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RESEARCH ARTICLE

ASSOCIATION OF SCREEN TIME AND PHYSICAL ACTIVITY WITH INFORMATION PROCESSING SPEED AMONG SCHOOL GOING EARLY ADOLESCENTS IN SOUTH INDIA

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Abstract

Background and Objectives: Excessive use of smartphones and computers among adolescents together with less physical activity is a major public health concern as it has shown to produce attention difficulties, decreased academic performance and various health issues. This study aims to identify the relationship among screen time, physical activity and cognitive function of adolescents.

Materials & Methods: This was a cross sectional study done on students between the age of 10 and 14years of one government and one private school in Trivandrum corporation Kerala.Information processing speed was assessed using Digit Letter Substitution Tests (DLST).Physical Activity was measured using the Youth Physical Activity Questionnaire (YPAQ). Screen time in the study included watching television, playing video games, and using smartphones, tablet devices, desktop, and laptop.

Results:147 students participated in the study. Screen time was high across all groups in the study, only 9.5 % of the study group had optimum screen time of 2 hours as recommended by WHO but this group had significantly higher information processing speed.57.1% of adolescents in the study group had adequate physical activity and this group of students had significantly higher DLST score compared to those with low physical activity.

Interpretation & Conclusions: The findings of the study could serve as a reliable indicator on the harmfulness of screen time and sedentary lifestyle on cognitive function of young adolescents. This can also help to implement a school-based monitoring on unhealthy life styles and interventions for intellectual development of adolescents in Kerala.

Introduction:-

Last few decades witnessed rapid evolution of technology which made digital communication an essential part of an adolescent's life. Adolescents are provided with smartphones at a very young age for education and entertainment without any limit to their use. These gadgets while increasing the access to knowledge inhibits the ability of a child to think and process the information.The American Academy of Pediatrics (AAP) recommends limits on screen-based media, citing health risks with excessive and inappropriate use[1]. Excessive use of smartphones and computers together with less physical activity is a major public health concern as it has shown to produce attention difficulties, decreased academic performance and various health issues. Increasing physical fitness is known to be associated with better cognitive skills including attention, memory and reaction time resulting in better academic

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performance. WHO developed the "Global Recommendations on Physical Activity for Health" which recommends 60 minutes physical activity daily for the age group 5–17 year[2].

Measurement of information processing speed is one of the most sensitive and robust markers of cognitive testing[3]. Information processing requires various cognitive skills and slowing of information processing speed indirectly suggests attention defects, delay in visual reaction and longer psychomotor performance time. It is measured by timed tests which measure number of items correctly answered in a specific time. It evaluates attention span, vigilance, visual scanning and psychomotor ability of the individual. Digit Letter Substitution Tests (DLST) is a popular assessment tool for information processing speed in various clinical and research settings. DLST is easy to administer in a less amount of time . It measures response speed, sustained attention, visiospacial skills and psychomotor ability. Van der Elstetal has established regression based normative data for school children aged between 8 to 15 years[4]. DLST tool has also been validated in Indian setting and normative data for DLST for girls and boys of age 9-16 years has been established earlier[5]. This study was done toassess the association between information processing speed assessed by DLST test with physical activity and screen time among school going early adolescents. The study also estimated the proportion of students who met the WHO recommended levels of physical activity and the average screen time per day in this sample population

Materials And Method:-

Study design and participants

This was a **c**ross-sectional study done on students studying in one government and one private school in Trivandrum corporation in the southern state of Kerala, India.Students between the age of 10 and 14 as per WHO definition of young adolescents and who have not repeated a year were included in the study. Students who are not willing to participate in the study, those with medical or neurological conditions which can affect their cognitive function like epilepsy, history of learning disability, those on medications which can affect their cognitive function were excluded from the study

Data collection and measurements

Sample size was determined after performing a pilot study among 20 students. Minimum sample size calculated for the study was 145. Samples were selected using multistage cluster sampling method. The invitation to participate in the study was sent to all parents of children of the selected division of the school. Informed consent was obtained from the consenting parents and the students were included in the study. The students were called in small groups with adequate social distancing and following all COVID Protocols the DLST test was given. The YPAQ proforma and details of screen time was collected from the students and telephonically verified from the parents. The demographic details such as age and gender and level of parental education were documented.

DLST work sheet

The instrument used for Digit-Letter Substitution Task (DLST) consists of a worksheet, which has 8 rows and 12 columns and randomly arranged digits in rows and columns. It has a substitution key on the top of the page. The substitution key shows the numbers 1 – 9, each of which are paired with different letter. The test item consists of digits which the child should substitute with the appropriate letters in the blank space under the letters. The students were asked to substitute as many target letters as possible in the specified time of 90 seconds. The test is scored giving one point to the correct response and one negative point to wrong substitution.

The YPAQ proforma

The YPAQ proforma measures the type of physical activity, its duration and frequency over the last seven days. It also measures the duration spend on sedentary activities in the past week. It is a self-reported questionnaire and covers four areas of physical activities- sports activities, leisure time physical activities, activities in school including physical education classes, other activities which includes sedentary activities such as watching television, using mobile phones, playing video games, doing home work. The student has to report the duration and frequency of each of the activity during week days and week ends for the past 7 days.Level of Moderate to Vigorous physical activity assessed with YPAQ was categorized into two: Those who met the current WHO recommended level of 60 minutes of MVPA per day for adolescents were categorized as "adequate" and those who did not meet the recommended levels were categorized as "low".

Screen time:
Screen time in the study would include watching television, playing video games, and using smartphones, tablet devices, desktop, and laptop. Total screen time in hours per day was calculated as the average time spend on the following screen activities – Smart phone usage (for study and entertainment), video games, watching television, computer. Total hours of screen time for the last one week were documented and average daily screen time was calculated. As recommended by the American Academy of Pediatrics (AAP) and World Health Organization (WHO) in children between 10-14 years the maximum permissible screen time is 2 hours. Daily screen time more than 2 hours was taken as high and less than 2 hours as optimal.

Ethical Considerations:
The study was done with clearance from the Institutional Ethics committee. Written informed consent was obtained from the participants before administering the study tools.

Statistical analysis
Categorical and quantitative variables were expressed as frequency (percentage) and mean ± SD respectively. Prevalence of above average DLST was expressed using 95 % Confidence Interval. Chi-square test was used to find association between above average DLST and selected variables. For all statistical interpretations, $p<0.05$ was considered the threshold for statistical significance. Statistical analyses was performed by using a statistical software package SPSS, version 20.0

Results:-
147 students participated in the study.42.2 % students belonged to the age group 10-12 years and 57.8% belonged to the age group 13-14 years. There were 85 girls and 52 boys in the sample studied. 57.1% students were studying in classes 5-7 and 42.9% in classes 8-10. 46.3% students were studying in Government school and 53.7% in private school.Only 4.76% had low level of parental education which was lower secondary or less.

DLST score
DLST percentile score was calculated for the population using the tool by W. Van der Elst et al for school aged children. Percentile score above 90 was considered above average and less than 50 was considered below average.Above average DLST score was seen in 27.9%. 93 students (63.3%) had average DLST score which was percentile value between 50-90.

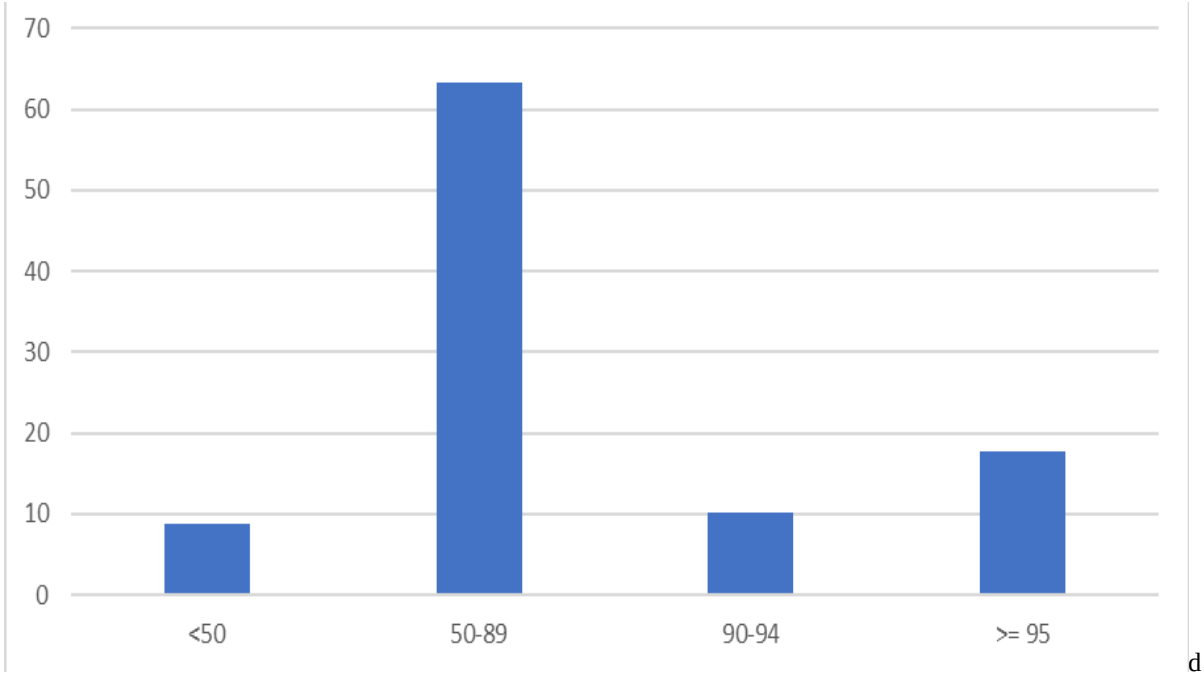

Fig 1:- Percentile distribution of the sample based on DLST score.

Relationship of above average DLST score with other variables

Table 1 shows the relation of above average DLST score with age, gender, class studied and type of school. In the cohort with above average DLST score gender was a were significant factor with more males than females. Other variables studied were not statistically significant

Table 1:- Association of Above average DLST with selected variables.

		Above average DLST				χ^2	p
		No		Yes			
		Count	Percent	Count	Percent		
Age	10 - 12	45	72.6	17	27.4	0.01	0.913
	13 - 14	61	62.9	23	37.1		
Sex	Male	67	78.8	24	28.2	4.52*	0.034
	Female	39	78.8	18	21.2		
Class	5 - 7	45	71.4	18	28.6	0.03	0.873
	8 - 10	61	72.6	23	27.4		
Type of school	Govt	53	77.9	15	22.1	2.14	0.143
	Pvt	53	67.1	26	32.9		

*: - Significant at 0.05 level

Physical activity

56.5% boys and 57.6% girls met the Physical activity guidelines. In the age group 10-12, 54.8% and in the age group 13-14, 58.8% had adequate physical activity. In students from government school 54.4% had adequate physical activity while in those from private schools 59.5% had adequate activity. These differences were not statistically significant(Table2)

Table 2:- Association of physical activity with selected variables.

		Low		Adequate		χ^2	p
		Count	Percent	Count	Percent		
Age	10 - 12	28	45.2	34	54.8	0.23	0.630
	13 - 14	35	41.2	50	58.8		
Sex	Male	27	43.5	35	56.5	0.02	0.885
	Female	36	42.4	49	57.6		
Class	5 - 7	27	42.9	36	57.1	0	1.000
	8 - 10	36	42.9	48	57.1		
Type of school	Govt	31	45.6	37	54.4	0.39	0.535
	Pvt	32	40.5	47	59.5		

Screen time

The average screen time of the study group calculated was 5.2 ± 2.3 hours per day. The study showed only 9.5% of adolescents had optimal screen time while 90.5% did not meet the screen time recommendations.

Association of screen time with other variables:

Screen time was high across all groups in the study. In 13-14 year age group only 8.2% had optimum screen time while in 10-12 age group 11.3% had optimal screen time. 14.5% boys and 5.9% girls had optimal screen time. 13.2% in government schools and 6.3% in private schools had optimal screen time. The differences were not statistically significant (table 3).

Table 3:- Association of screen time with selected variables.

		Optimum		High		χ^2	p
		Count	Percent	Count	Percent		
Age	10 - 12	7	11.3	55	88.7	0.39	0.533
	13 - 14	7	8.2	78	91.8		
Sex	Male	9	14.5	53	85.5	3.1	0.078
	Female	5	5.9	80	94.1		
Class	5 - 7	7	11.1	56	88.9	0.32	0.570

	8 - 10	7	8.3	77	91.7		
Type of school	Govt	9	13.2	59	86.8	2.02	0.155
	Pvt	5	6.3	74	93.7		

Association of Screen time and Physical activity with DLST score

The association of screen time and physical activity with above average DLST score was studied. 38.1% with adequate physical activity had above average DLST score. 57.1% with optimum screen time had above average DLST score.There was statistically significant difference in those with adequate physical activity and optimal screen time with above average DLST score.

Table 4:- Association of physical activity and screen time with DLST.

		Above average DLST				χ^2	p
		No		Yes			
		Count	Percent	Count	Percent		
Physical activity	Low	54	85.7	9	14.3	10.15**	0.001
	Adequate	52	61.9	32	38.1		
Screen time	Optimum	6	42.9	8	57.1	6.58*	0.010
	High	100	75.2	33	24.8		

**: - Significant at 0.01 level, *: - Significant at 0.05 level

Discussion:-

In this cross-sectional study of adolescents from 10-14 years we found that above average DLST score was significantly higher in those who had adequate physical activity and optimal screen time. 57.1% of adolescents in the study group had adequate physical activity as per current WHO guidelines. This group of students had significantly higher DLST score compared to those with low physical activity. Thus, the study results show that adequate physical activity is associated with high information processing speed.

Our findings are consistent with previous research results. Saunders et al in a systematic review of children and youth aged 5-20 years found that physical inactivity and sedentary behavior are highly prevalent among adolescents and achieving adequate amounts of daily physical activity and limiting exposure to sedentary behaviors such as screen time are both critical in maintaining desirable health indicators[6]. Poitras et al in a systematic review identified eight studies which examined the relationships between physical activity and cognition and found a favorable relationship between physical activity and academic achievement in adolescents[7]. In a study by Vera van den Berg in 195 students aged 10-15 years which the same DLST tool was used as in our study to assess cognitive function had contrasting result. They found that cognitive performance was not affected by acute exercise concluding that only consistent physical activity alone can improve cognitive function[8].

In this study 27.9% had above average DLST score. In the cohort with above average DLST there were significantly higher number of boys than girls. Age, class studied did not affect the DLST score In a similar study by Dekker et al on three hundred and six healthy adolescents aged 13 and 15 using the same DLST tool found that 29.6% had above average score and in contrast to our study they found that 25% best-performing students comprised twice as many girls as boys[9]. Dekker et al also found that the score improved in girls as their age increased. The difference noted in our study could have been because of younger population studied as 42% of our cohort was less than 13 years.

The average screen time of the study group was 5.2 hours per day which was considerably higher than the recommended standard of 2 hours per day. 90.5% of the study population did not meet the recommended standard of optimum screen time. This was probably because the study was conducted at the end of first wave of COVID pandemic. As a result of public health measures enforced by governments to curb the pandemic children had to stay at home and education was also continued online which lead to considerably increased time spend on digital media. The hazards of excessive screen time has been well documented in literature. Addiction on digital media leading to poor academic performance and social issues were highlighted in the study by Love et al[10].

Although only 9.5% of study group met the optimum screen time standards, they had a significantly higher DLST score highlighting the fact that excess screen time might be detrimental to the adolescent brain. Studies conducted during the COVID pandemic showed the association of increased screen time with altered emotional state and

behaviour of children. In a study published from Australia the pandemic has severely restricted physical activity, increased social media use and increased screen time[11]. Data from the land mark ABCD (Adolescent Brain Cognitive Development) study has shown that children who spent more than two hours a day on screen-time activities had worse mental health, increased behavioral problems, decreased academic performance, and poorer sleep compared to their peers [12].

Thus, the present study highlights the need for increasing physical activity and reducing screen time to improve the cognitive function of adolescents. With the new trends in continuing education online the present study may have relevance in showing the poor cognitive function with increased screen use.

Conclusion:-

COVID pandemic leading on to school closures indirectly affected children by increasing their screen time and reducing time spend on physical activity. This is probably one of the first studies conducted in India after the pandemic evaluating the effects of reduced physical activity and increased screen time on information processing speed. Screen time was higher across the study group. Information processing speed assessed with DLST test score was significantly higher in adolescents with adequate physical activity and optimum screen time. The findings of the study could serve as a reliable indicator on the harmfulness of screen time and sedentary lifestyle on cognitive function of young adolescents

Conflict of Interest:-
Nil.

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