ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

DOI: 10.5336/pediatr.2024-101303

Relationship Between Screen Time with Posture and Motor Coordination in Childhood: A Descriptive Study

Çocukluk Döneminde Ekran Süresinin Postür ve Motor Koordinasyon ile İlişkisi: Tanımlayıcı Bir Çalışma

Nihal PEKPAK[a], Turgay ALTUNALAN[b]

[a]Üsküdar University Faculty of Health Science, Department of Physiotherapy and Rehabilitation, İstanbul, Türkiye
[b]Karadeniz Technical University Faculty of Health Science, Department of Physiotherapy and Rehabilitation, Trabzon, Türkiye

This study was prepared based on the findings of Nihal PEKPAK's master thesis study titled "Examination of effects of screen usage time on body posture and movement skills in children" (İstanbul: Üsküdar University; 2022).

ABSTRACT Objective: The use of technology is increasing, and its impact on health is gaining importance. This study aimed to examine the use of technology in school-age children and investigate the relationship between posture and motor skills. **Material and Methods:** The cross-sectional and correlational research model sample comprised 116 typically developing children aged 6-14 years. The study employed the socio-demographic information form, New York Posture Rating Chart (NYPR), and Developmental Coordination Disorder Questionnaire. Median, quartiles, and Spearman correlation analyses were used as the data did not follow a normal distribution. **Results:** The study included 116 children, with a mean age of 10.66±2.73 years (range: 6-14 years), of whom 66 (56.9%) were boys and 50 (43.1%) were girls. Children commonly own televisions, smartphones, or tablets. The median daily usage time for these devices was 100 min for televisions and tablets and 60 min for smartphones. The median total daily screen usage time was 300 min. The study found a moderate negative correlation (p<0.001, r=-482) between total daily screen usage time and posture score, as well as a weak negative correlation (p=0.020, r=-215) with motor coordination. **Conclusion:** The use of screen-based technological devices in childhood is increasing. The children's posture and motor coordination scores worsened with increasing daily screen exposure. Approaches that reduce childhood screen time and improve physical activity may protect postural and motor coordination.

Keywords: Posture; motor activity; screen time; schools

ÖZET Amaç: Teknoloji kullanım yaşı giderek düşmektedir ve sağlık üzerine etkisinin önemi artmaktadır. Çalışmanın amacı, okul çağındaki çocuklarda teknoloji kullanımını incelemek, duruş ve motor koordinasyon arasındaki ilişkiyi araştırmaktır. **Gereç ve Yöntemler:** Kesitsel ve ilişki arama modeliyle yürütülen bu çalışmanın örneklemini 6-14 yaş arasında tipik gelişim gösteren 116 çocuk oluşturmaktadır. Veri toplama araçları olarak sosyodemografik bilgi formu, New York Postür Skalası ve Gelişimsel Koordinasyon Bozukluğu Anketi kullanıldı. Veriler normal dağılıma uygun olmadığı için analizlerde medyan, çeyreklikler ve Spearman korelasyon analizi kullanıldı. **Bulgular:** Çalışmaya dâhil edilen çocukların yaş ortalaması 10,66±2,73 (6-14 yaş arasında) ve 66'sı (%56,9) erkek, 50'si (%43,1) kızdır. Çocuklar en sık televizyon, akıllı telefon ve tablete sahiptir. Bu cihazların günlük ortanca kullanım süresi televizyon ve tablet için 100 dk, akıllı telefon için ise 60 dk'dır. Günlük toplam ekran kullanım süresinin ortanca değeri 300 dk'dır. Çalışmada günlük toplam ekran kullanım süresi ile postür skoru arasında orta düzeyde negatif bir korelasyonun (p<0,001, r=-482) yanı sıra motor koordinasyon ile zayıf bir negatif korelasyon (p=0,020 r=-215) bulundu. **Sonuç:** Çocukluk çağında ekran temelli teknolojik cihaz kullanım süreleri gittikçe artmaktadır. Günlük ekran maruziyeti arttıkça çocukların postür skorları ve motor koordinasyon becerileri kötüleşmektedir. Çocukluk çağı ekran kullanımını azaltıcı ve fiziksel aktiviteyi artırıcı yaklaşımların postür ve motor koordinasyon açısından koruyucu olabileceği düşünülmektedir.

Anahtar Kelimeler: Postür; motor aktivite; ekran süresi; okullar

TO CITE THIS ARTICLE:
Pekpak N, Altunalan T. Relationship between screen time with posture and motor coordination in childhood: A descriptive study. Turkiye Klinikleri J Pediatr. 2024;33(2):41-7.

Correspondence: Nihal PEKPAK
Üsküdar University Faculty of Health Science, Department of Physiotherapy and Rehabilitation, İstanbul, Türkiye
E-mail: nihal_pek@outlook.com

Peer review under responsibility of Turkiye Klinikleri Journal of Pediatrics.

Received: 05 Feb 2024 ***Received in revised form:*** 25 Mar 2024 ***Accepted:*** 01 Apr 2024 ***Available online:*** 18 Apr 2024

Screen time (ST) is the total time an individual spends viewing or using any digital device, such as a television, smartphone, tablet, computer, or game console. Screen-based technologies are widely used at a very early age. While some advantages of high quality and engaging ST have been demonstrated, excessive ST is linked to several adverse physical, behavioral, and cognitive outcomes.[1,2] Despite the recommended average ST of 20 to 60 minutes, the 8-12 age group has an average daily ST of over 4.5 hours, while the 13-18 age group exceeds 6.5 hours.[3,4] Excessive ST is adversely associated with sleep, body weight, cardiometabolic risk, health fitness, emotional health, and health-related quality of life.[5] The early and widespread use of technology has led to an increase in sedentary lifestyles from an early age. The guidelines suggest that children between the ages of 6 and 14 years should engage in appropriate activities, offer a range of options, and keep them entertained.[6] It recommends moderate-to-vigorous intensity aerobic physical activity for 60-90 minutes or more per day per week to improve cardiorespiratory fitness.[7] Excessive screen users did an average of 22 min less moderate-to-vigorous physical activity per day and 150 min more sedentary time on weekends than non-screen users.[8] The increasing use of technology among children leads to prolonged periods spent in a fixed posture and decreased motor experience.[9] Prolonged periods in a fixed position can have a detrimental effect on the alignment of the musculoskeletal system. One of the musculoskeletal problems negatively affected by technology is atypical posture.[10]

Posture is the position, order, or arrangement of parts of the human body relative to each other. Good posture is the balanced and proper arrangement of skeletal system elements that protects the body's support structures from injury and deformation. Motor habits shape human physical posture based on a specified morphological and functional background. Childhood experiences are significant for healthy posture development. Changes in posture are most common during school age because of their speed of growth and development.[11] This makes screen use among school-aged children even more important. The increased use of technology has a negative impact on children's physical health, leading to changes in posture, and musculoskeletal discomfort. Prolonged use of a digital screen causes excessive flexion of the neck.[12] Additionally, it triggers unnecessary muscle contractions and compensation mechanisms. This change has a negative impact on the biomechanical functions of the muscles.[13] Long-term atypical biomechanical functions can cause permanent postural dysfunction.

The increased use of technology reduces physical activity and increases sedentary behavior. The acquisition and mastery of motor skills in children occur through active experience.[14] Prolonged sitting may cause children to spend their free time more passively, thus limiting play opportunities that require body movements. It is well known that excessive ST has a negative impact on development from infancy.[15]

Childhood postural problems tend to get worsen with age. However, the age at which technological devices are used has gradually decreased. This early screen exposure increases the risk of postural problems in school-aged children. This study aimed to examine the use of technology in school-aged children and to investigate the relationship between posture and motor skills. In this study, we hypothesized that posture and motor skill disorders would increase as the duration of screen technology use increaseds.

MATERIAL AND METHODS

STUDY POPULATION

This study was conducted among children aged 6-14 years with digital screen use and their parents in Ümraniye district of Istanbul. A total of 130 children were enrolled between January and April 2022. Children with neurological, genetic, and metabolic diagnoses were excluded (n=14). The study included 116 children who met the inclusion criteria. Participants were invited to participate via social media calls and flyers. Measurements were performed at Büyük Çamlıca Kuvars Special Education and Rehabilitation Centre.

This study was approved by the Üsküdar University Non-Interventional Research Ethics Committee on (date: December 30, 2021, no: 613511242/December

2021-40). The study was conducted in accordance the Declaration of Helsinki. All participants, including parents and children, were informed of the study and provided their consent before participation.

DATA COLLECTION

Data were collected using the socio-demographic form, New York Posture Rating Chart (NYPR), and Developmental Coordination Disorder Questionnaire (DCDQ). The parents completed the demographic information form and the DCDQ.

The socio-demographic form inquired about the children's age, height, weight, health-related background, and economic status of the parents. The study recorded children's daily screen usage time, including the type of technological device (such as mobile phones, game consoles, computers, and tablets), duration of everyday use, and the age of start to use technological devices from parental reports.

NEW YORK POSTURE RATING CHART (NYPR)

The NYPR assesses the static posture of children. The NYPR is a measurement tool that evaluates 13 different parts of the body from the side and back during static postures. Body posture is assessed from the side view, considering the alignment of the neck, chest, shoulders, back, trunk, abdomen, and waist. From the back, the head, shoulders, spine, hips, and arch of the feet are assessed. A visual graph is used for scoring. Five points are scored for good posture in the correct position, three points for mild deformity, and one point for significant deformity. The test produces a total score ranging from 13 to 65 points, with higher scores indicating good posture.[16] This scale is commonly used in research on childhood postures.[10,17]

DCDQ

The DCDQ assesses the motor coordination skills of children aged 5-15 years. The DCDQ is a standardized assessment tool for evaluating motor performance and function in children's daily activities. The questionnaire comprises three sub-parameters: control during movement, fine motor/handwriting, and general coordination. The DCDQ is a 15-item questionnaire that was developed as a rapid motor assessment tool. It has high internal consistency, with a Cronbach's alpha of 0.94, sensitivity of 85%, and specificity of 71%.[18] The scale ranges from a minimum score of 15 to a maximum score of 75. A higher score indicates better motor coordination. A Turkish validation study of the test was conducted by Yildirim et al in 2019.[19]

STATISTICAL ANALYSIS

Power analysis, it was used to calculate a minimum of 82 with a power of 0.80 at an effect level of 0.5 and a 95% confidence interval. Considering the possibility of missing data, 116 children were included in the study.

Data were analyzed using IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp. IBM Corp. Released 2019 package. Data were defined using numerical values, percentages, and mean values with standard deviations. The normal distribution of continuous variables was assessed using the Kolmogorov-Smirnov test. Spearman's correlation was used to evaluate the relationship between ST, posture, and motor coordination. Statistically significance was set at $p<0.05$. The magnitude of correlation of coefficient was accepted if it was ranged 0.00 to 0.09 negligible correlation, 0.1 to 0.39 weak correlation, 0.40 to 0.69 moderate correlation, 0.70 to 0.89 moderate correlation, 0.90 to 1 very strong correlation.

RESULTS

The study included 116 children aged between 6 and 14 years; 66 (56.9%) boys and 50 (43.1%) girls. Of the children, 27% participated in regular sports, such as basketball, football, and gymnastics. Around 43% of children used screens for one hour a day before the age of two (Table 1).

Children had access to televisions, smartphones, and tablets (88%, 81%, and 74%, respectively). The median daily usage of television and tablets was 100 min each. Children's total daily usage time ranged from 0 to 615 min, with a median value of 300 (180-300) minutes (Table 2). There was a significant negative relationship ($p<0.001$ to $p=0.038$) between the duration of use of each technological device and the

TABLE 1: Clinical characteristics of the participants.

	n=116	X±SD
Age (year)		10.66±2.73
BMI		21.28±4.18
		f (%)
Sex	Boy	66 (56.9)
	Girl	50 (43.1)
Screen starting age	0	1 (0.9%)
(n=107) (year)	1	15 (14%)
	2	30 (28%)
	3	18 (16.8%)
	4	16 (15%)
	5 and up	27 (25.1%)
Regular sport	Yes	27 (23.3%)
	No	89 (76.7%)
Income	Minimum wage	30 (25.9%)
	2 times minimum wage	37 (31.9%)
	3 times minimum wage	18 (15.5%)
	4 times minimum wage and up	31 (26.7%)

SD: Standard deviation; BMI: Body mass index; f: frequency, Screen Starting Age: It refers to the age at which children start using screens for more than 1 hour a day.

posture scores. In addition, the duration of TV use was found to have a significant negative correlation (p=0.007) with the DCDQ total score (Table 2).

A Spearman's "Rho" Correlation indicated that there was a significant and moderate negative relationship, between children's total digital ST and posture scores (p<0.001, r=-0.482). There was also a statistically significant and weak negative correlation between screen usage time and the general coordination (p=0.011, r=-0.236) and control during moving (p=0.048, r=-0.184) sub-dimensions, as well as the DCDQ total score (p=0.020, r=-0.215). There was no significant relationship between the motor skills and posture scores (Table 3).

DISCUSSION

The present study analyzed the ST of school-aged children and investigated the relationship between ST, posture, and motor coordination. In our research, televisions, tablets, and smartphones were the most commonly used devices among school-aged children. Our findings indicate that daily ST varies between 0 and 615 min. There was a significant and moderate negative correlation between total daily ST and posture score. There was also a significant and weak negative correlation between total ST and both the total DCDQ score, general coordination and control during moving subskills. To our knowledge, this is the first study to investigate the correlation between ST and motor coordination skills in children aged 6-14 years.

Screen-based technologies have increasingly attracted young populations to use these devices. As a result, children and young people use them for many hours because of their specific needs, such as learning, socializing, leisure, and work. However, their prolonged use can put their health at risk. Our study showed that children most frequently reached televisions, smartphones, and tablets and used these devices most often, with daily use of 1-2 hours. Our study found that the median value of children's daily screen usage time was 300 min. While there is literature consistent with the daily ST in our study, there

TABLE 2: Duration of technological device use and its relationship to posture and motor skills.

Devices	n	M (Q1-Q3) (minute)	Minimum-maximum (minute)	Posture	DCDQ
Television	103 (88%)	100 (60-100)	15-210	**p=0.006***	**p=0.007***
				r=-0.253	**(r=-0.249)**
Smartphone	94 (81%)	60 (50-60)	10-360	**p=0.003***	p=0.084
				r=-0.274	(r=-0.161)
Tablet	86 (74%)	100 (60-100)	30-240	**p<0.001****	p=0.147
				r=-0.338	(r=-0.136)
Computer	45 (39%)	60 (60-60)	10-250	**p=0.038***	p=0.494
				r=-0.193	(r=-0.064)
Game Consol	41 (35%)	60 (30-60)	10-200	**p=0.037***	p=0.558
				r=-0.194	(r=-0.055)

Q1: First quartile; Q3: Third quartile; *p<0.05 and **p<0.001 based Spearman's "Rho" correlation analyses, DCDQ: Developmental Coordination Disorder Questionnaire.

TABLE 3: Correlation between posture screen time and motor coordination.

	Posture	Total screen time
Total screen time	**p=0.000** r=-0.482**	--
General coordination	0.500 r=-0.063	**0.011* r=-0.236**
Fine motor	0.723 r=-0.033	0.396 r=-0.080
Control during moving	0.698 r=-0.036	**0.048* r=-0.184**
DCDQ total	0.751 r=-0.030	**0.020* r=-0.215**

*p<0.05 and **p<0.001 based Spearman's "Rho" correlation analyses; DCDQ: Developmental Coordination Disorder Questionnaire.

are also publications that report less daily ST. Özdinçler et al. showed that children in a similar age group as our study used phones and tablets for an average of two hours per day.[10] A systematic review study found that children aged 6-14 years spend an average of 166 minutes per day in front of screens, and another large population study found that 5797 US adolescents spent 400 minutes per day in front of screens.[20,21] Similar to our study, the literature reports a wide range of average daily screen usage times. There has been a significant increase in children's average ST following the coronavirus disease-2019 pandemic.[20] The high level of ST in our study may be related to the fact that our data were collected after the pandemic.

Our study found that a significant and moderate relationship with worse posture scores increased ST. Posture changes throughout life, with the most significant changes occurring during growth. Therefore, childhood experiences play a crucial role in determining one's posture. A link exists between a child's physical activity, and the development of postural deformities.[22] Technological devices can reduce physical activity and increase prolonged periods of sedentary behavior. These technologies have led to the modern-day epidemic of "text neck," which refers to using a smartphone while the neck is flexed.[23] Fontenele et al. showed that adolescents had a significantly reduced lateral head tilt when operating a smartphone in front view and an anterior cervical spine posture (flexed posture) when typing in the side view.[12] Typical postures for digital screen use include shoulder forward and internal rotation and forward and downward movements of the neck. Smartphone use increases forward head posture and thoracic kyphosis among adolescents.[24] In our study, atypical postures were observed on the NYPS. However, owing to the structure of the NYPS, we were unable to perform statistical analyses for individual body parts. Staying in prolonged atypical postures can cause changes in the osteoarticular structure of the spine, neck, and upper extremities, including stretching, shortening, or weakening of the ligament and muscle structures.[13] So, it is important to develop strategies to decrease ST and increase physical activity.

Our study found a significant, weak negative correlation between screen usage time and the total motor coordination score, general coordination, and control during movement. High ST in early life is associated with low developmental scores.[25] Childhood development, particularly the learning new motor skills, is shaped by experience-dependent plasticity.[14] Children who engage in high-screen use may experience reduced motor skills due to increased sedentary behavior.[26] Low levels of physical activity levels are associated with poor motor coordination. Vice versa, a lack of motor skills can lead to increased sedentary behavior. Children with poor motor coordination may prefer screen use to physical activity during leisure time.[27] Physical activity provides various opportunities for experiences such as running, jumping, climbing, and problem-solving inherent in natural life. As children perform these skills in their daily lives, they master their motor proficiency. In our study, we found an association between ST and motor coordination skills that require physical activity, but not for fine motor skills that do not require physical activity. This finding supports the concept that posture and motor coordination are shaped by physical activity.

The strength of this study lies in examining the relationship between posture, motor coordination skills, and screen usage time. However, our study has some limitations. As the study asked parents to recall their children's use of technological devices retrospectively, there was a potential for recall bias. Another limitation was that we did not use clinical scales to assess posture and motor coordination. The cross-sectional nature of this study precludes establishment of causal relationships among ST, posture, and motor coordination.

CONCLUSION

Our study found that children between the ages of 4 and 16 used televisions, tablets, and smartphones most frequently and for the most extended duration, with a median total daily use of 300 minutes. There was a significant and moderate negative correlation between ST and posture, and a significant and weak negative correlation between ST and motor coordination. In future studies, children's ST should be measured prospectively using digital tools or sensors. Further studies should be conducted to monitor the variety of technological devices owned by children and the duration of their use. In future studies, it is recommended to measure the physical activity levels of children, in addition to ST and motor development. Health professionals can promote children's active and dynamic participation in games and play activities to reduce the potential effects of the increased use of screen devices.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Nihal Pekpak, Turgay Altunalan;* ***Design:*** *Nihal Pekpak, Turgay Altunalan;* ***Control/Supervision:*** *Turgay Altunalan;* ***Data Collection and/or Processing:*** *Nihal Pekpak;* ***Analysis and/or Interpretation:*** *Nihal Pekpak, Turgay Altunalan;* ***Literature Review:*** *Nihal Pekpak, Turgay Altunalan;* ***Writing the Article:*** *Nihal Pekpak, Turgay Altunalan;* ***Critical Review:*** *Turgay Altunalan;* ***References and Fundings:*** *Nihal Pekpak.*

REFERENCES

1. Staiano AE, Calvert SL. Exergames for physical education courses: physical, social, and cognitive benefits. Child Dev Perspect. 2011;5(2):93-8. [Crossref] [PubMed] [PMC]
2. Hancox RJ, Milne BJ, Poulton R. Association between child and adolescent television viewing and adult health: a longitudinal birth cohort study. Lancet. 2004;364(9430):257-62. [Crossref] [PubMed]
3. Virgara R, Lewis L, Phillips A, Richardson M, Maher C. A scoping review of physical activity and screen time guidelines for use in Outside School Hours Care. BMC Pediatr. 2020;20(1):463. [Crossref] [PubMed] [PMC]
4. Sussman CJ, Harper JM, Stahl JL, Weigle P. Internet and Video Game Addictions: Diagnosis, Epidemiology, and Neurobiology. Child Adolesc Psychiatr Clin N Am. 2018;27(2):307-26. [Crossref] [PubMed]
5. Dempsey PC, Owen N, Biddle SJ, Dunstan DW. Managing sedentary behavior to reduce the risk of diabetes and cardiovascular disease. Curr Diab Rep. 2014;14(9):522. [Crossref] [PubMed]
6. T.C. Sağlık Bakanlığı [İnternet]. ©2023 Halk Sağlığı Genel Müdürlüğü [Erişim tarihi: 1 Ocak 2024]. Türkiye Fiziksel Aktivite Rehberi. Erişim linki: [Link]
7. Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, Galuska DA, et al. The Physical Activity Guidelines for Americans. JAMA. 2018;320(19):2020-8. [Crossref] [PubMed] [PMC]
8. Harrington DM, Ioannidou E, Davies MJ, Edwardson CL, Gorely T, Rowlands AV, et al. Concurrent screen use and cross-sectional association with lifestyle behaviours and psychosocial health in adolescent females. Acta Paediatr. 2021;110(7):2164-70. [Crossref] [PubMed] [PMC]
9. Sheldrick MP, Maitland C, Mackintosh KA, Rosenberg M, Griffiths LJ, Fry R, et al. Associations between the Home Physical Environment and Children's Home-Based Physical Activity and Sitting. Int J Environ Res Public Health. 2019;16(21):4178. [Crossref] [PubMed] [PMC]
10. Özdinçler AR, Rezaei DA, Abanoz EŞ, Atay C, Keleş YA, Tahran Ö, et al. Okul çağındaki çocuklarda teknoloji bağımlılığının postür ve vücut farkındalığı üzerine etkisi [The effect of technology addiction on posture and body awareness in school age children]. Bağımlılık Dergisi. 2019;20(4):185-96. [Link]
11. Stodden DF, Goodway JD, Langendorfer SJ, Roberton MA, Rudisill ME, Garcia C, et al. A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. Quest. 2008;60(2):290-306. [Link]
12. Fontenele TMO, Nunes PPB, Silva FVM, Menezes CNB, Andrade RF, Mont'Alverne DGB, et al. Smartphone addiction and postural alterations in the cervical region in adolescents. Rev Paul Pediatr. 2023;42:e2023051. [Crossref] [PubMed] [PMC]
13. Berber M, Karadibak D, Uçurum SG. Adolesan dönemde ekrana bağlı aktivitelerin hamstring kas uzunluğu, reaksiyon zamanı ve vücut kitle indeksi üzerine etkisi [The effect of screen based activities on hamstring muscle length, reaction time and body mass index in adolesans]. DEU Tıp Derg. 2014;28(1):1. [Link]
14. Ismail FY, Ljubisavljevic MR, Johnston MV. A conceptual framework for plasticity in the developing brain. Handb Clin Neurol. 2020;173:57-66. [Crossref] [PubMed]
15. Rocha HAL, Correia LL, Leite ÁJM, Machado MMT, Lindsay AC, Rocha SGMO, et al. Screen time and early childhood development in Ceará, Brazil: a population-based study. BMC Public Health. 2021;21(1):2072. [Crossref] [PubMed] [PMC]

16. McRoberts LB, Cloud RM, Black CM. Evaluation of the New York posture rating chart for assessing changes in postural alignment in a garment study. CTRJ. 2013;31(2):81-96. [Link]

17. Kantara Aktansoy S, Kirmizigîl B. İlköğretim öğrencilerinde eurofit test bataryası ve postür değerlendirmesi [The evaluation of eurofit test batary and posture in primary schools students]. Turkiye Klinikleri J Health Sci. 2020;5(1):73-80. [Crossref]

18. Wilson BN, Crawford SG, Green D, Roberts G, Aylott A, Kaplan BJ. Psychometric properties of the revised Developmental Coordination Disorder Questionnaire. Phys Occup Ther Pediatr. 2009;29(2):182-202. [Crossref] [PubMed]

19. Yildirim CK, Altunalan T, Acar G, Elbasan B, Gucuyener K. Cross-cultural adaptation of the developmental coordination disorder questionnaire in Turkish children. Percept Mot Skills. 2019;126(1):40-9. [Crossref] [PubMed]

20. Qi J, Yan Y, Yin H. Screen time among school-aged children of aged 6-14: a systematic review. Glob Health Res Policy. 2023;8(1):12. [Crossref] [PubMed] [PMC]

21. Nagata JM, Smith N, Alsamman S, Lee CM, Dooley EE, Kiss O, et al. Association of physical activity and screen time with body mass index among US adolescents. JAMA Netw Open. 2023;6(2):e2255466. [Crossref] [PubMed] [PMC]

22. Latalski M, Bylina J, Fatyga M, Repko M, Filipovic M, Jarosz MJ, et al. Risk factors of postural defects in children at school age. Ann Agric Environ Med. 2013;20(3):583-7. [PubMed]

23. David D, Giannini C, Chiarelli F, Mohn A. Text neck syndrome in children and adolescents. Int J Environ Res Public Health. 2021;18(4):1565. [Crossref] [PubMed] [PMC]

24. Tsang SMH, Cheing GLY, Chan JWK. Severity of slouched posture during smartphone use is associated with the musculoskeletal discomfort, daily usage, and school year among adolescents. Ergonomics. 2023;66(9):1340-53. [Crossref] [PubMed]

25. Putnick DL, Trinh MH, Sundaram R, Bell EM, Ghassabian A, Robinson SL, et al. Displacement of peer play by screen time: associations with toddler development. Pediatr Res. 2023;93(5):1425-31. [Crossref] [PubMed] [PMC]

26. Downing KL, Hinkley T, Salmon J, Hnatiuk JA, Hesketh KD. Do the correlates of screen time and sedentary time differ in preschool children? BMC Public Health. 2017;17(1):285. Erratum in: BMC Public Health. 2017;17(1):367. [Crossref] [PubMed] [PMC]

27. Smith L, Fisher A, Hamer M. Prospective association between objective measures of childhood motor coordination and sedentary behaviour in adolescence and adulthood. Int J Behav Nutr Phys Act. 2015;12:75. [Crossref] [PubMed] [PMC]