

Negative Effects of Social Media on Children and Adolescents

The Clear Evidence

By

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Chapter 1

Introduction

In our era dominated by the ubiquitous presence of social media, it is important to consider the worrying toll taken on the mental health of children and adolescents. As these vulnerable age groups face the pressures of growth, the negative influence of social media has become an undeniable reality (1).

Aim of this book is to present the scientific evidence of all negative aspects of the uncontrolled and unregulated use of social media, including the relevance of duration of exposure on mental health, the importance of absence of screening and selection of available materials, the role of big network companies and their “uncontrolled” power, the increasing number of circulating fake news, the abuse of social media from negative individuals with personal aims, certainly detrimental for the target children and adolescents, the evidence provided by medical investigations in children exposed to excessive use of social media, the psychological issues in adolescent victims of abuse of social media, and the increasing incidence of suicides and attempted suicides correlated with availability of social media.

The massive extent of the use of social media has been quantified by a recently published meta-analysis and literature review revealing that the company Facebook, leader of the market, at the same time owner of four companies (Facebook, WhatsApp, Facebook-Messenger, and Instagram), in 2021, reported over 3.58 billion monthly users (2).

Due to the permanent and easy access to smartphones, enabling the young utilizers connections with social media and social network, unfortunately for the most fragile among these users this easy connectivity can lead to excessive use, resulting in negative consequences on mental health, particularly social anxiety and depression. It has been demonstrated that the systematic use of social networking sites may affect sleep quality and quantity, as well as altered emotional communication patterns (1,2).

As responsible adults, clinicians and educators, we decided to deeply investigate into this issue and to consider potential changes to safeguard the well-being of the youth.

Previous reports have already risen attention to the alarming connection between excessive social media use and mental health issues among the young population (3-7), while a systematic review and meta-analysis revealed a significant correlation between screen time spent on social media platforms and increased levels of depressive symptoms and suicidal thoughts in adolescents (3). The feelings of inadequacy, anxiety, and a sense of missing out, contributing to the rising prevalence of mental health disorders has been correlated with the incessant exposure to carefully crafted and often unrealistic portrayals of life on social media platforms (3-7).

Moreover, the rising incidence of cyberbullying on social media is exacerbating the mental health crisis, with victims of cyberbullying experience higher rates of depression and anxiety (4). The anonymity provided by social media emboldens bullies, with the barrage of hurtful messages and comments leaving deep emotional scars on young minds.

Further deterioration of the youth mental health is caused by the very design of social media platforms, with textual, video, speech, all network components that seem to encourage addictive behavior (1,2). Furthermore, the intermittent reinforcement mechanism utilized by all these platforms to keep users engaged contributes to the development of compulsive usage habits (5-7). A never-ending cycle of seeking validation and approval from others, ultimately affecting self-esteem and self-worth, is fueled by the incessant quest for likes, shares, and comments (3-7), with the correlation between design of social media and addiction clearly demonstrated (8).

Deleterious effects of the mental and psychological health of children and adolescents, because of the subsequent impairment of the longitudinal brain development, has been associated with continuous and excessive exposure to uncontrolled information and messages provided from social media (9-11).

After providing the existing evidence of the negative impact of social media on children and adolescents, in this book we try to propose potential actions to mitigate this impact, or at least to reduce incidence and severity of the consequences.

As responsible stakeholders in the digital age, both tech companies and parents should be involved and play pivotal roles in mitigating the damaging effects of social media on youth mental health.

Tech giants should acknowledge their ethical responsibility and prioritize user well-being over engagement metrics. Implementing features promoting mindful usage, providing tools for digital detox, and offering easy access to mental health resources, should be obvious steps in this direction.

Even if there have been many discussions about the effectiveness of social media detox, recent reports mentioned how the detox assisted persons with social media addiction (12-15).

Unfortunately, the tech giants do not appear actively involved in major works to mitigate this mental crisis, or, if and when they are, there are limitations and gaps in their existing work (2).

Parents should actively engage in open and honest conversations with their children about the potential pitfalls of social media. Understanding the platforms their children frequent, setting healthy screen time limits, and encouraging offline activities are crucial in fostering a balanced digital lifestyle (16). In addition, it has clearly been demonstrated the usefulness of how parents can help their children navigate social media and the dangers (17).

Furthermore, integrating digital literacy and mental health education into school curricula can empower young individuals to navigate the digital landscape responsibly and develop resilience against the negative impact of social media (9-11). It should be evident the need for educating the students about social media in schools, and even at universities, especially if the school and/or the university communicates with the students on mobile devices, which in turn necessitates mobile device use by an ever-younger population (18).

To bring about meaningful change, collaboration between governments, educators, mental health professionals, and technology companies should be indispensable/essential. Legislation and policies addressing online safety, data privacy, and age-appropriate content, must be formulated and enforced to protect the mental well-being of our children, taking in serious consideration the scientific evidence repeatedly demonstrating the nega-

tive consequences of the currently uncontrolled setting of all the social media.

It should be clarified if there are any existing legislation and policies at this time, considering the urgency to develop them in the context of our ever-growing digital era.

We conclude in this introduction that the damaging effects of social media on the mental health of children and adolescents have moved from a trending topic to a pressing societal concern. The mounting scientific evidence linking excessive social media use to a host of mental health challenges cannot be ignored. It is imperative for all stakeholders, parents, educators, and society at large, to consolidate the lay of the land surrounding this growing mental health crisis and initiate informed discussions and implement proactive measures to create a safer, healthier digital space for the young generation.

The medical and educational communities should create a mechanism of regularly sharing new and emerging evidence of the adverse impact of the social networking sites on the mental health of children and young people, so that this can be disseminated to the parents in appropriate forums.

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Chapter 2

The Vulnerability of the Developing Human Brain

Evolutionary and developmental basis of vulnerability

Humans are born with relatively immature brains, with only ~25% of adult brain volume present at birth, compared to much higher proportions in other mammals (1).

The human brain then undergoes a massive structural and functional metamorphosis that lasts well into the mid-twenties (1,2,9).

This reflects evolutionary prioritisation of:

- Environmental adaptability
- Social learning
- Cognitive Sophistication

This extended period of maturation, spanning from the prenatal stage through adolescence and into early adulthood, enables the emergence of complex cognitive, emotional, and social capabilities. However, it also renders the brain uniquely vulnerable to environmental influences (5,6,17).

Two fundamental principles define brain development:

- **Vulnerability:** heightened sensitivity to environmental input during fairly prolonged periods of developmental windows (16,17)

- **Neuroplasticity:** the capacity of the brain to structurally and functionally adapt in response to experience(1,11)

Neurodevelopment of the Human Brain

Neurogenesis

Neural stem cells proliferate rapidly to generate billions of neurons and glial cells (1,4).

Neuronal Migration

Newly formed neurons migrate to their appropriate cortical destinations. Errors during migration may lead to disorders such as epilepsy, intellectual disability, and autism spectrum disorders.

Synaptogenesis

Early childhood is characterized by a massive overproduction of synapses, creating a highly malleable neural network responsive to and dependent on experiences. Connections between neurons (synapses) form at an extraordinary rate. Synaptic density in early childhood greatly exceeds that seen in adulthood. This synaptogenesis allows the brain to become fertile ground for the multiple and myriad stimuli humans are exposed to early in life (3,4)

During early childhood as the brain over-produces connections, creating a dense, chaotic web, it is highly sensitive to the presence (or absence) of sensory and emotional stimulation (17,18).

This receptive developmental state supports:

- Learning

- Language acquisition
- Sensory mapping
- Social and emotional development

While this plasticity allows for incredible learning and adaptation, it also creates a prolonged “window of vulnerability” where external and internal stressors can derail the delicate process of neural assembly and function.

As a result, during childhood and adolescence, the brain is especially susceptible to environmental influences, nutritional deficiencies, stress, toxins, infections, trauma, social deprivation, and behavioural and lifestyle exposures such as screens and social media apps. Adverse experiences during these sensitive developmental windows can alter neurochemical systems, neural circuitry, emotional regulation, cognition, and long-term mental health outcomes.

Pruning: The brain also begins a process of “streamlining.” This involves **synaptic pruning** (removing unused connections). Unused synapses are selectively eliminated while frequently activated pathways are strengthened. This “use-dependent” process shapes mature neural networks. It is this process that sculpts the final functional architecture (9).

Myelination

Oligodendrocytes form myelin sheaths around axons, increasing conduction velocity and network efficiency. Myelination continues into early adulthood.

Early Childhood: The first period of vulnerability due to higher concentration of excitation-to-inhibition neural pathways (4,5)

Normal brain function depends on a delicate balance between **excitatory** and **inhibitory** pathways. Neuroscientists often call this the **excitation–inhibition balance (E/I balance)**

The basic idea

- **Excitatory pathways** increase the likelihood that neurons will fire electrical signals.
 - The main excitatory neurotransmitter is Glutamate.
- **Inhibitory pathways** reduce the likelihood that neurons will fire excessively.
 - The main inhibitory neurotransmitter is Gamma-Aminobutyric Acid.
 - GABA receptors act like “brakes” on brain activity.

The brain works properly when excitation and inhibition are balanced — not too much of either.

In the developing brain, excitatory neural systems mature before inhibitory systems to allow for the brain to develop and for connections to grow in response to ongoing environmental stimulation.

Early excitatory signalling acts as a “scaffolding” tool that guides neural migration and shapes the brain’s circuitry.

The ratio of excitation to inhibition leans toward excitation, which is necessary for activity-dependent learning in the brain and because it is biologically programmed, this imbalance is essential to allow new cognitive skills to be acquired.

Excitatory signalling (mainly glutamate)

Glutamate is the principal excitatory neurotransmitter, which is highly expressed during childhood and plays an essential role in:

- Synaptic plasticity
- Learning
- Memory formation

However, excessive glutamatergic activity may contribute to:

- Excitotoxicity
- Neurodevelopmental vulnerability

Delayed Maturation of Inhibition (GABA System)

Gamma-aminobutyric acid (GABA) is the principal inhibitory neurotransmitter in the mature brain.

The GABA system is “immature” in children because inhibitory neural networks develop more slowly than excitatory networks during normal brain development. This delayed maturation is biologically programmed and plays a crucial role in enabling early neuroplasticity and learning. Importantly, the immature GABA system is not defective, it is developmentally appropriate.

This imbalance between excitation and inhibition which is present to facilitate brain development also perversely contributes to the heightened vulnerability of the developing brain.

Adolescence: A Second Window of Vulnerability

Adolescence represents another major period of neurodevelopmental change(5).

From an evolutionary perspective, limbic and emotional processing systems are phylogenetically older than the highly developed human prefrontal cortex. These networks regulate fundamental survival functions including threat detection, reward seeking, emotional attachment, and reproduction. Because these functions are critical for survival and social adaptation for all mammals , limbic and reward circuitry matures relatively early during adolescence, There is therefore a developmental “gap” between the maturation of the **subcortical reward system(striatum and nucleus accumbens)** part of the limbic system and the **prefrontal inhibitory system** which is responsible for executive control, impulse regulation, and long-term planning continuing well into early adulthood.

This “mismatch” makes adolescents biologically more prone to risk-taking and more sensitive to the addictive properties of social media and gaming. Also, because the brain is plastic ,” addictions such as to social media apps, gaming, drug and substance abuse during this time can “lock in” certain neural pathways, significantly increasing the risk of lifelong dependency.

This is due to the effect of repetitive ongoing stimulation of the subcortical reward system that is unencumbered by the still immature prefrontal cortex

The limbic system maturing earlier than the prefrontal cortex results in

- Increased emotional reactivity
- Risk-taking behaviour
- Heightened sensitivity to peer influence and criticism

This developmental imbalance partly explains adolescent vulnerability to:

- Addiction
- Anxiety disorders
- Depression
- Impulsive behaviour
- Easier reinforcement of maladaptive behaviours such as excessive screen time

Why does the prefrontal cortex take so long to develop?

Human brains are extremely complex, and humans have unusually large and sophisticated frontal lobes. As advanced abilities like abstract reasoning, moral judgement, future planning, self-control and social cognition require enormous neural refinement.

The prefrontal cortex is highly experience-dependent. It is sculpted over years by: education relationships, emotional experiences, mistakes, social learning stress exposure environment and it is that resulting maturation process that takes so long (9,10)

The developing brain does not exist in a vacuum, it is constantly sampling the environment to decide how it should grow. When that environment is hostile, deficient or addictive, the biological response can be damaging.

Digital Media and the Developing Brain

Modern children are exposed to unprecedented levels of screen-based stimulation.

Excessive digital exposure may affect:

- Attention systems
- Reward pathways
- Sleep regulation
- Emotional processing
- Social development

Highly stimulating digital environments activate and cause dysfunction of dopaminergic reward circuits, particularly within the striatum and nucleus accumbens the reward circuits which are also implicated in drug and gambling addictions (14). Repeated overstimulation may contribute to impaired connection between the reward system and the emotional regulatory centres in the Prefrontal Cortex.

Over time this results in:

- Behavioural addiction
- Reduced attention span
- Emotional dysregulation
- Increased impulsivity

Emerging neuroimaging studies suggest associations between excessive screen exposure and:

- Altered white matter integrity

- Reduced prefrontal activation
- Dysregulated reward circuitry (14,15)

Increased sensitivity to environmental stress

Toxic Stress and the HPA Axis

Small amounts of stress are healthy, but **toxic stress**, prolonged activation of the stress-response system can be neurotoxic. Chronic exposure to cortisol which is associated with screen, social media and gaming addiction cortisol can:

- Shrink the **hippocampus** (memory and emotion regulation).
- Over-activate the **amygdala** (the fear center), leading to hyper-vigilance.
- Hinder the development of the **prefrontal cortex** (7,8)

Protective Factors and Resilience

Not all children exposed to adversity develop pathology. Protective factors can reduce vulnerability (6,8)

These include:

- Secure attachment
- Stable caregiving
- Physical activity
- Adequate sleep
- Good nutrition
- Education

- Positive peer relationships
- Emotional support

Importantly, positive interventions during childhood may partially reverse adverse neurodevelopmental effects.

Neuroplasticity: Strength and Weakness

Adaptive Plasticity

Neuroplasticity refers to the brain's ability to modify its structure and function in response to experience.

Positive experiences strengthen healthy neural pathways:

- Physical activity
- Language exposure
- Social interaction
- Education
- Emotional nurturing

Sleep and Brain Development

Sleep plays a crucial role in:

- Synaptic consolidation
- Memory processing
- Glymphatic waste clearance

Children and adolescents require substantially more sleep than adults because of ongoing neurodevelopment (1,4)

Chronic sleep deprivation a feature of screen addiction may contribute to:

- Impaired attention
- Emotional dysregulation
- Reduced academic performance
- Increased impulsivity
- Altered dopamine signalling

Physical Activity and Brain Protection

Physical activity is one of the most powerful protective influences on the developing brain (12,13)

Exercise increases:

- Brain-derived neurotrophic factor (BDNF)
- Dopamine regulation
- Serotonin availability
- Endorphin release
- Cerebral blood flow

Exercise also helps:

- Normalise cortisol levels
- Improve emotional regulation
- Enhance executive functioning
- Promote neurogenesis in the hippocampus

Regular physical activity therefore acts as a therapeutic and neuro-protective intervention during development.

Clinical and Public Health Implications

Understanding developmental vulnerability has major implications and is necessary for early intervention because:

- Neural pathways are highly modifiable
- Early experiences shape lifelong health
- Prevention is more effective than late treatment

Public health priorities should therefore include:

- Limiting exposure and duration of exposure to devices, smartphones and social media apps
- Supporting families
- Encouraging physical activity
- Promoting healthy sleep
- Improving nutrition
- Limiting harmful exposures
- Supporting mental health

Conclusions

The developing human brain is simultaneously extraordinarily powerful and profoundly vulnerable. It's prolonged maturation and remarkable neuroplasticity enable learning, creativity, emotional growth, and adaptation. Yet these same properties

render it highly sensitive to environmental influences during childhood and adolescence.

Experiences during early life shape neural architecture, neurochemical systems, emotional regulation, cognition, and long-term health. Positive experiences strengthen healthy neural pathways, while chronic stress, adversity, toxins, sleep disruption, and maladaptive behavioural exposures such as devices, smartphones and social media apps cause neurobiological dysfunction and dysregulation within the developing nervous system.

A deeper understanding of developmental brain vulnerability provides opportunities for prevention, early intervention, and the promotion of lifelong neurological and psychological wellbeing.

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Chapter 3

The Paradox of Connection: The Antisocial Effects of Social Media

Social media platforms were created with the promise of fostering global connection, reducing distances, and bringing people together in unprecedented ways. They are designed to be a digital town square, a place where friendships are maintained, communities are built, and information is shared instantly.

Humans are social creatures and since the time of humans living in tribes and farming communities there has always been a need to interact with each other for a variety of very powerful and obvious reasons.

The modern form of interacting changed as technology was embedded in our lives and the iterative process of communication through technology went through a number of phases which are outlined below.

The Evolution of Social Media

1. Early Online Communities (1970s–1990s)

- *1970s–80s*: The first “social” platforms were bulletin board systems (BBS) and Usenet groups: text-only forums where people exchanged messages.
- *1994*: *GeoCities* let users create personal websites grouped by themes (like neighbourhoods).

- 1997: *Six Degrees* launched, often considered the first true social network, where users created profiles, listed friends, and browsed connections.

2. *The Rise of Social Networking (2000–2005)*

- 2002: *Friendster* became popular, especially in Asia, as a place for connecting with friends.
- 2003: *MySpace* let users customise their profiles with music, photos, and blogs; it quickly became a hub for youth culture and music.
- 2004: *Facebook* started as a student-only network at Harvard before expanding worldwide.
- 2005: *YouTube* changed everything by making video-sharing mainstream.

3. *The Social Media Boom (2006–2010)*

- 2006: *Twitter* introduced short, real-time updates (“tweets”).
- 2006: *News Feed* opened to the general public and introduced by Facebook.
- 2007: *The iPhone* launched, making mobile social media possible.
- 2010: *Instagram* brought image-based social sharing to the forefront.

4. *The Age of Mobile and Apps (2010–2015)*

1. *Snapchat* (2011): Popularised disappearing photos and videos.
2. *WhatsApp* (2009, booming by 2010s): made instant, global messaging free.

3. *WeChat (2011)*: In China, combined messaging, payments, and social features.
4. *2012: Facebook acquired Instagram.*
5. *2014: Facebook acquired WhatsApp*, cementing dominance in messaging.

5. *Short-Form Video and the Algorithm Era (2015–Present)*

- *2016: TikTok (originally Douyin in China) launched*, using powerful algorithms to recommend short, addictive videos. It became the fastest-growing social platform ever.
- *2016: Instagram introduced Stories*, inspired by Snapchat.
- *2017–20: Live streaming*, filters, and interactive content spread across platforms.
- *2020s: Social media* became central to news, activism, business, and culture, so far so good because at its heart, social media has always been about the same human need: **to connect, share, and belong.**

However at some point in the last few years, the “raison d’être” for the creation and evolution of social media and its fundamental functionality changed and become grossly distorted .

Beneath the veneer of likes, shares, and endless scrolling lies a troubling paradox: a technology designed for social interaction can, in practice, lead to profoundly antisocial effects. Far from uniting people, the pervasive use of social media can erode genuine interpersonal relationships, diminish essential communication skills, and contribute to feelings of isolation and inadequacy.

What started off as a well-intentioned desire to communicate seamlessly has morphed in a very significant percentage of interactions into aggressive and malevolent behaviour by a significant minority of people who hide behind the anonymity that the social media platforms provide them.

Understanding the antisocial effects of social media many of which are outlined below helps parents guide children towards balance and safety.

From Connection to Isolation

Ironically, platforms designed for connection can often make young people feel more alone. Hours spent scrolling can replace time spent in real conversation, outdoor play, or family life. Instead of building deeper friendships, children may find themselves with hundreds of online “friends” but few genuine ones. Studies show that heavy use of social media is linked to increased feelings of loneliness, especially when it displaces real-world relationships.

Studies have demonstrated that heavy use of social media is linked to increased feelings of loneliness, especially when it displaces real-world relationships (1,2).

Comparison and Low Self-Esteem

Social media often shows a carefully curated version of life: the best holidays, perfect selfies, top achievements. For children and teenagers, this creates constant comparisons and induces pressure. They may feel that everyone else is more attractive, more successful, or more popular than they are. This “utopia” effect can

damage self-esteem, fuelling anxiety, eating disorders, and body image concerns.

Research studies have revealed the following: High social media use is associated with a tendency to compare oneself with others.

There is an association between higher online social comparison and greater body image concerns, as well as an association between higher online social comparison and greater eating disorders (3,4).

Cyberbullying and Harassment

One of the most damaging antisocial aspects of social media is cyberbullying. Unlike traditional bullying, which usually ends when a child comes home, online harassment can follow them everywhere, day and night. Negative comments, exclusion from group chats, or the spread of rumours can be devastating. For many, this leads to withdrawal from school, social anxiety, or depression (5,6).

Addiction and Distraction

Social media platforms are deliberately designed to be addictive, using notifications, likes, and endless scrolling to capture attention. For young people, this can mean hours lost each day, disrupted sleep, and difficulty concentrating on schoolwork. Over time, the constant pull of notifications reduces attention span and can contribute to poorer academic performance (7,8).

Distorted Communication Skills

Social media impacts social skills by altering the way individuals interact with one another. Traditionally, social skills were developed through direct, in-person experiences where individuals learned to interpret body language, facial expressions, and tone of voice, all critical components of effective communication. Face-to-face conversation teaches children empathy, reading tone, body language, and emotions. These interactions teach us how to respond to others, build rapport, and navigate complex social environments.

However, social media shifts much of this interaction into the digital realm, where communication is often text-based and lacks the richness of face-to-face encounters. The absence of non-verbal cues, such as a smile, a nod, or a frown, can make it difficult to fully understand the intent behind a message, leading to miscommunication and misunderstandings. Furthermore, the asynchronous nature of social media (where responses can be delayed) contrasts with the immediacy of real-time conversations, reducing opportunities to practice quick thinking and adaptive communication. Teenagers may find it harder to resolve conflicts in person, or to build the confidence to speak in real-world situations. Over-reliance on digital communication can leave them less prepared for adult relationships and the workplace.

Echo Chambers and Risky Influences

Social media algorithms often feed users more of what they already engage with. While this can seem harmless, it can also trap young people in “echo chambers” where only one view or extreme content is shown. The echo chamber effect occurs online when a