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DIGITAL DEMENTIA IN CHILDREN AND ADOLESCENTS: SYMPTOMS, RISK FACTORS AND PREVENTION STRATEGIES. A NARRATIVE REVIEW

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ABSTRACT

Children and adolescents, as the new generation of avid technology users, are often able to use it to their great benefit. However, it comes with the cost of being exposed to a variety of health risks, cognitive health being one of the main areas affected. As developing brains are the most susceptible to these risks, Manfred Spitzer's concept of digital dementia seems as relevant as ever nowadays.

In the present study, we analyse over a hundred published works with the goal of creating a compact yet comprehensive summary of existing knowledge on digital dementia in the population of infants, preschoolers, schoolchildren and adolescents.

Findings suggest that multiple cognition areas are affected, with memory, critical thinking and problem solving being among the most alarming. While the role of parents as guardians of digital health cannot be overstated, other factors such as environment and unmodifiable traits also play a role. For preventing and mitigating this problem, a collaborative effort of caretakers but also teachers, doctors and policy makers is most urgently needed.

We conclude that digital dementia among youth is a common problem, therefore recognising symptoms early, minimising risks and preventing its progression will prove beneficial to whole generations.

KEYWORDS

Digital Dementia, Cognitive Health, Children And Adolescents, Screen Time, Risk Factors, Prevention

CITATION

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Introduction

Dementia is a broad term describing a group of diseases which negatively affect cognitive abilities such as remembering, critical thinking, decision making and problem solving. They can also lead to behavioural changes, losing personal items and struggling with finding words, causing great confusion and difficulty in the daily lives of the people affected, as well as their families. Symptoms get more frequent and intense over time, often eventually leading to dementia patients needing daily assistance in everyday tasks. [1] As of 2021 World Health Organisation data, an estimated 57 million people around the world were diagnosed, with roughly 10 million new cases every year. With age being the main risk factor, mostly people 65 or older are affected. [2]

However, a German neuroscientist and psychiatrist Manfred Spitzer observed a similar case of deteriorating cognitive function in the younger generation, linking it to digitalization and introducing the term 'digital dementia'. In his 2012 book Digital Dementia: What We and Our Children are Doing to our Minds, as a result of research, professional and personal experience, the author concludes that digital media is causing significant damage to human cognitive health, particularly among the youth. The author points to the decline of education among school children, disruption of speech development, limitation of social skills and attention abilities. [3] Some studies support his views, revealing a semblance of symptoms in adolescents exposed to screens excessively with symptoms presented by adults in the early stages of dementia. [35]

The following research aims to analyse existing knowledge on the subject of digital dementia among children and adolescents, identifying the symptoms, risk factors and strategies for preventing and mitigating this problem.

Methodology

This study outlines the current state of knowledge on digital dementia in children and adolescents, with particular focus on symptoms, risk factors and prevention strategies. Research has been conducted with the use of reputable databases such as PubMed, Google Scholar, Scopus, Science Direct and Web of Science. More data has been obtained from renowned organisations' and data collection websites including World Health Organisation, NIH National Institute of Neurological Disorders and Stroke, Centers for Disease Control and Prevention, American Academy of Pediatrics and We Are Social. We focused on scientific works published between 2007 and 2025, while Manfred Spitzer's book Digital Dementia was published in 2012. A total of 103 studies were included. They were published in English and met the requirements for this review.

Results

Since the World Wide Web's early days in the 1990s, the Internet has taken a central role in the daily lives of people all around the world. According to the 2025 We Are Social report, among the total world population of 8.20 billion people, 70,5% (5.78 billion) are mobile phone users and 67,9% (5.56 billion) are internet users. Compared to the 2024 report, these figures have increased by 0,9% (70 million) in total world population, 2% (112 million) in phone users and 2,5% (136 million) in internet users. [96]

Children nowadays are a group exposed to screens at an alarmingly early age, with the majority viewing media on television or mobile devices within the first year of their lives. [7] The global changes in digital habits have been taking place most rapidly in the last two decades, but already in 2001 Marc Prensky pointed to technology being the main differentiator in behaviour, communication and perception between children and their parents and teachers. He used the term "digital natives" for the generations born practically immersed in technology, fluent in its "language" and "digital immigrants" for the generations born without such access to digital devices, having to adapt and learn how to use them later in life. [94] With the help of functional magnetic resonance imagining, researchers have proven that for the latter, online searching works as a cognitive exercise and increases neural activation, [4] while certain computer games improve overall cognitive function among older adults with the use of multitasking techniques. [49] Another study suggests that online research might also benefit neural activity of young people who are already fluent in the language of the internet. [4] However, the quality of media consumed plays a crucial role in the arrival of consequences. Technology develops faster than our brains can adapt to the substantial number of stimuli we are exposed to while using digital devices. That's causing our neural systems to be always alert, ultimately resulting in cognitive fatigue and a variety of its consequences. Research revealed that changes occurring in neural pathways and brain structure observed in adolescents exposed to excessive screen time resemble such changes in adults with neurodegenerative diseases such as Alzheimer's disease or frontotemporal dementia. [35]

Symptoms

Education, information acquisition, memory

Although digital devices often make our lives easier by providing the convenient role of "external memory" - remembering our friends' birthdays and phone numbers, sending us calendar reminders - relying on them too much deprives our brains of the extra mental exercise necessary for cognitive agility. [20] When we use them, mostly the left brain hemisphere is stimulated, whereas the right one - related to maintaining focus - remains at rest. Over time, this repeated pattern results in increased forgetfulness and deprives our brains of mental challenges proven to lower the risk of dementia. This seems particularly important for children and adolescents since their brains are still maturing. [38] The adversity screen-dependent children deal with at school remains a source of worry for parents and teachers. Continuous online presence comes with processing a significant amount of notifications and information which exceeds children's cognitive capacities, leaving them in a state of cognitive overload which negatively impacts short-term memory, long-term memory, working memory and attention, all necessary for effective learning. [33, 35] Excessive screen use remains linked to higher stress levels, anxiety, depression [21, 25] and fragmentation of attention, [20] all of those being proven to have a negative effect on deep focus and memory consolidation. [20, 21]

For adolescents, worsened academic performance is linked particularly with frequent television watching, playing video games, [55] multitasking between different digital devices and engaging in short-form videos. [86] The latter have a big role in the process of developing a habit of superficial data acquisition, translating into studying difficulties. [87]

Undoubtedly, modern technologies can be used to children's advantage in education due to the vast quantities of easily accessible information and big potential for helpful tools. However, it's important to use

them intently, as sometimes traditional ways prove more efficient. A Norwegian study revealed that teenagers who read texts printed on paper performed better in reading comprehension tests in comparison to students reading PDF files of the same texts on a computer screen. [83]

Behavioural problems

Long screen time use is associated with behavioural problems in the areas of peer relationships, emotions problems and conduct. These problems include irritability, anxiousness, rumination and acting out. [35, 100] This association increases with age, is linked particularly strongly with playing video games or frequent visits to online forums and is much less exhibited in children who mostly send messages via e-mail or social media communicators. [10, 100] Sometimes behavioural problems in children can be traced back to the increase in usage of digital devices. [15] Daily exposure to television, particularly for entertainment rather than education, increases the risk of hyperactivity and inattention in follow-up studies. [64] These findings were supported in another study on preschoolers - watching violent TV programmes resulted in bigger statistical prevalence of aggressive, anti-social behaviours a few years later. [63] A study on Chinese preschoolers found a link between daily screen time exceeding one hour and a higher risk of externalising behaviours such as aggression, disrupted attention or internalising behaviours such as anxiousness, somatic complaints. [70] These findings were further supported in a 2024 systematic review by Merín et al. [71] Viewing content highly focused on physical appearance on social media platforms such as TikTok results in social comparison and heightens the risk of distorted, negative body image. [88] The attention-grabbing nature of short-video social media platforms often leads users to spend more time than intended and conditions their brains to rely on short-term gratifications, resulting in diminished self-regulation - one of the main risk factors of developing addictions later in life. [84, 92]

While excessive usage of the internet can be linked to problems with conduct and emotional regulation, the usage of mobile phones seems also linked to hyperactivity and inattention. However, pre-existing peer relationship problems exhibit a strong correlation with overuse of both types of digital devices, suggesting that they're related and it's important that caretakers and researchers take a holistic look at the reasons and ways of solving children's behavioural issues. [31]

Communication and social skills

Checking social media and being "up to date" are often cited as reasons for time spent in front of screens. As harmless as it sounds, results might be completely opposite since the availability of the digital world can make people prone to self-isolation. [35] This isolation gets them caught in a vicious circle where maintaining real-life relations becomes increasingly more challenging - considering problems in peer relationships are also an important predicting factor of Internet addiction. [93] Frequently checking social media forms a strong attachment to one's cellular device [40], resulting in more time spent on other screen activities. Researchers from Los Angeles, California conducted an experimental study which proved their hypothesis that time away from technology and being exposed to more face-to-face interactions sharpen children's ability to recognise emotions and understand social cues. [12]

Nonetheless, thousands of researchers work on finding ways to make technology beneficial for us and our children and their results shouldn't be overlooked. After analysing digital habits of 500 children and their families, Anitha et al. concluded that viewing suitable media with an adult present led to age-appropriate development in communication and social skills, contrary to children with unhealthy media habits which received lower scores in assessment of those skills. [7]

For children with diseases leading to social isolation, such as cancer, the use of digital devices can be crucial in maintaining relationships and preserving a sense of normalcy in their lives. [81] Children on the autism spectrum often find communication to be one of the biggest challenges. According to computer scientists, robots - as they're more predictable than humans - can be an efficient tool for learning social cues and finding interactions with people less difficult. [80]

Problems solving difficulties

Children with problematic screen use patterns showed sub-average problem-solving skills in comparison to those who watched age-appropriate content with their parents present as they exhibited age-adequate development in that area. [7] Decision-making and taking up cognitively demanding projects can prove increasingly difficult over time if one often succumbs to the habit of passive scrolling [90] and gets accustomed to social media's features such as infinite scroll or autoplay. [84] It can be explained by the imbalance between the hyperactivity of brain's reward circuit pathway and hypoactivity of its inhibition system as a consequence of continuous screen exposure. These pathways are responsible not only for making decisions but also for

development of addictions later in life, which warrants concern over long-term implications of screen behaviours in youth. [35, 39]

Another alarming phenomenon is the increasing popularity of artificial intelligence tools for everyday tasks requiring problem solving and decision making. Instead of putting their brains through the effort of facing those tasks on their own, many adolescents decide to turn to tools such as Chat GPT which may save time but take away the possibility of personal growth and development. [36]

Development

A 2021 study aimed to compare toddlers' ability to learn new words using three different types of conditions. The in-person approach led to significantly higher efficacy in word learning than when using a virtual agent. Results in the group using a video chat overlapped with the other two. [68] The brain regions responsible for recognising and development of speech express a significantly higher activity during reading print compared to using digital devices- in schoolchildren [24] as well as pre-school children [23]. Higher exposure to screens in early childhood leads to lower structural integrity in white matter tracks responsible for language and literacy skills, [23] resulting in delayed language acquisition. [26, 82] Children regularly exposed to higher screen time can exhibit poorer performance on general development tests compared to their peers as well as to their own previous results. [9, 82] The majority of media is consumed while sedentary and physical activity levels tend to decrease as screen time increases. Low activity levels are a known factor for hindering synaptic connectivity and brain neuroplasticity, further endangering cognitive skills. [34]

Statistically, children and adolescents with higher screen time per day are also at a higher risk of precocious puberty. [45, 46, 47] It can be traced back to multiple mechanisms, including blue light emission which disrupts circadian rhythm and hormonal regulation, especially in early puberty and prepubertal stage, [48] frequent exposure to sexually explicit content [52] or increased stress. [51] As early puberty is linked to a higher risk of obesity, cardiovascular diseases and type 2 diabetes, these findings warrant concern about overall health of avid screenagers. [51]

When considering the side-effects of digital devices it's also important to remain up-to-date with evidence pointing to some of them being beneficial to the youth's development. Active video games lead to an improvement in fitness and posture of healthy children [60] as well as serve as a rehabilitation tool and promote development of gross motor skills, especially among children with motor skill deficits caused by developmental disabilities, eg. cerebral palsy, developmental coordination disorder and Down syndrome. [59] Some evidence points to scrolling at an early age leading to earlier development of fine motor control compared to their non-scrolling peers. [66]

Sleep patterns

The usage of digital devices affects sleep in all age groups. Data from a UK study on infants and toddlers aged 6–36 months points to a pattern of decreased total sleep duration, with shorter night-time sleep and longer day-time sleep. For every extra hour of using screens, an average of 15,6 minutes of total sleep duration was lost. [28] Similar reports are found on adolescents. According to both subjective and objective measures, decreased sleep efficiency, difficult awakenings, [29] continuous fatigue and sleepiness during the day [27] can all be traced back to dependency on tablets and mobile phones. The association between sleep and screen time goes both ways, as children who have pre-existing sleep difficulties tend to consume more media after school. [37]

Multiple studies have inquired into the consequences of screen time for sleep quality among the youth. The identified factors include: blue light emitted by digital devices suppresses melatonin, leading to disruption of melatonin levels responsiveness and to circadian misalignment [65]; screens activities take away from sleep duration; content viewed on digital devices increases alertness and agitation. [28]

Watching television and using tablets, especially late in the evening, is a proven risk factor for changes in sleep quality and schedule, as it can lead to poorer sleep consolidation, later bedtime and later awakening among preschoolers, with no association found with changes in overall sleep time. To the surprise of researchers, evening iPod use pointed to earlier bedtimes. It could be traced back to parents using these devices for playing calm music aimed at soothing their child to sleep. [65] Undoubtedly further research is recommended on this phenomenon, especially considering the role of sleep as a mediator in cognitive development. [71]

Attention

As the number of attention-deficit hyperactivity disorder (ADHD) diagnoses increases, [13] the disease remains an objective of extensive research. Multiple studies point to a positive association between screen use and its length and children developing symptoms of ADHD [6, 10, 11], while others conclude that the

association is non-existent [16, 17] or negative. [22] One hypothesis for a potential correlation between screen time and attention impairment is the pattern of using technology applied by many young people, where repetitive shifts of attention and using multiple screens at once diminish one's ability to focus on one task or one type of stimuli at a time. [8] Ward et al. point to the mere presence of a smartphone nearby impairing one's ability to receive, process and acquire information. They use the term "brain drain" to describe a state of constant awareness of the device nearby which negatively affects performing the current task, as even avoiding checking the phone takes up a significant part of the cognitive capacity. [32] Reshaa F. Alruwaili looked into another phenomenon called scroll immersion, meaning a habitual, unintended form of media engagement leading to losing track of time. [84] It's highly associated with short-form video platforms, such as TikTok, Instagram stories and reels, YouTube shorts and Snapchat. Their design compels the user to consume media longer than intended, as their algorithms are highly responsive and user-tailored and content "never ends", allowing for endless scrolling. The passive, low-effort, high-stimulation form of brain involvement taking place operates on fast-switching stimuli and has many negative implications for cognitive functions. It increases distractibility, shortens attention span, impairs emotional regulation and leads to perpetual cognitive fatigue. [89] Since short videos viewing makes for a big part of the youth's leisure time, its absence may also lead to withdrawal symptoms. [85]

An association has also been observed between screen time and brain structure changes- in particular bigger total cortical volumes- and increased prevalence of attention deficits. [6]

Critical thinking

Spending long hours consuming social media leads to constant exposure to algorithms. They are designed to show more and more user-tailored content based on the user's internet activity, making it more and more difficult for the endless scrolling to end. Therefore, users are repeatedly reassured of their opinions and rarely exposed to diversity of world views. The stark contrast with the real world full of people with a variety of different experiences and opinions on the same things becomes a stressor for the young mind. Without strong digital literacy, they may feel convinced to delve further into their internet circles. The youth's still developing brains are more susceptible to misinformation, fabricated headlines [97] and engaging in radical ideas e.g. distrust in science [50] or red pill movement [5]. What cannot be overstated is the role of digital influencers; through targeted marketing and frequent personal life updates, they create a sense of para-social friendships in children, which impairs their vigilance and often shapes their views in a very imperceptible way. [98, 99]

Risk factors

While the omnipresence of digital devices makes it impossible to avoid them completely, certain factors are linked to a significantly bigger prevalence of digital dementia symptoms among youth. A thorough analysis of literature on the subject points to the vast majority of those risk factors being modifiable. (Table 1)

Table 1. Digital dementia risk factors in children and adolescents

modifiable	potentially modifiable	unmodifiable
• time of first use • screen use patterns in youth • time of use during the day • parental supervision • parental patterns of media use • availability of digital devices • sleep patterns • time spent indoors	• living neighbourhood • lower education in parents	• race • adolescent age • personality traits

Given the neural plasticity being at its peak levels during early childhood, the types and frequency of stimuli exposure play the key roles in development of cognitive skills. Early onset of regular digital media use increases the risk of impaired development and setbacks compared to peers. [9] Type and timing of screen time are two more key factors. According to multiple studies, using screens during the evening and at night impairs sleep patterns, sleep quality and consequently - cognition. [71] One of Spitzer's main concerns was

habitual multi-tasking. According to his findings, long-term use of multiple media at once diminishes one's ability to suppress irrelevant stimuli. [3] Nine years later Manwell et al. studied this phenomenon, observing it mainly in Generation Z. [35] Considering the vast - and constantly increasing- amount of types of screen-based devices and activities available nowadays, it's insufficient to analyse their impact based only on time spent. Findings suggest that newer screen behaviours such as social media, online games and online videos are a risk factor for depression on a much bigger scale than television, [25] which warrants increasing concern as these make for the majority of time the youth spends online. The use of smaller screens such as smartphones is more likely to result in sleep reduction than bigger screens such as television, [65] while frequent engagement in short-form videos and succumbing to scroll immersion are associated with self-reported difficulties in attention regulation and working memory. [84] A bilateral correlation is observed for sleep patterns as children who reduce their sleep due to screen use but also children who get less sleep because of other reasons tend to use screens more often for leisure. [37] The mere presence of digital devices in a child's bedroom as well as the number of those devices in the house [30] exhibit a positive association with leisure screen time.

Parental rules on prohibiting digital devices in children's bedrooms, particularly shortly before sleep, have great importance in the process of preventing digital dementia symptoms. [75] Removing electronic media, especially TV screens, from children's bedrooms lowers the risk of digital dementia symptoms but also somatic diseases, especially adiposity. [76] Majority of children co-view media with their parents or caregivers, with screen time distribution between the two overlapping [7] and being the longest during weekends for all family members as well as parent-child dyads. [72] While further, comprehensive research is essential, some studies suggest a correlation between screen time in early motherhood and a higher prevalence of ADHD in children. [17]

The overall activity also shapes digital habits among the youth, as observed during the COVID-19 pandemic, when globally a reduction in physical activity and an increase in screen time took place. [95]

One of the main factors highly affecting the choices of leisure activities - including digital media consumption - is the living environment. Teenagers residing in metropolitan areas spend 4 hours or more a day in front of screens more often than their peers living in nonmetropolitan areas. [18] These findings were supported in studies on RST (recreational screen time) among children living in walkable neighbourhoods - as availability of walking infrastructure and parks increased, RST decreased. [39, 42, 43, 72] On the other hand, a similar study on Polish children's habits revealed those residing in major cities as more active, which may be a result of higher accessibility of different leisure activities compared to rural areas. [54]

A 2014 study involving 11,434 participants found evidence that children of mothers with lower education levels are more prone to exceeding 2 hours a day in front of a screen. [53] A similar correlation is observed among families with lower socioeconomic status, as they spend more time on average on sedentary behaviours and in front of screens. [76]

Although excessive screen time and its consequences remain a global challenge, the youth of middle- and high-income countries seems more susceptible to developing internet addiction and digital dementia symptoms. [30, 33]

Racial and cultural factors may also influence this risk as research points to Black teenagers being more prone to screen activity above 4 hours a day. [18] An Australian study on culturally and linguistically diverse children and adolescents (CALD) concluded that on average some CALD groups have lower daily screen time compared to their peers. [62] With results being inconclusive but suggesting possible connotations, further research is recommended as it could point to solutions more tailored to different cultural, linguistic and racial backgrounds. As they are highly sensitive to external stimuli, adolescents' brains are particularly at risk of developing symptoms of digital dementia, [33] especially those with psychological traits such as impulsivity and proneness to boredom. [84]

Strategies for prevention and mitigation

As media-related cognitive decline among youth warrants a growing concern, it remains fundamental to focus on preventing further decline and mitigating its symptoms. Collaborative effort is required, with involvement of parents, caretakers, educators, pediatricians and policy makers.

Considering the limitations in children and adolescents' digital awareness, habits and autonomy, much of the responsibility for mitigating this problem is carried by parents. Their own digital habits as well as the ones they elicit in children have long term results. While many parents are aware of the negative results of digital dependency, expressing concern about addictions, vision problems, conduct problems [7] and sacrifices to quality family time, [102] enforcing healthy screen behaviours remains challenging. Among the many

parental motivations for allowing or even encouraging screen time are silencing their child to focus on their own tasks, rewarding good behaviour [69] or preventing a tantrum in a public space. [102] A 2025 report revealed that over 70% of parents admit to allowing screen time in order to manage their child's behaviour in public, most of them feeling guilty about it. Parental authority and involvement in setting boundaries on time spent using digital devices is essential, as children often struggle with self-control and putting down digital devices on their own, [7, 14] with only 14,6% of the reasons for doing so being a child's deliberate choice to do something else with their time. A Delhi study proved the efficacy of educating parents on limiting their infants' screen exposure. After 6 months of follow up, only 3% of children's screen time exceeded 1 hour per day compared to the control group where this rate reached 53%. [44] It seems crucial to invest in educating parents on digital health and underline the consequences of problematic media use. To draw a big picture of the consequences, teaching materials should also include bad dietary habits [50, 54, 57, 74], obesity, [56, 73] depression, [18, 25] increased risk of early-onset dementia as adults [35] and vision impairment. [30] While studies suggest differences between maternal and parental influence on children's physical activity, screen-based passive behaviours are passed down to children equally by both parents. [61] Whole families must be included in bringing healthy digital habits into life by making better choices every day. These include: co-viewing age-appropriate, educational media, [7] avoiding digital devices right before sleep and shortly after waking up, frequently engaging in mentally stimulating (e.g. solving puzzles, reading) and physical activities (mostly aerobic e.g. swimming, cycling), [20, 101] choosing the more engaging online activities (e.g. research) rather than low-attention fast-switching ones (TikTok, YouTube shorts, Instagram Reels, Snapchat, video games), practising mindful use of media rather than the habitual "doom scrolling".

The so-called 'paradox of technology'- mobile devices leading to freedom but also dependence [40]- weakens the ability to change habits. While literature on complete digital detox in children and adolescents remains inconclusive [41] and points to more questions and doubts such as risks and maintenance of withdrawal symptoms, [42] a reduction of screen time has been generally proven beneficial for cognitive function [40] and overall mental well-being. [43] Taking periodical breaks from screens, particularly during the weekends, [72] doing homework in digital-free study zones, [35] turning off non-essential notifications, setting screen time schedules [33] and limits (e.g. using the 'Screen Time' option in iOS settings or downloading apps designed to track screen time and block certain apps after reaching a time limit) can help reverse the state of continuous digital alertness. Research is inconclusive on the extent of screen time limitation among children necessary to ensure their adequate cognitive development. The Canadian 24-Hour Movement Guidelines for Children and Youth recommends no screen time in infants, no more than 1 hour per day for toddlers and preschoolers and no more than 2 hours of recreational screen time per day in the ages 5 to 17. [77] In 2016, the American Academy of Pediatrics released a set of guidelines instructing on avoiding screen time up to 2 years of age and limiting screen time to one hour for children 2 to 5 years of age [78] but later retreated from setting a specific time limit and pointed to a greater focus on the quality of screen-based activities. [79]

Proper guidance from figures of authority such as teachers and pediatricians can prevent digital dementia before its symptoms become burdensome. Their role should consist of engraining healthy digital habits in children, recognising symptoms early and educating on preventing further cognitive decline. The institutions with the biggest power - government bodies, health associations and other policy makers - need to react with urgency and frequently update their recommendations to keep up with the fast-changing world of digital technologies. Furthermore, we believe the expansion of tools for detection and diagnosing technology-related disorders is necessary. Education aimed at caretakers, children and adolescents themselves and tailoring guidelines to groups at risk, with inclusion of low-cost high-efficiency solutions, can come with great benefits to the cognitive and physical health of the whole population. They urgently need to take measures supervising the quality and preventing dangers of the content the youth are exposed to, as they often get exploited through the addictive nature of technology. [35] These include creating stricter legislation on advertisements disclosures in influencers' content, [98] limiting advertisements normalising substance use [35, 39] and stricter access to age-inappropriate media. [7, 33]

Discussion

While not established as a medical diagnosis, the concept of digital dementia and Spitzer's findings encouraged more questions and research on the matter. In over a decade since his publication, what has been observed globally is a significant increase in digital activity [15, 103] which is likely to increase considering the advent of immersive, user-tailored content in everyday life (e.g. Virtual Reality games or Chat GPT). The COVID-19 pandemic played a big role as well as the lifestyle changes the world was forced to make have resulted in increase in screen time among all age groups. Digital devices became the main tools for education, entertainment and maintaining relationships. Studies comparing screen time in children and adolescents before, during and three years after March 2020 indicate that time spent in front of screens has greatly increased during the COVID-19 pandemic [95] and despite noting a decrease three years later, still remains higher than before lockdown. [58] Considering the vulnerability and plasticity of developing brains [84], they are the most susceptible to the numerous health hazards of unhealthy device use, with cognitive health decline among the most alarming. Using technology wisely and teaching children to do so in the highly digitised landscape will continue to be one of the main challenges for parents of the 21st century. Complex but realistic guidelines and digital laws are required from the public health organisations and government agencies responsible. The role of pediatricians and school teachers in ensuring digital literacy should also be broadened as their regular presence in the lives of youth and their parents can allow for a more approachable environment and fast intervention. While escaping technology completely seems impossible in this day and age, it remains a priority to encourage 'positive' media aimed at researching, expanding skills and active leisure in contrast to the fast-paced low-attention algorithms of social media which encourage sedentary lifestyles.

We recognise digital dementia as a global problem and analysed studies from all around the world. Some of them were focused on specific cities (e.g. Delhi, Riyadh), countries (e.g. Canada, Denmark, Japan, Poland) and regions (e.g. Europe, North Africa), while others took a more international approach. Considering various symptoms across different age groups, thoroughly analysing risk factors and prevention tactics while focusing on most recent studies (but reaching to older literature for perspective) are what we believe to be the strengths of this narrative review. We believe it provides a holistic summary of current knowledge on the subject of digital dementia in children and adolescents of all ages.

Despite the educational values of this research, we are aware of its limitations. Multiple studies within the scope of this review relied on self-reported or parent-reported data, putting them at danger of recall bias. The heterogeneity of research quality and design- in terms of methods, sample sizes, age groups included, types of variables investigated- also remains a limiting factor and a potential source of data imbalance. The exclusion of unpublished works and works published in different languages than English increases the chances of incomplete data acquisition and publication bias. Many works focused primarily on time of screen activity but shared insufficient insights on the types of digital activities.

At present, multiple researchers inquire into the subject with the attempts to advance our knowledge. One interesting example is The Digital Child Study on Danish preschoolers. It considers the whole context of screen use such as demographic information, living environment, overall health, cognitive consequences and types of content consumed. [69]

Extensive future research is urgently needed to determine the scope of short-term and long-term consequences of digital devices for cognitive health. Longitudinal studies analysing functional neuroimaging, sleep patterns and hormonal changes, with regular assessments by neurologists, psychiatrists, psychologists and pediatricians could help identify symptoms sooner, better understand the process and allow for the introduction of research-based guidelines for early prevention. Neurobiologists should focus on recognising changes to the micro- and macro-structure of the brain and levels of neurotransmitter as the youth's increased technology use overlaps with their developmental stage. Including multiple device- and activity-type-specific variables is required as well as the broad environmental context. It's also important to further analyse whether these symptoms overlap with internet addiction, ADHD and whether reverse causation takes place in research so far. Frequent reports and analysis of data are necessary to estimate the trajectory of digital dementia prevalence among children and adolescents.

Conclusions

The cognitive health of children and adolescents going into decline as a result of unhealthy digital habits warrants a growing concern for the future. As digital dependency is on the rise, ensuring developmental success of children poses a challenge to society. In this narrative review we analysed the available literature to examine the complexity of this issue and offer prevention tactics. The results prove its spread across multiple domains including memory, behaviour, communication, speech and motor development, attention, sleep, critical thinking and problem solving. Not all types of media exposure are associated with equal risks of digital dementia, as the many demographic and behavioural variables affect the outcomes. The multidimensional nature of this phenomenon calls for immediate collaboration between parents, teachers, doctors and lawmakers. With technology developing faster than many adults can comprehend, frequent revisions of guidelines are also essential in keeping them effective. Undoubtedly further studies are necessary on the underlying associations between digital activity, cognitive impairment in children and the similarity with dementia symptoms in older adults.

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