ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)

Vol 11, Issue 3, March 2024

Smartphone and Cognition in Children: Systematic Research Review

[1] Harpreet Kaur, [2] Garima, [3] Ankit Dangi

[1][2] Department of Psychology, SGRRU, Dehradun, India
[3] Department of Psychiatry, Military Hospital, India
Email: [1] harpreetghotra@gmail.com, [2] garimasingh@sgrru.ac.in, [3] ankitdan9454@gmail.com

Abstract*— Smartphones and other mobile technologies are acknowledged as versatile and potent tools that, when used wisely, can improve human cognition, there is also a growing concern that routine use of these devices may have a detrimental and long-lasting effect on children's cognitive ability. The scientific literature is not yet mature enough to support any clear findings in the areas of potential cognitive repercussions of smartphone-related behaviors and cognitive performance, which is the focus of the current review, which is intensifying but still restricted. Our study focuses largely on cognition that is implicated in the public conversation on the effects of smartphone use, and we then take into account data about the wider connections between smartphone usage patterns and regular cognitive performance. After collecting data from various databases 16 studies found to be eligible.

***Index Terms*— Smartphone, Addiction, Preteens**

I. INTRODUCTION

Definition of Smartphone Usage: The most widely accepted definition of smartphone usage typically refers to the activities and behaviors associated with using a smartphone, which is a multifunctional mobile device. While the specific wording may vary slightly, the essence of the definition is consistent. Here is a common and widely accepted definition:

"Smartphone usage encompasses the use of a handheld mobile device equipped with advanced computing and communication capabilities, including but not limited to making calls, sending text messages, accessing the internet, using mobile apps, social media, email, taking photos and videos, and performing various tasks and activities that leverage the device's features and functionalities."

This definition covers the broad range of activities that individuals engage in when using smartphones, highlighting their versatility as communication, information, and entertainment tools. Remember that this definition may evolve as smartphone technology advances and new features and functions become commonplace.

Incidence in India

Young Indians love their smartphones. According to a Nokia study, the average person checks their phone every 6.30 minutes for 16 hours in the morning. At least 10% of 20-25 year olds suffer from smartphone and computer injuries in the 20-45 year old group. These are mostly upwardly mobile patients who look at their phones at a forward angle. They complain of backaches, neck problems, and texting thumb muscle pain while texting. Tendon injuries, carpal tunnel syndrome, electrical problems, vision problems and computer blindness are diseases caused by constant use of cell phones. (Khosla V., 2013)

Background

The widespread use of smartphones in India and growing concerns about their influence on children's cognitive abilities. The widespread smartphones use has brought about a digital revolution in India, impacting various aspects of society, including the lives of children and adolescent Consequently, smartphones have become ubiquitous tools, influencing how children learn, communicate, and engage with the world around them. The prevalence of smartphone usage among Indian children is a topic of great interest and concern among educators, parents, researchers, and policymakers. It represents a complex interplay between technological advancement, cultural norms, and generational shifts in behavior. This rapid smartphone use is not limited to urban areas but is spreading to rural areas, bridging the digital divide. Indian children today are often called “digital natives” because they have grown up in an era where technology, especially smartphones, has become an integral part of everyday life. Unlike previous generations, they are accustomed to digital interaction from a very young age.

Smartphones have become integrated into the educational environment in India, especially during the COVID-19 pandemic when online learning has become the norm. These changes have raised questions about the effectiveness of digital learning tools and their impact on cognitive development. For Indian children, smartphones provide access to social media platforms and online communication. They use these devices to create virtual communities where they can communicate with peers, share experiences, and influence social and emotional development. Children consume a variety of content on their smartphones, from educational apps to video streaming platform.

Parents in India are faced with the challenge of managing their children's smartphone use while balancing the benefits of technology with concerns about screen time, online safety

ISSN (Online) 2456 -1304
International Journal of Science, Engineering and Management (IJSEM)
Vol 11, Issue 3, March 2024

and maintaining relationships in the real world. are facing it. Recognizing the need for responsible smartphone use by children, Indian regulators have prepared guidelines and recommendations for digital industries and educational institutions. There is a growing study on the influence of smartphone use on children in India, but more comprehensive and longitudinal research is required to understand the effects on cognition, mental health and wellbeing. and general well-being. In conclusion, the rapid integration of smartphones into the lives of Indian children presents both opportunities and challenges. Understanding the nuances of smartphone use in this context is critical to shaping educational practices, parental guidance, and policies that ensure a balanced and healthy digital environment for the next generation.

II. PURPOSE

To systematically review existing research on the relationship between smartphones and cognition in children, and finding research gaps.

III. METHODOLOGY

A.Search Strategy

The databases Google scholar and PUBMed were systematically searched from 2010.

Eligibility Criteria:

Inclusion criteria

- Participants: Children
- Exposure: measurement of smartphone use
- Outcome: Cognitive abilities assessed by validated instruments
- Studies published in journals with full text available in English

Exclusion Criteria

1. Studies include meeting internet activities such as video gaming unless smartphone use is assessed.
2. Substance abuse, eating disorders, well-being, life satisfaction, body image problems, conduct disorders, and psychiatric disorders unless the outcomes of interest were also measured by the researchers.

IV. III DATA EXTRACTION

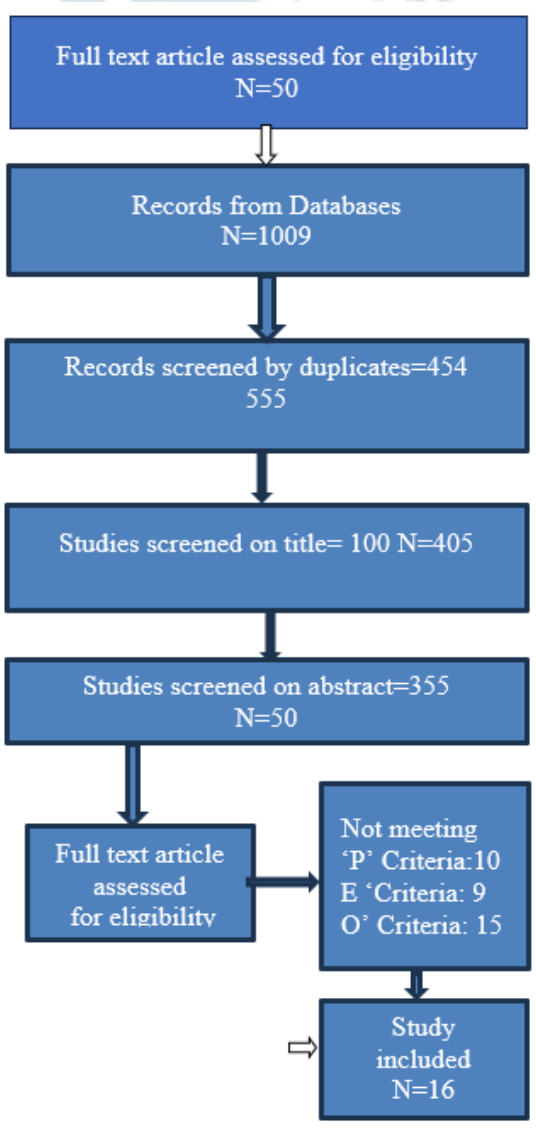
All papers from the automated database searches were collated. After duplicates were deleted, screening was conducted to ensure that studies fulfilled the eligibility criteria. In a three-stage process, papers were screened on title and abstract and the remaining papers were screened on full text. Key information relevant to the research question was systematically extracted and tabulated to aid the comparison and synthesis of the studies. These data comprised authors, publication date, country of origin, study design and data analysis method, relevant outcome measures, sample size, demographic data and results.

V. DATA ANALYSIS

We could not perform statistical analysis because the study parameters differed. Instead, a narrative synthesis was made. This leads to consideration of confounding, concordance, and variability, which are often overlooked in metaanalyses (Popay et al., Citation1995).

VI. RESULTS

The literature search produced 1009 articles from the two databases. After 454 duplicates were removed, screening on title excluded 100 papers. The remaining 455 articles were screened on abstract, with 405 removed, leaving 50 papers. On reading the full text, 34 papers were found to be ineligible, the most common reason being the age range and domain related. Ultimately a total of 16 papers were eligible for the review.



VII. RESEARCH REVIEW

Fox AB et.al, 2009 Study was done on 69 Participants to understand the cognitive effect of concurrent chatting. Participants completed a reading and comprehension task uninterrupted or while concurrently holding a Chatting conversation. Negative consequences of instant messaging could be established, Participants who were chatting while performing the reading task took significantly longer to complete the task. Though it did not affect reading comprehension scores. Additional analyses revealed that the more time participants reported spending on IM, the lower their reading comprehension scores. They found that the more time participants reported spending on IM, the lower their self-reported scores.

Abramson et.al,2009 Using a cross-sectional epidemiological design, the MoRPhEUS (Mobile Radiofrequency Phone Exposed Users' Study) study investigated cognitive function in secondary school pupils. A total of 317 7th graders, with a median age of 13 years old (144 males and 173 girls), were chosen from 20 local Melbourne, Australia, schools. The Interphone study's exposure questionnaire, a battery of computerized cognitive tests, and the Stroop color-word test had been completed by the participants. The primary exposure parameter was the total number of voice calls from mobile devices that were reported each week. Response times and accuracy results from cognitive tests were fitted using linear regression models. Standard errors were corrected for clustering by school and the effects of age, gender, ethnicity, socioeconomic level, and handedness were fitted as variables. Working memory accuracy was worse, and response time for a straightforward learning test was slower, associative learning response time shorter and accuracy poorer in children reporting more mobile phone voice calls.

There were no meaningful connections between exposure and estimates, movement monitoring, or signal detection. Those who reported more mobile phone voice conversations took longer to finish the Stroop word identifying tasks. The results were consistent for the total number of short messaging service (SMS, often known as text) messages sent each week, indicating that radiofrequency (RF) exposure was unlikely to be the cause of these cognitive alterations. In general, using a phone while performing higher level cognitive activities was linked to quicker and less accurate responses. The constant usage of a cell phone may have taught these tendencies.

Thomas et al. 2010 examined the impact of adult cell phone use on cognitive function. However, adolescents and teens are of special interest because of their developed neural systems. The Australian Mobile Radiofrequency Phone Exposed Users' Study (MoRPhEUS), which comprised a baseline evaluation of Year 7 students in 2005/2006 and a 1-year follow-up, supplied the data for this study. A questionnaire was used to gather sociodemographic and exposure data. The Stroop Color-Word test and a computerised battery of tests were used to evaluate cognitive ability. Both examinations were finished by 236 students. The number of mobile phone owners and the weekly volume of voice calls and short messaging services (SMS) both increased from baseline to follow-up. Participants with higher baseline call and text frequency experienced slower cognitive abilities.

Jacobson WC et.al,2011 examined how university students' usage of electronic media affected their social and academic life. The usage of various forms of electronic media among first-year students was investigated using time-diary and survey data. Results from time diaries indicate that the majority of pupils multitask using electronic media. Strong regression findings show a poor correlation between first-semester grades and the use of different electronic media. Additionally, the study showed a favourable correlation between the usage of social networking sites, mobile communication, and in-person social engagement.

Sparrow.et.al,2011 conducted four research that revealed that individuals are predisposed to think about computers when presented with challenging problems and that when people anticipate having access to knowledge in the future, their recollection of the material itself is decreased and their remember of how to acquire it is boosted. The Internet has emerged as the main medium for collectively storing knowledge outside of ourselves in an external or transactive memory.

Alloway and Alloway et.al 2012, According to research, certain Facebook and YouTube actions, such monitoring friends' status updates and recommending videos to friends, can predict how well a person would score on a working memory exam. The results also showed that the attentional control characteristics of Active and Passive SNS users were fundamentally different. In the first block of trials, the Active SNS users were more accurate and missed the target stimuli less frequently. Additionally, they were less likely to overlook distractor stimuli and did not restrict their attentional resources to the target stimuli. They looked to be using SNS for exploration, and they gave equal weight to incoming information streams. Participants' self-reports of social connection were substantially correlated with Facebook use and not with Twitter or You tube accessibility probably due to the former SNS's higher ability to post private content.

Paul et.al 2012, did a survey of business students at a large state university. Structural equation modeling (SEM) was used to assess the results of survey. The findings showed a statistically significant inverse correlation between students' OSN usage and academic achievement. The students' attention spans were shown to have a significant impact on how long they stayed on OSN. In particular, we found that OSN duration is decreased in proportion to attention span. Additionally, it was shown that attention span has a strong

correlation with traits that predict or affect student behaviour, such as how they feel about how society views social networking, what they like and hate about OSN, how simple it is to use, etc.

Minear et.al,2013 Ophir, Nass, and Wagner (Proceedings of the National Association of Sciences 106:15583–15587, 2009) discovered that those who regularly use several media platforms perform worse at multitasking, probably because they have trouble blocking out irrelevant inputs coming from both external sources and internal representations in memory. We classified heavy media multitaskers (HMMs) and light media multitaskers (LMMs) using the media multitasking index (MMI) created by Ophir et al. We then tested these individuals on measures of attention, working memory, task switching, fluid intelligence, as well as self-reported impulsivity and self-control. We discovered that those who regularly multitask with media reported being more impulsive and fared worse on tests of fluid intelligence than individuals who did not frequently multitask with media. However, we were unable to discover any evidence to substantiate the claim that HMMs perform worse than LMMs while multitasking, such as when moving between tasks, or that they exhibit any weaknesses when dealing with irrelevant or distracting information.

According to Lenord (2015), the popularity of smartphones among the younger population has skyrocketed. They stay in touch and monitor what they can. As a result, it can sometimes lead to serious back problems, nerve pain, anxiety, depression and other problems

Parasuraman, et.al, (2017), in his survey reveals that misuse of mobile phone can cause psychological and physiological problems. In the same line, Arora (2018) reveals that children are observed mostly using smartphones to play games etc. for longer duration. In this way, usage and openness might result in negative outcomes like: - Growth (radiation effects), messed-up brain activity, inappropriate media, and taught carelessness.

"Researchers from Carnegie Mellon, the University of California, San Diego, and the University of Texas at Austin collaborated and conducted a study in 2018. They divided 548 individuals into three groups and conducted the study. All of them had to undergo computer tests. According to the findings, "the mere presence of a smartphone can reduce the available cognitive capacity and impair cognitive function even when subjects are successfully concentrating on a given task."

Excessive use of mobile devices in classrooms affects students' concentration and learning.

Mendoza JS, et. al. 2018 looked at the potential effects of using mobile devices during lectures on learning, as attention spans decline over time. Participants in two studies watched a 20-minute lecture under different circumstances of mobile device use (keep or remove). Groups holding cell phones at the lecture received intrusive text messages. The participants tried out the lecture. Depending on when the subject was taught, the quiz questions were divided into four halves. Finally, it was determined how nomophobic individuals were, or how afraid they were of being without their phone. Participants who had their cell phones during an exam regarding subjects presented in the third quarter of the lecture fared worse than those who did not. Participants who had their cell phones during an exam regarding subjects presented in the third quarter of the lecture fared worse than those who did not. Participants who were distracted performed worse than those who were not on a test on the same topic. In the subscales related to the loss of connectivity and, in particular, the relinquishment of comfort, participants with higher levels of nomophobia performed worse on the information contained in the third quarter of the lecture. According to research, using mobile phones during a short presentation has the most negative effect on concentration and learning within 15 minutes. This study offers new insights into how technology and learning interact to support teachers and students in maximizing learning.

A study by Madigan, S.et.al (2019) examined the association between screen time, including smartphone use, and children's performance on a developmental screening test. She found that increased screen time was associated with poorer performance in certain developmental domains.

Tanil CT, et.al 2020 studied the effect of mobile phone presence on learning and memory among students. 119 college students completed the Smartphone Addiction Scale (SAS) and a memory test. As expected, students with a smartphone were found to have low recall accuracy compared to those who had a smartphone. The results showed a significant negative correlation between conscious thought of the phone and memory recall—specifically, “How often did you think about your phone?”—but not between SAS and memory recall. Memory accuracy was significantly predicted by thinking while on the phone. Tracking the presence of a mobile phone has led to the idea of high phone awareness affecting human learning and memory control and showing the adverse consequences of mobile phone proximity on our learning and memory.

Geng-Feng Nieu et.al investigates how mobile phones affect cognitive performance and the potential moderating impact of fear of missing out (FoMO). (1) Participants in the present group had poorer accuracy and longer response times in the operational span task compared to the absent group, suggesting that the presence of cell phones has a detrimental effect on cognitive performance; The effect was greater for people with higher levels of FoMO. FoMO moderated the effect of smartphone presence on accuracy and response time in the operating span test.

Mukherjee et.al, 2020 Developmental evaluation on an E-Platform (DEEP), a tablet-based, gamified cognitive assessment tool, was created. It can be delivered in rural Indian households by non-specialists and is well-liked by all end users. They presented proof-of-concept for predicting a child's cognitive growth using metrics generated from

playtime on DEEP, benchmarked to the Bayley's Scale of Infant and Toddler growth, 3rd Edition (BSID-III) cognitive scale. The BSID-cognitive scores and projected DEEP scores had strong agreement (ICC [2,1] > 0.6) and a positive correlation (Pearson's r = 0.67), and model performance metrics were very similar between the training and test datasets. DEEP has the potential to serve as an acceptable and practical cognitive assessment tool to close the detection gap and enhance optimal child development by using the power of ML, which enables incremental improvements as more diverse data become accessible for training.

Meena et.al ,2020 examined the incidence and patterns of screen-based media exposure in infants and toddlers between the ages of 15 and 18 months. and found that all the children between 15-18 months are exposed to social media therefore there is a requirement of developmet of guildelines for their smartphone use and same should be circulated to parents.

Yang et.al,2020 The study explored a cognitive-affective framework in which internalisation of an ideal body image, comparisons to others' appearances, and social anxiety over appearance are sequentially mediating factors in the relationships of social media and smartphone usage with body esteem. Through increased cognitive internalisation, which exacerbates appearance comparisons and anxiety related to poor appearance appraisal, excessive social media usage among female teenagers (N = 100) between the ages of 13 and 18 results in bad body esteem.

John et.al 2021 studied and found that out of the 189 kids who participated in the research, 89.4% used screens excessively (more than 1 hour per day), with an average of 2.14 hours. Inconsistently monitored screen time was reported by 45.0% of parents.

Tyagi et.al ,2021 According to the statistical study, lockdown situations have increased smartphone use, which roughly 90% of people also said. Additionally, 95% of the participants think that using technology excessively raises the risk of developing particular health problems. Individuals under the age of 30 are observed to be highly impacted by lockdown (45.7%) because to their excessive reliance on technology. Additionally, among participants in different vocations, participants in online teaching-learning are most affected (42.6%).

Varadarajan et.al,2021 In Tamil Nadu, India, the field training area of rural and urban health centres, a population-based cross-sectional study was carried out. Developmental delay was strongly linked to higher ST, especially in the areas of communication and language acquisition. ST and language delay (AOR = 52, 92) were both linked with delay in children under the age of two (AOR = 17.75, 95% CI: 5.04-62.49, p 0.001). little ones; At age 2, ST (AOR = 16.79, 95% CI: 2.26-124.4, p and lt; 0.001) and language delay (AOR = 20.93, 95% CI: 2.68-163.32, p) were both linked with delay in 2 domains. It was discovered that there was a very high frequency of excessive ST, which was strongly linked to child developmental delay.

Gupta et.al,2022 studied and found that excessive screen usage (>1-2 hours per day) and there appears to be a high prevalence of screen-based media exposure among children in India. The association suggests avoiding screen exposure for infants under the age of two, while limiting exposure for children between the ages of 24 and 59 months to no more than an hour of supervised screen time per day and for children between the ages of 5 and 10 years old to no more than two hours per day.

Saxena et.al,2022 performed study on 423 children with neurodevelopmental disability and according to analysis, 92.7% (n = 392) of all respondents own cellphones. According to 61% (n = 258) of the respondents, mobile devices were utilised by their children before they turned two. Only 13.4% (n = 57) of the parents of the diagnosed children were told by their paediatricians about the potential harms of media use.

VIII. RESEARCH GAPS AND SIGNIFICANCE

Research on the impact of smartphone use on adolescent thinking in India is a developing field, and several research gaps need to be addressed to achieve a more comprehensive understanding of the issue. Longitudinal studies that track adolescent smartphone use and cognitive development over the long term are needed to clarify causality and understand the evolution of smartphone use. Studies often lump them together, but cognitive development and smartphone usage patterns can vary significantly in this area across age groups. Research should consider how these variables may influence smartphone use patterns and cognitive development in adolescents from different regions and backgrounds. Contextual factors: Research should examine how contextual factors such as parental education, socioeconomic status, and urban/rural environment influence smartphone use and cognitive outcomes in adolescents. Understanding how smartphones affect these specific domains can provide more nuance. These factors may play an important role in determining the impact of smartphone use on cognition. Examining moderating factors such as parental guidance and restrictions, quality of smartphone apps and content, and duration of use can help determine when and how smartphone use can become cognitively harmful or beneficial. Internet safety and cyberbullying: There is little research on how smartphone use affects adolescents' mental health, including their exposure to online risks such as cyberbullying and harassment. Research in this area is important to address security aspects and their impact on cognitive development. Impact of COVID-19: The COVID-19 pandemic has significantly increased the use of smartphones for online education and communication. The study should find out how parental involvement affects both smartphone usage habits and cognitive outcomes. Ethical considerations: Research is needed that addresses the ethical considerations of data protection and informed consent when investigating smartphone use and cognitive development in preadolescents.

Addressing these research gaps is important for outreach, educational strategies, and parental guidance to ensure that Indian youth can benefit from smartphone use while minimizing potential negative cognitive consequences.

IX. COMPREHENSIVE OVERVIEW OF PARENTAL EDUCATION AND AWARENESS TO PROMOTE HEALTHY SMARTPHONE USE AMONG CHILDREN

Promoting healthy smartphone use among children is essential for their physical and mental well-being. Organize workshops and seminars for parents to educate them about the potential risks and benefits of smartphone use in children. These sessions can cover topics like screen time guidelines, age-appropriate apps, and setting boundaries. These resources should contain information on the effects of excessive screen time, recommended screen time limits, and tips for responsible smartphone use. Develop or recommend smartphone apps or tools that help parents track and manage their children's screen time. These apps often come with features like setting daily limits, monitoring app usage, and providing reports. Encourage parents to have open and ongoing conversations with their children about smartphone use. Parents should be aware of what their children are doing on their devices and be able to discuss any concerns or issues that may arise. Parents should set a positive example by practicing healthy smartphone use themselves. Children are more likely to emulate the behavior they see in their parents, so it's important for parents to demonstrate responsible device usage. Help parents create designated tech-free zones in the home, such as the dinner table or bedrooms, and tech-free times, such as before bedtime. Inform parents about the built-in parental control features available on smartphones and recommend third-party parental control apps. These tools can help parents restrict access to certain apps, websites, and content. Teach parents how to educate their children about media literacy, critical thinking, and online safety. This knowledge will empower children to make responsible choices when using smartphones and the internet. Encourage parents to establish clear rules and agreements regarding smartphone use, including acceptable screen time limits, content restrictions, and consequences for breaking the rules. Emphasize the importance of regularly reviewing and adjusting smartphone usage rules as children grow and their needs change. Encourage parents to foster offline interests and hobbies in their children, such as sports, arts, or reading. These activities can help balance screen time and contribute to a child's overall development. Facilitate the formation of peer support groups for parents where they can share experiences, challenges, and strategies for promoting healthy smartphone use in children. Partner with schools to integrate digital literacy and responsible smartphone use into the curriculum. This ensures that children receive consistent messages about healthy device usage at home and in school. Encourage parents to stay informed about the latest research on the effects of smartphone use in children. Prepare parents with a crisis response plan for situations where smartphone use becomes problematic or harmful, such as cyberbullying or excessive screen time addiction.

X. SUMMARY

The Summary of research review is presented in the form of Table 1.

Table 1

References	Studies
Abramson et al,2009	Utilisation of mobile devices predicts quicker but less precise Stroop performance.
Fox et.al,2009	Using instant messaging while reading slows down reading speed without affecting understanding; more frequent use of instant messaging is associated with worse academic achievement.
Jacobsen and Forste,2011	Electronic media use is negatively correlated with academic achievement; face-to-face engagement is positively correlated with media use.
Sparrow et.al, 2011	People who believe they will have access to knowledge in the future had poorer recall rates for that information, but they do remember where to get it.
Minear et.al,2013	There is no correlation between media multitasking and task switching, however frequent media multitaskers have higher impulsivity and less fluid intelligence.
Lenord (2015)	Smartphone use can sometimes lead to serious back problems, nerve pain, anxiety, depression and other problems
Parasuraman, et.al, (2017)	Excessive use of mobile devices in classrooms affects students' concentration and learning.
Mendoza JS, et. al. 2018	Using mobile phones during a short presentation has the most negative effect on concentration and learning within 15 minutes.
Madigan, S.et.al 2019	Increased screen time was associated with poorer performance in certain developmental domains.
Tanil CT, et.al 2020	The results showed a significant negative correlation between conscious thought of the phone and memory recall
Mukherjee et.al, 2020	Cognitive assessment too named DEvelopmental assessment on an E-Platform (DEEP) holds promise to serve as an acceptable and feasible cognitive assessment tool to bridge the detection gap and support optimum child development.

Meena et.al ,2020	There is a requirement of developmet of guildelines for smartphone use and same should be circulated to parents.
Yang et.al,2020	Through increased cognitive internalisation, which exacerbates appearance comparisons and anxiety over unfavourable appearance appraisal, excessive usage of social media contributes to bad body esteem.
John et.al 2021	Inconsistently monitored screen time was reported by 45.0% of parents.
Varadarajan et.al,2021	There was a very high prevalence of excessive ST, which was strongly linked to children's developmental delays.
Gupta et.al,2022	excessive screen usage (>1-2 hours per day) and extremely early exposure to screen-based media appear to be widespread among Indian youngsters
Saxena et.al,2022	potential harms of media use.

XI. CONCLUSION AND DISCUSSION

Although there is currently a dearth of empirical study on the cognitive consequences of smartphone technology, smartphones have the ability to affect a wide range of cognitive areas. This makes sense considering how new and dynamic the underlying technology is. But the prevalence of cellphones in our life increases every year. Research in this field will soon be pertinent to the majority of people on the planet rather than just a small subset of people. So that we may take the appropriate actions to lessen the negative effects, it is crucial that we understand how smartphone technology impacts us.This paper's study lays the groundwork for an endless number of "next steps" that might be contemplated. There is a tremendous need for more study to help psychologists and the general public better grasp the immediate and long-term implications of smartphone technology.

REFERENCES

[1]. Fox AB, Rosen J, Crawford M. Distractions, distractions: does instant messaging affect college students' performance on a concurrent reading comprehension task? Cyberpsychol Behav. 2009 Feb;12(1):51-3. doi: 10.1089/cpb.2008.0107. PMID: 19006461.

[2]. Jacobsen, W. C., & Forste, R. (2011). The wired generation: Academic and social outcomes of electronic media use among university students. Cyberpsychology, Behavior, and Social Networking, 14(5), 275-280.

[3]. Sparrow, B., Liu, J., & Wegner, D. M. (2011). Google effects on memory: Cognitive consequences of having information at our fingertips. science, 333(6043), 776-778.

[4]. Abramson, M. J., Benke, G. P., Dimitriadis, C., Inyang, I. O., Sim, M. R., Wolfe, R. S., & Croft, R. J. (2009). Mobile telephone use is associated with changes in cognitive function in young adolescents. Bioelectromagnetics: Journal of the Bioelectromagnetics Society, The Society for Physical Regulation in Biology and Medicine, The European Bioelectromagnetics Association, 30(8), 678-686.

[5]. Alloway, T. P., & Alloway, R. G. (2012). The impact of engagement with social networking sites (SNSs) on cognitive skills. Computers in Human Behavior, 28(5), 1748-1754.

[6]. Paul, J. A., Baker, H. M., & Cochran, J. D. (2012). Effect of online social networking on student academic performance. Computers in human behavior, 28(6), 2117-2127.

[7]. Mendoza, J. S., Pody, B. C., Lee, S., Kim, M., & McDonough, I. M. (2018). The effect of cellphones on attention and learning: The influences of time, distraction, and nomophobia. Computers in Human Behavior, 86, 52-60.

[8]. Madigan, Sheri & Browne, Dillon & Racine, Nicole & Mori, Camille & Tough, Suzanne. (2019). Association Between Screen Time and Children's Performance on a Developmental Screening Test. JAMA Pediatrics. 173. 10.1001/jamapediatrics.2018.5056.

[9]. Tanil ,C. T., & Yong, M. H. (2020). Mobile phones: The effect of its presence on learning and memory. PloS one, 15(8), e0219233.

[10]. Geng-Feng Nieu,et.al .Nov(2022) Can smartphone presence affect cognitive function? The moderating role of fear of missing out. Comput Hum Behav.Vol 136.

[11]. Mukherjee, D., Bhavnani, S., Swaminathan, A., Verma, D., Parameshwaran, D., Divan, G., ... & Patel, V. (2020). Proof of concept of a gamified Developmental assessment on an E-Platform (DEEP) tool to measure cognitive development in rural Indian preschool children. Frontiers in Psychology, 11, 1202.

[12]. Meena, P., Gupta, P., & Shah, D. (2020). Screen time in Indian children by 15–18 months of age. Indian Pediatrics, 57, 1033-1036.

[13]. Yang, H., Wang, J. J., Tng, G. Y., & Yang, S. (2020). Effects of social media and smartphone use on body esteem in female adolescents: Testing a cognitive and affective model. Children, 7(9), 148.

[14]. John, J. J., Joseph, R., David, A., Bejoy, A., George, K. V., & George, L. (2021). Association of screen time with parent-reported cognitive delay in preschool children of Kerala, India. BMC pediatrics, 21,1-8.

[15]. Tyagi, A., Prasad, A. K., & Bhatia, D. (2021). Effects of excessive use of mobile phone technology in India on human health during COVID-19 lockdown.

[16]. Varadarajan, S., Govindarajan Venguidesvarane, A., Ramaswamy, K. N., Rajamohan, M., Krupa, M., & Winfred Christadoss, S. B. (2021). Prevalence of excessive screen time and its association with developmental delay in children aged< 5 years: A population-based cross-sectional study in India. Plos one, 16(7), e0254102.

[17]. Gupta, P., Shah, D., Bedi, N., Galagali, P., Dalwai, S., Agrawal, S., ... & IAP Guideline Committee on Digital Wellness and Screen Time in Infants, Children and Adolescents. (2022). Indian Academy of Pediatrics Guidelines on screen time and digital wellness in infants, children and adolescents. Indian pediatrics, 59(3), 235-244.

[18]. Coutinho, F., Saxena, G., Shah, A., Tilak, S., Desai, N., & Udani, V. (2022). Mobile media exposure and use in children aged zero to five years with diagnosed neurodevelopmental disability. Disability and Rehabilitation: Assistive Technology, 17(6), 645-651.