

후기 학령기 아동의 스마트폰 의존에 영향을 미치는 요인: 그릿과 가족건강성을 중심으로

제민지, 이지원

부산가톨릭대학교 간호대학 간호학과

Factors Associated with Smartphone Dependence of Late School-Aged Children: A Focus on Grit and Family Strengths

Minji Je, Ji-Won Lee

College of Nursing, Catholic University of Pusan, Busan, Korea

Background: This study was to identify the factors influencing smartphone dependence among late school-aged children, focusing on grit and family strengths.

Methods: A cross-sectional descriptive study was conducted with 218 children in grades 5 and 6 who were recruited from elementary schools in U and Y cities. The data were collected through self-reported questionnaires, including smartphone dependence, grit, family strengths and general characteristics, for the month of December 2019, just before the novel coronavirus pandemic after obtaining approval from IRB. The collected data were analyzed using multiple regression.

Results: Smartphone usage time, the main purpose of smartphone usage (game and social networking), and grit were identified as significant factors of smartphone dependence. This model explained 38% of the total variance showing the variable of grit with the greatest variance.

Conclusions: A strategy to develop grit is needed to reduce smartphone dependence among late school-age children.

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Keywords: Smartphone, Dependence, Grit, Family strengths, Child

INTRODUCTION

South Korea has a fairly high smartphone penetration rate. In 27 countries worldwide, the average percentage of smartphone users is about 76%, whereas, in Korea, smartphone users comprise 95%.¹⁾ The proportion of Korean teenagers who own a smartphone continues to increase,

reaching 89.7% in 2019 and 94.4% in 2020.²⁾ As smartphone use becomes more ubiquitous, the risk of overdependence is also increasing annually. Across the risk groups by age, the ratio of the teenage group is the highest, compared to other age groups.^{2,3)} The smartphone overdependence ratio in school-aged children is about 30%, which is higher than that in preschool children (27%) and adults (22%).³⁾

During the late school age, the frontal lobe has not yet developed.⁴⁾ This issue may make children highly impulsive children are highly impulsive and lack control and are at high risk of dependence on technology like a smartphone or the internet.³⁾ Children's excessive use of smartphones causes various health issues. When a child spends a lot of

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■ Corresponding author : Ji-Won Lee, PhD
College of Nursing, Catholic University of Pusan, 57 Oryundae-ro,
Geumjeong-gu, Busan 46252, Korea
Tel: +82-51-510-0724, Fax: +82-51-510-0747
E-mail: jwlee@cup.ac.kr
ORCID: <https://orcid.org/0000-0001-5157-3675>

time using a smartphone, it can cause neck and spine flexion⁵⁾ and visual impairment.⁶⁾ Additionally, the risk of obesity, sleep disorders, and poor physical activity increases.^{7,8)} Technology like internet and smartphone addiction also affects brain development, causing children to become distracted and have a shorter attention span, increasing the likelihood of attention deficit hyperactivity disorder.^{8,9)} Furthermore, children who constantly use smartphones are at an increased risk for depression, anxiety disorder, and suicidal ideation.⁹⁾ To preserve children's health into adolescence and adulthood, it is necessary to identify the factors that influence smartphone dependence in children, as they are more prone to overuse.

Several studies identify factors related to smartphone dependence.¹⁰⁻¹³⁾ Factors such as impulsivity and lack of self-control were found to be internal individual factors highly correlated with smartphone dependence.^{11,12)} Recently, grit has gained attention as an internal individual factor related to technology dependence.¹⁴⁾ Grit refers to the ability to manage impulsivity and self-control in connection with addiction, as well as the ability to maintain perseverance and passion in the long term to achieve goals.¹⁵⁾ Grit is a variable that allows for a better understanding of an individual's internal characteristics associated with dependence and addiction. Grit is an acquired ability that can be learned through practice and experience,¹⁶⁾ so it can serve as a protective factor against addiction. However, few studies have examined grit as a factor in children's dependence. Therefore, the present study selected grit as an internal factor of smartphone dependence.

The family is an external factor that has a significant influence on children's behavior. Children who lack support at home or have poor familial relationship become preoccupied and dependent on the relationship they create online and are more susceptible to harmful behaviors and addiction.^{13,17)} Among family-related factors, family strengths are qualities that emphasize the well-being of the family and can be used as an index to identify family functions such as familial relationship, emotional support, and communication.¹⁸⁾ Therefore, this study selected family strengths as an external factor in children's smartphone dependence.

Several studies to identify factors of smartphone dependence have been conducted on young adolescents attending middle or high school.^{10,11,13)} Studies on children aimed at identifying both internal and external factors of smartphone

dependence are rare. Therefore, this study aimed to investigate grit as an internal factor and family strength as an external factor that would be significant factors associated with smartphone dependence among late school-aged children. This study's findings are expected to provide a basis for interventions to help children avoid smartphone overdependence.

METHODS

1. Study design

This study was conducted based on a descriptive correlational study design.

2. Study participants

This study was conducted using a convenience sampling method. The participants consisted of late school-aged children from two schools in U and Y city, South Gyeongsang province. The inclusion criteria were as follows: children in grades 5 and 6 (10 to 11 years old), children who are currently using a smartphone and could answer the provided questionnaire in Korean. The exclusion criteria were as follows: children who received treatment or psychological counseling for smartphone addiction or internet game addiction. The children voluntarily consented to participate in the study, and their guardians also gave written consent to the children's participation.

It is recommended that the number of samples required for multiple regression analysis be at least 40 per predictor.¹⁹⁾ We predicted five predictors and dropout odds of 20% and calculated that the estimated sample size was 200. We distributed 240 copies and collected all of them, of which 22 were excluded as not all of the questions were answered. Therefore, the responses of 218 questionnaires were analyzed.

3. Data collection

This study was approved by the Institutional Review Board of K University (KSU-19-11-009). The data were collected for the month of December 2019 (just before the novel coronavirus [COVID-19] pandemic). Prior to data collection, we communicated with the elementary school administrators and head teachers in charge of grades 5 and 6, and

a recruitment notice was posted on the bulletin board in the 5th and 6th-grade classrooms. The students who wanted to participate in the study told the researcher or homeroom teacher. We met the study participants in the classroom and explained the purpose, methods, procedures, potential risks and benefits, and then a letter containing information about the study was sent to their guardians. They read the letter, filled out the informed consent and sent it to us by mail. After we confirmed informed consent from both study participants and their guardians, the homeroom teacher distributed self-report questionnaires to the participating students, who filled it out in the classroom and submitted it to their teacher, and the teacher passed us the questionnaires.

4. Measures

1) Smartphone dependence

Smartphone dependence was evaluated using the short version of smartphone addiction scale²⁰⁾ that is recognized as a valid and reliable tool for the dependence of smartphone use. This tool consisted of 10 items which can be scored in a 6 point scale, which ranges from 1 point (“not at all”) to 6 points (“always”). The scores of each response are added together for a total score. A higher total score indicates a greater intensity of smartphone dependence. Cronbach's α was 0.91 at the time of its development²⁰⁾ and 0.85 in the present study.

2) Grit

Grit was evaluated using the original grit scale (Grit-O) originally developed by Duckworth et al.¹⁵⁾ Lee and Sohn²¹⁾ has translated the Grit-O into Korean and presented Cronbach's α of 0.79. The tool consisted of 12 items. Responses were based on a five-point scale ranging from 1 point (“not at all”) to 5 points (“always”). The total score is calculated as a sum of item scores. A higher total score indicates higher grit level. Cronbach's α was 0.66 in the present study.

3) Family strengths

Family strengths was evaluated using the scale for measuring family strengths for Korean developed by Eo and Yoo.¹⁸⁾ The tool consisted of 34 items. Responses were based on a 5-point scale ranging from 1 point (“not at all”) to 5 points (“always”). The total score is calculated as a sum

of item scores. A higher total score indicates greater family strength. Cronbach's α was 0.94 at the time of its development¹⁸⁾ and 0.96 in this study.

In addition to the items regarding smartphone dependence, grit and family strengths, we collected data on general characteristics: gender, smartphone usage duration (year), average smartphone usage hours per day (<2 hours or ≥ 2 hours) and the main purpose of using a smartphone (gaming, social networking, listening to music, watching videos, searching information or phone call, and text messaging).

5. Data analysis

The data were analyzed using SPSS version 25 software (IBM Corp., Armonk, NY, USA). The data were first analyzed using descriptive statistics with frequencies, and percentages and means and standard deviations were calculated for the participants smartphone dependence and other variables. The differences in smartphone dependence according to the general characteristics were analyzed using the independent *t*-test or one-way analysis of variance. The correlations among the variables were performed using Pearson's correlation analysis. Multiple regression analysis was done to identify the factors associated with smartphone dependence. Categorical variables are converted to dummy variables, and the variables of general characteristics that showed significant associations with smartphone dependence in previous studies^{10,13)} were entered as control variables. In the model, there was no multicollinearity, with the variance inflation factor of 1.069-5.047. There was no auto-correlation, as shown by a Durbin-Watson statistic of 1.985. A *P*-value of less than 0.05 was considered statistically significant.

RESULTS

Of 218 respondents, 55% were female. As for smartphone usage duration, 47.3% of participants were more than 3 years. 57.3% of the participants used a smartphone for less than 2 hours a day. The main purpose of using a smartphone was to watch a video (37.2%), followed by social networking (26.6%) and games (22.5%) (Table 1). The mean scores for smartphone dependence by general characteristics are presented in Table 2. We found significant differences in smartphone dependence based on the smartphone usage hours per a day ($t=-4.38$, $P<0.001$) and the main purpose of usage

($F=3.24$, $P=0.008$). The overall smartphone dependence of the participants was 2.47 (± 0.93) out of 6. The participants'

Table 1. General characteristics of participants (n=218)

Characteristic	Value
Gender	
Female	120 (55.0)
Male	98 (45.0)
Smartphone usage duration, y	
< 1 y	33 (15.1)
1-2 y	39 (17.9)
2-3 y	43 (19.7)
> 3 y	103 (47.3)
Smartphone usage time, a day	
< 2 hours	125 (57.3)
≥ 2 hours	93 (42.7)
The main purpose of smartphone usage	
Gaming	49 (22.5)
Social networking	58 (26.6)
Listening to music	12 (5.5)
Watching videos	81 (37.2)
Searching information	6 (2.8)
Phone calls and text messaging	12 (5.5)

Values are presented as number (%).

grit was 3.30 (± 0.49) and family strengths was 3.99 (± 0.68) out of 5. A significant negative correlation was observed between the participants' smartphone dependence and grit ($r=-0.56$, $P<0.001$). The participants' family strengths was also significantly and negatively correlated to the smartphone dependence ($r=-0.32$, $P<0.001$) (Table 3).

Table 4 shows the multiple regression statistics of factors influencing the smartphone dependence. In the model, the explanatory power was 38% ($F=17.620$, $P<0.001$) and smartphone usage time ≥ 2 hours per a day ($\beta=0.198$, $P<0.001$), gaming ($\beta=0.215$, $P=0.046$) or social networking ($\beta=0.304$, $P=0.007$) of the main purpose of smartphone usage and grit were significant factors associated with the levels of smartphone dependence.

DISCUSSION

This study was conducted to investigate grit as an internal factor and family strength as an external factor on the smartphone dependence of late school-aged children.

Grit exerts the most significant influence on smartphone dependence in children in this study, which means that the lower grit, the higher the smartphone dependence. This is

Table 2. Differences of smartphone dependence according to general characteristics (n=218)

Variable	M \pm SD	t or F	P
Gender		1.51	0.133
Female	2.56 \pm 1.04		
Male	2.37 \pm 0.78		
Smartphone usage duration, y		0.83	0.480
< 1	2.31 \pm 0.82		
1-2	2.39 \pm 0.71		
2-3	2.44 \pm 1.05		
> 3	2.57 \pm 0.99		
Smartphone usage time, a day		-4.38	<0.001
< 2 hours	2.24 \pm 0.81		
≥ 2 hours	2.79 \pm 1.00		
The main purpose of smartphone usage		3.24	0.008
Gaming	2.43 \pm 0.84		
Social networking	2.77 \pm 1.00		
Listening to music	2.00 \pm 0.66		
Watching videos	2.48 \pm 0.92		
Searching information	1.82 \pm 0.70		
Phone calls and text messaging	1.98 \pm 0.92		

Abbreviation: SD, standard deviation.

Table 3. Correlation between variables (n=218)

Variable	Grit	Family strengths	Items	Range	M±SD
	<i>r</i> (<i>P</i>)	<i>r</i> (<i>P</i>)			
Smartphone dependence	-0.56 (<0.001)	-0.32 (<0.001)	10	1-6	2.47±0.93
Grit	1	0.375 (<0.001)	12	1-5	3.30±0.49
Family strengths	0.375 (<0.001)	1	34	1-5	3.99±0.68

Abbreviation: SD, standard deviation.

Table 4. Relationship between smartphone dependence and the variables (n=218)

Variable (reference)	β^a	SE	<i>t</i>	<i>P</i>	VIF
Constant value		0.440	12.258	<0.001	
Smartphone usage time, a day (<2 hours) ^b					
≥2 hours	0.198	0.104	3.585	<0.001	1.069
The main purpose of smartphone usage (phone calls and text messaging) ^b					
Gaming	0.215	0.239	2.009	0.046	4.027
Social networking	0.304	0.235	2.717	0.007	4.373
Listening to music	0.031	0.306	0.409	0.683	1.973
Watching videos	0.217	0.231	1.805	0.072	5.047
Searching information	0.040	0.370	0.616	0.539	1.479
Grit ^c	-0.488	0.111	-8.382	<0.001	1.187
Family strengths ^c	-0.085	0.082	-1.433	0.153	1.245

$F=17.620$ ($P<0.001$), $R^2=0.403$, adjusted $R^2=0.380$, Durbin Watson=1.958.

Abbreviations: SE, standard error; VIF, variance inflation factor.

^aStandardized coefficients.

^bDummy variable.

^cContinuous variable.

in line with previous studies that have shown that grit has a significant factor on addictions.^{14,22)} This is because the grit is the ability to sustain effort over a long period to achieve a goal;¹⁵⁾ hence, a person with a high level of grit will continue to strive to reduce or avoid smartphone use, even if there are obstacles. People with a high level of grit self-regulate and control themselves to achieve their goals.¹⁵⁾ In other words, children with a high level of grit are better at managing and controlling smartphone use, so they are more resistant to overdependence. Given that grit is an acquired ability¹⁶⁾ and that childhood is a period when parental control begins to wane and inhibitory control, such as self-control and regulation, begins to improve,⁴⁾ strengthening grit during childhood will help children avoid overdependence and achieve desired growth and development. Grit is also an important quality that contributes to the overall development and successful adaptation.^{16,21)} Therefore it is necessary to enhance the grit of late school-age children through educational interventions that have been found to be effective

in promoting grit.

Children whose main purpose of smartphone usage is gaming or social networking have a higher level of dependence than children who use smartphone mainly for calling and messaging. Previous studies reported that engagement with social media or games may be a strong factor of dependence.^{10,13)} The reasons child smartphone users engage strongly with social media platforms or games may be to form friendships, have fun, and relieve stress.¹⁰⁾ Social media platforms and games allow them to build relationship better than is possible for them in real life, while also bringing them joy. These benefits give children a sense of belonging and help them relieve negative emotions such as depression and anxiety. This acts as a reward, further encouraging overdependence.^{10,13)} Therefore, offline activities from which rewards can be derived and that encourage physical activity and peer interaction are needed to meet children's needs.

Time spent on a smartphone was also found to be a factor of smartphone dependence. Previous studies have demon-

strated that the longer the usage time, the higher the risk of technology addiction.^{13,23)} However, restricting usage, that is, forcibly limiting time spent on smartphones, is known to be ineffective against overdependence.^{24,25)} Therefore, as an alternative strategy, it is important to direct children toward spending more time on offline activities, rather than forcing them to refrain from using smartphones. Additionally, as previously mentioned, it is vital that children develop the ability to self-regulate and exercise self-control through mechanisms such as grit. Moreover, improving media literacy, which is the ability to exercise judgment and control concerning media use, will be more effective in relieving children's maladjustment problems caused by smartphone use.²⁶⁾

In this study, the external factor, family strengths, was not significant. This may be attributable to the fact that although modern society incorporates many different types of families, the tools used in this study were developed based on a traditional nuclear family,¹⁸⁾ so it may not reflect the behavior of different kinds of families. Future research that encompasses a range of family types is needed to measure family strengths more accurately. Furthermore, since the overall explanatory power of the model was rather low, external factors affecting smartphone dependence should be expanded. It is necessary to explore environmental factors surrounding children that affect smartphone dependence, such as parents' smartphone use time and patterns, relationships with friends. The present study showed that dependence is not associated with gender. Gender is known to be a major predictor of smartphone dependence, but some studies have proven otherwise.¹³⁾ According to previous studies, girls mainly use their phones for social media, while boys tend to play online games.^{13,17)} In other words, there are gendered differences in the purposes of smartphone use, which seem to cause differences in smartphone dependence. Additional research is needed to collect more evidence.

1. Limitations and suggestions

This study has some limitations. First, convenient sampling was used to select subjects from two regions. Care should therefore be exercised in generalizing the findings. Secondly, family strengths constituted the sole external factor. Since children are strongly influenced by their peers as well as by their families, external factors need to be ex-

panded to include peers. Third, Cronbach's α of grit was measured as low. Grit scale was developed for adults and translated into Korean for high school students. Therefore, it should be used for children through the process of refinement of tools. Nevertheless, this study has significance as follows. Due to the COVID-19 pandemic, smartphone use has become more common, and more activities are happening online. Given that the research data were collected just prior to the outbreak of the COVID-19 pandemic, the findings of this study can be used to compare children's degree of dependence pre- and post-pandemic. The research is also significant in that the study focused on childhood, during which there is a high chance of becoming heavily smartphone dependent. Finally, the study has demonstrated that grit, an acquired ability, is one of the major factors preventing smartphone dependence.

요 약

연구배경: 후기 학령기 아동의 스마트폰 과의존은 복합적인 건강 문제를 가져올 수 있으므로, 이들의 스마트폰 과의존에 영향을 미치는 요인을 그릿과 가족건강성을 중심으로 살펴보았다.

방법: 2019년 12월에 울산과 경남에 위치한 초등학교 두 곳의 초등학생 5, 6학년 218명을 대상으로 구조화된 설문지를 이용하여 자료를 수집하였다. 스마트폰 과의존의 영향요인을 파악하기 위해 다중 회귀분석을 시행하였다.

결과: 후기 학령기 아동의 스마트폰 과의존에 영향을 미치는 요인은 스마트폰 사용시간, 스마트폰 주 사용 목적(게임, 소셜 네트워크 서비스) 및 그릿이었으며, 이 중 그릿이 가장 큰 영향을 미쳤다.

결론: 후천적인 능력인 그릿을 개발시킨다면 후기 학령기 아동의 바람직한 스마트폰 사용과 나아가 청소년기 및 성인기의 스마트폰 과의존을 예방할 수 있을 것이다.

중심 단어: 스마트폰, 과의존, 그릿, 가족건강성, 아동

ORCID

Minji Je <https://orcid.org/0000-0001-7182-5067>
Ji-Won Lee <https://orcid.org/0000-0001-5157-3675>

REFERENCES

1. Silver L. Smartphone ownership is growing rapidly around the

- world, but not always equally [Internet]. Washington, D.C; Pew Research Center; 2019 [cited Aug 5, 2020]. Available from: <https://www.pewresearch.org/global/2019/02/05/smartphone-ownership-is-growing-rapidly-around-the-world-but-not-always-equally/>.
2. Korean Information Society Development Institute. 2020 Korea media panel survey [Internet]. Jincheon: Korean Information Society Development Institute; 2020 [cited Sep 1, 2021]. Available from: https://stat.kisdi.re.kr/kor/tblInfo/TblInfoList.html?vw_cd=MT_ATTITLE&siteGb=SITE002&sub_div=E.
 3. Ministry of Science and ICT & National Information Society Agency. The survey on smartphone overdependence [Internet]. Sejong: Ministry of Science and ICT & National Information Society Agency; 2021 [cited Sep 1, 2021]. Available from: https://doc.msit.go.kr/SynapDocViewServer/viewer/doc.html?key=bb2ec689a0b44c8fa6219368274ce36c&convType=img&convLocale=ko_KR&contextPath=/SynapDocViewServer.
 4. Hockenberry MJ, Wilson D. Wong's nursing care of infants and children. 10th ed. St. Louis: Elsevier; 2018. p.832-59.
 5. Lee S, Kang H, Shin G. Head flexion angle while using a smartphone. *Ergonomics* 2015;58(2):220-6.
 6. Wang J, Li M, Zhu D, Cao Y. Smartphone overuse and visual impairment in children and young adults: systematic review and meta-analysis. *J Med Internet Res* 2020;22(12):e21923.
 7. Kuss DJ, Griffiths MD. Internet and gaming addiction: a systematic literature review of neuroimaging studies. *Brain Sci* 2012;2(3):347-74.
 8. Kenney EL, Gortmaker SL. United States adolescents' television, computer, videogame, smartphone, and tablet use: associations with sugary drinks, sleep, physical activity, and obesity. *J Pediatr* 2017;182:144-9.
 9. Sohn SY, Rees P, Wildridge B, Kalk NJ, Carter B. Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young people: a systematic review, meta-analysis and GRADE of the evidence. *BMC psychiatry* 2019;19(1):356.
 10. Cha SS, Seo BK. Smartphone use and smartphone addiction in middle school students in Korea: prevalence, social networking service, and game use. *Health Psychol Open* 2018;5(1):1-15.
 11. Lim EJ, Park CS, Kim BJ, Cha BS, Kim SJ. Personality characteristics in children and adolescents with internet and smartphone addiction. *J Korean Acad Addict Psychiatry* 2019;23(2): 100-4.
 12. Cudo A, Torój M, Demczuk M, Francuz P. Dysfunction of self-control in facebook addiction: impulsivity is the key. *Psychiatr Q* 2020;91(1):91-101.
 13. Busch PA, McCarthy S. Antecedents and consequences of problematic smartphone use: a systematic literature review of an emerging research area. *Comput Hum Behav* 2021;114:106414.
 14. Borzikowsky C, Bernhardt F. Lost in virtual gaming worlds: grit and its prognostic value for online game addiction. *Am J Addict* 2018;27(5):433-8.
 15. Duckworth AL, Peterson C, Matthews MD, Kelly DR. Grit: perseverance and passion for long-term goals. *J Pers Soc Psychol* 2007;92(6):1087-101.
 16. Duckworth A. Grit: the power of passion and perseverance. 2nd. New York: Scribner; 2016. p.19-42.
 17. Lee EJ, Kim HS. Gender differences in smartphone addiction behaviors associated with parent-child bonding, parent-child communication, and parental mediation among Korean elementary school students. *J Addict Nurs* 2018;29(4):244-54.
 18. Eo EJ, Yoo YJ. A study on the development of the scale for measuring family strengths. *J Korean Home Manag Assoc* 1995;13(1):145-56.
 19. Cohen P, West SG, Aiken LS. Applied multiple regression/correlation analysis for the behavioral sciences. 3rd ed. New York: Routledge; 2002. p.1-536.
 20. Kwon M, Kim DJ, Cho H, Yang S. The smartphone addiction scale: development and validation of a short version for adolescents. *PLoS One* 2013;8(12):e83558.
 21. Lee SR, Sohn YW. What are the strong predictors of academic achievement?—Deliberate practice and grit. *The Korean Journal of School Psychology* 2013;10(3):349-66.
 22. Kim C, Kwak K, Kim Y. The relationship between stress and smartphone addiction among adolescents: the mediating effect of grit. *Curr Psychol* 2022;1-17.
 23. Chang FC, Chiu CH, Chen PH, Chiang JT, Miao NF, Chuang HY, et al. Children's use of mobile devices, smartphone addiction and parental mediation in Taiwan. *Comput Hum Behav* 2019;93:25-32.
 24. Park N, Oh H. Impact of adolescent life stress and smartphone use on academic impairment: focusing on the effect of parent involvement on adolescents' smartphone use. *Journal of the Korea Contents Association* 2016;16(9):590-9.
 25. Livingstone S, Haddon L. EU kids online. *J Psychol* 2009;217(4): 236.
 26. Buckingham D. Constructing the "media competent" child: media literacy and regulatory policy in the UK. *Medien Pädagogik* 2005;11:1-14.