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ESTUDOS EM DESENVOLVIMENTO MOTOR DA CRIANÇA XVII

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André Pombo
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Carlos Luz

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EXPLORING THE IMPACT OF SCREEN-TIME EXPOSURE ON MOTOR COMPETENCE AND HEALTH-RELATED PHYSICAL FITNESS PARAMETERS IN 4th GRADE CHILDREN

ANÁLISE DO IMPACTO DA EXPOSIÇÃO AO TEMPO DE ECRÃ NA COMPETÊNCIA MOTORA E NOS PARÂMETROS DE APTIDÃO FÍSICA RELACIONADOS COM A SAÚDE EM CRIANÇAS DO 4.º ANO DE ESCOLARIDADE

Bruno Figueira[1], Bruno Gonçalves[1], Rodrigo Silva[1], Tomás Aleixo[1], Raul Rosa[1], Gabriela Almeida[1]

[1] *Departamento de Desporto e Saúde, Escola de Saúde e Desenvolvimento Humano, Universidade de Évora, Portugal. Comprehensive Health Research Centre (CHRC), Universidade de Évora, Portugal*

Abstract
Children are spending large periods of the day engaged in screen-based activities, despite research demonstrating potential harms related to obesity, sleep, fitness, and cognitive, social, and emotional development, among others. Although there are evidence-based guidelines for physical activity, sleep patterns, and healthy screen-time levels, no studies have addressed how children's screen-time exposure affects motor competence levels and health-related physical fitness variables in the scholarly context. This study included a cross-sectional design with 143 children in the 4th grade (males: n = 74, 9.9 ± 0.4 years; females; = 69, 10.1 ± 0.4 years) in the municipality of Évora, who attend elementary school. The findings highlight the impact of screen time duration on specific aspects of physical fitness and motor competence, with lower screen time being associated with better performance in several key tests.

Key words
Elementary school; technology; aerobic capacity; vertical jump; body mass index.

Resumo
As crianças passam grandes períodos do dia em atividades que envolvem ecrãs, apesar da investigação demonstrar os potenciais danos relacionados com a obesidade, sono, aptidão física, desenvolvimento cognitivo, social e emocional, entre outros. Embora já existam diretrizes baseadas em evidências para o tempo de atividade física, padrões de sono e níveis saudáveis de tempo de ecrã, nenhum estudo aborda como a exposição ao tempo de ecrã das crianças afeta os níveis de competência motora e variáveis de aptidão física relacionadas com a saúde no contexto escolar. Este estudo incluiu um desenho transversal com 143 crianças a frequentar o 4.º ano de escolaridade no município de Évora (sexo masculino = 74, 9.9±0.4 anos; feminino = 69, 10.1±0.4 anos). Os resultados destacam o impacto da duração do tempo de ecrã em aspetos específicos da aptidão física e competência motora, sendo que menos tempo de ecrã está associado a um melhor desempenho em vários testes-chave.

Palavras-chave
Escola primária; tecnologia; capacidade aeróbia; impulsão vertical; índice de massa corporal.

INTRODUCTION

Physical inactivity (PI) is a significant risk factor for the development of diabetes, depression, cerebrovascular and cardiovascular diseases, oncological, and respiratory, incurring an associated cost of €80.4 billion per year on the EU-28 (1). Additionally, PI is estimated to contribute to approximately 1 million deaths and 8.3 million disability-adjusted life-years annually in the WHO European Region (2). These estimates seem to be conservative since they do not account for mental health and musculoskeletal issues. Furthermore, the direct societal costs, which encompass potential environmental benefits arising from greater walking, cycling, or the utilization of public transportation, along with the subsequent decrease in fossil fuel consumption, have not been factored into the overall impact assessment (3).

Despite the associated health benefits, the majority of young Portuguese citizens do not meet international recommendations for physical activity. It is estimated that only approximately 28.6% of young children (aged between 4- and 6-year-old) meet the physical activity recommendation considering the WHO 24-Hour Movement Guidelines for Children and Youth (4). Some early evidence has shown that children's lifestyle behaviors concerning physical activity levels, sleep patterns, and excessive screen time might interactively or independently affect cognition (5). Additionally, recent studies suggest that excessive screen time is negatively associated with levels of attention, memory, impulse control, and academic performance (6). Conversely, further research has documented a positive relationship between cognitive skills and sports performance, with the largest effect sizes observed for information-processing speed (7). This positive effect on general cognitive skills appears to be linked to increased aerobic capacity (8), the coordinative demands of sports environments (9), constant memory updating (9), and decision-making processes (10). Considering this, the goal of the present research is to determine how children's screen-time exposure affects motor competence levels and health-related physical fitness variables.

METODOLOGY

Participants

Participants were 143 children (males: n = 74, 9.9±0.4 years; females: n = 69, 10.1±0.4 years) residing in the municipality of Évora and attending 4th year of elementary school. All children were free from disabilities, medical or neurodevelopmental conditions associated with motor clumsiness, and were not diagnosed with any physical, sensory, or cognitive impairments. Participants and their parents were thoroughly informed about the research procedures, requirements, benefits, and risks, and written consent was obtained prior to the commencement of the study. Ethical approval was obtained from Ethics Committee of University of Évora (22814), Ethics Research Committee of NMS/FCM-UNL (127/2023/CEFCM), Ethics Committee for Health of the Alentejo Regional Health Administration (24/CE/2023) and Ministry of Education (MIME)

Procedures

Data collected incorporating input from both children and their parents, alongside a multi-methodological framework employing both questionnaires and tasks. Evaluation of children occurred within small group settings, with each assessment session spanning approximately 45 to 60 minutes. These assessments were administered collectively during school hours, either within a designated gymnasium area or within a secluded and noise-controlled environment. Meanwhile, parents were entrusted with the completion of questionnaires within the confines of their homes, subsequently returning them to the research team. All data were collected by an expert team in the field of human kinetics, with assessment experience in school-age children. Furthermore, a meticulously crafted protocol delineating the assessment procedures is slated for development, with the aim of optimizing the acquisition of variable data, as explicated in Table 1.

Testing procedures for physical fitness components are consistent with national guidelines for school-based fitness assessment (DGE/MEC). Children's motor competence was measured using the Motor Competence Assessment (MCA) instrument. The MCA instrument assesses the three theoretical categories through six motor tasks: (1) stability (i. jumping sideways and ii. shifting platforms), (2) locomotor (iii. standing long jump and iv. shuttle run) and (3) manipulative skills (v. ball kicking velocity and vi. ball throwing velocity). All tasks were carried out according to the descriptions provided by the authors (11). Screen time levels were assessed using ScreenQ (12). The survey measures access, frequency, content, and caregiver-child co-viewing.

Table 1. Overview of the protocol assessment.

Dimensions of analysis	Variables/Instruments
Health-related physical fitness	i) Anthropometry and Body Composition - height (H) - weight (W) - waist circumference (WC) - hip circumference (HP) ii) Cardiorespiratory fitness/20-meter shuttle run test (SR-20m)
Motor competence	i) MC/Motor Competence Assessment instrument (MCA)
Health-related behavior	i) Screen-based activity/ ScreenQ

Statistical Analysis
The Shapiro-Wilk test was used to confirm that the data were normally distributed, thus permitting parametric tests. Descriptive statistics were performed to calculate mean ± SD and frequencies. Group comparison was performed using a one-way (Screen-time) analysis of variance (ANOVA). When significant main effects were achieved, Bonferroni post hoc analyses were performed to locate the pairwise. To estimate the strength of significant findings, effect sizes (ES) were determined using the Cohen's *d*. Effect size values were interpreted as follows: < 0.20 represents a trivial effect, 0.20 to 0.49 is classified as a small effect, 0.50 to 0.79 corresponds to an intermediate effect, and 0.80 and higher is considered as a large effect (13,14). Statistical analyses were performed using SPSS (Version 20 for Mac; SPSS Inc., Chicago, IL, USA) and statistical significance was set at p < .05.

RESULTS
Table 2 displays the results of the effect of screen time duration on various health-related physical fitness and motor competence variables. The following performance variables showed significant differences among the screen time categories: waist circumference (F = 3.43; p < .05, ηp^2 = .05), shuttle run 20m (F = 4-.05; p < .02, ηp^2 = .07), standing long jump (F = 5.93; p < .01, ηp^2 = .09), locomotor (F = 4.36; p < .05, ηp^2 = .07), and motor competence (F = 3.34; p < .05, ηp^2 = .05).
For WC, participants with more than 180 minutes of screen time had significantly higher values compared to those with 60-179 minutes (Cohen's *d* [95% confidence Interval]; -0.88 [-1.60; 0.16]) and less than 59 minutes (-0.30 [[-0.65; 0.08]). In the SR-20m, participants with less than 59 minutes of screen time performed significantly better than those with more than 180 minutes (0.51 [[-0.11; 0.92]). Standing long jump performance was significantly better in the less than 59 minutes group compared to the more than 180 minutes group (0.98 [0.26; 1.70]). Similarly, for locomotor, participants with less than 59 minutes of screen time outperformed those with more than 180 minutes (0.86 [0.14; 1.58]). The motor competence assessment (MCA) also showed that participants with less than 59 minutes of screen time had better performance compared to those with more than 180 minutes (0.45 [0.08; 0.82]). Conversely, no significant differences were observed in the following variables W, BMI, HC, JS, SP, SR, BT, BK, and S.

Table 2. Effect of Screen Time Duration on Health-Related Physical Fitness and Motor Competence Variables.

Variables	<59min	60-179min	>180min	F	p	ηp²	Post-Hoc Cohen's d		
							a	b	c
W (kg)	35.3±7.60	36.80±7.32	40.50±7.66	2.02	.14	.03	-0.19 [-0.56; 0.17]	-0.70 [-1.41; 0.02]	-0.50 [-1.20; 0.21]
BMI (kg/m²)	18.10±2.88	19.10±3.17	20.30±3.56	2.70	.07	.04	-0.32 [-0.68; 0.05]	-0.71 [-1.43; 0.01]	-0.40 [-1.10; 0.31]
WC (cm)	63.70±7.51	66.10±8.26	71.00±12.60	3.43	.04*	.05	-0.30 [-0.65; 0.08]	-0.88 [-1.60; -0.16]	-0.51 [-1.30; 0.12]
HC (cm)	74.10±7.42	75.40±7.64	77.90±6.42	1.12	.33	.02	-0.16 [-0.53; 0.20]	-0.50 [-1.22; 0.21]	-0.34 [-1.05; 0.37]
SR-20m (au)	37.40±19.50	28.50±16.00	24.10±13.50	4.05	.02*	.07	0.51 [-0.11; 0.92]	0.76 [-0.05; 1.57]	0.25 [-0.55; 1.05]
JS (%)	62.00±27.00	52.00±26.00	45.00±30.00	2.73	.07	.04	0.37 [0.00; 0.74]	0.61 [-0.10; 1.33]	0.24 [-0.46; 0.95]
SP (%)	57.00±28.00	48.00±23.00	54.00±29.00	2.09	.13	.03	0.37 [0.00; 0.74]	-0.12 [-0.60; 0.83]	-0.25 [-0.96; 0.45]
SLJ (%)	72.00±26.00	59.00±26.00	47.00±28.00	5.93	<.01*	.09	0.51 [0.14; 0.88]	0.98 [0.26; 1.70]	0.47 [-0.24; 1.20]
SR (%)	64.00±26.00	58.00±25.00	49.00±27.00	1.79	.17	.03	0.26 [-0.11; 0.62]	0.59 [-0.13; 1.30]	0.33 [-0.38; 1.03]
BT (%)	52.00±30.00	51.00±33.00	48.00±26.00	0.05	.95	.00	0.01 [-0.35; 0.38]	0.11 [-0.60; 0.83]	0.10 [-0.60; 0.81]
BK (%)	16.00±18.00	13.00±17.00	25.00±29.00	1.84	.16	.03	0.15 [-0.22; 0.51]	-0.52 [-1.24; 0.19]	-0.70 [-1.38; 0.04]
S (%)	59.00±24.00	50.00±20.00	50.00±25.00	2.95	.06	.05	0.43 [0.06; 0.80]	0.44 [-0.27; 1.16]	0.08 [-0.70; 0.71]
L (%)	68.00±24.00	58.00±23.00	48.00±26.00	4.36	.02*	.07	0.43 [0.06; 0.80]	0.86 [0.14; 1.58]	0.43 [-0.28; 1.13]
M (%)	34.00±19.00	32.00±20.00	37.00±23.00	0.24	.80	.00	0.07 [-0.30; 0.44]	-0.16 [-0.87; 0.56]	-0.23 [-0.93; 0.45]
MCA total (%)	54.00±17.00	47.00±15.00	45.00±14.00	3.34	.04*	.05	0.45 [0.08; 0.82]	0.56 [-0.16; 1.27]	0.11 [-0.60; 0.82]

Abbreviations: p = between group-subject effect; ηp² = effect size; m = minutes; a = <59m vs 60-179m; b = <59m vs >180m; c = 60-179m vs >180m; W = Weight; BMI = Body Mass Index; WC = Waist Circumference; HC = Hip Circumference; SR = Shuttle Run; JS = Jumping Sideways; SP = Shifting Platforms; SLJ = Standing Long Jump; BL = Ball Throwing; BK = Ball Kicking; S= Stability; L = Locomotor; M = Manipulative; MCA = Motor Competence Assessment

DISCUSSION

The investigation into children's screen-time exposure and its effects on motor competence levels and health-related physical fitness variables revealed significant differences in various performance variables based across different screen time categories. Participants with lower screen time demonstrated better results in tests such as waist circumference, shuttle run, standing long jump, locomotor skills, and motor competence assessment. Conversely, no significant differences were observed in other variables like weight, BMI, and height, suggesting that screen time did not significantly affect these measures (15). These findings corroborate prior research that has explored the relationship between motor competence, physical activity, and health outcomes in children, underscoring the critical importance of encouraging children who experience extended periods of sedentary behavior to comply with established physical activity and exercise guidelines.

Previous studies have shown that actual motor competence and perceived motor competence are linked to physical activity levels and weight status in children (16). Furthermore, our results contribute to bridging a gap in the literature regarding the impact of screen time on physical activity and motor skills in preschoolers (17). The combined influence of screen time, motor competence levels, and health-related physical fitness variables exerts a substantial impact on overall health. A prior study involving school children revealed that those with low cardiorespiratory fitness levels had a 15% increased risk of elevated waist circumference, independent of screen time. When screen time was considered, this risk increased to 24% (18). Thus, understanding the relationships among motor competence, physical activity, and weight status is crucial for fostering healthy development in children.

Available research have highlighted the importance of interventions to improve motor skills, physical fitness, and overall well-being in children with different levels of motor competence(19). Additionally, the adherence to movement guidelines can positively influence physical fitness components in adolescents (20). Given that children increasingly spend substantial portions of their day engaged in screen-based activities, it is imperative to adhere to international physical activity guidelines to mitigate the adverse effects associated with the convergence of various risk factors.

CONCLUSION

The findings emphasize the effect of screen time duration on specific aspects of physical fitness and motor competence, with reduced screen time associating with improved performance in several key tests such as WC, SR-20m, SLJ and MCA.

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