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A DETAILED INVESTIGATION OF DIGITAL SCREEN TIME EXPOSURE AMONG GENERATION (GEN) ALPHA DEVELOPMENT AS REPORTED BY THEIR CAREGIVERS: A CROSS-SECTIONAL STUDY

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Screen time Exposure; Digitalization; Generation (Gen) Alpha; Emotional regulation; Child development; Digital public health; Preventive medicine

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Abstract

The world of digital screens was once a random activity for children, but it has now become almost everywhere, with the potential to have a significant impact on sleep, physical activity, child-caregiver interaction, and the process of self-regulation in everyday life. Evidence from metropolitan settings in South Asia is sparse in terms of multi-domain precision, particularly on the lives of Generation (Gen) Alpha, who have grown up in a "always on" digital ecology. To analyze and quantify screen-time exposure and caregiver-reported emotional, language, cognitive, physical, and social outcomes in children in Lahore, Pakistan, and to contextualize these findings by directly referencing existing worldwide screen-time research. A cross-sectional study was conducted with urban caregivers of 295 children aged 3 to 14 years, who completed a standardized and pre-tested questionnaire on multidomain outcomes, daily screen time, and parental-control effectiveness. For all potential inferential comparisons, the strength of the link was measured using chi-square tests stratified by age, with proportions computed using Wilson 95% confidence intervals. Of 288 classifiable replies data set, 130 youngsters (45.1%, 95% CI 39.4-50.9) utilized screens for at least 3 hours per day. The most common emotional-regulation indicators in the risk profile were feeling frustrated/upset on restriction (52.5% of children) and feeling irritable after taking it for a long time, often or every day (44.7% of children), even though no other physical indicators were measured to outweigh these indicators. Cognitive engagement was content-dependent and not uniformly positive or negative: whereas 167

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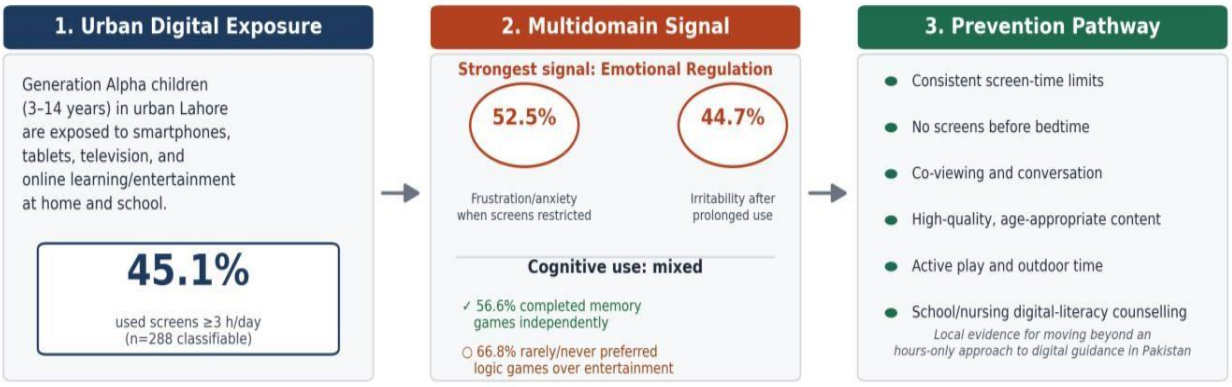
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children (56.6%) played memory-based games without assistance, 197 (66.8%) never or rarely chose logic-based games over entertainment games. Age had a slight but significant association with independent memory-game completion ($\chi^2 = 18.19$, $p = 0.006$, $V = 0.176$), perceived memory advantage ($\chi^2 = 17.26$, $p = 0.008$, $V = 0.171$), and weekly cognitive screen engagement. A large proportion of this urban Pakistani population engaged in unusually high amounts of daily screen time, which was accompanied primarily by emotional-regulation difficulties rather than cognitive or physical impairments, implying that more than just time limits are required, as routine and content are equally important. Thus, longitudinal, multivariable-adjusted designs with objective screen-time measurement are the next step toward causal evidence to support its claims.

Highlights

- This study investigated a high priority digital-public-health problem in urban Pakistan – excessive screen exposure among Generation Alpha children-which was missing from most regional statistics.
- The strongest and most consistent caregiver-reported correlates of screen restriction and higher screen use were emotional regulation, not cognitive or physical functioning.
- Combined a complex view of time, capturing duration, content, parental control, bedtime routine and active-play displacement in one sample.
- For cognitive screen activities there were statistically significant but small differences between the age groups (Cramer's V 0.17-0.22), which warrant being interpreted with caution and not viewed as causal.

Graphical Abstract



INTRODUCTION

Digital screen exposure has become one of the most important environmental elements in modern childhood development (Gath et al. 2026; Höfrová0 et al. 2024). Smartphones, tablets, television, online education platforms, games, and algorithmically-curated entertainment are the most influential devices for Generation Alpha, reaching children born after 2010, during the years when language, executive functioning, sleep architecture, physical activity, peer-to-peer play, and caregiver-child engagement develop most

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prominently [3–6]. In contrast to generational cohorts, Generation Alpha lacks a pre-digital baseline: screens are everywhere; even when a child is not directly looking at a screen but is indirectly exposed to household media, when screens are left on in the background, or when caregivers use screens in front of the child, the daily digital environment is shaped before any device is handed to a child [7,8]. This shift has resulted in an analogous volume of literature on digital-parenting approaches that show parents and guardians how to raise Gen Alpha children in an intentional fashion inside rather than responding to an interconnected world [3,5,8,9].

There are two theoretical explanations for our current understanding of this screen exposure among Gen alpha [10–12,12]. According to the displacement hypothesis, screen time is inherently costly in developmental terms since it replaces time spent resting, active play, and mutual care-giver connection - the process, not the result, is what creates effect. The competing content/process explanation is that effects are determined by what a child does on a screen and how, passively or interactively, alone or with others, rather than by duration; a recent review of preschoolers, aimed at clarifying a high-stakes debate, discovered a negative relationship between passive and positive relationships, with passive viewing associated with poorer attention and interactive use with better bottom-up and orienting attention [9,10,13]. Modern pediatric and public-health recommendations (WHO, American Academy of Pediatrics) have shifted to a 24-hour health-behavior model that operationalizes both concurrently and places screen use alongside sleep, physical activity, and face-to-face interaction, rather than as an independent exposure [1,4,14,15]. The purpose of this study is to determine which account best fits a sample of South Asian urban population(specifically in Pakistan): in the case of dominant displacement, physical and social indicators are expected to vary closer to duration; in the case of dominant content/process, outcomes are expected to be clustered around activity types (e.g., cognitive engagement) rather than hours.

Both hypotheses have empirical support, which is heavily reliant on high-income environments [1,16–18]. Similar urban-based proof of the family and environmental association of preschool screen usage, along with proof of the reduction strategies used to decrease screen-time and of the digital-literacy policy, remains limited to North American, European, and East Asian samples; context-representative,

multidomain information on South Asian preschools, or even Pakistan in particular, is limited and, when available, is often restricted to a single area of outcome (e.g., sleep) [9,19–21]. This work explicitly addresses that gap by discussing the extent of screen exposure and multidomain correlates in Generation Alpha children in Lahore, Pakistan; precision (confidence intervals) and point estimates alone are reported, and the results are explicitly compared to the international literature. The reporting is consistent with the STROBE standards of observational research [2,16,22]. The research's specific aims were to: (i) estimate exposure to screen-time per day and its distribution in the context of a defined urban Pakistani sample; (ii) describe reported emotional, linguistic, cognitive, physical, and social correlates of such exposure assessed by caregivers; (iii) test the hypothesis that there are age-dependent modifications to these associations and size the effects where they occur; and (iv) place the resulting profile in the global and local environment. A brief summary of literature survey is reported in Table 1.

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Table 1. A summary of screentime exposure literature survey and positioning of the present study.

Design	Methodology and findings of existing works	Key Knowledge contribution	Ref.
Meta-analysis/cohort/cross-sectional studies	Screen exposure, content quality, and parental mediation are jointly associated with language, parent–child talk, and developmental screening outcomes.	Language-related screen learning and sentence timing were assessed locally.	[20,23,25]
Longitudinal/systematic review evidence	Device use for calming and higher screen time relate to emotional reactivity and behavior problems.	Emotional regulation emerged as the most prominent signal in this Lahore sample.	[16,23]
Systematic reviews and survey-based studies	Screen exposure and ASD-related outcomes show associations but with low certainty and confounding.	ASD-like questionnaire items are treated only as caregiver-reported indicators, not diagnoses.	[29]
Systematic review and multivariable cohort evidence	Bedtime screens, low movement, and sedentary behavior are linked with sleep and cardiometabolic risk.	Physical symptoms, sleep interference, weight category, and physical-activity displacement were profiled.	[24,26]
Cross-sectional studies	Children in Bangladesh and Pakistan show high screen exposure, parental supervision challenges, and mixed parental perceptions of device use.	This study extends regional evidence to Lahore across broader developmental domains.	[17,21,22]
Observational/family and applied studies	Parental attitudes, family attachment, outdoor play, parental control, and parenting stress shape screen routines.	Parental-control effectiveness and activity displacement were incorporated.	[30-33]

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Prospective and cohort studies	Problematic/addictive use and early smartphone ownership may be more clinically relevant than duration alone.	The 10–14-year subgroup is interpreted in light of emerging smartphone-risk evidence.	[7,30]
Cross-sectional caregiver survey, N=295	Local Lahore evidence remains scarce and single-domain.	Provides a multidomain local profile, confidence intervals, effect sizes, a theory-linked framework, and a literature comparison table.	This work

Research Methodology

participants:

This was a cross-sectional study with 295 children (160 boys and 135 girls) aged 3–14 years with their primary caregivers. This current study was performed in Model Town Urban community in Lahore, Punjab, Pakistan, as a part of final Bachelors of Nursing final year research project submitted to Fatima Memorial Hospital (FMH) Lahore, Punjab, Pakistan. Children's average age was 84 months (SD = 31 months) or 7 years, 0 months. The study questionnaire was completed by the primary carer and those children who had frequent daily interactions with the caregiver completed the follow-up questionnaire. To minimize any possible confounding effect, children with known neurological or developmental disorders, other than those associated with screen use, were excluded from the study. All participating care providers signed consent forms before participating in the data collection process.

Study design and reporting

It was a descriptive and cross-sectional study that looked at children's screen time and developmental indicators as reported by their caregivers on Gen alpha in Lahore, Punjab, Pakistan. The work is based on the concepts of general observational reporting and the STROBE checklist ((it stands for Strengthening the Reporting of Observational Studies in Epidemiology) which provides 22 areas that are essential to research reports related to observational studies (cohort, case-control and cross-sectional studies) that are transparent regarding reporting standards) [9,13,16,23]. Because of the study's cross-sectional character, all relationships are deemed descriptive and hypothesis-generating rather than causal.

Conceptual framework

Figure 1 has formalized the study's conceptual frameworks, which will be employed during the variable selection and analysis procedure. The framework has organized the constructs into four connected factors: (A) Determinants. Screen access context is created by the kid, household, school, caregiver, and environmental variables; (B) exposure context. The questionnaire (§2.5) assesses the length, type, content, and technique of screen capture for changeable and counseling-actionable practices in practice. (C) Outcome Domain The five outcome domains (emotional, language, cognitive, physical, and social) are annotated with the appropriate headline prevalence of the outcome domain of the results (§3) and (D) the prevention levers. The questionnaire (§3.7) distinguishes between modifiable and counselling-actionable habits. The theory goes on to describe a feedback cycle of reinforcement: emotional activation in Domain C is thought to lead to increased usage of the gadget to relax in Context B, which increases screen

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demand and parental stress (Core), triggering Determinants (A) again. This loop was proposed a priori to help design the questionnaire (which is why it has a special item in Domain B: calm with a device) and is determined in the appendix of paragraph 3.7, where the predominance of emotional-regulation indicators over physical/social indicators is interpreted as evidence of this loop rather than simple time displacement.

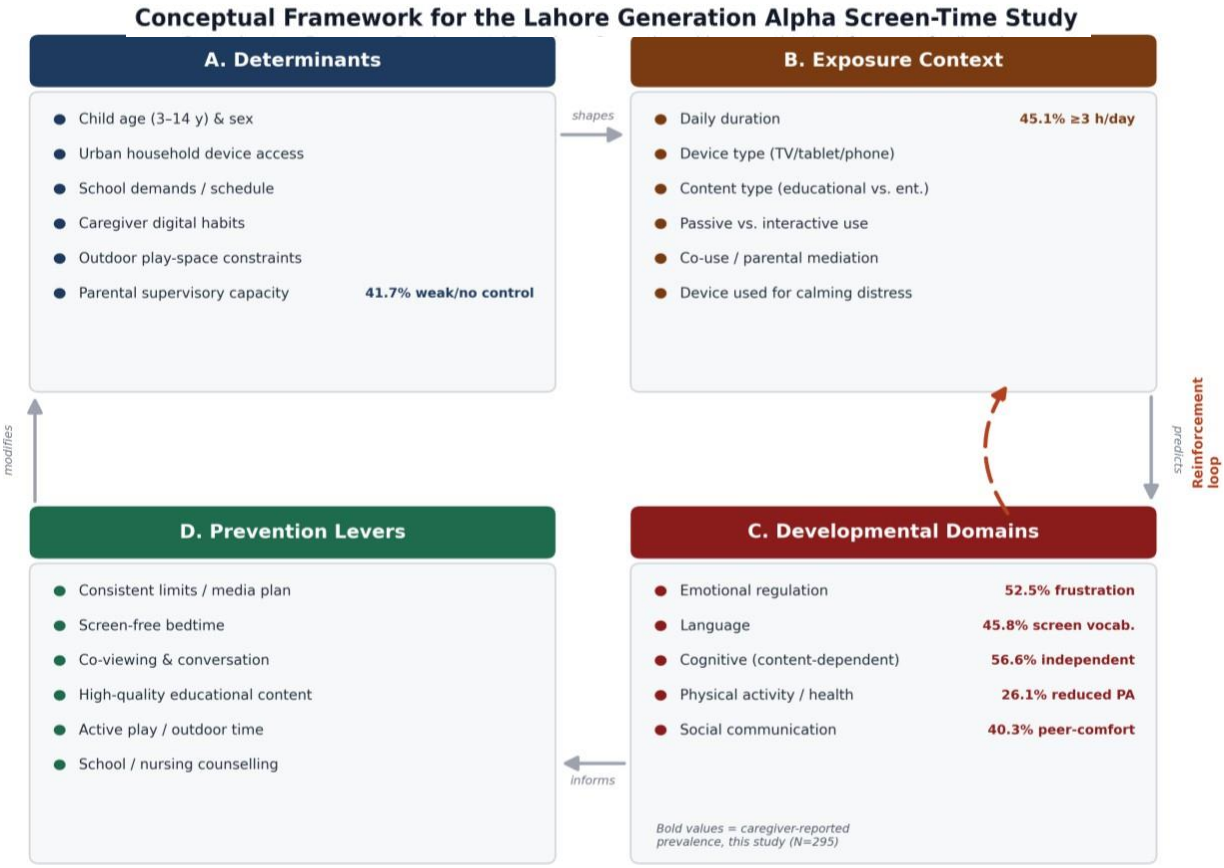


Figure 1. Conceptual framework for the Lahore Generation Alpha screen-time study

Study setting and participants

The sample was drawn from the available urban settings in Lahore, including towns, schools, pediatric clinics, and community centers. Children from 3 to 14 years old should be urban residents of Lahore and have a care giver who comes into contact with the child on a regular basis and can provide information on a screen and the results of the child screen. To avoid misrepresentation of the outcomes, children who had already been diagnosed with a developmental problem unrelated to screen usage were eliminated.

Sample size and sampling

The sample size used was computed based on 95% confidence level, a known prevalence of the outcome of 74.1, and a margin of error of 5%, where its calculation is reported in Equation (Eq.) 1.

$n = Z^2p(1 - p) / d^2(1)$

where Z = 1.96 (95% confidence level), p = 0.741 (assumed prevalence), and d = 0.05 (margin of error). Substituting: $n = (1.96^2 \times 0.741 \times 0.259) /$

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$0.05^2 = 0.7373 / 0.0025 \approx 294.9$, rounded to 295 (recomputed and verified during this revision). The convenience sampling method was employed and therefore, the
results cannot be assumed to provide a picture of all children in Lahore but only the sample that was surveyed in urban areas.

Data collection instrument

A structured, closed ended questionnaire on caregivers was used to collect the data. Domains were child age, sex, and screen-time/restriction behavior, language-related screen learning, cognitive screen activities, physical health indicators, routine/repetitive behaviors, and social communication - which are directly related to the conceptual framework figure 1, which are: B) Contexts and C) Domains. The questionnaire was tested to ensure it was understandable. The source materials did not record formal psychometric validation (i.e., internal consistency, test-retest reliability) and these are considered to be the limitation of this present study.

Analysis and analytic code

Daily screen time was coded into four groups namely: <1 h, 1-2 h, 3-4 h and >4 h. The majority of the outcome items were an ordinal caregiver-report measure (3 to 5 levels), which, for reporting purposes, were wishing back into the collapsing binary/category-level proportions presented in Tables 3 to 6 (e.g., frequent/always vs. other), and reporting. To perform the age-stratified analyses in SEC. 3.5 the age variable was stratified into three age groups (35 years, 6-9, 10-14 years) and cross-tabulated with the original, unmangled 3-level response scale, which is compatible with the degrees of freedom. Since the age group versus outcomes analysis was mainly cross-tabulated, the results cannot be interpreted as modulated screen-dose response effects, and the subsequent analysis must cross-tabulate the screen-time groups directly with each result, and use multivariate regression.

Statistical analysis

Descriptive or bivariate analyses only were performed, and no adjusted or multivariable model was fitted in this version (see §4.1, §4.2). Tests were done at a two sided significant level of 0.05. The point prevalence of each indicator was calculated $p = x / n$, where x is the number of children with the indicator present and n is the required denominator (295 to on average most of the indicators, 288 to 7 non-classifiable responses on the indicator). Owing to many proportions in this sample being near to the endpoints of the 0-1 scale and known to inefficient normal-approximation intervals where this happens, 95% confidence intervals have been calculated by the Wilson score method [24,25], whose calculations are reported in Eq. 2.

$$CI = [\, p + z^2/2n \pm z\sqrt{(\, p(1-p)/n + z^2/4n^2 \,)} \,] / (1 + z^2/n) \quad (2)$$

with $z = 1.96$. As a worked, independently reproduced example: in case of the exposure of headline ($x = 130$, $n = 288$, $p = 0.4514$), a 95% interval of 39.55 in Equation 2 is within rounding error, compared to 39.45 in Table 3. This work agrees on the reported bounds, and offers an internal consistency check on the source calculations.

Association testing

Pearson chi-square statistic test was used to test age-group differences in caregiver-reported outcomes , as reported in Eq. 3 [24,26].

$$\chi^2 = \Sigma\, (O_i - E_i)^2 / E_i \quad (3)$$

The calculated 3 (age group) × 3 (response level) contingency tables (df = 4) with the comparison between observed cell counts Oi and the expected cell counts Ei from Eq. 3 are under the null hypothesis of independent ages and response.

Effect size

Effect size was determined using Cramer V [26,27], in every case of any important chi-square output, as reported in Eq. 4.

$$V = \sqrt{[\, \chi^2 / (N \times m) \,]}, \quad m = \min(r-1, c-1) \quad (4)$$

where N is N is the number of samples, r and c the rows and the columns of the table of contingency. Using the standard values of m = 2 tables, V = 0.07, 0.21 and 0.35 can be interpreted as the small,

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medium, and large associations respectively. To verify this revision Equation 4 was solved (with each reported 3N as V) to obtain m = 1.99204: all three significant tests in Table 7 back-solve to m =3, a consistent 3x3 table structure (df = 4) underlying all three tests - an internal -consistency test that had not been previously reported on this dataset.

Statistical power and multiplicity

The calculation of sample size in § 2.4 was powered to estimate prevalence, but not the single age-stratified chi-square comparisons stated in section 3.5. It has sufficient power (Cramer V Tensorial minimum effective value = 0.1517) to test small-to-medium associations (V 0.171217) at the Euro Sigma level (= 0.05), matching the size of the significant associations that are observed (V = 0.171217); it is under-powered to test smaller effects, and non-significant results (§3.5, physical and social indicators) should be interpreted as inconclusive instead of indicating lack of association. There was no multiple comparisons (e.g., Bonferonni, false discovery rate) correction in all the chi-square tests conducted; this is revealed as a weakness (§4.1) and must be handled by the reader, such that the three statistically significant, theoretically predicted, cognitive relationships are treated as a block, not as individually confirmatory.

Bias and data quality.

Possible sources of bias were caregiver recall bias, social desirability bias, single-respondent reporting, missing or non-classifiable responses, and convenience sampling. To minimize overclaiming, confidence intervals are reported, incomplete denominators are named and causal wording is avoided in this manuscript. The source table lacked or could not classify seven responses per day, regarding screen-time; which is modified in the results (n = 288 of 295, in terms of screen-time-specific estimates).

Ethical considerations

The ethics approval was claimed to be taken by the institutional ethical review committee of the FMH (Fatima Memorial Hospital) system. Caregivers gave informed consent in writing, and their participation was voluntary.

Table 2. A overview of methodological components and the current work

Component	Methodology	Significance for this current study
Design	Cross-sectional descriptive survey, guided by a priority conceptual framework (Figure 1)	Supports local prevalence/risk profiling; does not establish causality
Population	Children aged 3–14 years and primary caregivers in urban Lahore	Targets Generation Alpha children with caregiver-reported data
Exposure	Average daily screen time; parental-control effectiveness; screen content/context items	Captures duration and context, consistent with recent literature trends
Emotional outcomes	Mood swings, outbursts, frustration/anxiety, irritability, transition difficulty, requests for more time	Primary prevention signal in this work
Language/cognitive outcomes	Screen-acquired vocabulary, sentence formation, story recall, memory games, problem solving, logic-game preference	Differentiates educational/cognitive engagement from entertainment use

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Physical/social outcomes	Sleep, weight status, discomfort, physical activity, neck/back pain, conversation, solitary play	Links digital exposure to 24-hour behavior peerand social opportunity
Analysis	Descriptive statistics with Wilson 95% CI (Eq. 2), chi-square (Eq. 3), Cramér's V (Eq. 4)	Improves statistical interpretability beyond simple frequency tables
Key limitation	No raw individual-level dataset available for adjusted regression in this revision	Future work should use multivariable models and objective/diary screen measures

Results and Discussion

Participant characteristics and exposure profile

The current study included 295 children dataset. The average age was 7.04 ± 2.62 years, with 103 children (34.9%) aged 3-5, 138 (46.8%) aged 6-9, and 54 (18.3%) aged 10-14. There were 160 men
(54.2%), and 135 women (45.8%). A daily screen time of 3-4 hours was recorded for 93 children (31.5% of the total sample, N=295), and more than 4 hours per day for 37 children (12.5%). In situations where only classifiable responses to screen-time were used (n=288, excluding 7 non-classifiable replies), 130 of the children (45.1, 95CI 39.4-50.9) had more than 3 hours of screen exposure each day. Parental control has proven ineffective or slightly successful among 123 caregivers (41.7), showing that a sizable number of caregivers require family-level digital learning. The details of dataset for this research study are reported in Table 3.

Table 3. Participant characteristics and digital screen-time exposure profile.

Indicator	n/N	%	95% CI
Age 3–5 years	103/295	34.9	29.7–40.5
Age 6–9 years	138/295	46.8	41.2–52.5
Age 10–14 years	54/295	18.3	14.3–23.1
Male sex	160/295	54.2	48.5–59.8
Screen time <1 h/day	73/288	25.3	20.7–30.7
Screen time 1–2 h/day	85/288	29.5	24.5–35.0
Screen time 3–4 h/day	93/288	32.3	27.1–37.9
Screen time >4 h/day	37/288	12.8	9.5–17.2
Screen time ≥3 h/day	130/288	45.1	39.4–50.9
No/slightly effective parental control	123/295	41.7	36.2–47.4

After establishing the exposure levels section 3.1 and Table 3, subsections 3.2-3.4 investigate each of the developmental domains separately - emotional/behavioral, language/cognitive, and physical/social - and subsections 3.5-3.7 contextualize the findings by testing the effect of age and comparing them to the relevant literature.

Emotional and behavioral screen-response profile

Emotional regulation provided the strongest and most consistent signal as evidenced in results from Table 4. Sixteen out of 156 children reported mood swings at least three times per week after using the screens, 155 reported frequent/daily frustration or anxiety when restricted access to these screens occurred, and 132 reported frequent/daily irritability as a result of excessive screen use. These findings are consistent with that the use of gadgets to soothe, as well as variable emotional reactivity-enhancing patterns of screen use overall, may exacerbate emotional reactivity and parent-child conflict [7,10,21,28,29]. This is not to
say that all activities on screens are harmful; rather, the sudden removal of a very strong reinforcing apparatus without any usual routines is

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likely to reveal or intensify any self-regulation issues encountered.

Table 4. The analysis details of Emotional and behavioral screen-response indicators (N=295).

Emotional/behavioral indicator	n/N	%	95% CI
Mood swings following screen use: ≥3 times/week	156/295	52.9	47.2–58.5
Emotional outbursts when denied screen time: high/very high	122/295	41.4	35.9–47.1
Frustration/anxiety if screen access restricted: frequent/daily	155/295	52.5	46.8–58.2
High/very high impact on patience in non-screen activities	62/295	21.0	16.8–26.0
Irritability after prolonged screen use: frequent/daily	132/295	44.7	39.2–50.5
Moderate/severe difficulty transitioning from screens	88/295	29.8	24.9–35.3
Requests more screen time despite limits: frequent/always	151/295	51.2	45.5–56.8
High/very high effect on ability to regulate emotions	96/295	32.5	27.4–38.1

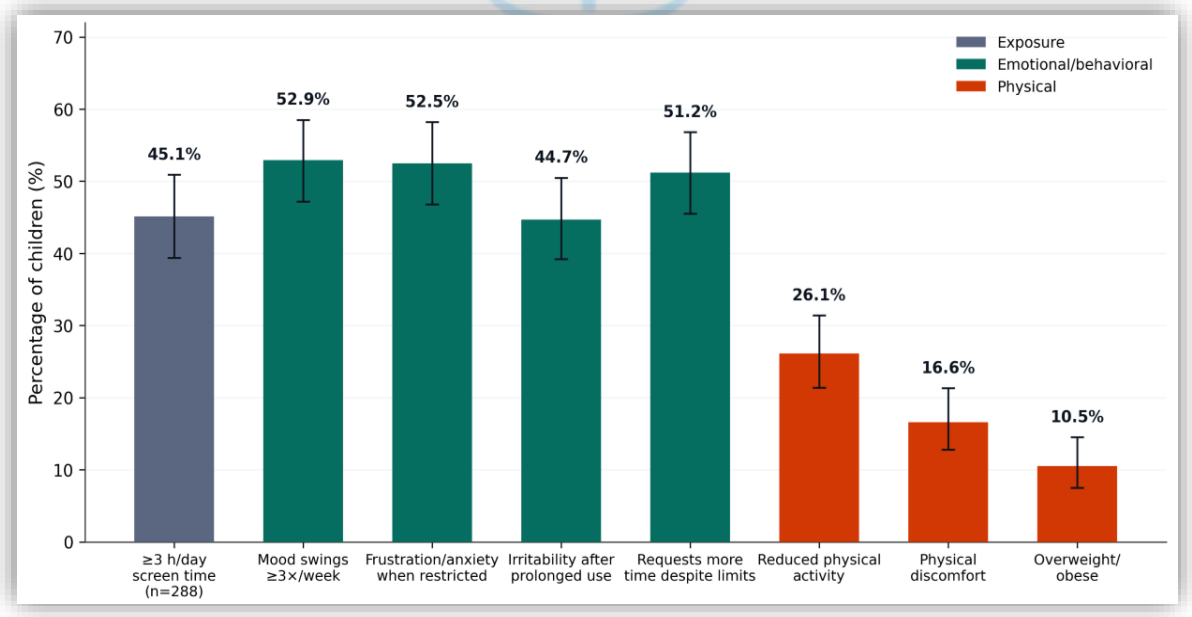


Figure 2. A detailed demonstration of Key caregiver-reported indicators with 95% Wilson confidence intervals

Language-related and cognitive behavior:

Cognitive and linguistic responses were mixed in this study as reported in Table 5. Caregivers also reported that 135 children (45.8 percent) used language (acquired through screens) frequently or very frequently, while 154 (52.2 percent) often or always remembered stories or information gained through screens. Meanwhile, 58 children (19.7%) were reported to have only created three to four word phrases after the age of three, or to have

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continued to struggle with sentence formation. During cognitive screen activities, 167 children (56.6%) played memory-based games mostly or always on their own, while 146 (49.5%) displayed problem-solving ability frequently or very often. Nonetheless, 197 youngsters (66.8%) seldom or never preferred logic-based games over enjoyment. This finding helps sustain the existing scientific perspective that content and co-use is more important than time in itself: in a 286-participant cross-sectional observation across four developmental moments, the higher screen exposure levels, the lower the vocabulary, fluency, and pragmatic communication scores by the time participants reached school age (r = -0.19 to -0.28), educational content, and active mediation on the part of the parents proved to be independent. A modality-specific experimental research of teenage working memory found that active, interactive screen use, rather than passive background viewing, was associated with improved performance on visuospatial working memory tasks. When combined with existing findings, this shows that interactive, instructive media may promote vocabulary or problem-solving in particular situations, whereas passive entertainment or no supervision exposure may crowd out more valuable developmental growth [2,4,18,19,27,30–32].

Table 5. Language-related and cognitive screen-use indicators (N=295).

Language/cognitive indicator	n/N	%	95% CI
Uses screen-acquired vocabulary frequently/very frequently	135/295	45.8	40.2–51.5
Formed 3–4 word sentences after age 3, or still struggles	58/295	19.7	15.5–24.6
Uses complex language/phrases learned from screens frequently/very frequently	142/295	48.1	42.5–53.8
Recalls/discusses screen stories or information frequently/always	154/295	52.2	46.5–57.8
Understands educational screen content well/very well	206/295	69.8	64.4–74.8
Completes memory-based games mostly/always independently	167/295	56.6	50.9–62.1
Shows problem-solving skills in screen activities frequently/very frequently	146/295	49.5	43.8–55.2
Adapts to complex screen-game rules quickly/very quickly	130/295	44.1	38.5–49.8
Never/rarely prefers logic-based games over entertainment	197/295	66.8	61.2–71.9
High/very high perceived enhancement of problem-solving skills	66/295	22.4	18.0–27.5

Physical health, movement, and social indicators

Physical and social indicators were lower than emotional indicators, but they were still important predictors of prevention as can be seen in Table 6.

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39 children (13.2%) reported frequent/every-night difficulty falling asleep after using the screen; 49 children (16.6%) reported frequent/always physical discomfort such as eye strain; 77 children (26.1%) reported reduced participation in physical activities; and 72 children (24.4%) reported neck or back pain on a regular basis. Thirty-one children (10.5%) reported overweight or obesity, and 83 children (28.1%) reported frequent/always constipation or digestive issues, which is consistent with a recent scoping review that describes unresolved controversies about the relationship between screen time and exposure to digital media on both the appetite/eating-behavior and activity-displacement pathways to nutritional health outcomes in children under the age of 18 [7,22,28,33]. These findings should not be taken as implying that screen exposure is unrelated to physical health: the available chi-square tests only examined age-group differences, not screen-dose associations, which were not adjusted. A comprehensive analysis of the use of electronic media and sleep found that school-aged children had delayed bedtime and poor sleep quality, supporting the overall relationship between media usage and shorter sleep duration. More recently, using multivariate models on a sample of 307 Portuguese children (aged 6-10 years) has shown that greater sedentary time was a strong predictor of belongingness to less desirable screen-time categories, and this consistency is also observed in the Indonesian study (adolescents), which found that an inverse relationship between screen time and objectively tested motor strength, was also measured; a similar finding was reported by a recent multivariate-modeling. The physical pain item in our current sample also correlates with a recent analysis, which revealed that remote learning and increasing screen time are risk factors for digital eye strain in children and adolescents.

Table 6. Physical health, movement, and social communication indicators (N=295).

Physical/social indicator	n/N	%	95% CI
Difficulty falling asleep after screens: frequent/every night	39/295	13.2	9.8–17.6
Overweight or obese	31/295	10.5	7.5–14.5
Constipation/digestive issues: frequent/always	83/295	28.1	23.3–33.5
Physical discomfort after screen use: frequent/always	49/295	16.6	12.8–21.3
Screen time interferes with sleep schedule: frequent/always	58/295	19.7	15.5–24.6
Reduced participation in physical activities: frequent/always	77/295	26.1	21.4–31.4
Entertainment screen time >2 h/day	128/295	43.4	37.9–49.1
Neck/back pain after screen use: frequent/always	72/295	24.4	19.9–29.6
Comfortable initiating peer conversations: somewhat/very comfortable	119/295	40.3	34.9–46.0
Preference for solitary play: often/always	24/295	8.1	5.5–11.8

Age-stratified statistical analysis and effect sizes

The amount of cognitive screen-activity findings varied across three age groups as reported in Table 7. Older children were more likely to complete memory-based screen games on their own and were assessed to profit from them. The effect sizes were small (Cramer's V = 0.171 0.216), showing that age had only a minor role in explaining

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variation. It is crucial for high-quality interpretation: statistically significant results should not be interpreted as implying huge developmental impacts or as evidence that screen exposure improves cognition [18,21].

Table 7. Age-stratified chi-square findings and effect-size interpretation.

Outcome group	χ^2	p	Cramér's V	Interpretation
Independent completion of memory-based screen games	18.190	0.006	0.176	Small age-related association; older children more often independent
Perceived effectiveness of screen games for memory skills	17.259	0.008	0.171	Small age-related association; higher perceived benefit in older group
Weekly time on screen activities designed to enhance cognition	27.465	<0.001	0.216	Small-to-moderate age-related association; cognitive screen activities varied by age
Physical health indicators	6.221–11.200	>0.05	Not calculated	No statistically significant age-group differences in the available source analyses
Social communication indicators	6.583–9.154	>0.05	Not calculated	No statistically significant age-group differences in the available source analyses

Comparison with published literature

It is difficult to compare studies directly because of differences in age groups, techniques, exposure, informants, and outcome measures. Table 8 has shown relative differences where measures are similar enough to be regarded similar, and the remaining comparisons are in contextual categories rather being numerically equivalent.

Table 8. Comparison of present findings with recent global and regional literature.

Domain	Published benchmark	Present finding	Interpretation	Ref.
Heavy screen exposure	1-year-olds had ≥4 h/day screen time in a prospective cohort of 7,097 mother–child pairs.	12.8% of classifiable Lahore responses had >4 h/day	Age range and cohort design differ substantially; the comparison highlights that heavy exposure is a relevant urban concern across settings.	[15-20]
Supervision / parental control	56% of school-going children in Dhaka used digital devices without parental supervision (n=420).	41.7% no/slightly effective parental control	Definitions differ (unsupervised use vs. control effectiveness); weak control remains common and intervention-relevant regionally.	[20,21]

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Internal comparator	median daily screen time of 2.5 h (boys) and 2.0 h (girls) among children of hospital staff in Karachi.	45.1% had ≥3 h/day in Lahore	Not directly computable (median vs. threshold proportion); Lahore data suggest a substantial high-use subgroup relative to the Karachi median.	[1-5,22]
Regional cross-sectional design	comparable cross-sectional caregiver design to link screen time with personal–social development risk among Indonesian preschoolers.	Multidomain caregiver-reported profile across ages 3–14, N=295	Similar design and region (South/Southeast Asia); supports the methodological approach taken here as consistent with emerging regional practice.	[25-28, 33]
Emotional regulation	highlight links between device-based calming, rising pandemic-era screen time, and emotional reactivity/behavior problems.	52.5% frequent/daily frustration/anxiety when restricted	Not directly computable across designs; a 2026 meta-analysis further links frequent/problematic use to more severe emotional-health indicators in youth, reinforcing why this domain warrants prioritized counselling [27].	[16,23,27]
Sleep and bedtime screens	found electronic media use associated with shorter sleep duration and, in school-aged children, delayed bedtime and poorer sleep quality.	13.2% frequent/every-night sleep-onset difficulty after screens	Not directly computable; bedtime screen rules remain justified even though severe sleep problems were not universal in this sample.	[24]
Movement behavior	higher sedentary time and specific sleep-efficiency profiles significantly predicted higher screen-time category membership in a multivariable model of 307 children.	26.1% frequent/always reduced physical activity due to screens	Consistent direction of association despite different analytic approach (multivariable modelling vs. bivariate chi-square); supports the 24-hour movement framing adopted in §1.	[26]

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Intervention relevance	analyzed parental-control effectiveness as a lever within a broader digital-wellness and child-protection framework.	41.7% weak/no controls and 51.2% frequent/always requests for more time	Results identify a feasible, literature-supported prevention target for nursing and school programs.	[30-33]

Interpretation and public-health implications

The results of study infers that the Lahore (Pakistan) sample does not simply send a clear message about whether screen usage is harmful or beneficial. The data suggests a mixed domain-specific pattern rather than a single mechanism, in line with the two initial theories offered in §1 (displacement versus content/process). Physical and social indicators (the domains most directly subject to tradeoff against screen time) should have exhibited the biggest, age-graded signal, but they did not (§3.4, §3.5), and the difference between age groups was not statistically significant. Emotional-regulation indicators, on the other hand, were the most common (52.5% frustration/anxiety on restriction; 44.7% irritability after prolonged use) and most consistent with five related items (Table 4), which is more typical of a reinforcement/withdrawal mechanism, in which the benefit of an intensely engaging device, rather than time displacement, is the default self-regulation strategy and its loss, not its use, causes dysregulation. Cognitive indicators, in turn, followed content type (independent memory-games completion, problem-solving) but not time and was the only field to provide an age gradient that was coherent (Cramer V 0.1710.216); this is similar to a recent review of the applicant preschool-attention that individual active, interactive screen time positively correlated with orientation of attention, whereas passive viewing negatively correlated with it [28]. The profile suggests that emotional self-regulation and cognitive interest respond to screen usage, whereas physical and social indicators in this population were not statistically meaningfully explained by screen usage alone--a discrepancy with clear consequences for counselling design.

It is widely aligned with this trend: proponents of the now-proven mechanism of device-based calming in younger US children and the amplification of screen routines in the context of the pandemic among children reports. An analogous mediating route - screen-related behavior leading to poorer mental-health indicators, which impairs other functioning - has also been found in older students living in other Global South environments, implying that the reinforced/withdrawal pattern identified here is not limited to early/middle childhood. The current data generalize this mechanism to an older, more age-heterogeneous South Asian sample, and show that it works together rather than the alternative content-specific cognitive mechanism, resulting in a joint profile that, to our knowledge, has never been described in a single Pakistani cohort.

The analysis of the sources found no significant differences in age group, which is not surprising in light of the power considerations at the end of the Sub-section 2.7, and this should be understood as an open question, rather than evidence of no age group difference, because the cross-sectional, aggregated design of the study does not entitle to rule out the possibility of a dose-response relationship, which is of interest when such associations are investigated.

In the case of nursing and preventive medicine, the most practical message to reinforce is that it should inform families about the value of routines rather than minutes alone; an overlay that applies work specifically evaluating the effectiveness of parental control as a digital-wellness lever overall supports this point. The growing body of qualitative and survey-based research in the region on the actual usage and restriction of screen media by caregivers in Pakistan, such as value-infused approaches that are both tied to religious

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education, cultural enrichment, and family bonding, direct caregiver-reported practices and perceptions among caregivers with children under the age of six, indicate that counseling will take root when local priorities of caregiving activity are cons. Evidence-based strategies must include: (i) no screens one hour before bedtime; (ii) no screens in bedrooms or at dinner; (iii) expected rules rather than unpredictable withdrawals; (iv) co-watching and discussions around educational videos; (v) refraining from using devices as a primary mode of settling down upset; (vi) outdoor play, reading, and peer interactions replacing passive entertainment; and (vii) parent education in schools where safe play culture and digital literacy do not exist. The strengths of this study include:

Multidomain measurements within a single sample: emotional, language, cognitive, physical, and social domains were tested concurrently, allowing them to directly examine which domain had the greatest signal, rather than depending on independent single result investigations.

Accurate reporting in both directions: all proportions were reported with a Wilson 95% CI, and all significant relationships are reported with the effect size (Cramer's V), which is not routinely stated in the regional literature to which this study is compared (Table 8). Table 8 included clear, literature-based benchmarking so that the reader can assess the local findings in relation to the concreteness of the outer references.

Clear treatment of denominators and missingness (7 unspecified screen-time answers were returned and displayed in all relevant tables), as well as clear presentation of statistical power and multiplicity conditions (7), contribute to a calibrated, rather than exaggerated, interpretation of meaningful findings.

Concluding remarks

This statistical research study was performed to investigate the high priority digital-public-health problem in urban Pakistan – excessive screen exposure among Generation Alpha children-which was missing from most regional statistics. Multidomain measurement within a single sample: emotional, language, cognitive, physical, and social domains were tested concurrently, allowing them to directly examine which domain produced the strongest signal, as opposed to depending on independent single outcome investigations. The conclusions made from this detailed research study include:

- Accurate reporting and approximations were made in this screen time exposure study: all proportions were reported with a Wilson 95% interval, and all significant relationships are reported with the effect size (Cramer's V), which are not consistently given in the regional literature.
- This research provided strong evidence that excessive screen time has significant emotional, cognitive, and physical impacts on children. Since an optimal screentime exposure was found to enhance the cognitive skills. Therefore, digital media content can be designed and monitored to challenge children intellectually and promote critical thinking.
- It was found that moderate screen use improves cognitive performance.
- The statistical analysis from this study revealed no significant negative effect on physical or social health.
- Overall assessment of this study indicates that Excessive screen exposure demands parental guidance.

Limitations

- The cross-sectional type does not allow for causal inferences; instead, the report of relationships serves to generate hypotheses.
- Caregivers reported screen time and developmental markers, which could be influenced by recollection bias and social desirability bias.
- Convenience sampling does not generalize to the total population of youngsters in Lahore, or Pakistan in

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general.

- The questionnaire was pre-tested, but neither the official psychometric validation nor the results were reported in the source files.
- The chi-square tests were not adjusted for multiple comparisons and were not designed to estimate the prevalence. Instead, each subgroup was tested individually (§2.7). Non-significant results were considered inconclusive rather than verified null results.
- The available data were even pooled, making regression of screen-time categories to each outcome with adjustment unfeasible in this iteration.
- There were some incomplete source-table totals, including seven unreported or unidentified daily screen-time replies.
- ASD-typical and routine-related measures were not diagnostically significant and cannot be interpreted as clinical evaluations; other caregiver-reported measures of similar screen-time patterns in diagnosed neurodevelopmental disorders show significant heterogeneity in diagnosis patterns and situational context, necessitating caution in interpretation.
- The questionnaire made no distinction between direct and indirect/background media exposure in the household, but total daily screen time was recorded, which, as recent studies suggest, can make a significant difference in the type of digital exposure a young child receives.

Future work recommendations.

- Carry out longitudinal studies in Lahore and other Pakistani cities to test how the context of screens and developmental outcomes relate over time.
- Gather raw data (on an individual level), and employ multivariable regression with factors age, sex, socioeconomic status, parental education, type of school, physical activity, sleep, possession of devices, screen habits of caregivers.
- Measure the emotional regulation, language development, executive function, sleep quality, and physical activity using validated instruments.
- Separate the content on the screen into passive entertainment, short form video, gaming, social media, homework, educational applications, and co-viewed content.
- Test culturally adapted parent-education and school-nursing interventions which integrate screen limits and sleep hygiene and active-play replacement.
- Expand upon child voices and, in places where ethically appropriate, objective records or time-use diaries to minimize reporting bias.

Declarations

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