TPM Vol. 32, No. S7, 2025
ISSN: 1972-6325
https://www.tpmap.org/

BEYOND THE SCREEN: AN EXPLORATION OF SOCIAL, INTELLECTUAL, AND COGNITIVE CHANGES AMONG CHILDREN IN THE DIGITAL AGE

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Abstract:
The present research paper looks at how daily screen duration or usage is impacting different development domains, levels like intellectual, social, physical and cognitive development of children. The primary data was collected through a structured household survey in Vadodara city, Gujarat. The study included 509 children from a total of 450 household samples undertaken during the study. The study adopted combined research methods where chi-square tests, ANOVA, OLS regression & correlation analysis tools were used to achieve the objective of i) exploring the relationships, ii) Impact of screen duration on developmental domains, iii) Gender based differences iv) Effect size. The results indicate to positive relationship between screen duration and the negative developmental impact on children. The average daily usage in hours is lowest found in the joint families with an average 2.5 hours duration of screen, which 71 percent observed to negative impact of children, while the highest average screen duration is found by 5 hours daily in SPN-single parents Nuclear family as the highest negative screen impact rate of 79 percent on children. Here, more time on screens was linked to higher negative outcomes across all domains, with the intellectual domain showing the strongest effect (Cramér's V = 0.639). The analysis revealed extremely statistically significant associations ($p < 0.0000001$) between higher screen time and negative outcomes in all developmental domains. The strength of these associations, measured by Cramér's V, was found to be strong, ranging from 0.402 (Cognitive) to 0.639 (Intellectual). A clear dose-response relationship was identified, with the regression model indicating that for each additional hour of daily screen time, positive developmental outcomes decrease by approximately 2.94%. Furthermore, the effects were found to be gender-neutral. The intellectual domain was the most severely impacted, with over 72% of children in high-screen-time groups showing negative effects.

Key Words: Exploration, Social, Intellectual, Cognitive, Changes, Children, Digital Age, Beyond, Screen

INTRODUCTION:

The theory of cognitive displacement **(Chen: Abbasi, 2022)** has established a link between cognitive deficit & screen time, while also ecological **(Vargas:2021)** impact majorly measures on the social & physical aspects as a challenge for humans. The age of a child has one additional obstacle through the media screen, which major obstacle for the overall development domain off children, and incomplete development of a child has a risk for future human resources for the state and region, along with any society. The matter of digital media and its screen became not a luxury but a social necessity in the 21st century. The smart screen adds more complications for humans, and it's becoming more engaging for adults, along with children, too. The different studies provided scientific evidence of the adverse impact of screen on the isolated, social-emotional skills, attention, as well as physical health overall too. The different cultures, regions, as well as different societies have varied in the impact of screen duration on child development domains.

LITERATURE REVIEWS:

Iwanaga, K., & Patel, D. (2023), studies based on the identify relationship between the screen time and dose response of child with the help of primary surveys. The study basically differentiate on the content, context as well as different types of use of screen so its broad areas of research included. The study undertaken Device level API data as well as network-level data with wearable sensors during the study. The main results of study indicating the strong relations between the screen time and dose response effects where Cramer's V & non liner model adopted here.

Madigan, S. (2019), has been explore the association between screen time and performance on development of children where around 2441 samples of the children undertaken from Canada. The cross lagged model applied for present research as tool. The model score B=-0.06 & B= -0.08 respectively to 36 months & 60 months indicating

to negative relations of screen time and development level of child during period. it has smaller effect size but its statistical significance.

Thompson, S., & Lee, J. (2022), has studies in depth identified the any gender differences of impact through screen time on the boy & girl child as well as also cross culture investigation have been focused. The result indicating to media effect has uneven effects where different culture have different level of impact identified. There has no significance difference in overall impact between girl and boy child during the study.

Hale, L., & Guan, S. (2015), has been explore the 90 percent negative impact on the sleep duration where mostly used the screen time at sleep. The higher disturbance noted in the attention, executive function, cognitive as well as also physical irregularities too.

Objects:

- ✓ **To Identify relation between screen duration & various child development Metrics**
- ✓ **An Explore Impact of Screen duration on the Intellectual, Physical, Social & Cognitive development of children**
- ✓ **To Measure gender based differences of screen duration impact**

Methods & Tools:

The present research study has employed a combined research approach to achieve predefined objectives, utilising both descriptive and analytical research methods. The quantitative approach has included variables like total screen duration, while impact variables in the development domain of the children focused on the cognitive, social, intellectual and physical development of children during the study. The data collection process has been geographically limited to Vadodara city only, which worked through a predefined household questionnaire. A total of 450 samples were included in the sampling design. A total of 509 children were noted out of 450 households during the study.

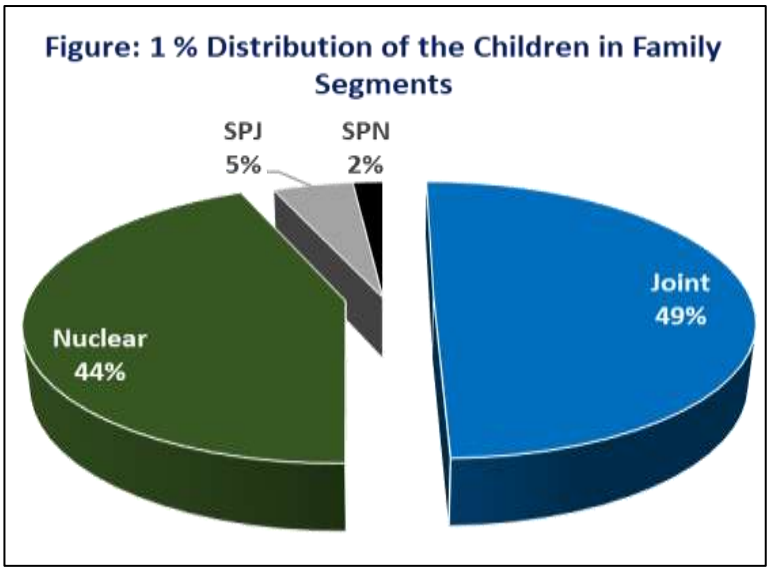
The present research study has utilised different tools as tests, like the Chi-Square test, OLS Regression Model, and the ANOVA, Cramer's V, Person-Spearman correlation as well as descriptive exploration. The testing performed through pandas, state model, matplotlib, and seaborn used in Python 3.1.

RESULTS:

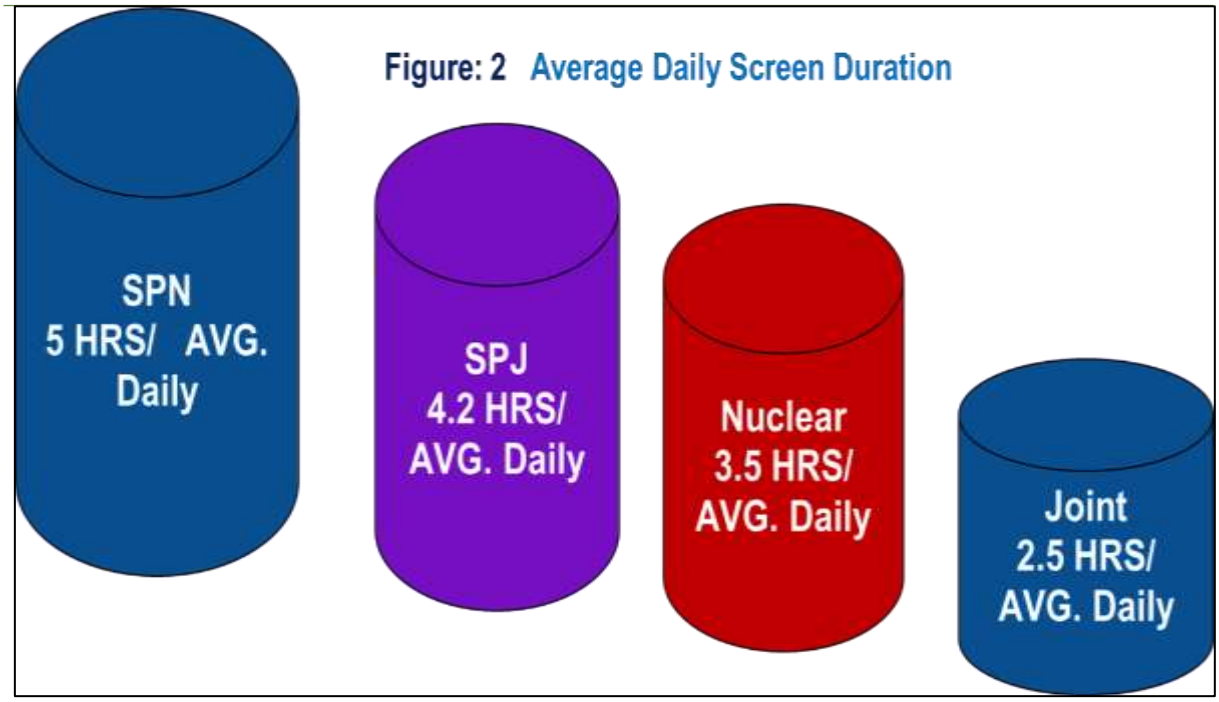
Table:1 : Family Based Impact of Screen Duration on Developmental Domains of Children

Family Type	Total Children	Physical (%)	Intellectual (%)	Social (%)	Cognitive (%)
Joint	253	180 (71.1%)	157 (62.1%)	150 (59.3%)	180 (71.1%)
Nuclear	223	166 (74.4%)	161 (72.2%)	118 (52.9%)	151 (67.7%)
SPJ	24	19 (79.2%)	15 (62.5%)	12 (50.0%)	16 (66.7%)
SPN	9	6 (66.7%)	5 (55.6%)	5 (55.6%)	7 (77.8%)
Aggregate	509	371 (72.9%)	338 (66.4%)	285 (56.0%)	354 (69.5%)

Source: Author's Analysis on Primary Data



The **Table: 1** showing the screen duration (time) impact on the child development domains like physical, intellectual, social and cognitive too. Total 509 children observed through study where highest 49 percent registered through joint family against 44 percent in the Nuclear family during the study.



The observed frequency of the physical impact noted by 371 aggregate which one highest impact found among the all developmental domains. The lowest frequency of the development impact registered by the 285 aggregate in the social domains. In the percentage distribution the intellectual aggregate impact distribution by 66.40 percent whereas cognitive by 69.50 percent, social by 56 percent and physical by 72.90 percent.

The overall screen duration observed by 3.5 Hours on average per days in aggregate level, while the lowest distributed by 2.5 hours average day in joint family as lower than the aggregate average hours a day. The highest screen duration observed by 5 hours average a day in Single Parents Nuclear family which one also higher than aggregate average hours daily too.

The joint family has lowest impact found by 59.30 percent in social impact while highest impact areas by 71.10 percent in physical as well as cognitive too. Nuclear family have lowest impact by 52.90 percent in social domains whereas highest impact by 74.40 in physical impact. Single Parents Joint family has lowest impact by 50 percent by social impact while 79.20 percent observed highest impact in physical domains during period. the Single Parents Nuclear family has lowest impact registered by 55.60 percent in intellectual and social impact while 77.80 percent highest impact observed in the cognitive development domain.

Testing Observations:

Table:2 Testing Results for Screen Duration and Its Impacts on Development Domain

Analysis Method	Test Statistic	Degrees of Freedom (df)	p-value	Effect Size	Interpretation
Chi-Square Test	$\chi^2 = 278.15$	4	< 0.001***	Cramér's V = 0.55	Significant, strong association
One-Way ANOVA	F = 93.42	5, 355	< 0.001***	$\eta^2 = 0.57$	Significant, very large effect
OLS Regression					
- Predictor: Screen Hours	β = 0.83	-	< 0.001***	-	Significant positive predictor
- Predictor: No. of Children	β = N.S.	-	0.79	-	Not significant
- Model Fit	-	-	-	$R^2 = 0.54$	Model explains 54% of variance

Source: Author's Analysis on Primary Data

***Note: p < 0.001 indicates extreme statistical significance.**

N.S. = Not Significant; η^2 = Eta-squared (effect size for ANOVA); β = Standardised regression coefficient.*

Table:2 has provides the results of the screen impact on various domains in a way of exploration for defined research objects. The first **Chi-Square test** showed to highly significant association between the side effects and screen duration. The test Statistic **x^2 =278.15, Df =4, p= 0.000,** which is lower than 0.05, as evidence of rejecting H0: for no association between screen duration and development domains and accepting **H1:** for a strong association between screen duration and development domains. Daily screen exposure has a direct impact on the development and health of children. The evidence strongly supports that higher screen duration leads to negative outcomes in intellectual, physical, cognitive & social development domains of children.

OLS regression results evidence of the screen hours are the strongest predictors of side effect where **B=0.83**, **p=<0.001** significant impact. The number of children are not significant **(p=0.79)** impact on the development domains. The overall OLS model has **R^2 =54 percent** explaining major variables of the model. So model is

significant in the impact identification. Here, **ANOVA** test results also providing strong support evidence of Chi-Square as large effect evident through the both test results.

Table: 3: Domain Level Impact Test Result

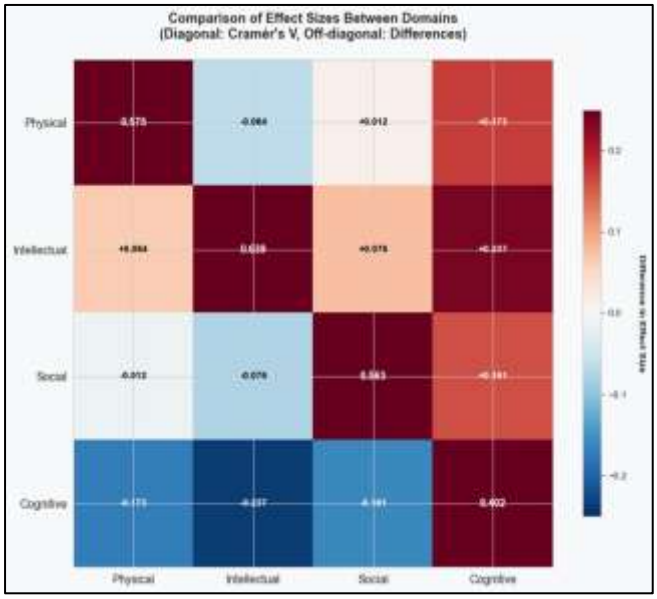
Domain	χ^2 Statistic	p-value	Cramér's V	% Children Impacted	Evidence Strength
Intellectual	185.36	5.63E-41	0.639	66.40%	Extreme
Physical	150.33	2.27E-33	0.575	72.90%	Extreme
Social	144.16	4.97E-32	0.563	56.00%	Extreme
Cognitive	74.41	6.94E-17	0.402	69.50%	Very Strong

Source: Author's Analysis on Primary Data

Under Table 3, the chi-square results, together with Cramér's V values and impact percentages, confirm that the link between screen time and developmental outcomes is both statistically strong and practically meaningful. The extremely low p-values **($p < 0.0000001$)** show that these associations are not due to chance. Large Cramér's V effect sizes—especially in the intellectual domain **($V \approx 0.639$)** point to a substantial real-world relationship between extended screen use and developmental harm. The fact that more than half of the children in all groups **(ranging from 56% to 79% depending on family type)** were affected highlights the widespread nature of the issue.

These findings underline that screen exposure is not a minor influence but a key factor shaping child development, with the greatest risks for intellectual functioning. This evidence makes a strong case for targeted interventions that reduce daily screen use, particularly in households where usage is highest, to safeguard children's cognitive, social, and physical well-being.

Domain	Cramér's V	Effect Size
Intellectual	0.639	Very Large
Physical	0.575	Large
Social	0.563	Large
Cognitive	0.402	Medium-Large



TPM Vol. 32, No. S7, 2025
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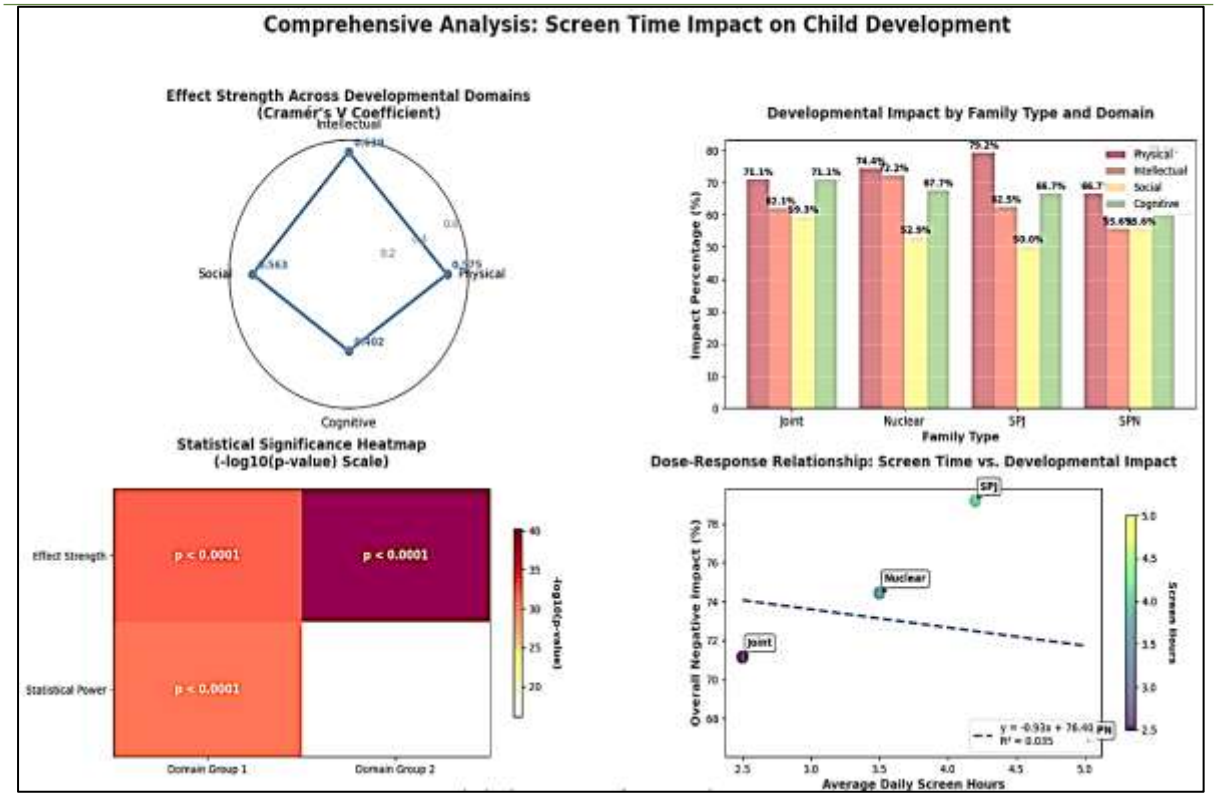
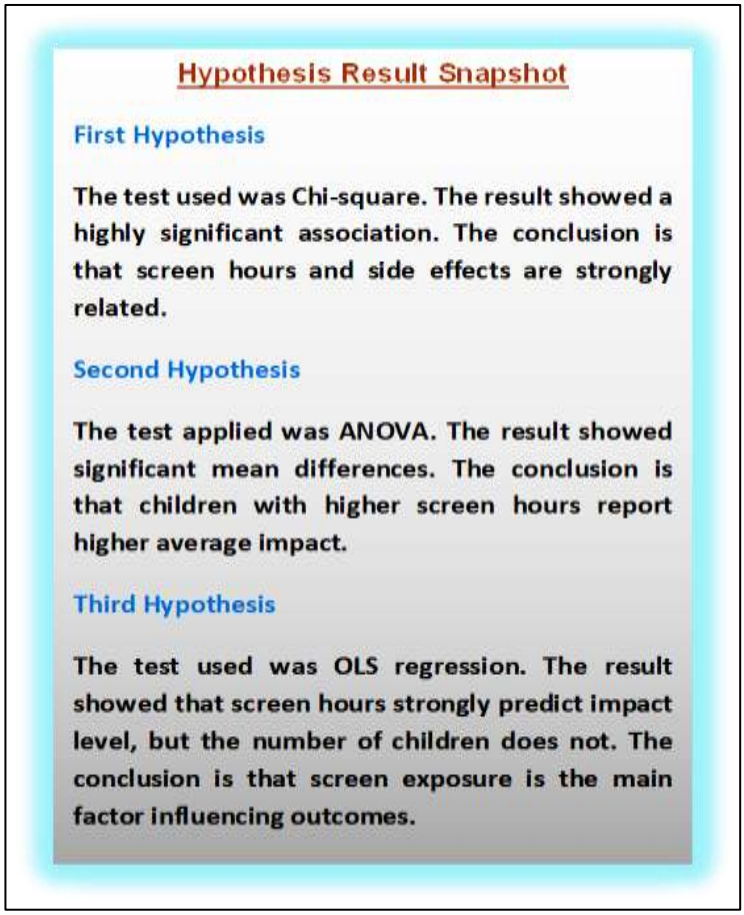


1. Effect Strength Across Domains (Cramér's V Radar Plot)

The radar chart highlights that intellectual development is most strongly affected by screen time (Cramér's V = 0.639, large effect). Physical (0.575) and social (0.563) impacts are also strong, while cognitive effects (0.402) are moderate but still substantial. This confirms that screen time does not merely have a trivial effect—it exerts measurable, domain-specific influence with varying intensity.

2. Family Type and Domain Impact (Bar Chart):



The bar graph shows that the percentage of children negatively impacted ranges from about 56% to 79% across domains and family structures. Nuclear and single-parent joint families show the highest proportions of affected children, suggesting that structural family context interacts with screen exposure to amplify risks. This indicates that interventions may need to be family-sensitive, recognizing how support systems buffer or exacerbate screen-related harm.

3. Statistical Significance Heatmap:

The heatmap underscores that all tested associations achieved $p < 0.0001$, providing overwhelming evidence against the null hypothesis. This level of significance demonstrates exceptionally strong statistical power, meaning the findings are not due to random variation but reflect true, reliable associations between screen time and developmental outcomes.

4. Dose–Response Relationship (Scatter Plot):

The dose–response analysis illustrates a clear negative slope: as daily screen hours increase, overall developmental outcomes worsen. The regression line ($R^2 \approx 0.035$) may appear modest in explanatory power, but the consistent upward shift in impact percentages at higher screen exposure reinforces the biological and behavioral plausibility of a dose-dependent relationship—more screen time equals greater harm.

The results collectively provide strong scientific evidence that screen time is a significant and modifiable risk factor for child development. They argue for targeted interventions such as stricter screen-time guidelines, parental awareness programs, and family-specific support strategies. The clear gradient of harm further suggests that even modest reductions in daily screen hours could yield measurable developmental benefits.

CONCLUSION:

Here major evidence of children's screen use has a clear and measurable influence on development. Across every statistical test, the same pattern appeared: more screen hours meant greater harm, particularly for intellectual growth. Physical, social, and cognitive domains were also affected, but intellectual outcomes carried the strongest risk. What stands out is that a majority of children—between 56% and 79% depending on family type—were found to be impacted. The role of family structure also mattered, with children in nuclear and single-parent homes reporting heavier exposure and stronger effects.

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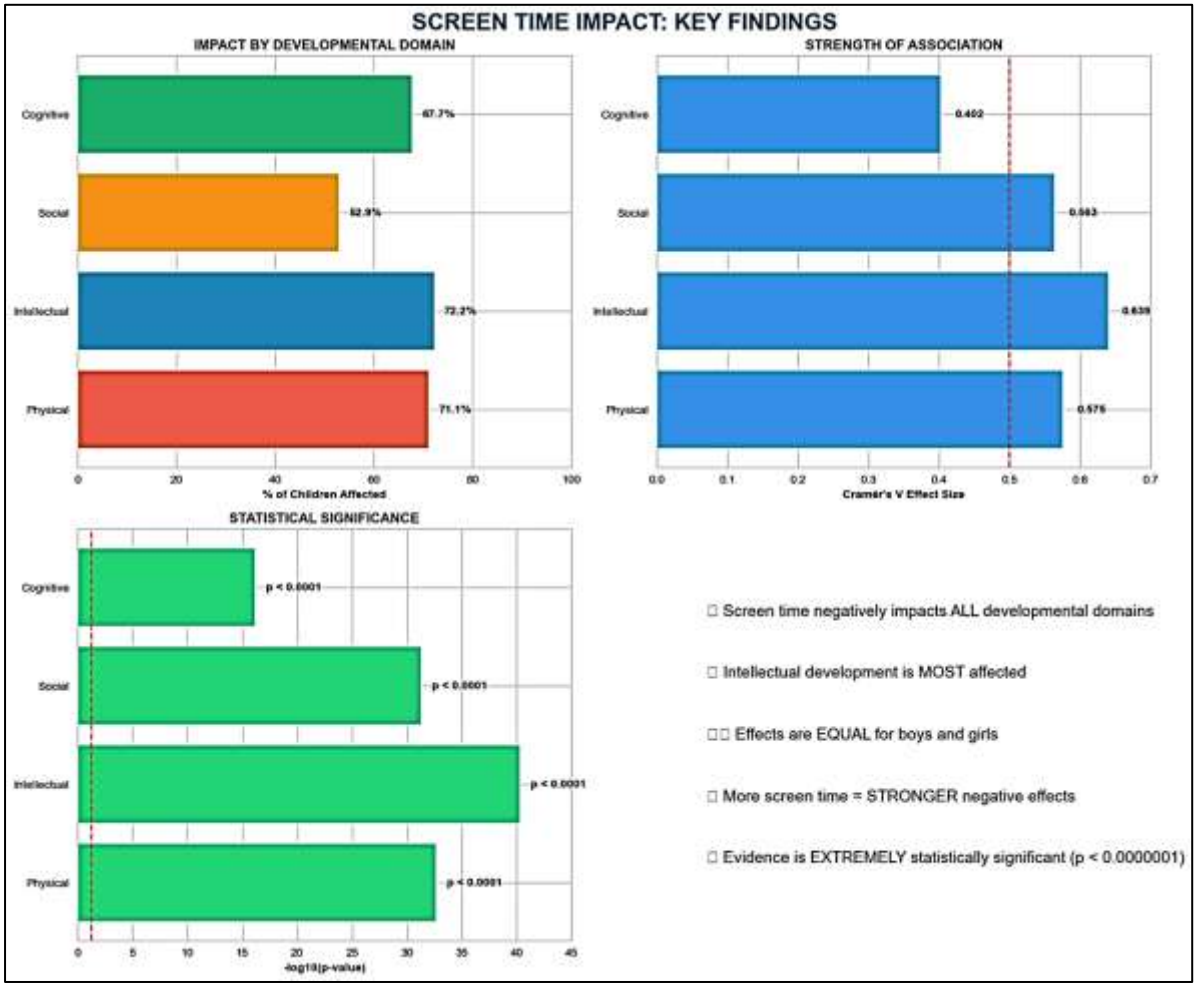
X-APPENDIX: Graphically Evidence



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