

LITERATURE REVIEW

RISK OF INTERNET ADDICTION AMONG ADHD CHILDREN AND ADOLESCENTS DURING THE CORONAVIRUS PANDEMIC

Risiko Adiksi Internet pada Anak-Anak dan Remaja dengan ADHD selama Pandemi Coronavirus

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ABSTRACT

Background: Children and adolescents with Attention-Deficit/Hyperactivity Disorder (ADHD) are more susceptible to internet addiction. COVID-19 pandemic has forced them to carry out their schoolwork, social and leisure activities online. Prolonged use of the internet during this period would exacerbate their severity of ADHD and, at the same time, aggravates internet addiction susceptibility among these already high-risk individuals. **Purpose:** This literature aims to study the relationships between ADHD and internet addiction among children and adolescents with ADHD despite the COVID-19 pandemic. **Methods:** A systematic review search of studies published between 11 March 2020 and 15 May 2021 was performed across Google Scholar, NCBI, and Science Direct with the keywords 'internet addiction', 'ADHD', 'children', 'adolescent', and 'COVID-19'. Children and adolescents with ADHD were selected as the population, and measurement of problematic internet use was set as the outcome. Non-English articles, non-full length articles, and review Articles were set as exclusion criteria and hence, excluded in the review. **Results:** Four eligible cross-sectional studies were included in the current review. In general, lockdowns significantly resulted in heightened screen time and internet usage, placing adolescents with ADHD at heightened susceptibility towards internet addiction. **Conclusion:** Further intervention and lockdown policies should be done with a greater caution towards its impact on the main correlates in this study: inattentivity, executive and motivational dysfunction, interpersonal problems, COVID-19 induced negative affects and subpar familial cohesions.

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ABSTRAK

Background: Anak dan remaja dengan Attention-Deficit/Hyperactivity Disorder (ADHD) sangat rentan mengalami Adiksi Internet). Pandemi COVID-19 telah memaksa mereka melaksanakan aktivitas akademik, sosial, dan waktu luang mereka lalui internet. Penggunaan internet dalam waktu lama akan memperburuk derajat keparahan ADHD, dan di sisi lain gejala ADHD yang memburuk akan meningkatkan risiko mereka mengalami kecanduan internet. **Tujuan:** Literatur ini bertujuan mengkaji hubungan ADHD dan IA di kalangan anak-anak dan remaja dalam situasi pandemi Covid-19. **Metode:** Pencarian sistematis dilakukan melalui Google Scholar, NCBI, dan Science Direct dengan kata kunci 'adiksi internet', 'ADHD', 'anak-anak', 'remaja', dan 'COVID-19'. Populasi dari studi ini adalah anak-anak dan remaja dengan ADHD, sedangkan indicator potensi mengalami IA ditetapkan sebagai luaran. Jurnal yang tidak berbahasa Inggris, kumpulan dan laporan kasus, bab dari buku, catatan editorial, dan artikel ulasan ditetapkan sebagai kriteria eksklusi. **Hasil:** Empat penelitian yang memenuhi disertakan dalam tinjauan ini. Secara umum, penelitian menyimpulkan bahwa didapatkan peningkatan penggunaan gawai, sehingga meningkatkan kerentanan individu ADHD terhadap adiksi internet. **Kesimpulan:** Intervensi lanjutan dan Kebijakan Karantina harus dilakukan dengan menimbang penuh kehati-hatian factor-faktor yang dihubungkan dengan IA di studi ini: inatentivitas, disufngsi eksekutif dan motivasional, masalah interpersonal, masalah emotional akibat COVID-19, dan kohesi keluarga.

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INTRODUCTION

In modern-day society, the role the internet plays in our lives is paramount, particularly since currently schools are of the internet in our lives, particularly since schools are currently forced to shift their teaching process to online platforms. More than 130 countries have closed schools to prevent the spread of COVID-19 (Lin, 2020).

The prohibition of outdoor activities, social isolation, and home confinements might be particularly challenging to adolescents with Attention-Deficit/ Hyperactivity Disorder (ADHD) as they have pronounced novelty and sensation-seeking compared to their peers. On the other hand, the internet offers them immediate feedback and rewards, with countless possible activities to choose from. These internet features prevent its users from getting bored. Instead, the continuous influx of immediate rewards makes them feel

appreciated. Moreover, the internet provides a virtual world where anyone can build their fantasies. Thus, they feel more compelled to use the internet (Evren, Evren, Dalbudak, Topcu, & Kutlu, 2018). Highest prevalence of Internet Addiction (IA) is typically observed among adolescents, often dominated by their quest for personal identity, which is facilitated by these features (Leménager et al., 2018).

The use of the internet becomes problematic when their failure to resist their internet-related urges results in an impairment of their psychological, social, physical, spiritual, and financial well-being. Such problematic internet use is called internet addiction (Bisen & Deshpande, 2018).

High prevalence of the dopamine receptor D2 (DRD2) gene Taq1A1 polymorphism was noted among individuals with internet addiction, which was also associated with ADHD pathogenesis of

ADHD among children (Moro, El-Gebaly, Zaky, & Kamal, 2019). Dysfunction of the dopaminergic system plays a key role in both ADHD and internet addiction. Hence, they are categorized as reward deficiency syndrome by some researchers. They are also correlated with their commonality of Prefrontal Cortex (PFC) dysfunction (Nie, Zhang, Chen, & Li, 2016).

Not surprisingly, ADHD and internet addiction have a bi-directional relationship. Firstly, ADHD symptoms place adolescents at greater risk of developing internet addiction. Secondly, prolonged use of the internet itself would exacerbate the severity of ADHD. Prolonged internet use increases the threshold for stimulation in these individuals, resulting in an increased difficulty in concentrating on a less-interesting routine. It would potentially deteriorate their daily functions and interpersonal relationships, increasing the likelihood of using the internet as a coping strategy, thereby resulting in a vicious cycle between ADHD symptoms and internet addiction (Marmet, Studer, Grazioli, & Gmel, 2018).

Adolescents with ADHD are at a greater risk of suffering from the consequences of prolonged internet use since habituation towards repeated reinforcements happens quicker in adolescents with ADHD (Marmet, Studer, Grazioli, & Gmel, 2018). When habituation occurs, what starts as impulsivity become compulsivity, and might be precursor to behavioral addiction. This regulation requires amygdala, hippocampus, and other parts of PFC are not fully mature yet in adolescence and are highly implicated in individuals with ADHD (Stahl, 2013).

As such, comorbidity of ADHD and internet addiction occurring during the period of adolescence warrants clinical severe attention. This systematic review offers a comprehensive overview of ADHD, internet addiction, and the relationship between the two despite the COVID-19 pandemic among children and adolescents with ADHD.

METHODS

A systematic review of studies investigating Internet Addiction Risk in Children and Adolescents with Attention-Deficit/Hyperactivity Disorder (ADHD) published between 11 March 2020 and 15 May 2021 was conducted across Scopus-indexed publications via Google Scholar, NCBI, and Science Direct. Non-English articles

were set as exclusion criteria and hence, excluded from the review.

Children and adolescents with ADHD were selected as Population (P), and measurement of problematic internet use was set as the Outcome (O). According to Tawfik et al (2019), Patient and Outcome are adequate when performing systematic review of observational studies, especially epidemiological one. This would be useful especially in an urgent phenomenon, yet scarce information is available. Search criteria entered into the database includes: 'internet addiction', 'ADHD', 'children', 'adolescent', and 'COVID-19 pandemic'. Free text words and Medical Subject Headings (MeSH) were employed independently or as combination. The selection of literatures based on inclusion criteria is shown in Figure 1.

RESULTS

Four eligible studies published between 11 March 2020 and 2021 in Scopus-indexed publications were included in the current review. All studies concluded that a correlation between ADHD and internet addiction is present. The studies were conducted in Australia (Sciberras et al., 2021), China (Shuai et al., 2021), Italy (Bruni, Giallonardo, Sacco, Ferri, & Melegari, 2021), and Switzerland (Werling, Walitza, & Drechsler, 2021). The details about the population, methods, and results of each study are listed in Table 1.

Measurement Tools Used to Establish ADHD Diagnosis

Bruni, Giallonardo, Sacco, Ferri, & Melegari (2021), Sciberras et al. (2021), and Shuai et al. (2021) used clinical samples which have formally been diagnosed with ADHD, with the latter specified the use of semi-structured interviews Clinical Diagnostic Interview Scale (CDIS) in the diagnostic process. Out of these, only Sciberras et al. (2021) discussed their inabilities to ensure an accurate diagnosis of ADHD and its comorbidities throughout all processes, despite their clinical samples. While Werling, Walitza, & Drechsler (2021) also examined clinical samples that have been referred to the Department of Child and Adolescent Psychiatry and Psychotherapy (CAPP), University of Zurich, Switzerland for ADHD, not all samples have been formally diagnosed with ADHD.

Table 1.

Summary of Studies Investigating Internet Addiction Risk in Adolescents with ADHD during COVID-19 pandemic

Source	Sample	Method	Findings	Limitations
Werling, Walitza, & Drechsler (2021)	126 adolescents with ADHD	Cross-sectional	In adolescents with ADHD, the amount of time spent on screen media increased by 46% during COVID-19 lockdown. It did not completely return to pre-Corona levels after the lockdown ended.	-Highly prone to recall bias, especially since pre-pandemic functionings were assessed retrospectively by parents. -Diagnostic of ADHD was highly dependent on self-assessments -Only used parent ratings, without any cross-referencing. -Only parent-report was used.
Bruni, Giallonardo, Sacco, Ferri, & Melegari (2021)	992 children and adolescents with ADHD	Cross-sectional study	During the COVID-19 lockdown, 59.3% of children and 69.4% of adolescents with ADHD reported an increase in the screen time exposure. This is significantly associated with a change of sleep patterns and increased sleep disturbances.	-No threshold of 'problematic screen time' use, although this study did support the notion that lockdown increases screentime. -No comparison with healthy controls.
Sciberras et al (2021)	213 children and adolescents with ADHD	Longitudinal study	In comparison to the time before COVID-19 pandemic occurred, children and adolescents with ADHD had significantly increased time spent on social media (OR=2.4; 95% CI 1.3–4.5) and online gaming (OR=2.0; 95% CI 1.3–3.0)	-High risk of selection bias since only help-seeking individuals were included -Confounding factors might be present (59.5% of the samples were diagnosed with anxiety) -Pre-pandemic functioning was assessed self-retrospectively, resulting in a recall bias risk.
Shuai et al (2021)	192 participants aged 8-16 years with ADHD	Case control	Heightened inattention, impulsivity, EF deficits. occurrence of stressful life events and worsened symptoms of emotional disorders, depression, anxiety, oppositional defiant (ODD) and conduct disorders (CD) were observed among ADHD individuals with Problematic Digital Media Use (PDMU).	-No comparison to the pre-COVID levels. -Use of self-report -Incorporation of parent-report would be more useful -Confounding factors (i.e medication use) were not controlled

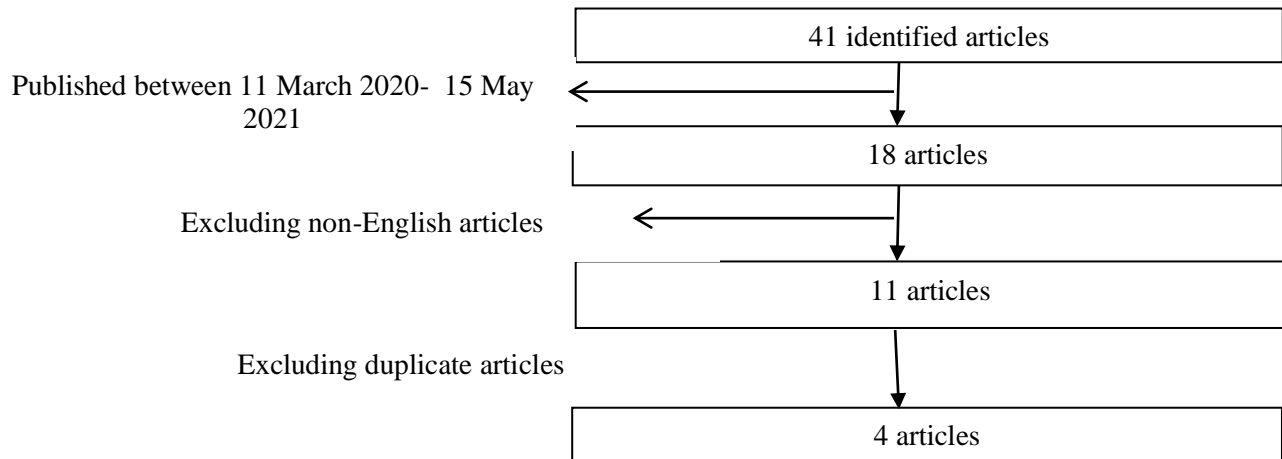


Figure 1. The literature selection process based on the inclusion criteria

Measurement Tools of Problematic Internet Use / Internet Addiction

Shuai et al. (2021) used a combination of Self-rating Questionnaires for Problematic Mobile Phone Use (SQPMPU), along with a well-validated Young's Internet Addiction Test (IAT). Werling, Walitza, & Drechsler (2021) used a newly developed Problematic Use of the Internet-screening (PUI-Screening Questionnaire for Children and Adolescents). Sciberras et al. (2021) did not formally use a specified internet addiction test, instead, a subscale of The CoRoNaVirus Health Impact Survey (CRISIS) was being used. Similarly, Bruni et al. (2021) used screentime changes pre-and during COVID to assess problematic media use.

Treatment of Possible Confounding Factors

No control group (i.e individuals without ADHD) was observed throughout all studies. Comorbidities were not further assessed (Sciberras et al., 2021), and a large percentage of the samples were also given a formal diagnosis of anxiety disorder. Shuai et al. (2021)'s study was also carried out in similar situations, and it specifically noted that it did not control medication use throughout all the samples. A study by Werling, Walitza, & Drechsler (2021) should be interpreted with caution since ADHD diagnostic has yet to be officially given for some samples. Differential definition of 'internet addiction', 'problematic digital media use', and screen time should also be examined with caution.

Changes in Screen Time Use

Most research featured in this study consistently established that COVID-19 restriction was associated with extended screen time use,

despite the terminology used. (Sciberras et al., 2021; Shuai et al., 2021; Werling, Walitza, & Drechsler, 2021) Unfortunately, easing the restrictions did not seem to return the screen time level to its pre-corona level (Werling, Walitza, & Drechsler, 2021).

Risk Factors of Internet Addiction

Life Changes Due to COVID-19

Only one study by Sciberras et al. (2021) reported the adjustments these individuals and their families have to make following COVID-19. If not taken for, such factors could present themselves as confounding factors in the study. In any case, the study about above-mentioned condition tells that three individuals have their external families diagnosed with COVID-19. Furthermore, nearly one-third of the samples were concerned about becoming infected with COVID-19 (29%) or if such cases happened in their family and friends (27%). This worry, however, was not associated with IA.

Almost half of the parents in this study (50%) have reported COVID-19 restrictions as being distressing for their children. Sciberras et al. (2021) further asserted that COVID-19 restrictions were associated with negative mental health outcomes. The COVID-19 stress-related outcome would, in turn, be related to extended social media use, but not gaming and television.

Poor Family Cohesion and Psychosocial Factors

Shuai et al. (2021) indicated that poorer family cohesion was overrepresented in ADHD individuals with Problematic Digital Use (PDMU). Poor attachment bonds between child and their caregivers may also increase adolescents'

susceptibility to developing internet addiction, especially when the inadequacy persists into adolescence. Presence of interpersonal problems were indeed overrepresented with ADHD suspected of IA. It is also discovered that stress levels, along with symptomatology of depression, anxiety, and oppositional defiant, were higher in ADHD individuals with Problematic Digital Media Use (PDMU) than in ADHD without such problems. However, comorbidity of ADHD with clinical depression and anxiety did not result in such differences.

Physical Activity

Shuai et al. (2021) also implied the above-mentioned condition might be caused by a significantly lower physical activity that was observed among PDMU subjects. The decreased level of physical activity, elevated loneliness, and negative affect during lockdown were also noted in Sciberras et al. (2021). However, no comparison was made between IA suspects and non-IA suspects.

Executive and Motivational Dysfunction

Executive function (EF) was found to be significantly worse among ADHD individuals that are suspected of Problematic Digital Media Use (PDMU), including Internet Addiction (Shuai et al., 2021). ADHD individuals with PDMU were observed with lowered learning motivation in the Shuai et al. (2021)'s study. They were also found to exhibit more significant learning and academic problems in the same study.

Impact of Internet Addiction on ADHD Symptoms

During lockdown, greater screen time use has also been associated with more severe inattentivity and aggression and ADHD symptoms in general, but not necessarily hyperactivity (Werling, Walitza, & Drechsler, 2021). Aggravated inattentive symptoms have been observed in ADHD individuals (Shuai et al., 2021). It has also been shown to disturb sleep patterns in ADHD adolescents. Average sleep duration decreased, while there was an increase in sleep duration <6 hours and >10 hours a day. Furthermore, ADHD adolescents reported an increase in sleep disturbances in comparison to the time before lockdown caused by the COVID-19 pandemic, which generally included difficulties in falling asleep, bedtime anxiety, night awakenings,

nightmares, and sleepiness at daytime (Bruni, Giallonardo, Sacco, Ferri, & Melegari, 2021).

DISCUSSION

How Digital Media Inherently Places ADHD Children and Adolescents at High Risk for Developing Internet Addiction

Most studies agree that declined executive and motivational dysfunctions, significantly when they co-occur, are linked with higher susceptibility towards greater problematic media use. Indeed, such findings add testament to how problems arising from ADHD have long been theorized to result from the dysfunction along with the two complementary systems: the executive and reward system. Executive dysfunction, which results from disruption along the fronto-dorsal striatal circuit and corresponding dopaminergic branches, would result in subpar inhibitory control needed to regulate one's internet use. Motivational dysfunction, best known as delay aversion, is associated with the dopaminergic reward system (i.e fronto-ventral striatum circuits) in the brain, involving sensory, motoric, cognitive, and emotional processing. Motivational dysfunction manifests itself as an excessive preference for immediate rewards, which the internet could provide with ease (Zhou, Zhang, Li, Xue, & Zhang-James, 2020).

On the other hand, the endless influx of notifications and information provided by the internet (or, in the case of gaming, validation received from the game) behaves similarly to rewards. These notifications and information tend to be instantaneously available. They could stimulate the dopaminergic system in the cortico-striatal circuit and give 'satisfaction' to ADHD individuals. Internet activities may be favoured by ADHD patients because of their delay aversion/motivational disorder. Generally, internet features stimulate users to habitually check their gadgets and trap them in a vicious cycle. When negative effects would occur, they fail to achieve this reward and realize the consequences of their choice (Chou et al., 2017; Firth et al., 2019).

Additionally, the diverse range of information and the option to open multiple applications simultaneously conditions people to engage in multi-tasking instead of engaging in activity that requires sustained concentration. On the other hand, multi-tasking behavior has reduced one's task-switching capability. In the long run, this habit aggravates one's distractibility, which poses

even bigger problems for ADHD individuals (Firth et al., 2019).

Even in healthy children and adolescents, their executive function and reward systems are still yet to be fully developed. Therefore, it is appropriate to place them (especially adolescents) as the key population as their inadequate mastery of these two systems makes them very vulnerable to acquiring various types of addictions (Marciano, Camerini, & Morese, 2021). Children and adolescents with ADHD might be even more particularly challenged to break their cycle as their dysfunction in their inhibitory control is at a greater baseline, resulting in poor self-control in their internet use (Wang, Yao, Zhou, Liu, & Lv, 2017). Therefore, it is not surprising when the addiction seems to correlate with worsened ADHD symptoms Masi et al. (2021), including in studies covered in this study.

In the first place, individuals with ADHD face a challenge in socializing with others and making social decisions, partly due to their impairments in social cognition. These difficulties are typically caused by—and aggravated by—emotional dysregulation, one common characteristic of ADHD (Humphreys et al. 2017). Individuals with poor social skills tend to view themselves as socially inept and are predisposed to choosing online social interactions over face-to-face interactions. On the other hand, the internet may fulfill one's need for intimacy (Cerniglia et al., 2017). The internet provides an alternative space for individuals with ADHD to socialize with much ease due to the option to stay anonymous and communicate with others without engaging in face-to-face interactions. Individuals with ADHD, as such, could release their emotions without considering the possible reactions they might get

from their interactions. Hence in the short term, they experience less anxiety in online interactions (Chou et al., 2017).

Individuals with emotional dysregulation are prone to behavioral addictions. Their engagement with such addictions might be driven by their needs to participate in escapism, alleviate their dysphoric moods, and manage their loneliness. Engaging in activities that offer immediate rewards might be their way of dealing with their negative emotions (Evren et al., 2018). These are important points to discuss because interpersonal problems and negative affect are overrepresented in the studies covered in this review.

How COVID-19 Aggravates This Susceptibility

Figure 2 is created by the authors in this study, and as such, no permissions from other parties are needed. Upon performing the current systematic review, we have since created a diagram to illustrate better how COVID-19 and the resulting restrictions aggravate the vulnerability of developing problematic media use and Internet Addiction among ADHD individuals (Figure 2).

Generally, the studies agree that COVID-19 restrictions result in greater distress and academic problems and worsened mental health and interpersonal problems. These combined encourage greater screen time use for ADHD individuals to alleviate the resulting negative effect and compensate for challenging interpersonal relationships in real life. At the same time, school activities are mostly done through internet. Once exposed to the endless influx of notifications and features from gadgets through these activities, their ADHD symptoms might hamper their ability to regulate their reward-seeking behavior (Wang et al., 2017).

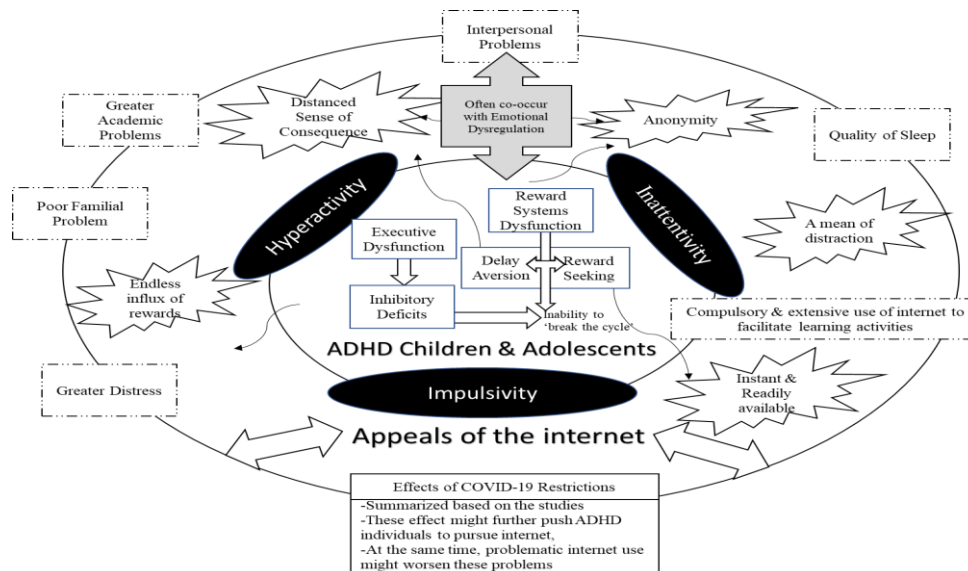


Figure 2: Vulnerability of Internet Addiction among ADHD Children and Adolescents during COVID-19, simplified and summarized from the studies covered in this review.

It might be especially true for those with greater ADHD symptoms before COVID-19. At the same time, familial cohesion and parental bonding are essential predictors of Internet Addiction in the general population of children and adolescents, as they would indicate greater interpersonal problems. It is also compromised during COVID-19, as the studies show. It would help to perpetuate greater internet addiction risk in the long run 1 (i.e., Ballarotto, Volpi, Marzilli, & Tambelli (2018)).

The increased susceptibility towards Internet Addiction within this key group results from interactions between sequelae of COVID-19 restrictions (as suggested by studies covered in this systematic review), inherent susceptibilities of ADHD children and adolescents towards behavioral addiction (as suggested by studies covered in this systematic review and theories of ADHD and adolescences). Also, the alluring properties of the internet becomes part of the susceptibility of Internet Addiction (Figure 2).

Research Limitations

Possible Biases

Conflicting findings have been noted regarding several outcomes induced by the covid-19 restrictions. Sciberras et al. (2021) said that two-thirds of the parents reported positive impacts on the family condition, whereas Shuai et al. (2021) noted otherwise. It was also evident in Werling, Walitza, & Drechsler (2021) reported a reduced

9in ADHD-related problems overall, in contrast to the remaining studies featured in this study. Although in both, a greater ADHD symptomatology and poorer familial bonding are over-represented in those with greater screentime use.

Upon further investigation, this might be due to the different methodology being used. Those who reported positive outcomes tend to assess parents' reports (i.e. Sciberras et al. (2021); (Werling, Walitza, & Drechsler (2021))), whereas those with negative reports depended solely on parents' reports examined self-reports of the subjects. They both have their own biases. However, parents' reports might be particularly vulnerable to parents' self-functioning. It is, as such, suggested to cross-reference both self-reports of the subjects and their parents' reports. It aims to increase the accuracy of the research.

CONCLUSION

Generally, lockdowns significantly increased screen time and internet usage, placing adolescents with ADHD at more significant Internet Addiction risks. Greater ADHD manifestations due to executive and motivational dysfunction, interpersonal problems, COVID-19 induced negative effects, and subpar familial cohesion are among the main correlates of this phenomenon. How interactions of these factors might contribute to these phenomena has been illustrated in Figure 2 These factors, as well as possible overlaps,

should be a point of caution for further interventions and lockdown policies. A more comprehensive intervention should also try to address psychosocial factors (including familial distress and lack of cohesion) and emotional dysregulation across these individuals, rather than emphasizing the ADHD symptoms.

On the other hand, the current systematic review has several limitations. Heterogeneity of the studies, particularly due to the different tools being used to measure IA, is relatively high. Due to COVID-19 measures, direct assessment by psychiatrists was not possible in most studies. However, this is ultimately the best compromise considering the urgency of the matter.

We have several recommendations for future original studies. Future original studies (i.e., observational and experimental studies) should consider adopting prospective research methodology instead of relying on cross-sectional studies. In line with this, original & observational studies should also consider cross-referencing self-reports of the subjects in question with their parents' reports (and vice versa) to increase the accuracy of the research. After all, COVID-19 may result in mental distress for both stakeholders and might especially affect parents' perception of their children's well-being. Researchers investigating adolescents should delve deeper into how adolescents' desires to seek identities and establish autonomy from their parents affect their susceptibility toward Internet Addiction. In COVID-19, the restricted social domains might compromise their autonomy and identity-seeking tendencies, increasing their vulnerability.

CONFLICT OF INTEREST

The authors declared no conflict of interest in this research.

AUTHOR CONTRIBUTION

FRE: Conceptualization, Methodology, Data curation, Writing- Original draft preparation, Editing. YS.: Supervision, Writing- Reviewing, Validating, Editing. HA: Supervision, Writing- Reviewing, Editing. IGAIA: Supervision, Writing- Reviewing, Editing.

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REFERENCES

- Ballarotto, G., Volpi, B., Marzilli, E., & Tambelli, R. (2018). Adolescent internet abuse: a study on the role of attachment to parents and peers in a large community sample. *BioMed Research International*, 2018, 1–10. <https://doi.org/10.1155/2018/5769250>
- Bisen, S. S., & Deshpande, Y. M. (2018). Understanding internet addiction: a comprehensive review. *Mental Health Review Journal*, 23(3), 165–184. <https://doi.org/10.1108/MHRJ-07-2017-0023>
- Bruni, O., Giallonardo, M., Sacco, R., Ferri, R., & Melegari, M. G. (2021). The impact of lockdown on sleep patterns of children and adolescents with ADHD. *Journal of Clinical Sleep Medicine*, 17(9), 1759–1765. <https://doi.org/10.5664/jcsm.9296>
- Cerniglia, L., Zoratto, F., Cimino, S., Laviola, G., Ammaniti, M., & Adriani, W. (2017). Internet addiction in adolescence: neurobiological, psychosocial and clinical issues. *Neuroscience and Biobehavioral Reviews*, 76, 174–184. <https://doi.org/10.1016/j.neubiorev.2016.12.024>
- Chou, W. J., Huang, M. F., Chang, Y. P., Chen, Y. M., Hu, H. F., & Yen, C. F. (2017). Social skills deficits and their association with internet addiction and activities in adolescents with attention-deficit/hyperactivity disorder. *Journal of Behavioral Addictions*, 6(1), 42–50. <https://doi.org/10.1556/2006.6.2017.005>
- Evren, B., Evren, C., Dalbudak, E., Topcu, M., & Kutlu, N. (2018). Relationship of internet addiction severity with probable ADHD and difficulties in emotion regulation among young adults. *Psychiatry Research*, 269, 494–500. <https://doi.org/10.1016/j.psychres.2018.08.112>
- Firth, J., Torous, J., Stubbs, B., Firth, J. A., Steiner, G. Z., Smith, L., ... Sarris, J. (2019). The “online brain”: how the internet may be changing our cognition. *World Psychiatry*, 18(2), 119–129. <https://doi.org/10.1002/wps.20638>
- Humphreys, Kathryn L., Galan, Chardee A., Tottenham, Nim, Lee, S. S. (2017). Impaired Social Decision-Making Mediates the Association between ADHD and Social Problems. *Physiology & Behavior*, 176(10),

- 139–148. <https://doi.org/10.1007/s10802-015-0095-7>. Impaired
- Leménager, T., Hoffmann, S., Dieter, J., Reinhard, I., Mann, K., & Kiefer, F. (2018). The links between healthy, problematic, and addicted Internet use regarding comorbidities and self-concept-related characteristics. *Journal of Behavioral Addictions*, 7(1), 31–43. <https://doi.org/10.1556/2006.7.2018.13>
- Lin, M. P. (2020). Prevalence of internet addiction during the covid-19 outbreak and its risk factors among junior high school students in Taiwan. *International Journal of Environmental Research and Public Health*, 17(22), 1–12. <https://doi.org/10.3390/ijerph17228547>
- Marciano, L., Camerini, A. L., & Morese, R. (2021). The developing brain in the digital era: a scoping review of structural and functional correlates of screen time in adolescence. *Frontiers in Psychology*, 12, 1–15. <https://doi.org/10.3389/fpsyg.2021.671817>
- Marmet, S., Studer, J., Grazioli, V. S., & Gmel, G. (2018). Bidirectional associations between self-reported gaming disorder and adult attention deficit hyperactivity disorder: evidence from a sample of young Swiss men. *Frontiers in Psychiatry*, 9(December). <https://doi.org/10.3389/fpsyg.2018.00649>
- Masi, L., Abadie, P., Herba, C., Emond, M., Gingras, M. P., & Amor, L. Ben. (2021). Video games in ADHD and non-ADHD children: modalities of use and association with ADHD symptoms. *Frontiers in Pediatrics*, 9(3), 1–10. <https://doi.org/10.3389/fped.2021.632272>
- Moro, M. M., El-Gebaly, H. H., Zaky, E. A., & Kamal, T. M. (2019). A study of dopamine D2 receptor Taq1 A alleles in children with attention-deficit hyperactivity disorder. *Current Pediatric Research*, 23(1), 9–16.
- Nie, J., Zhang, W., Chen, J., & Li, W. (2016). Impaired inhibition and working memory in response to internet-related words among adolescents with internet addiction: a comparison with attention-deficit/hyperactivity disorder. *Psychiatry Research*, 236, 28–34. <https://doi.org/10.1016/j.psychres.2016.01.004>
- Sciberras, E., Patel, P., Stokes, M. A., Coghill, D., Middeldorp, C. M., Bellgrove, M. A., ... Westrupp, E. (2021). Physical health, media use, and mental health in children and adolescents with ADHD during the Covid-19 pandemic in Australia. *Journal of Attention Disorders*, 1–14. <https://doi.org/10.1177/1087054720978549>
- Shuai, L., He, S., Zheng, H., Wang, Z., Qiu, M., Xia, W., ... Zhang, J. (2021). Influences of digital media use on children and adolescents with ADHD during Covid-19 pandemic. *Globalization and Health*, 17(1), 1–9. <https://doi.org/10.1186/s12992-021-00699-z>
- Stahl, S. M. (2013). *Stahl's essential psychopharmacology: neuroscientific basis and practical applications* (4th editio). USA: Cambridge University Press.
- Tawfik, G. M., Dila, K. A. S., Mohamed, M. Y. F., Tam, D. N. H., Kien, N. D., Ahmed, A. M., & Huy, N. T. (2019). A step by step guide for conducting a systematic review and meta-analysis with simulation data. *Tropical Medicine and Health*, 47(1), 1–9. <https://doi.org/10.1186/s41182-019-0165-6>
- Wang, B. qian, Yao, N. qi, Zhou, X., Liu, J., & Lv, Z. tao. (2017). The association between attention deficit/hyperactivity disorder and internet addiction: a systematic review and meta-analysis. *BMC Psychiatry*, 17(1), 1–12. <https://doi.org/10.1186/s12888-017-1408-x>
- Werling, A. M., Walitza, S., & Drechsler, R. (2021). Impact of the Covid-19 lockdown on screen media use in patients referred for ADHD to child and adolescent psychiatry: an introduction to problematic use of the internet in ADHD and results of a survey. *Journal of Neural Transmission*, 128(7), 1033–1043. <https://doi.org/10.1007/s00702-021-02332-0>
- Zhou, B., Zhang, W., Li, Y., Xue, J., & Zhang-James, Y. (2020). Motivational but not executive dysfunction in attention deficit/hyperactivity disorder predicts internet addiction: evidence from a longitudinal study. *Psychiatry Research*, 285(152), 1–8. <https://doi.org/10.1016/j.psychres.2020.112814>