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Original articles

Muscle strength and screen time in children and adolescents undergoing oncological treatment: a cross-sectional study with a correlation analysis

Força muscular e tempo de tela em crianças e adolescentes em tratamento oncológico: um estudo transversal com análise de correlação

Fuerza muscular y tiempo de uso de pantallas en niños y adolescentes en tratamiento oncológico: un estudio transversal con análisis de correlación

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Keywords:
Malignant neoplasms;
Muscle strength;
Screen time;
Sedentary behavior.

ABSTRACT
This study evaluated isometric muscle strength (elbow and knee flexors and extensors), screen time, and their associations with individual and contextual factors in pediatric oncology patients. A portable dynamometer and a questionnaire were used. Muscle strength was below age- and sex-specific norms. Screen time exceeded 4 hours/day in 42% of participants on weekdays and in 31.4% on weekends. Solid tumours are correlated with chemotherapy (r=0.56; p=0.001), and sex correlated negatively with sedentary behavior (r=–0.37; p=0.030), indicating that females reported higher sedentary behavior than males. In the multiple regression model, age was the only independent predictor of muscle strength (β= 10.07, p= 0.001). The observed deficits in muscle strength and high screen time suggest that strategies addressing physical activity and sedentary behavior warrant consideration in pediatric oncology care.

Palavras-chave:
Neoplasias malignas;
Força muscular;
Tempo de tela;
Comportamento sedentário.

RESUMO
Este estudo avaliou a força muscular isométrica (flexores e extensores de cotovelo e joelho), o tempo de tela e suas associações com fatores individuais e contextuais em pacientes pediátricos oncológicos. Utilizou-se um dinamômetro portátil e um questionário. A força muscular esteve abaixo dos valores normativos. O tempo de tela excedeu 4 h/dia em 42% nos dias de semana e 31,42% nos finais de semana. Os tumores sólidos apresentaram correlação com a quimioterapia (r=0,56; p=0,001) e o sexo correlacionou-se negativamente ao comportamento sedentário (r=–0,37; p=0,030), o qual indica que as meninas tinham maior comportamento sedentário. A idade foi o único preditor independente da força (β=10,07, p=0,001). Os déficits observados na força muscular e alto tempo de tela, sugerem que estratégias de atividade física e diminuição do tempo sedentário sejam consideradas nos cuidados da oncologia pediátrica.

Palabras clave:
Neoplasias malignas;
Fuerza muscular;
Tiempo de pantalla;
Comportamiento sedentario.

RESUMEN
Este estudio evaluó la fuerza muscular isométrica (flexores y extensores de codo y rodilla), el tiempo de pantalla y sus asociaciones con factores individuales y contextuales en pacientes pediátricos oncológicos. La fuerza muscular estuvo por debajo de los valores normativos. El tiempo de pantalla superó 4 h/día en 42% entre semana y 31,42% los fines de semana. Los tumores sólidos presentaron correlación con la quimioterapia (r=0,56; p=0,001) y el sexo se correlacionó negativamente con el comportamiento sedentario (r=–0,37; p=0,030), lo cual indica que las niñas tienen mayor comportamiento sedentario. La edad fue el único predictor independiente de la fuerza (β=10,07, p=0,001). Los déficits observados en la fuerza muscular y el alto tempo de pantallas, sugieren que estrategias con actividad física y disminución del tiempo sedentario sean considerados en los cuidados de la oncología pediátrica.

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INTRODUCTION

Pediatric cancer affects children and adolescents from birth to 19 years of age. Although the survival rate for pediatric cancer has significantly increased in recent decades due to early detection and advances in treatment, it currently ranges from 80% to 85% in developed countries (Brasil, 2023; Santos et al., 2023; Vázquez López, 2024). In Brazil, according to the National Cancer Institute (INCA), the cure rate can also reach 80% for children and adolescents when the disease is diagnosed early and treated in specialized centers (Santos et al., 2023). The increased survival of these patients has resulted in a growing number of childhood cancer survivors reaching adulthood. However, treatment can lead to adverse effects that may appear in the short, medium, or long term (Vázquez López, 2024).

Short-term effects include vomiting, a weakened immune system (Hooke and Linder, 2019), cancer-related fatigue (Daniel et al., 2013), loss of strength, and balance issues (Söntgerath and Eckert, 2015). Medium- and long-term effects may include impairments in motor development, growth, muscle strength, cognitive function, and other areas (Hamari et al., 2020). Additionally, treatment often requires multiple hospitalizations, which may be prolonged. In this context, both acute and chronic adverse effects, combined with frequent hospitalizations, negatively impact daily activities and, consequently, the patients' quality of life (Ness et al., 2009). These factors contribute to increased sedentary behavior (Götte et al., 2023), which can further impair strength levels and motor performance.

Although international research on functional capacity, muscle strength (Söntgerath and Eckert, 2015), and sedentary behavior (Götte et al., 2023) in pediatric cancer patients has advanced in recent years, especially in high-income countries, studies in the Brazilian context remain limited. To date, only one Brazilian study has evaluated upper limbs and lower limbs muscle strength in children and adolescents diagnosed with cancer compared with apparent healthy control (Barbosa et al., 2025). However, Barbosa et al. (2025) also included young adults with cancer, patients could be at different stages of treatment, such as after the treatment phase, which can influence the strength parameters.

This highlights a need for further research in pediatric oncology to better understand, from a local perspective, how Brazilian children and adolescents undergoing cancer treatment are progressing in terms of muscle strength, sedentary behavior, and overall functional capacity. Given the limited research in Brazil, particularly within the public healthcare system, it is essential to understand the realities of pediatric oncology units in referral hospitals, such as those in Southern Brazil. This knowledge is crucial for identifying patients' current functional limitations and for guiding the development of targeted, context-specific physical exercise interventions for this vulnerable population.

The primary objective of this study was to assess the isometric flexor and extensor elbow and knee muscle strength in pediatric cancer patients undergoing treatment and to compare the results with age- and sex-specific reference values. Additionally, sedentary behavior was evaluated based on screen time. The secondary objective was to explore potential associations between muscle strength, sedentary behavior, participants' characteristics, and contextual factors. It was hypothesized that: (a) these patients would exhibit reduced muscle strength across the evaluated muscle groups compared to reference values; and (b) muscle strength would be associated with screen time, participants' characteristics, and contextual factors.

METHODS

PARTICIPANTS

This study was conducted in 2022 at the *Hospital Infantil Joana de Gusmão* (HIJG) in Florianópolis, Santa Catarina, Brazil, following the STROBE guidelines. Participants were selected through non-probabilistic, voluntary sampling. Inclusion criteria were: a confirmed cancer diagnosis; age between 5 and 15 years (both sexes); undergoing outpatient oncology treatment at HIJG (any type and at any treatment phase); and having sufficient cognitive ability to participate, as determined by researchers through direct observation and discussion with parents. Participants were excluded if they were in the maintenance phase of treatment, had completed treatment, were unable to perform the muscle strength test, or did not complete the questionnaire.

Recruitment took place at the hospital, either while patients awaited medical consultations or prior to receiving treatment. Eligible participants were identified from hospital lists on data collection days and invited to participate following approval from the responsible medical team.

PROCEDURES

The study was approved by the Research Ethics Committee of HIJG (approval no. 5.753.048) and the Research Ethics Committee on Human Subjects at the Federal University of Santa Catarina (UFSC) (approval no. 5.723.204). Informed consent was obtained from parents and from literate children and adolescents willing to participate. Participants were fully informed about the study's procedures, risks, and benefits and were assured of their right to withdraw at any time without consequence.

SAMPLE CHARACTERIZATION

Anthropometric, sociodemographic (sex and age), and health condition data (cancer type, treatment type, medication frequency, and dosage) were collected through patient anamnesis and medical record review.

Body mass was measured using a Marte® PP 180 scale (accuracy: 100 g), and height was measured with an AlturaExata® stadiometer (accuracy: 1 mm). Body Mass Index (BMI) was then calculated as body mass divided by height squared (kg/m²) and used to assess nutritional status according to Ministry of Health cutoff points.

MUSCLE STRENGTH

Isometric force production of the elbow and knee flexor and extensor muscle groups was assessed using a handheld dynamometer (microFET2 HHD; Hoggan Health Industries, Salt Lake City, Utah), validated for use in children and adolescents (Beenakker et al., 2001). Participants performed maximal voluntary isometric contractions against the device, which displayed force in Newtons (N). For each muscle group, bilateral assessments were conducted, and the highest value obtained from two to three attempts was recorded, with 1-min30-second rest intervals to minimize fatigue.

Joint positioning at 90° for both the elbow and knee was standardized using a universal goniometer with two 20 cm arms and a fulcrum accurate two degrees (Trident Gon-pvc). Knee flexor and extensor strength was measured in the seated position on the examination table (see Figure 1 for further clarity), while elbow flexor and extensor strength were assessed in the supine position. For analysis, mean strength values computed for each muscle group ($\bar{x}$ = (right + left)/2), and classification followed normative reference values (Beenakker et al., 2001).

SEDENTARY BEHAVIOR THROUGH SCREEN TIME

Sedentary behavior was assessed using a questionnaire adapted from Costa and Assis (2011). Parents or guardians reported their children's average daily screen time, including television, video games, and computer use, separately for typical weekdays and weekends. A weighted average was calculated to combine these periods, with screen time categorized as <2 hours/day or ≥2 hours/day. Total screen time was further classified into three groups: <2 hours, 2–4 hours, and ≥4 hours per day.

STATISTICAL ANALYSIS

Categorical variables were presented as absolute (n) and relative (%) frequencies, while continuous variables were summarized using means and standard deviations. Pearson's correlation coefficient (r) was used to examine linear association between variables, with values ranging from –1 (perfect negative correlation) to 1 (perfect positive correlation), and 0 indicating no linear correlation. The magnitude of correlations followed Cohen's (1988) benchmarks: Negligible ($|r| < 0.09$), Low ($0.10 \leq |r| < 0.29$), Moderate ($0.30 \leq |r| < 0.49$) and High ($|r| \geq 0.50$).

To further explore predictors of muscle strength, a multiple linear regression model was performed with strength production (N), as the dependent variable. The independent variables entered into the model were age, sex, BMI, type of treatment, and type of cancer. Prior to regression, assumptions of normality, linearity, homoscedasticity, independence of errors, and absence of multicollinearity were verified through graphical and statistical diagnostics. Regression coefficients (β), standard errors (SE), t-values, and the coefficients of determination (R^2 and adjusted R^2) were reported to evaluate model fit and the explanatory contribution of each predictor.

All analyses were performed using RStudio (version 4.2.2), with statistical significance set at $p < 0.05$.

RESULTS

A total of 35 children and adolescents undergoing oncology treatment were included in the analysis. Table 1 summarizes the sample's key characteristics, including age, sex, body mass index (BMI), cancer type, treatment type, and average sedentary hours on weekdays and weekends.



Figure 1. Procedures for isometric strength assessment of knee and elbow flexor and extensor muscle groups using a handheld dynamometer. Procedures for assessing isometric strength of knee and elbow flexor and extensor muscle groups using handheld dynamometer (microFET2 HHD; Hoggan Health Industries, Utah, USA). Bilateral measurements were obtained, recording the highest value from two ro three maximal voluntary contractions with 30-second rest intervals. Knee assessments were performed in the seated position, and elbow assessments in the supine position, with joint angles standardized at 90° using a universal goniometer. Source: Developed and prepared by the authors based on the MicroFET2™ Muscle Test Dynamometer Manual (Hoggan Scientific, LLC).

Table 1. Participants' characteristics and screen time (n=35).

Variables	Mean ± SD
Age (yrs)	9.54±3.53
BMI (kg/m^2)	17.44±3.38
Sociodemographic	**n (%)**
Gender (Male)	21 (60.00)
Going to School (No)	24 (68.57)
Cancer type	
Non-solid tumor	21 (60.00)
Treatment	
Chemotherapy (yes)	29 (82.85)
Screen time	**n (%)**
Typicl week-day	
<2 hours	6 (17.14)
2-4 hours	14 (40.00)
> 4 hours	15 (42.85)
Weekend	
<2 hours	10 (28.57)
2-4 hours	14 (40.00)
>4 hours	11 (31.42)

Note: n = absolute frequency; **%** = relative frequency; **SD** = standard deviation; **BMI** = body mass index; **yrs** = years old; **Source:** prepared by the authors.

Mean isometric muscle strength values (N) for the elbow and knee flexor and extensor muscle groups are presented by age group. When only one participant was in a given age group, the individual value is reported. Tables 2 and 3 show the results for male and female patients, respectively, alongside reference values for healthy children of the same age (Beenakker et al., 2001). Notably, strength production capacity was below age-related reference values in both sexes. To explore potential associations between muscle strength, sedentary behavior, participants' characteristics, and contextual factors in pediatric oncology patients, a correlation matrix using Pearson's correlation coefficient was conducted (Figure 2).

The correlation matrix revealed a strong, significant association between solid cancer type and chemotherapy (r=0.56, p=0.001). A moderate, statistically significant negative correlation was found between sex and sedentary behavior (r=–0.37, p = 0.030), suggesting that girls exhibited higher levels of sedentary behavior. No significant correlations emerged between normalized muscle strength and sedentary behaviour (r=–0.008), cancer type (r=–0.26), or treatment type (r=–0.011).

Table 2. Average force production in Newtons (N) of male participants (n=21) and reference values relative to age.

Age	Elbow flexors (n)		Dif%	Elbow extensors (n)		Dif%	Knee flexors (n)		Dif%	Knee extensors (n)		Dif%
	M	P		M	P		M	P		M	P	
5	44(3)	70(12)	62.9	41(3)	--	--	60(3)	105(20)	73	73(3)	--	--
6	64(2)	103(21)	62.1	62(2)	73(8)	84.9	45(2)	158(38)	79	79(2)	156(33)	50.6
9	56(3)	134(24)	41.8	47(3)	89(22)	52.8	73(3)	195(40)	117	117(3)	194(30)	60.3
10	83(2)	173(19)	48.0	54(2)	120(18)	45.0	72(2)	268(48)	113	113(2)	267(47)	42.3
11	105(2)	153(30)	68.6	81(2)	103(31)	78.6	129(2)	218(64)	201	201(2)	239(65)	84.1
12	78(2)	160(25)	48.8	59(2)	104(31)	56.7	83(2)	201(34)	136	136(2)	225(43)	60.4
13	136(3)	195(26)	69.7	85(3)	128(42)	66.4	123(3)	273(59)	170	170(3)	296(70)	57.4
14	135(4)	253(50)	53.4	94(4)	158(42)	59.5	132(4)	307(64)	209	209(4)	370(61)	56.5

Note: (n) = number of participants evaluated for each variable, indicated in parentheses in the table; **M =** measured; **P =** predicted; Dif%: percentage difference in muscle strength between the reference value and the value obtained by the participant; **Source:** prepared by the authors.

Table 3. Average force production in Newtons (N) of female participants (n=14) and reference values relative to age.

Age	Elbow flexors (n)		Dif%	Elbow extensors (n)		Dif%	Knee flexors (n)		Dif%	Knee extensors (n)		Dif%
	M	P		M	P		M	P		M	P	
4	52(2)	69(21)	75.4	46(2)	--	--	39(2)	92(25)	42.4	64(2)	--	--
5	43(3)	66(12)	65.2	36(3)	--	--	49(3)	99(15)	49.5	66(3)	--	--
6	63(1)	105(9)	60.0	51(1)	73(8)	69.9	75(1)	154(33)	48.7	97(1)	148(24)	65.5
8	83(1)	115(16)	72.2	61(1)	82(10)	74.4	81(1)	160(23)	50.6	109(1)	166(30)	65.7
9	**245(1)**	125(28)	196.0	**159(1)**	91(24)	174.7	**216(1)**	180(54	120.0	**395(1)**	173(57)	228.3
10	81(2)	134(21)	60.4	55(2)	84(20)	65.5	75(2)	175(29)	42.9	118(2)	198(57)	59.6
11	70(1)	172(25)	40.7	69(1)	108(25)	63.9	84(2)	246(52)	34.1	232(2)	265(36	87.5
13	129(1)	201(23)	64.2	104(1)	118(26)	88.1	115(1)	301(38)	38.2	189(1)	346(49)	54.6
14	59(1)	193(32)	30.6	60(1)	129(23)	46.5	166(1)	271(76)	61.3	242(1)	280(69)	86.4
15	189(1)	198(48)	95.5	130(1)	141(37)	92.2	247(1)	282(61)	87.6	158(1)	325(79)	48.6

Note: (**n) =** number of participants evaluated for each variable, indicated in parentheses in the table; **M =** measured; **P =** predicted; **Dif%:** percentage difference in muscle strength between the reference value and the value obtained by the participant; **bold values:** participant with a score above the reference value;
Source: prepared by the authors.

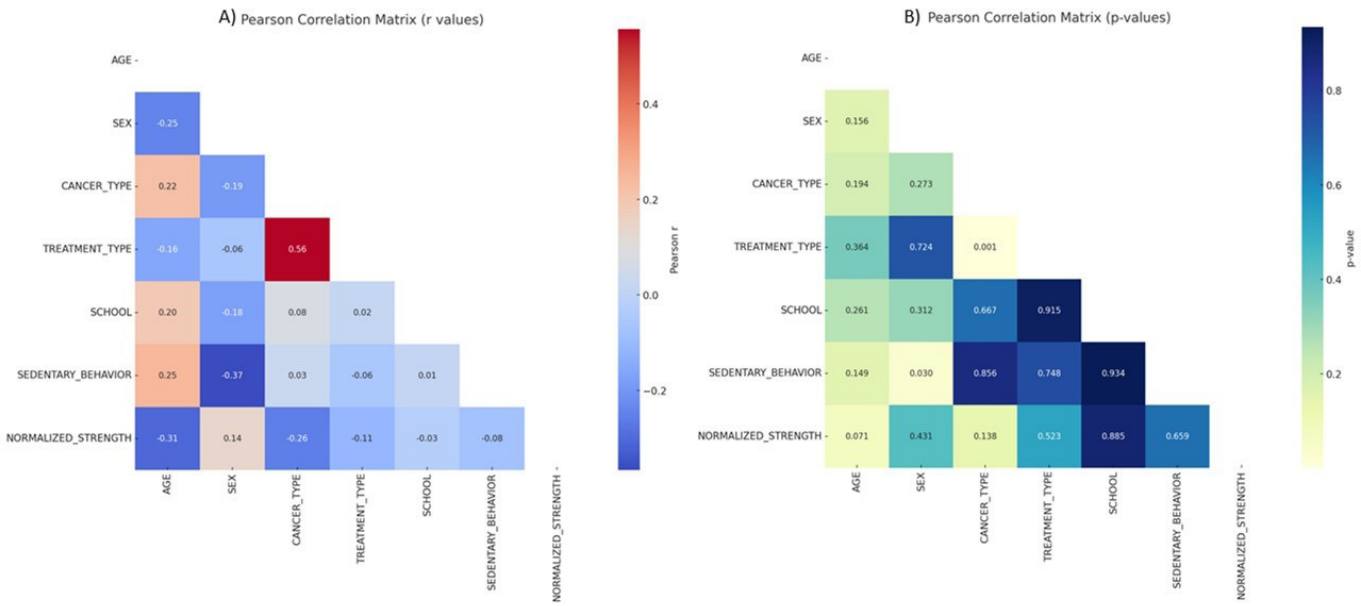

Figure 2. Pearson correlation matrix. A) Matrix of Pearson correlation coefficients (r) between age, sex, cancer type, treatment type, school attendance, sedentary behavior, and normalized muscle strength. B) Corresponding p-values for each correlation. Positive correlations are shown in blue; negative correlations in red. The strength of the correlations was interpreted as follows: Negligible (|r| < 0.09), Low (0.10 ≤ |r| < 0.29), Moderate (0.30 ≤ |r| < 0.49) and High (|r| ≥ 0.50). Darker tones indicate stronger relationships. Abbreviations: r, Pearson correlation coefficient; p, significance value (p < 0.05 considered statistically significant). Source: prepared by the authors.

Table 4. Multiple linear regression model for predictors of muscle strength (STRENGTH PRODUCTION) in pediatric oncology patients (n=35).

Predictor	β (Coef.)	SE	t	p-value
Intercept	–18.20	42.22	–0.43	0.670
Age (years)	10.07	2.58	3.90	0.001
Sex	–13.63	14.72	–0.93	0.362
BMI (kg/m^2)	1.28	2.46	0.52	0.606
Type of treatment	–0.15	22.85	–0.01	0.995
Type of cancer	9.55	17.67	0.54	0.593

Model fit: R^2 = 0.505; Adjusted R^2 = 0.419; F(5,29) = 5.91; p = 0.0007;

Note: β = unstandardized regression coefficient; SE = standard error; BMI = body mass index. The dependent variable was muscle strength production **(N)**. The model included age, sex, BMI, type of treatment, and type of cancer as independent variables. Statistical significance was set at p < 0.05. Age was the only independent predictor significantly associated with muscle strength.

Although age showed a moderate negative correlation with normalized strength (r=–0.31), this was not statistically significant (p=0.071), indicating the need for further research with larger samples.

Additionally, a multiple linear regression model (Table 4) was performed including age, sex, BMI, type or treatment, and type of cancer as predictors of muscle strength. The model was statistically significant (F=5.91, p=0.0007), explaining 50.5% of the total variance in strength production (adjusted R^2=0.419). Age was the only independent predictor of strength (β=10.07, p=0.001), indicating that each additional year of age was associated with an increase of approximately 10 N in muscle force. No independent associations were observed for sex, BMI, treatment type, or cancer type.

DISCUSSION

This study assessed isometric strength of the elbow and knee flexor-extensor muscles and evaluated sedentary behavior via screen time in pediatric oncology patients. It also examined associations between muscle strength and anthropometric factors, sedentary behavior, treatment type, cancer classification (solid vs. non-solid), and school attendance. Aside from Barbosa et al. (2025), this is only the second study conducted in Brazil to assess knee muscle strength in this population, and the first to evaluate elbow flexor and extensor strength in conjunction with sedentary behavior.

With respect to the first hypothesis, both male and female participants demonstrated reduced muscle strength

across all evaluated muscle groups when compared with age-specific reference values. Thus, this hypothesis was confirmed. The second hypothesis was not supported, as muscle strength showed no significant associations with screen time, participants' characteristics, or contextual factors. Although small to moderate correlations were observed for some variables, none reached statistical significance, indicating that in this sample muscle strength was not related to sedentary behavior, cancer type, treatment type, or age.

Regarding sedentary behavior, 42% of patients reported over four hours of weekday screen time, and 31.4% did so on weekends. Although high, these values are slightly lower than those reported by Webster et al. (2023), who found childhood cancer survivors spend more than six hours daily on screen-based activities. Notably, both studies excluded mobile device use from their screen time measures, likely underestimating true exposure.

The high screen time in this population may reflect the clinical and psychosocial effects of cancer treatment. About 70% of childhood cancer survivors experience late treatment effects, such as cardiomyopathy, obesity, insulin resistance, osteoporosis, persistent fatigue, and psychological distress (Gibson et al., 2016; Hamari et al., 2020; Vázquez López, 2024), which can reduce motivation and physical capacity, leading to increased sedentary behavior (Kappelmann et al., 2023). Physical activity levels typically decline after diagnosis and often fail to return to pre-treatment levels even in remission. The combined impact of treatment burden, extended hospitalizations, movement restrictions, and limited access to structured exercise programs likely fosters sedentary habits that begin during treatment and persist long-term (Kelly, 2011; Rapti et al., 2023).

Excessive screen time in this context reflects not just a behavioral choice but the result of multiple treatment-related barriers (Kappelmann et al., 2023). Understanding these obstacles is crucial for developing targeted interventions that encourage physical activity during and after treatment, tailored to each patient's medical condition, fatigue, psychological well-being, and social support. Several barriers to physical activity in pediatric cancer patients have been identified, including fatigue, shortness of breath, physical symptoms, fear of injury, lack of social and medical support, embarrassment about appearance, and excessive screen time (Ross et al., 2018). These obstacles are concerning, as sedentary behavior negatively impacts cognitive and motor development, muscle strength, functional capacity, socialization (Michel et al., 2020; Eroglu and Hazar, 2023; Webster et al., 2023), and metabolic and cardiovascular health in children and adolescents (Pinto et al., 2023).

Physical activity guidelines recommend limiting screen time to no more than 60 minutes daily for children aged 2 to 5 years (Camargo and Añez, 2020), and for those over 5 years, at least 180 minutes of physical activity at any intensity while minimizing sedentary behavior (Camargo and Ciro, 2020). International experts advocate incorporating tailored physical exercise into the routines of children and adolescents with cancer, regardless of diagnosis or treatment stage (Wurz et al., 2021). Such activity can take place in hospitals, schools, or at home and should be supervised by qualified professionals who consider each patient's limits and preferences while maintaining close communication with the medical team to ensure safety and effectiveness.

Isometric strength of the elbow and knee flexors and extensors was, on average, below age-related reference values for both sexes. In males, strength was consistently lower across all ages, while in females, one nine-year-old participant exceeded expected values, highlighting individual variability possibly influenced by personal or contextual factors. Barbosa et al. (2025) assessed knee extensor and flexor strength using the same equipment as the present study and measured upper limb strength with handgrip dynamometry. They found no significant differences in knee strength between childhood cancer survivors and controls, though the comparison was limited by unequal sample sizes (15 vs. 30). Unlike the present study, they included young adult survivors aged 18–21 years.

Differently from our study, in the final analysis of Barbosa et al. (2025), the survivor group included one participant in pre-treatment, five in active treatment, and nine in the maintenance phase. No significant differences in muscle strength were found between pediatric cancer survivors and healthy controls, possibly because most survivors were in the maintenance phase. Additionally, the low physical activity levels in the control group, predominantly inactive or insufficiently active, may have further reduced the likelihood of detecting between-group differences. However, functional capacity tests revealed reduced mobility in pediatric cancer patients compared to controls (Barbosa et al., 2025), likely due to the disease, intensive treatments, and frequent hospitalizations that contribute to increased sedentary behavior (Santo et al., 2024).

Muscle strength during childhood and adolescence is a key health indicator, closely linked to bone mineral density and functional abilities such as climbing stairs, standing, and playing (Ortega et al., 2008; Goodenough et al., 2021). However, chemotherapy and radiotherapy negatively affect muscle mass and function. Marmol-Perez et al. (2024) reported deficits of 57% in handgrip strength and 60% in lower limb strength among childhood cancer survivors (average age 12.1 years), even five years post-treatment, suggesting that long-term treatment effects and sedentary behavior may contribute to persistent muscle weakness. In contrast, in pediatric exercise oncology, clinical trials have shown that combined aerobic and strength training during cancer treatment can improve muscle strength. Stössel et al. (2020) reported that eight weeks of moderate-intensity training during chemotherapy or radiotherapy improved knee flexor strength in children. Similarly, Fiuza-Luces et al. (2017) found that 19 weeks of combined training during chemotherapy significantly increased muscle strength in pediatric patients with solid tumors, whereas the control group showed declines.

These studies demonstrate that physical exercise can effectively improve strength in pediatric cancer patients undergoing treatment, provided that individual needs are respected. However, since these interventions were conducted in well-resourced hospital settings with close monitoring, adapting such models to Brazil's healthcare context will require careful consideration.

The correlation matrix revealed a moderate, statistically significant negative association between sex and sedentary behavior (r=–0.37, p=0.030), indicating that girls exhibited higher levels of sedentary behavior. This underscores the need for targeted interventions that address girls' specific barriers and promote activities tailored to their preferences. This finding aligns with previous research showing that adolescent girls often face more and distinct obstacles to physical activity than boys, including low energy, lack of motivation, self-consciousness, and fear of judgment (Webster et al., 2023). Rosselli et al. (2020) found that girls were significantly more likely than boys to report barriers to physical activity (odds ratio: 1.52; 95% CI: 1.29–1.79), with fatigue and low willpower being the most commonly cited reasons. Systematic reviews further support this sex-based disparity, showing that girls are more affected by internal barriers, such as body image concerns and low self-efficacy, while boys typically report external barriers like lack of time or companionship (Zelenović et al., 2021). Additionally, qualitative studies highlight broader socioecological factors, including societal expectations, peer judgment, and gender norms, that further discourage girls from engaging in physical activity (Cowley et al., 2021).

Although age showed a moderate negative correlation with normalized strength (r = –0.31), this association was not statistically significant (p = 0.071), highlighting the need for further investigation with larger samples. This trend aligns with previous research demonstrating that weight and height are key predictors of muscle strength in children and adolescents, largely due to their relationship with lean body mass and functional capacity (Braam et al., 2016b). Additionally, no significant correlations were found between normalized strength and sedentary behaviour evaluated through screen time, cancer type, or treatment type. This finding is consistent with earlier studies (Marmol-Perez et al., 2024), which reported persistent muscle strength deficits in pediatric cancer survivors, regardless of sedentary behavior levels, suggesting that long-term treatment effects play a critical role in reduced strength.

Although muscle strength values were below age-predicted norms, no association was found between strength and screen time. This may be explained by the fact that reduced muscle strength in pediatric oncology patients is largely driven by treatment-related factors, such as chemotherapy-induced myopathy, prolonged hospitalizations, fatigue (Goodenough et al., 2022), and reduced opportunities for physical activity, rather than by sedentary behaviour alone (Kappelmann et al., 2023). In this population, muscle weakness often reflects the cumulative physiological burden of cancer and its treatment, which may overshadow the influence of screen-based sedentary behaviours (Hamari et al., 2020). Additionally, screen time assessed in this study, may not accurately capture the full range of sedentary activities, particularly because mobile device use was not assessed in the questionnaire (Costa and Assis, 2011), potentially diluting the relationship between sedentary behaviour and muscular function.

In addition to the correlation analysis, a multiple linear regression model was performed including age, sex, BMI, type of treatment, and type of cancer as predictors of muscle strength. The model was statistically significant and explained approximately 50% of the total variance in strength production. Notably, age was the only independent predictor of muscle strength, indicating that each additional year of age was associated with an increase of approximately 10 N in isometric force production. In contrast, sex, BMI, cancer type, and treatment type were not independently associated with muscle strength when adjusted for age.

This finding highlights the central role of biological growth and neuromuscular maturation in strength development during childhood and adolescence. Although cancer diagnosis and treatment are known to impair muscular function, the regression model may indicates that maturational factors had a stronger influence on muscle strength than anthropometric or disease-related variables in this sample, consistent with previous studies (Braam et al., 2016a; Markarian et al., 2025). This may explain why, despite substantial deficits relative to age-predicted norms, muscle strength was not independently associated with sedentary behaviour, cancer type, or treatment type.

In light of these findings, this study is notable for its pioneering assessment of elbow flexor and extensor muscle strength in Brazilian children and adolescents with cancer. It also advances understanding of the effects of oncological treatment on muscular function and sedentary behavior in this population. The use of objective and validated measurement tools, such as hand-held dynamometry, combined with a sample representing different treatment phases, strengthens the clinical relevance and applicability of the results.

Nevertheless, several limitations should be acknowledged. The absence of a control group limits direct comparisons with healthy peers, and the small sample size restricts the generalizability of the findings. Additionally, the study lacked data on the total number of pediatric cancer patients undergoing treatment during the research period, the duration of each patient's treatment, and information on those who declined participation or were unable to complete the tests due to physical limitations or treatment side effects. Sedentary behavior assessment relied on parent-reported screen time, which did not account for mobile device use, likely leading to an underestimation of actual sedentary exposure.

Furthermore, psychosocial variables, which could offer a more comprehensive understanding of the patients' quality of life, were not included. Lastly, the cross-sectional design limits the ability to infer causal relationships between variables, highlighting the need for longitudinal studies to track changes in muscle strength over the course of treatment and to evaluate the effectiveness of interventions aimed at reducing sedentary behavior in this population.

CONCLUSION

Pediatric patients undergoing oncology treatment showed muscle strength values below age-predicted norms, indicating marked deficits in both upper and lower limb performance in male and female. Screen time levels were elevated across participants; nonetheless, no significant association was identified between screen time and muscle strength. The multiple regression analysis demonstrated that age was the only independent predictor of muscle strength, highlighting the predominant influence of maturational factors on force production in this population. Together, these findings highlight that reduced muscle strength and high sedentary behavior coexist in this population, but appear to occur independently.

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CONFLICTS OF INTEREST

The authors have declared that no competing interests exist.

DATA AVAILABILITY

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author upon request.

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