional Study

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ABSTRACT

The study aimed to examine the association between smartphone usage and cognitive function among older adults in Beijing, China. A cross-sectional study was conducted on 209 older adults aged 60 years and above in Beijing in 2023. This study was divided into two parts: a face-to-face questionnaire and objective data collection on smartphone usage. Multiple linear regression was used to identify predictors of cognitive function. Results showed that education level, marital status, and years of smartphone use were significant predictors of cognitive function. Besides, apart from social applications, there was a positive correlation between smartphone usage and cognitive function. Therefore, it is advisable to encourage older adults to start using smartphones across various categories, with particular emphasis on non-social applications.

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INTRODUCTION

Studies have demonstrated that smartphone use can enhance cognitive abilities by providing rich cognitive stimulation. For instance, older adults could use smartphones to access health information, stay connected

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with family and friends, enhance their sense of safety, and engage in entertainment and cognitive activities (Benge et al., 2023; Peek et al., 2016).

However, previous research has notable limitations in assessing smartphone usage patterns. Self-reported measures show weak correlations with objective metrics, are prone to bias, and lack sensitivity in predicting basic technology use (Ellis et al., 2019; Mahalingham et al., 2023; Parry et al., 2021). In contrast, objective data offer ecologically valid insights in a shorter time while minimizing subjectivity, memory biases, social desirability, and response preferences in older adults (Hartanto et al., 2023; Ryding & Kuss, 2020). Moreover, many studies tend to focus narrowly on one aspect of smartphone use and lack comprehensive measurement across multiple dimensions. For example, most studies concentrated solely on social media use and employ items that only yield dichotomous yes or no responses, overlooking the intricate interactions between different functional applications. This narrow focus limits our understanding of older adults' internet usage patterns and the potentially intricate effects they may have (Foong et al., 2022). This study combines self-assessment and objective data to examine the relationship between smartphone use and cognitive function among Chinese community-dwelling older adults.

METHODOLOGY

A cross-sectional study was conducted from October to December 2023. The participants were community-dwelling older adults residing in Beijing, China.

The inclusion criteria were: 1) aged 60 years and above, 2) community residents with Beijing household registration, 3) users of a single smartphone operated independently, and 4) users of the Android operating system for over one year. Exclusion criteria were: 1) reluctance to provide screenshots of screen usage, 2) previous diagnosis of dementia, 3) severe depression or other mental illnesses, and 4) severe impairment of vision, hearing, or communication skills. Ultimately, 209 respondents met the inclusion criteria and completed the survey for this study.

The sample size calculation was performed using G*Power 3.1. A linear multiple regression F-test was used to determine the required sample size. The statistical test employed was liner multiple regression with a fixed model and R^2 deviation from zero. An effect size $f^2 = 0.15$, significance level = 0.05, a power $(1-\beta) = 0.95$, and 11 predictors were used for the calculations. Based on these parameters, G*Power determined the required sample size to be 178. Since the actual number of participants reached 178, the sample size requirement for this study was met.

The study exclusively targeted Android users, as Android is the most widely used operating system in China, accounting for 78.3% of mobile devices (Quest Mobile, 2022). This selection also helped minimize potential biases arising from differences in system performance and interface design.

The survey in this study comprised two components: a questionnaire and the collection of objective smartphone usage data. The questionnaire covered demographic variables, the paper version of the Montreal Cognitive Assessment (MoCA) Chinese-Beijing 7.1 (Nasreddine et al., 2005), and self-assessed smartphone usage. It was primarily self-administered, supplemented by face-to-face interviews to ensure clarity, provide necessary guidance, and enhance the reliability and completeness of responses.

The objective smartphone usage data were collected through screenshot techniques and were accessible via common Android operating systems, such as Huawei, Xiaomi, and Samsung. The sample was instructed to submit screenshots of their screen usage via WeChat before bedtime, including one workday and one non-workday within a week.

Pearson correlations was used to investigate the association between smartphone use and cognitive function. Subsequently, multiple linear regression was employed to explore predictors of cognitive function related to smartphone usage.

Ethical approval for the study was obtained from the JKEUPM (Ethic Committee for Research Involving Human Subject) Universiti Putra Malaysia (Approval No. JKEUPM-2023-1189). Information sheets detailing the study were provided to participants before the survey, and consent was obtained from those who agreed to participate. All data collection was kept confidential for the purposes of this study.

RESULTS AND DISCUSSION

Table 1 shows the demographical variables, smartphone use, and cognitive function of the samples.

Table 2 shows the Pearson correlations between demographical variables, smartphone use, and cognitive function. Years of smartphone use, the number of applications used, and non-social applications usage were positively associated with cognitive function ($rs > 0.180$, $Ps < 0.01$). However, a negative relationship was observed between social applications usage and executive functions ($r = -0.160$, $P < 0.05$). Despite the numerous cognitive benefits linked to smartphone usage, our study revealed a negative association between the use of social applications and executive functions, consistent with prior research. This line of inquiry suggests that engaging with social media can foster a fear of missing out, which may prompt individuals to continually refresh social networking sites. This heightened anxiety can lead to excessive smartphone use and reduced inhibitory control, thereby impairing executive functioning (Baumgartner et al., 2014).

The standardized coefficients of the model are shown in Table 3. The results showed that education level ($B = 2.285$, $P < 0.001$), marital status ($B = 1.775$, $P = 0.020$) and years of smartphone use significantly predicted cognitive function. Overall, the model had an R^2 of 0.265, indicating that approximately 36% of the variance in cognitive function was explained by years of smartphone use, age, years of education, and marital status. Following

the convention of Cohen (1988), a combined effect of this magnitude can be considered large ($f^2 = 0.361$).

There was a positive correlation between years of smartphone use, number of applications used, non-social applications usage time, cognitive function, and partial of sub-domains cognition. This association was primarily attributed to the cognitive stimulation provided by smartphone usage among older adults (Chen et al., 2024; Krug

Table 1
Demographical variables, smartphone use, and cognitive function of the sample (N = 209)

	Category/unit	n	%	M	SD
Age		209		66.49	4.36
Gender	Female	126	60.3		
	Male	83	39.7		
Education level	Junior high school and below	60	28.7		
	High school and above	149	71.3		
Personal income	CNY	209		5493.94	2155.44
Marital status	Unmarried	18	8.6		
	Married	191	91.4		
Years of use	Year	209		8.38	2.30
Number of applications used	Items	209		50.96	22.15
Number of unlocks	Times	209		91.90	53.74
Social applications usage	Minute	209		561.93	341.60
Non-social applications usage	Minute	209		317.85	298.32
Cognitive function		209		23.67	3.39

Note. n= frequency, % =percentage, M= mean, SD = standard deviation; Unmarried: including divorced, widowed, unmarried or single; Personal income: personal monthly income; $1=MYR4.68=CNY7.18 at time of the data collection; Number of unlocks, social applications usage, and non-social applications usage represent the total time for both a working day and a non-working day

Table 2
Correlations between smartphone use, cognitive function and six cognitive domains

	MoCA SCORE	SUB-SCORE OF MoCA IN SIX COGNITIVE DOMAINS (*r*)					
		Memory	Visuospatial	Executive	Attention	Language	Orientation
Years of use	0.221**	0.199**	0.117	0.202**	0.098	0.216**	-0.058
Number of applications used	0.236***	0.175*	0.092	0.110	0.191**	0.192**	0.118
Number of unlocks	0.073	0.035	-0.080	0.056	0.140*	0.031	0.113
Social applications usage	-0.125	-0.099	-0.067	-0.160*	-0.040	-0.102	0.038
Non-social applications usage	0.187**	0.108	0.145*	0.166*	0.121	0.155*	-0.044

Note. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

Table 3
Unstandardized and standardized coefficients, t value and p value for demographic variables, years of use, number of applications used, number of unlocks, social applications usage time and non-social applications usage time in predicting cognitive function

Dependent variable: Cognitive function, $R^2 = 0.265$, $f^2 = 0.361$					
Variable	**Unstandardized coefficient**		**Standardized coefficient**	***t*** Value	***p*** Value
	B	SE	β		
Age	0.098	0.052	0.126	1.895	0.059
Gender (0 = female, 1 = male)	0.014	0.445	0.002	0.031	0.975
Education level (0 = junior high school and below, 1 = high school and above)	2.285	0.508	0.305	4.499	<0.001***
Personal income	2.137	1.463	0.097	1.460	0.146
Marital status (0 = unmarried, 1 = married)	1.775	0.757	0.147	2.344	0.020*
Years of use	0.201	0.093	0.137	2.159	0.032*
Number of applications used	0.018	0.010	0.116	1.781	0.076
Number of unlocks	0.003	0.004	0.051	0.783	0.434
Social applications usage	-0.001	0.001	-0.052	-0.706	0.446
Non-social applications usage	0.001	0.001	0.086	1.229	0.221

Note. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

et al., 2019; Qi et al., 2021). In a study in Norway, research investigated the years of use among smartphone users over 60 years old, reporting an average of 8.7 years of usage, which aligns with the findings of our study (Busch et al., 2021). However, studies have not examined the association between years of use and cognitive function. Many previous studies have focused on assessing smartphone usage frequency using single measurement indicators, lacking objectivity. However, this study made up for this shortcoming and provided an in-depth assessment of the older adults' smartphone usage from multiple dimensions. It not only verified previous research, but also provided correlations between multiple smartphones usage indicators and cognitive function and identifies years of smartphone use as a positive predictor of cognitive function through multiple linear regression analysis. Despite the numerous cognitive benefits associated with smartphone use, our study identified a negative correlation between social apps usage time and executive functions, consistent with previous research findings (Al-Khlaiwi et al., 2020; Parry et al., 2019). These studies showed that the use of social media could produce fear of missing out, which was an anxious experience. This anxiety may lead to excessive smartphone use and diminished inhibitory control, impairing executive functioning. Notably, previous research has predominantly focused on adolescents and workers, leaving a gap in understanding the relationship between social app usage time and executive functions in older adults.

CONCLUSION

In summary, this study integrates self-assessment and objective data to measure smartphone use among older adults across multiple dimensions. The results indicate a positive relationship between years of smartphone usage, the number of applications used, and non-social applications usage with both cognitive function and sub-domains cognition in older adults. Thus, promoting sustained smartphone usage among older adults, particularly for non-social activities such as memory games, reading e-books and news, and listening to music, may enrich their lives and support cognitive function.

This study has several limitations. Firstly, as a cross-sectional design, it cannot establish causality but effectively examines associations between smartphone use, cognitive functions. Secondly, categorizing applications as either social or non-social based solely on their primary function may oversimplify application usage. Finally, this study focused on Android users to avoid potential data discrepancies arising from differences in system design, Future studies could include iOS users by employing experience sampling methods to capture a more comprehensive dataset.

This study underscores the necessity of longitudinal research to establish the causal relationship between smartphone use and cognitive function in older adults. Additionally, future studies should examine the underlying mechanisms mediating these associations, such as cognitive load and neural plasticity. Furthermore, expanding research to diverse cultural and socioeconomic contexts could enhance the generalizability of findings and provide a more comprehensive understanding of the impact of smartphone use on cognitive ageing.

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REFERENCES

Al-Khlaiwi, T. M., Habib, S. S., Meo, S. A., Alqhtani, M. S., & Ogailan, A. A. (2020). The association of smart mobile phone usage with cognitive function impairment in Saudi adult population. *Pakistan Journal of Medical Sciences, 36*(7), Article 1628. https://doi.org/10.12669/pjms.36.7.2826

Baumgartner, S. E., Weeda, W. D., van der Heijden, L. L., & Huizinga, M. (2014). The relationship between media multitasking and executive function in early adolescents. *The Journal of Early Adolescence, 34*(8), 1120-1144. https://doi.org/10.1177/0272431614523133

Benge, J. F., Kiselica, A. M., Aguirre, A., Hilsabeck, R. C., Douglas, M., Paydarfar, D., & Scullin, M. K. (2023). Technology use and subjective cognitive concerns in older adults. *Archives of gerontology and geriatrics, 106*, Article 104877. https://doi.org/10.1016/j.archger.2022.104877

Busch, P. A., Hausvik, G. I., Ropstad, O. K., & Pettersen, D. (2021). Smartphone usage among older adults. *Computers in Human Behavior, 121*, Article 106783. https://doi.org/10.1016/j.chb.2021.106783

Chen, Q., Ji, H., & Shang, Q. (2024). The association between the diversity of online activities on smartphones and cognitive function among middle-aged and elderly Chinese adults. *BMC Public Health, 24*(1), Article 547. https://doi.org/10.1186/s12889-024-17932-0

Ellis, D. A., Davidson, B. I., Shaw, H., & Geyer, K. (2019). Do smartphone usage scales predict behavior?. *International Journal of Human-Computer Studies, 130*, 86-92. https://doi.org/10.1016/j.ijhcs.2019.05.004

Foong, H. F., Lim, S. Y., Rokhani, F. Z., Bagat, M. F., Abdullah, S. F. Z., Hamid, T. A., & Ahmad, S. A. (2022). For better or for worse? A scoping review of the relationship between internet use and mental health in older adults during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health, 19*(6), Article 3658. https://doi.org/10.3390/ijerph19063658

Hartanto, A., Lee, K. Y., Chua, Y. J., Quek, F. Y., & Majeed, N. M. (2023). Smartphone use and daily cognitive failures: A critical examination using a daily diary approach with objective smartphone measures. *British Journal of Psychology, 114*(1), 70-85. https://doi.org/10.1111/bjop.12597

Krug, R. D. R., d'Orsi, E., & Xavier, A. J. (2019). Association between use of internet and the cognitive function in older adults, populational longitudinal study EpiFloripa Idoso. *Revista Brasileira de Epidemiologia, 22,* Article e190012. https://doi.org/10.1590/1980-549720190012

Mahalingham, T., McEvoy, P. M., & Clarke, P. J. (2023). Assessing the validity of self-report social media use: Evidence of No relationship with objective smartphone use. *Computers in Human Behavior, 140*, Article 107567. https://doi.org/10.1016/j.chb.2022.107567

Nasreddine, Z. S., Phillips, N. A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., & Chertkow, H. (2005). The montreal cognitive assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society, 53*(4), 695-699. https://doi.org/10.1111/j.1532-5415.2005.53221.x

Parry, D. A., & Roux, D. B. L. (2019). Media multitasking and cognitive control: A systematic review of interventions. *Computers in Human Behavior, 92*, 316-327. https://doi.org/10.1016/j.chb.2018.11.031

Parry, D. A., Davidson, B. I., Sewall, C. J., Fisher, J. T., Mieczkowski, H., & Quintana, D. S. (2021). A systematic review and meta-analysis of discrepancies between logged and self-reported digital media use. *Nature Human Behaviour, 5*(11), 1535-1547. https://doi.org/10.1038/s41562-021-01117-5

Peek, S. T., Luijkx, K. G., Rijnaard, M. D., Nieboer, M. E., Voort, C. S. V. D., Aarts, S., Hoof, J. V., Vrijhoef, H. J. M., & Wouters, E. J. M. (2016). Older adults' reasons for using technology while aging in place. *Gerontology, 62*(2), 226-237. https://doi.org/10.1159/000430949

Qi, S., Sun, Y., Yin, P., Zhang, H., & Wang, Z. (2021). Mobile phone use and cognitive impairment among elderly Chinese: A national cross-sectional survey study. *International journal of environmental research and public health, 18*(11), Article 5695. https://doi.org/10.3390/ijerph18115695

Quest Mobile. (2022). *China mobile internet annual report*. China Trading Desk. https://www.chinatradingdesk.com/post/2022-chinamobile-internet-review

Ryding, F. C., & Kuss, D. J. (2020). The use of social networking sites, body image dissatisfaction, and body dysmorphic disorder: A systematic review of psychological research. *Psychology of Popular Media, 9*(4), Article 412. https://doi.org/10.1037/ppm0000264