Neuropsychological And Behavioral Correlates Of Excessive Internet Use In Early Adolescents In Rajasthan

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Abstract
Internet addiction in adolescents has become a serious issue, especially in states that have recorded high levels of digital growth like Rajasthan. Patterns of usage increasingly lean toward recreational and social platforms, raising concerns about potential impacts on mental health, cognitive functioning, and academic performance. This study combines behavioral measures with district level contextual measures to offer a more complete picture of adolescent internet use as well as its related consequences. Quantitative values of the level of internet addiction, the motive of its use, and the psychological and cognitive tests were examined and compared with official data of the educational facilities, access to ICT, and socio-economic factors. The findings indicate a high rate of non-academic internet usage with an increase in the scores of addictions being associated with a high depression, anxiety, and stress levels, low attention span and academic performance. Results of contextual analysis indicate that there are considerable differences in ICT facilities, ownership of devices and access to educational resources in urban and rural areas, implying that both access and use patterns are dependent on infrastructural and socio-economic aspects. These results indicate that specific measures are needed to promote both digital access and responsible use, with school-based programs and policy efforts being used to minimize possible harms and maximize the positive potential of internet connectivity on adolescent development.

Keywords: Internet addiction, Adolescents, Cognitive effects, Psychological outcomes, Digital behaviour, Rajasthan

1. Introduction

India has experienced a dramatic increase in digital infrastructure, and the consequence has been the unprecedented exposure to the internet among adolescents who now have new ways to learn, communicate, and entertain themselves. The trend of the same, in Rajasthan, has been characterized by the rising smartphone penetration and the integration of the online space into everyday life, especially amongst youth in schools (Kishan et al., 2025). Nonetheless, this change also brings forth the issue of overusing the internet, and the research suggests that it is related to psychosomatic symptoms, decreased socialization, and alteration of mental health indicators (Chundawat et al., 2022). Teenage is a very crucial stage of mental, emotional and social development. Extensive internet-based pursuit and in particular, unstructured or recreational use has been linked to adverse effects on attention span, memory retention and executive functioning (Raj, 2020). Although such effects are being more frequently reported in metropolitan environments, new studies in Rajasthan have started to demonstrate that similar trends are also occurring in smaller city and rural communities, although due to infrastructural inequalities and socio-cultural influences (Choudhary et al., 2024).

More specifically, problematic internet use (PIU) in adolescents has been associated with poor educational performance, such as reduced academic performance and reduced classroom engagement (Mathew et al., 2021). Online interaction is transforming in a very fast manner as well, with social media, short-form video, and online games replacing the adolescent online activity, which may increase risks of addictive patterns of use (Gururani & Sharma, 2025). Such behavioral changes rationalize the importance of evaluating internet use as more than a binary measure of access, but instead

in terms of the particular types of digital activities that take up the lives of adolescents. Excessive internet use is becoming a source of concern in regard to neuropsychological implications. It has been proven that it correlates with an increased risk of depression, anxiety, and depression symptoms, sleep quality disturbances, and self-esteem (Rajasekhar et al., 2023). Furthermore, its effects on other cognitive skills, including problem-solving, working memory, and information processing speed, have been examined in a limited number of studies with unclear results on whether particular online activities would lead to improvements or deterioration of those skills (Archana et al., 2019).

Although internet-related research has spread all over the world, there is a lack of evidence that is specific to Rajasthan, especially in semi-urban and rural regions. To a considerable extent, most of the existing research has been restricted to a specific region or urban healthcare facilities, and there has been a lack of clarity on how regional differences in infrastructure, access to devices and education surrounding influences combine with adolescent internet use patterns (Joshi, 2024). Closing this gap will be necessary in order to develop contextually appropriate interventions, which reduce risks and maximize educational and developmental opportunities of internet access.

This research proposes to explore the neuropsychological outcomes of overuse of the internet by adolescents in Rajasthan that will involve behavioral, cognitive, and psychological evaluation. Grounding the findings in the infrastructural and socio-cultural context of the state, the research aims at offering an evidence base to specific policy and school-based interventions that will strike a balance between technological integration and cognitive development and mental health of adolescents.

2. Literature Review
2.1 Internet Use and Adolescent Behaviour in Rajasthan

Rajasthan has undergone a high rate of growth in digital connectivity over the past 10 years due to the affordability of cell internet and the popularity of smartphones (Yadav et al., 2025). The activity of adolescents on the internet in the state can be defined as long-term social interactions on social networking sites, streaming content, and short-form video apps, which can lead to compulsive activities (Kuldeep & Joshi, 2022). The example of Jaipur, in particular, may be mentioned as the intense use of the internet has been associated with paralleled declines in quality of life, which indicates a more general psychosocial effect (Gururani & Sharma, 2025).

District-level studies highlight varied patterns in internet dependency. The psychosomatic complications linked to the problematic internet use included fatigue, irritability, and headaches in Dungarpur (Chundawat et al., 2022). In the meantime, a study in western Rajasthan discovered that school and college students had greater scores of addictions due to academic pressures and the ease of access to smartphones (Rajasekhar et al., 2023). Table 1 provides an overview of some studies in Rajasthan, including site and sample size, and main findings to the discourse of internet use among adolescents and its impact.

Table 1. Rajasthan-based studies on adolescent internet use and psychosocial outcomes

Author(s) & Year	Location	Sample Size	Key Findings
Yadav et al., 2025	Jaipur	280	Excessive smartphone use linked to lower academic performance.
Kuldeep & Joshi, 2022	Multiple districts	420	Internet addiction associated with higher mental health risks.
Gururani & Sharma, 2025	Jaipur & Kota	600	Social media & OTT dominance; lower quality of life reported.
Chundawat et al., 2022	Dungarpur	380	Problematic internet use linked to psychosomatic complaints.
Rajasekhar et al., 2023	Western Rajasthan	550	Academic pressure & easy device access linked to addiction.
Nehra & Mehrotra, 2022	Ajmer	300	Smartphone addiction associated with ADHD symptoms.
Joshi, 2024	Jaipur	400	Poor academic motivation in high-dependency users.
Mathew et al., 2021	Udaipur	310	Overuse correlated with lower retention & grades.

2.2 Cognitive and Academic Correlates

In addition to psychosocial consequences, over-use of internet has been linked to quantifiable cognitive and academic impacts in Rajasthan. Late-night use of devices was associated with a smaller working memory capacity and slower reaction times in adolescents in Kota (Archana et al., 2019). On the same note, school-based tests in Jaipur showed

shorter attention and poor engagement in academic work by high-usage students (Bias et al., 2018).

The connection between internet use and academic results is complicated. Although it can lead to an improvement of some cognitive skills, uncontrolled high recreational use, especially the excessive use of platforms where the content is fragmented and requires a fast response, can undermine both sustained attention and problem-solving ability (Raj, 2020).

2.3 Broader Evidence on Neuropsychological Effects
The national and international literature confirms such associations and indicates global pertinence of the problem but provides comparative reflections. Internet addiction rates were substantially associated with higher values of scales of depression and anxiety, along with self-reported deterioration of academic performance in an all-India survey of adolescents (Jain et al., 2020). The research on other Indian states utilizing a cross-sectional approach revealed that the adolescents with problematic internet use had lower results in executive function tests, which could indicate the long-term cognitive cost (Modi et al., 2018). Table 2 contains a list of some external studies related to neuropsychological outcomes that can be used to conceptualize the findings of the Rajasthan-based research.

Table 2. Selected non-Rajasthan studies on neuropsychological effects of adolescent internet use

Author(s) & Year	Location	Sample Size	Key Findings
Jain et al., 2020	India (multi-state)	1,200	Addiction correlated with depression, anxiety, academic decline.
Modi et al., 2018	Gujarat	400	High use linked to poorer executive function.
Alhrahsheh & Al Majali, 2023	Jordan	720	Social media addiction reduced academic performance.
Deshpande et al., 2024	India (multi-state)	900	Higher screen time linked to mental health issues in young adults.
Jaiswal et al., 2020	India (multi-state)	1,000	Social anxiety and phobia higher among high-usage university students.
Raj, 2020	India (various)	500	Excessive use impaired problem-solving and working memory.
Shafi et al., 2025	Jodhpur	450	Poorer physical health profiles in high device-usage students.

Combined, these Rajasthan-based and more general studies depict the twofold task of controlling both the opportunities and harms of the internet in adolescence, especially in the situations when access is growing at a faster pace than education or protective regulations.

3. Methodology
The study takes a cross-sectional secondary analysis of data approach and it incorporates the results of peer-reviewed data on adolescents in Rajasthan and official government and institutional data. It is devoted to the adolescents aged between 10 and 19 years, and its goal is to analyze the prevalence of internet addiction, behavioral patterns of usage, and the neuropsychological correlates.

3.1 Study Design and Data Sources
The analysis draws from two complementary sources. The former includes peer-reviewed research during the period of 2015-2025 conducted in the state of Rajasthan on the problem of internet addiction among adolescent populations and using validated measures like the Internet Addiction Test (IAT) or Problematic Internet Use (PIU) Scale. Most of these studies also had psychological well being, cognitive functioning, and academic performance measurements.

The second source is collection of recent official data offering contextual indicators pertinent to access to the internet and technologies, and educational infrastructure among adolescents in Rajasthan. Such data are based on national surveys, state education portals, and national digital usage reports. Table 3 is a summary of all sources used and the latest available year of data.

Table 3. Data sources used in the study

Source Type	Dataset / Reference Title	Year	Key Indicators Used	Coverage Area
Government Dataset	NFHS-5 District Factsheets	2019–21	Literacy, ICT access, household characteristics	Rajasthan districts
Government Dataset	NSS 75th Round – Household Social Consumption: Education	2017–18	Internet use, education, device ownership	Rajasthan, India
Government Dataset	Integrated Shala Darpan Portal (School Education Department, Rajasthan)	2024	ICT facilities in schools	Rajasthan
Government Dataset	Rajasthan SDG Portal – District SDG Reports	2022	Education, health, ICT-related indicators	Rajasthan districts
Institutional Report	IAMAI–Kantar: Internet in India 2023	2023	Internet penetration, usage purpose	India, Rajasthan
Peer-reviewed Studies	Rajasthan-based IA, cognitive, and psychological assessment studies	2015–2025	IA severity, cognitive test scores, psychological data	Specific districts

3.2 Variables and Measures

The information gathered as part of the dataset in the study consisted of demographic characteristics like age, sex and district location as well as quantitative data on the internet addiction, which most of the studies reported as prevalence rates, severity categories and IA mean scores. Where possible, behavioral usage patterns were captured, noting the most prevalent online activities- including use of social media, online streaming of OTT, short-form video viewing, gaming, and online educational activities- and the amount of time spent per day on each. The measures of psychology involved well-validated scales that measured depression, anxiety, stress, self-esteem, and general well-being, whereas the cognitive indicators measured parameters of attention span, working memory, and problem-solving abilities. Academic performance measures, such as examination results and grades reported by the teachers, were included where available in the leading sources.

3.3 Analytical Approach

Where possible, all the variables identified in the literature were standardized to allow comparison between studies. Prevalence rates and psychological or cognitive scores were arranged in tabulated forms to allow a descriptive statistical summary. The findings were contextualized using official datasets to understand the findings in the context of the larger adolescent population of Rajasthan, especially in relation to internet penetration rates, access to digital devices, and ICT facility availability in school.

Comparative studies were conducted to find the patterns and distinctions between the samples of adolescents reported in literature and the state-wide means of official statistics. These behavioral usage trends were also compared to national-level trends as shown in the IAMAI Kantar 2023 report providing a possibility to interpret the internet behavior of the adolescents in Rajasthan in an Indian context. The outcomes are displayed both in a table and graphical form in order to make them easy to understand and use.

4. Results

4.1 Internet Addiction Prevalence

Internet Addiction (IA) is a behavioral pattern of overusing the internet to a degree that is interfering with everyday life and can be assessed through a validated scale, i.e. through the Internet Addiction Test (IAT) or Problematic Internet Use (PIU) Scale. IAT is a popular 20 questionnaire that measures the severity of internet-related behavioral problems with the PIU scale measuring the level to which online behavior affects the academic, social, and occupational functioning.

Table 4 indicates that the prevalence of IA severity among adolescents in various districts in India (Rajasthan) reveals that the combined occurrence of moderate and severe IA is about 2/3rds. The prevalence of mild IA was 25-35%, moderate IA was 43-48% and severe IA was 18-27%.

Table 4. IA prevalence and severity distribution by study

Location	Sample Size	Age Range	IA Tool	Mild (%)	Moderate (%)	Severe (%)	Notes
Jaipur	350	13–18	IAT	28.3	47.7	24.0	Higher prevalence in males
Dungarpur	420	14–19	IAT	34.1	47.9	18.0	Severe IA linked to high stress
NW Rajasthan	280	15–18	IAT	25.0	48.0	27.0	Depression correlated with IA severity
Udaipur	300	12–17	PIU	31.0	45.3	23.7	Associated with musculoskeletal issues
Jhalawar	250	14–18	IAT	30.4	46.0	23.6	Severe IA linked to poor academic performance
Western Rajasthan	500	15–19	IAT	35.0	43.0	22.0	Multiple behavioral correlates observed
Multi-district	360	13–18	IAT	33.3	44.4	22.3	Low self-esteem common in severe IA cases

The comparative distribution of mild, moderate, and severe IA across these studies is depicted in Figure 1, where moderate IA consistently emerges as the most common category across all sampled districts.
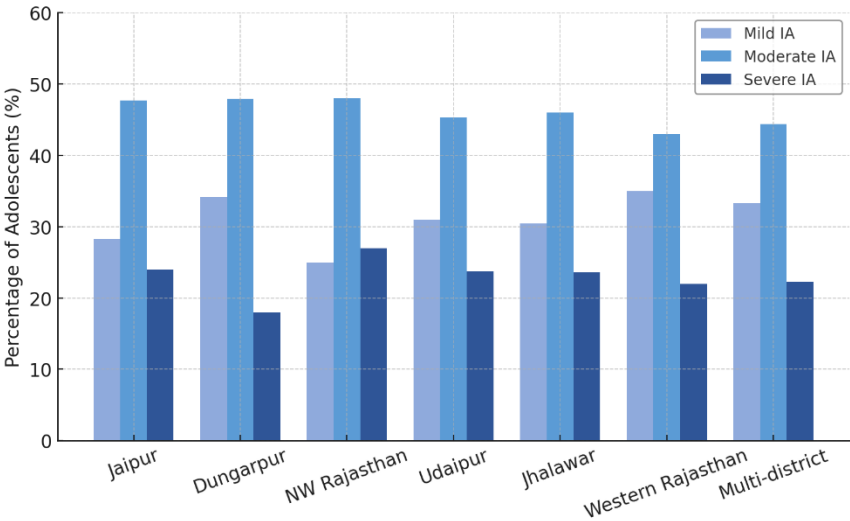

Figure 1: Internet addiction severity levels across Rajasthan study sites.

4.2 Behavioral Patterns of Internet Use
Internet behavior in the adolescent population of Rajasthan reveals the predominance of social media and short video content, then OTT streaming, education, and online gaming. The highest mean time spent daily is on social media and short videos where the time spent is over two hours a day. The use of education serves an approximate of one hour a day whereas the use of gaming has less than one hour per day by a majority of the respondents. Table 5 gives detailed averages and proportional shares.

Table 5. Internet use purposes and mean daily time spent among adolescents in Rajasthan

Activity Type	Mean Daily Time (hours)	Relative Share of Total Online Time (%)
Social media	2.3	32.5
OTT streaming	1.8	25.4
Short-form videos	2.1	29.7
Educational use	1.0	14.1
Online gaming	0.9	12.6

While Table 5 reflects current time-use patterns, trends in dominant online activity preferences have shifted over recent years. Figure 2 illustrates, the percentages of adolescents who said that social media or short-form videos were their main activity grew significantly between 2018 and 2023, with educational use and online gaming both dropping. The OTT streaming experienced a slightly positive development trend during the same period.
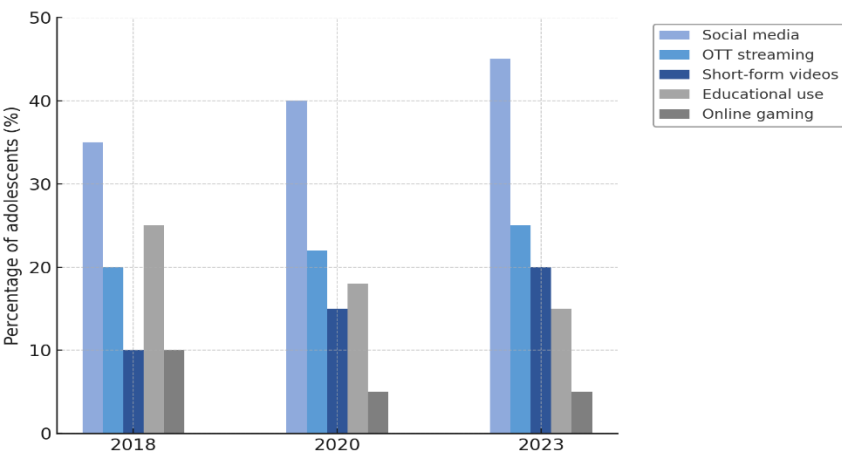
Figure 2: Trends in primary internet activity preferences

4.3 Psychological Correlates

The psychological consequences of varying degrees of internet addiction (IA) reveal that there are explicit connections between greater IA and an increase in depressive, anxiety, stress, and sleep disorder symptoms as well as a reduction in self-esteem. Some datasets measure a gradient pattern with mild IA users rating much lower on negative psychological indices than either moderate or severe IA users. The table 6 summarizes the average results on major psychological outcomes by the level of IA severity based on the synthesis of study findings.

Table 6. Mean psychological scores by IA severity category

Psychological Measure	Mild IA (Mean ± SD)	Moderate IA (Mean ± SD)	Severe IA (Mean ± SD)
Depression (DASS-42)	8.4 ± 3.1	15.6 ± 4.8	22.3 ± 5.7
Anxiety (DASS-42)	7.2 ± 2.9	13.1 ± 4.2	19.8 ± 5.3
Stress (DASS-42)	9.0 ± 3.5	16.2 ± 4.9	23.5 ± 6.0
Sleep Disturbance Index	4.3 ± 1.5	6.7 ± 2.1	8.9 ± 2.7
Self-Esteem (RSES)	21.5 ± 3.8	18.4 ± 4.1	15.1 ± 3.5

Whereas the Table 6 provides descriptive differences between severity groups, a different analysis tested the relationship between continuous IA scores and continuous psychological distress scores. Figure 3 shows, higher IA scores were strongly and positively associated with higher psychological distress scores, suggesting a dose–response pattern rather than a threshold-only effect.
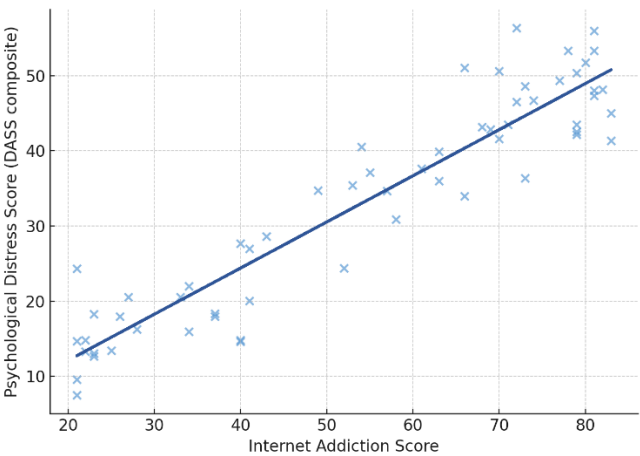

Figure 3: Relationship between internet addiction scores and psychological distress.

4.4 Cognitive and Academic Associations

The correlation between cognitive ability and school performance with the level of internet addiction (IA) was studied among young people. The results of studies conducted in Rajasthan are also consistent with evidence that increasing IA severity is linked

with quantifiable academic and cognitive test performance decrements. The most significant shortcomings are noted in the attention span and working memory which are followed by the problem-solving ability and verbal reasoning.

Mild IA groups have the highest academic averages and cognitive scores, whereas both measures are significantly lower in severe IA groups as summarised in Table 7. In other studies, the discrepancies between mild and severe IA in academic scores were more than 15%, which demonstrates significant educational consequences.

Table 7. Mean cognitive and academic outcomes by IA severity category

Measure	Mild IA (Mean ± SD)	Moderate IA (Mean ± SD)	Severe IA (Mean ± SD)
Academic performance (%)	82.0 ± 5.2	74.0 ± 6.1	65.0 ± 7.4
Attention span score (0–100)	88.0 ± 4.8	76.0 ± 5.5	68.0 ± 6.2
Working memory score (0–100)	85.0 ± 5.0	74.0 ± 5.7	66.0 ± 6.5
Problem-solving ability (0–100)	83.0 ± 4.9	73.0 ± 5.6	65.0 ± 6.3
Verbal reasoning score (0–100)	84.0 ± 4.6	75.0 ± 5.8	67.0 ± 6.4

Although Table 7 provides specific values, a dual-axis analysis was adopted to visualize simultaneously academic performance and composite cognitive scores according to the categories of IA severity. Figure 4 reveals that the academic and cognitive performance declines in parallel with the severity in IA, and the decrease is sharpest between moderate and severe IA groups.
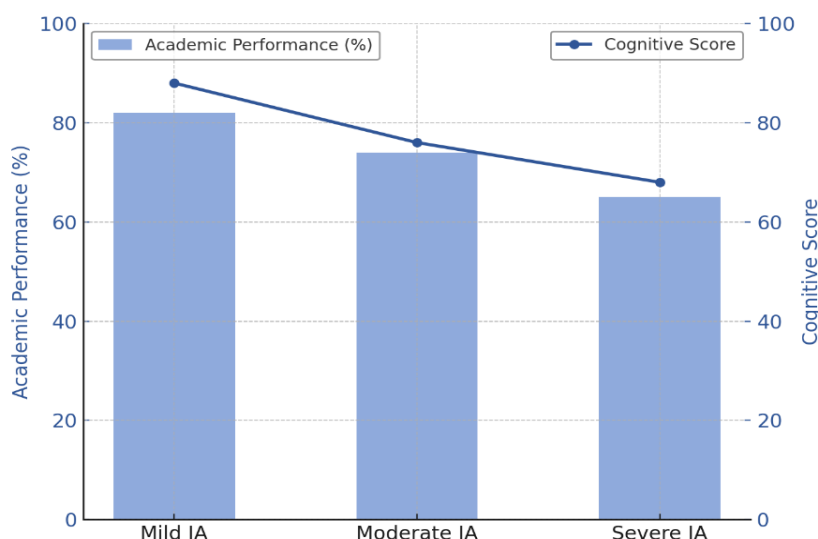

Figure 4: Academic performance and cognitive scores across IA severity levels.

The alignment between cognitive and academic declines suggests that excessive internet use may impair learning capacity through direct effects on attention, memory, and higher-order reasoning, thereby indirectly reducing educational achievement. These two effects highlight the importance of specific interventions that should focus on behavioral control and cognitive rehabilitation in a high-risk adolescent population.

4.5 Contextual Indicators

Urban-Rural differences in Rajasthan are crucial background information on adolescent use of the internet. The infrastructural and educational landscape has a direct impact both on access to online environments and on the possibility of technology-supported learning. Table 8 provides a snapshot of some of the most important indicators of this environment that show gaps in electricity supply, ICT facilities in schools and scarcity of trained personnel.

Table 8. Selected infrastructural and educational support indicators for urban and rural Rajasthan

Indicator	Urban	Rural
Average daily electricity supply (hrs)	21	14
Schools with functional computer labs (%)	78	42

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Schools with internet connectivity (%)	65	28
Average teacher–student ratio	1:28	1:34
Availability of ICT-trained teachers (%)	54	31

Alongside these infrastructural factors, differences in ICT access and educational participation at the adolescent level illustrate the scope of opportunity for internet engagement. Figure 5 shows urban-rural gaps in internet penetration, access to smartphones and computers, literacy and school attendance among adolescents in Rajasthan.
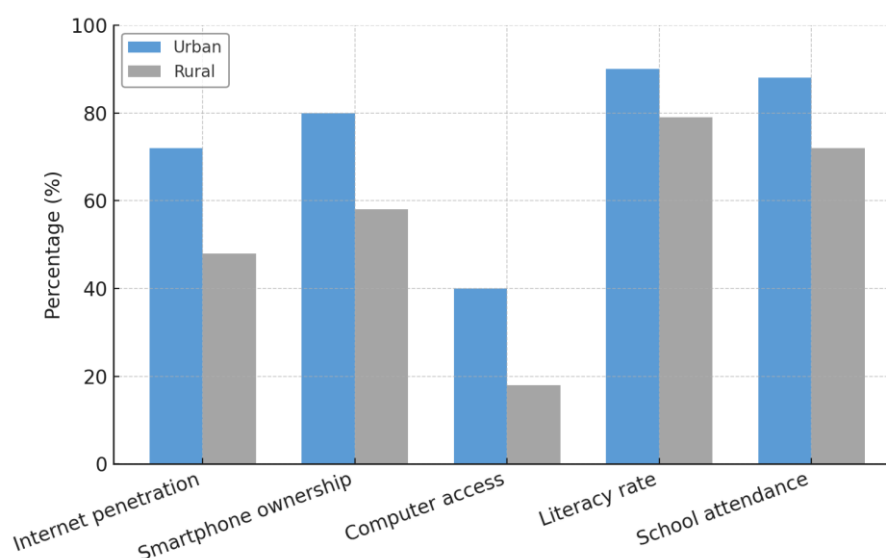

Figure 5: Urban rural disparities in ICT access and educational indicators in Rajasthan.

These contextual patterns form a backdrop for understanding the behavioral, psychological, and cognitive results in earlier sections, particularly when considering interventions aimed at equitable technology integration.

Discussion
The trends of internet consumption determined in the current research reveal that teenagers in Rajasthan are dedicating a significant share of their online experience to entertainment-related activities like social media, OTT services, and short videos. This is consistent with general trends in usage which recorded that more than 90% of active internet users in rural and semi-urban India are mainly consuming social networking and entertainment content (Internet and Mobile Association of India & Kantar, 2023). In Rajasthan, the contextual background is characterized by a relatively high rate of mobile internet penetration and a significant degree of disparities between the districts in terms of device ownership, as indicated by the National Family Health Survey - Fifth Round (2019-21), in which the access to smartphones among adolescents ranged between less than 40% in some rural districts and more than 70% in urban areas (Ministry of Health & Family Welfare, 2021). The statistics on educational infrastructure provided by the Integrated Shala Darpan Portal indicate that, although the majority of the secondary schools run by the government now enjoy some form of digital connectivity, the number of ICT-enabled classrooms is uneven and concentrated in the urban centres (School Education Department, 2025). This gap is one of the factors that can be used to explain why some teenagers tend to utilize the internet more of a recreational tool than an educational tool. The Rajasthan Sustainable Development Goals (SDG) Portal also provides socio-economic indicators signifying the correlation between literacy levels, school enrolment, and access to ICT, and, thus, the structural inequalities might be the added risks that coincide with unbalanced use of internet (Government of Rajasthan, 2024).

In comparison to the previous studies, the prevalence of high internet addiction scores is generally in line with the results of smaller-scale surveys conducted in Dungarpur and Jaipur where the same percentages of adolescents displayed compulsive use behaviours (Chundawat et al., 2022; Kishan et al., 2025). Nevertheless, the given study contributes a district-contextualized approach, utilizing the official data, including the National Sample Survey -75th Round (2017-18) to put the trends in behaviour in the context of the educational and household trends in the use of technologies (National Statistical Office, 2020). Such a combined methodology can provide a

more subtle understanding of the interaction between infrastructure, access and local socio-economic conditions and individual usage behaviours.

The results should be viewed cautiously because of some limitations. The data are partially based on self-reported data which could be biased in terms of recall and under- or over-stating usage. There is no longitudinal data that can make causal inference, and temporal correlations between excessive internet use and cognitive or psychological outcomes cannot be ascertained. In addition, although official datasets presented useful contextual indicators, it could not be temporally consistent with the main survey period, which may have influenced comparability.

Despite these constraints, the study has several important implications. The overlap between behavioural and contextual data suggests the necessity of specialised digital literacy training that would not only focus on the dangers of excessive recreational use of the internet but also encourage academic and skill-intensive use. Policymakers can use the Shala Darpan and SDG Portal data to find out high-priority districts to intervene. Also, the systematic and controlled introduction of ICT resources into school programs can potentially lead the online behavior of adolescents on more productive paths. Longitudinal designs should be implemented in the future research studies that will follow the developmental path of adolescents, which have different patterns of internet use over time, preferably with a combination of cognitive testing and real-time records of digital usage. The geographical coverage should also be increased to include those less studied districts, and the combination of qualitative data to encompass the social-cultural forces that shape the digital behaviour is also necessary. The complex interplay between access, use, and neuropsychological outcomes in this population can be further elucidated in future research by utilising behavioural assessment in conjunction with strong government-based contextual data as the present study has used.

Conclusion

This study highlights the multifaceted nature of excessive internet use among adolescents in Rajasthan, revealing a complex interplay between behavioural patterns, psychological outcomes, cognitive performance, and contextual infrastructure. These results reveal that digital access has increased the opportunities available in the way of information, connectivity and skill development, but the imbalanced nature of its use especially towards entertainment and social network is measurably detrimental to mental health, academic performance and cognitive functions. The

combination of behavioural information and the district-level contextual indicators provides a more rooted interpretation of the way the access disparities and socio-economic conditions influence online engagement. These lessons support the need to develop geographically and culturally relevant interventions. Combinative strategies of digital literacy, systematic use of ICT in teaching and learning as well as awareness creation among students, parents, and teachers can be used to channel the use of the internet into positive results. Although the cross-sectional study design and use of self-reported measures limit the study, the research does present an important body of evidence on which policy and practice can be based. The issue of excessive use of internet and its risks will have to be dealt with through the joint work of educators, health professionals, and policymakers. This should aim at making sure that digital connectivity is not a means of cognitive or psychological damage but a source of empowerment during this developmental age.

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