Pediatric Exercise Science, (Ahead of Print)
https://doi.org/10.1123/pes.2023-0065

First Published Online: Mar. 27, 2024

Human Kinetics
ORIGINAL RESEARCH

Accelerometer and Survey Assessed Physical Activity in Children With Epilepsy: A Case-Controlled Study

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Purpose: Anecdotal evidence suggests that children with epilepsy (CWE) are limited in the frequency of their daily physical activity (PA). However, there is limited research utilizing device-based measures of PA. We compared levels of PA and sedentary behavior in CWE (11–15 y) and age- and gender-matched healthy controls. ***Method:*** Participants (n = 60 CWE [25 males, 35 females] and n = 49 controls [25 males, 24 females]) wore a Actigraph accelerometer (GT3X or GT3X+) for 7 consecutive days during waking hours and self-reported their PA and sedentary behaviors. CWE were compared with control children on time spent in different intensities of PA and on self-reported PA and sedentary behavior. Factors associated with PA were analyzed using linear regression. ***Results:*** CWE spent less time in accelerometer assessed light (189.15 vs 215.01 min/d, $P < .05$) and vigorous PA (35.14 vs 44.28 min/d, $P < .05$) on weekdays compared with controls. There were no significant differences between CWE and control participants in accelerometer assessed time spent sedentary or time spent in PA on weekends. Among CWE, older children engaged in more reported sedentary behavior and younger children spent more time in most domains of PA ($P < .05$). Furthermore, CWE reported less PA than controls ($P = .006$). Sixteen percent of controls met World Health Organization PA guidelines compared with 10% of CWE. There was a positive relationship between accelerometer assessed PA and quality of life for CWE. ***Conclusion:*** CWE spent less time in light and moderate to vigorous PA on weekdays. Further research is needed to understand reasons for these differences.

Keywords: quality of life, seizures, adolescents, exercise

Key Points

- Children with epilepsy (CWE) spent less time than controls in accelerometer assessed light and vigorous physical activity (PA) on weekdays.
- There were no significant differences between CWE and controls on weekends.
- Sixteen percent of controls met World Health Organization PA guidelines compared with 10% of CWE.
- There was a positive relationship between PA and quality of life for CWE.

During childhood and adolescence, lifestyles that include adequate levels of physical activity (PA) and low levels of sedentary time (ST) are essential to support growth, maintain positive physical and mental health, prevent chronic disease and promote healthy weight trajectories (11,38,40). However, many young people are insufficiently active (ie, do not meet the World Health Organization recommended minimum of an average of 60 min of moderate to vigorous PA per day [8]), and spend prolonged periods of time sedentary (eg, sitting at school and during leisure time [43]). Low levels of PA are of particular concern for young people living with disabilities and chronic medical conditions (9), not least because of the power of PA in improving health and overall well-being.

Epilepsy is the most common serious neurological condition in childhood. It is a disease of the brain typically defined by the presence of 2 unprovoked (or reflex) seizures occurring >24 hours apart or the presence of an epilepsy syndrome (22). The prevalence of epilepsy in children ranges from 3.2 to 5.5/1000 children in developed countries and 3.6–44/1000 children in underdeveloped countries (21). In addition to epileptic seizures, many children with epilepsy (CWE) have co-occurring neurodevelopmental and mental health difficulties including an increased risk for intellectual disability, difficulties with motor coordination, autism, attention deficit hyperactivity disorder, depression, and anxiety (12,39). Therefore, it is important to consider these difficulties are possible contributors to levels of PA in CWE. Additionally, previous research suggests that seizure-related factors may be related to levels of PA in some CWE (29). Previous studies have also shown that age, gender, sleep, and body mass index (BMI) are associated with levels of PA in children in the general population (6,17,32,33,44) and in some survey-based studies of PA in CWE (29). Parental mental health difficulties are more common in CWE than parents of healthy children (20,28). Additionally, parental mental health problems have been associated with reduced PA in children with some chronic health conditions (16), and therefore, it is important to consider parental mental health when exploring contributors to PA in CWE.

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A recent systematic review found, based on self- or parent-report data, that children and adults with epilepsy engage in less PA than their peers (29). CWE who are physically active have better physiological and psychological profiles than those with epilepsy who are not active (13). However, there is evidence that CWE are often subjected to restrictions on PA participation because of parental concerns about injury, concerns about safety in relation to the occurrence of seizures, and a lack of understanding of the benefits and risks associated with PA participation (50).

Children and adolescents with epilepsy are at increased risk of social isolation (36), and PA could play a role in improving quality of life (QoL) and social integration. However, to better understand PA levels and the outcomes associated with PA among CWE, so that PA can be promoted, it is essential to accurately measure the behavior. To date, few studies have utilized more objective devices (such as accelerometers) to assess PA among CWE. Studies have shown that pedometers are feasible to assess step counts among CWE (15,49) but to date there are no studies utilizing accelerometers. Accelerometers are able to provide more robust and detailed information on time spent in different intensities of PA.

The Physical Activity in Children with Epilepsy (PACE) study is an observational study of PA levels among young adolescents (11–15) with "active" epilepsy and age-matched peers. The aim of this study is to compare levels of PA among children with "active" epilepsy (CWE), and age- and gender-matched healthy controls, using both accelerometers and survey methods. Furthermore, this study aims to examine factors (eg, age, gender, BMI, seizure-related factors, sleep, behavior-emotional functioning, motor coordination, and parent well-being) associated with accelerometer assessed PA in CWE and to examine the associations between PA and QoL.

Methods

Study Procedure

Following ethics approval from the West of Scotland Research Ethics Committee (REC) 3, cross-sectional data were collected between March 2020 and June 2022. Recruitment to the study began in March 2020, but was subsequently put on hold due to COVID-19 restrictions. The study re-opened in April 2021 and a blended approach to recruitment was adopted where potential participants could either self-refer via an online portal (which was advertised via PACE Study Flyer; thechannel.org.uk) or were referred to the study from 2 participating hospitals. Once CWE had registered their interest in the study, they were then contacted by the research team via telephone or video call and introduced to the study. Digital written consent from caregivers and assent from children were then taken before participation in the study could commence. Those who had provided consent to take part in the study received a package through the post containing questionnaires for completion at home and an accelerometer to wear for days.

To be eligible for the study, CWE needed to have "active" epilepsy (ie, currently taking anti-seizure medicine and/or had a seizure within the last 12 mo). Parent reported epilepsy diagnoses were validated against medical records provided via a clinical extraction document completed by the children's general practitioner or pediatrician (see Supplementary Material S1 [available online]). Control participants were children matched on age with the participants with epilepsy. Children in both groups with significant physical/motor impairment that restricted ability to participate in PA were excluded. This was formally defined as having a Gross Motor Function Classification System (GMFCS) greater than level 2. Children at GMFCS levels 1 and 2 could be included. The children in both groups had to be attending secondary school in England and be aged between 11 and 15 years at the time of participation.

Recruitment

Figure 1 shows recruitment in PACE study.

In total, 94 CWE expressed an interest in participating (n = 79 from mainstream school and n = 15 from special schools). Eighteen participants dropped out before providing consent, 13 withdrew after providing consent, and 3 did not complete the assessments. One of the primary reasons for withdrawal (n = 10) was concerns about wearing the accelerometer, a particular concern was that it would be visible to others. Eighty-eight children expressed an interest in participating in the control group (84 mainstream school and 4 special school). Twenty-eight controls dropped out before providing consent, and a further 5 dropped out after providing consent. A further 6 participants did not complete the full assessment process. In total, there were 60 CWE who completed the assessment and 49 control participants. One epilepsy and one control participant completed the survey measures but did not provide accelerometer data.

Measures

Accelerometer Assessed PA and Sedentary Behavior

All participating children received an Actigraph accelerometer (GT3X or GT3X+) through the post with detailed instructions on how to wear it. All children were asked to wear the accelerometer on an elasticated belt, over their right hip for 7 consecutive days during waking hours. Children were instructed to remove the devices when sleeping or during water-based activities to limit discomfort and potential device damage. Actigraph accelerometers are an established measure of PA and ST among all populations (26,41).

Accelerometers were initialized to collect data at 100 Hz using ActiLife version (version 6.13.4), and the data were re-integrated into 15-second epochs and processed using Kinesoft (version 3.3.20, https://www.kinesoft.org). Periods of ≥60 minutes of consecutive zeros (with a tolerance of 2 min of nonzero interruptions) were classified as nonwear time and excluded, as was the period 12 AM to 7 AM to minimize possible misclassification of overnight wear/sleep as ST.

A day was defined as valid when participants had worn the accelerometer for at least 480 minutes. All participants with at least 3 valid days were included in the analyses. Accelerometer data were expressed as average counts per minute (CPM), which is the total counts per valid day, divided by valid monitor wear time per day. ST was considered when CPM were less than 100, light PA when CPM were between 101 and <2995, moderate PA when CPM were between 2995 and <4012, and vigorous PA when CPM were 4012 or more, following established cut points by Evenson (18).

Survey Measures of PA

All participants were asked to complete the Physical Activity Questionnaire for Adolescents (PAQ-A), a 7-day recall used to assess general PA levels ([30]; see Supplementary Material S2 [available online]). The PAQ comprises 13 validated questions relating to PA undertaken in the previous week and is designed for school-age children and young people. Each question is scored out of 5 and a final score is calculated as the mean of all 9 responses; higher scores indicate higher activity.

The original questions were validated for a Canadian population and so minor revisions were made in terms of sporting activities and phrasing to adjust for cultural and sporting preferences in the United

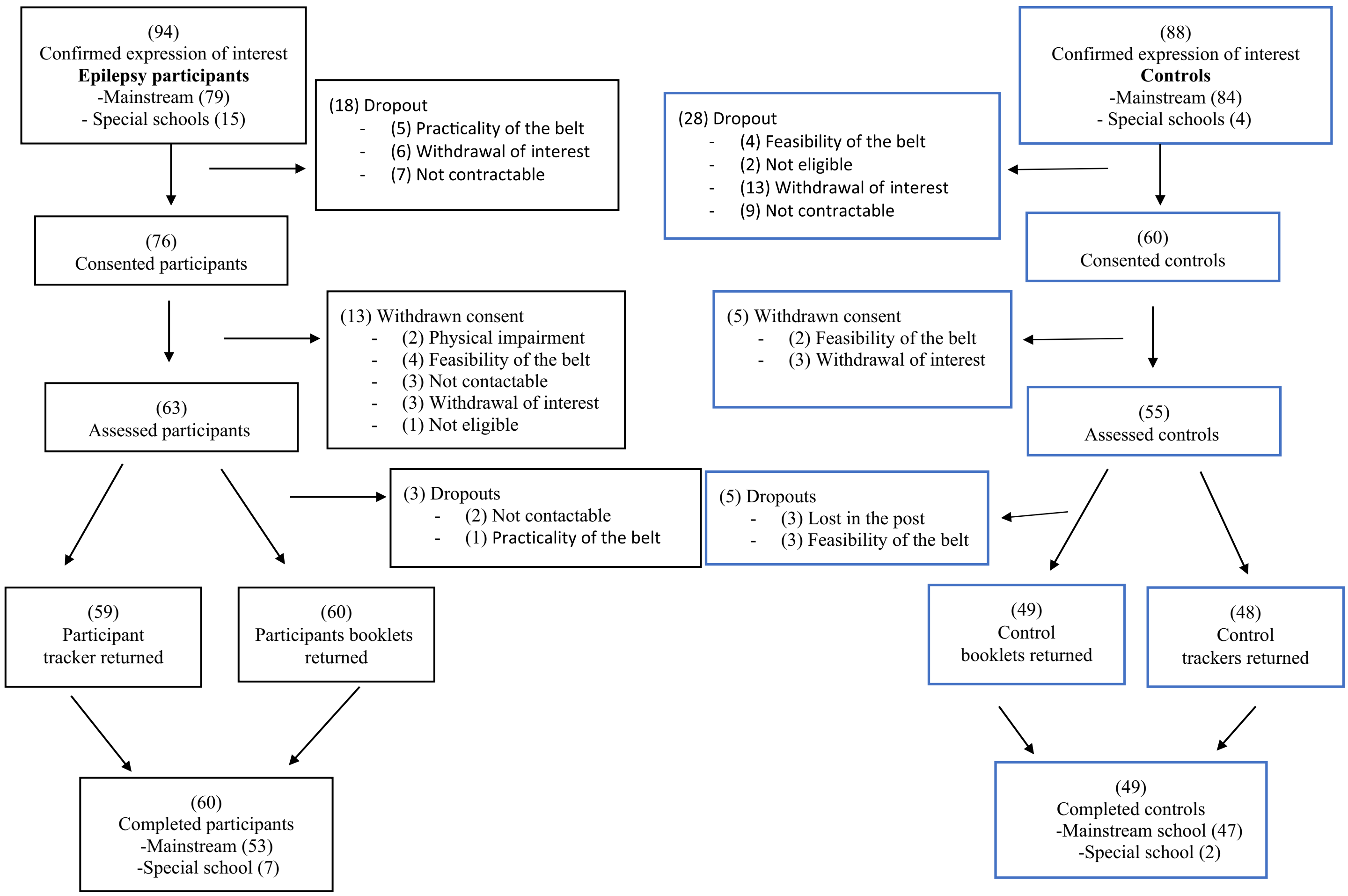

Figure 1 — Recruitment in The PACE study. PACE indicates Physical Activity in Children with Epilepsy.

Kingdom. In particular, question 1 lists 22 sports that respondents are asked to quantify involvement in over the preceding week; in place of floor hockey, street hockey, ice hockey, ice skating, baseball, and Canadian football, we inserted tennis, athletics, cricket, rugby, martial arts, and gymnastics. Previous studies conducted in the United Kingdom and other countries have shown that the revision of questions to suit the local population provides satisfactory results and validity (1,3,27,46). Questions 2–10 relate to activity at specific times of the day and question 11 asks how often PA was performed for each day of the preceding week. Questions 12 and 13 focus on injuries which may have impeded engagement in PA.

Participants were also asked to complete the Adolescent Sedentary Activity Questionnaire (ASAQ [24], see Supplementary Material S3 [available online]), which focuses on self-reported weekday and weekend sedentary behaviors (outside of school). Participants reported the duration of time they engaged in a variety of sedentary behaviors in their free time on a typical weekday and weekend day. The ASAQ measures 11 sedentary behaviors across 5 different domains: small screen recreation (TV, videos/DVDs, and computer for fun), education (doing homework with/without a computer and being tutored), travel (seated in a vehicle), cultural (reading, playing an instrument, crafts, or hobbies), and social (sitting around with friends, talking on the telephone, and religious activities). Time spent in each domain was calculated. Totals from the 5 categories were then summed to yield 3 outcomes; total time spent in sedentary behavior on weekdays, total time spent in sedentary behavior on weekend days, and total time spent in sedentary behavior during the week (ie, weekdays + weekends).

BMI was calculated using the National Health Service healthy weight calculator (https://www.nhs.uk/live-well/healthy-weight/bmi-calculator/, accessed November 12, 2022). BMI was determined for each participant based on their height and weight. This calculator is based on the measurements found within the UK national growth charts (45,53). The calculator provides BMI scores as a percentile, with percentiles then falling into 4 categories: underweight (on the 2nd percentile or below), healthy weight (between the 2nd and 91st percentile), overweight (on the 91st percentile or above), and very overweight (on the 98th percentile or above).

Epilepsy Variables

In the CWE, we collected data on clinical parameters (eg, seizure frequency via a seizure diary, current epilepsy medication, age of epilepsy onset, number of seizure types) and current educational provision from medical records (see Supplementary Material S1 [available online]) and parent report.

Deprivation

Index of Multiple Deprivation (IMD) was calculated for each participant based on their home post codes. This is an indicator of area-level deprivation, using the IMD 2019 rankings (Department of Communities and Local Government); English indices of deprivation retrieved from https://imd-by-postcode.opendatacommunities.org/ (accessed during study period). Lower scores are associated with lower deprivation.

Measures of Child Behavior and Caregiver Well-Being

The children and caregivers in both groups completed the following assessments: Strengths and Difficulties Questionnaire—a measure of child behavior/mental health (23), Pediatric Quality of Life Inventory (self-report)—a measure of quality life in children (47), and the Insomnia Severity Index—a measure of sleep difficulties (2). The primary caregiver of the CWE and controls also completed the Developmental Coordination Disorder Questionnaire (51)—a measure of child motor coordination. Additionally, all primary caregivers completed the Depression Anxiety Stress Scale (25) which is a measure of parental mental health.

Analyses

Descriptive statistics were used to characterize the participants. Time spent in sedentary, light, moderate, and vigorous PA on weekdays and weekend days were compared between the epilepsy group and control groups using independent sample *t* tests. Regarding gender, between-group differences were also explored using independent *t* tests. We compared total score and individual question scores on the PAQ-A and subscales on the ASAQ between the 2 groups using sample independent *t* tests.

Univariable linear regression was used to identify factors associated with sedentary behavior and activity levels on weekdays and weekend days. Factors associated at the $P < .200$ level on univariable analyses were included in multivariable linear regression modeling (34). Factors considered were epilepsy variables (eg, seizure frequency, age of first seizure, anti-seizure medicine status), child factors (eg, gender, age, socioeconomic status [via IMD data], sleep, emotional behavioral difficulties, coordination difficulties, school placement), and caregiver mental health. All analyses were done with IBM SPSS (version 28.0).

Results

Demographics of CWE and Children in the Control Group

Table 1 shows the characteristics of the CWE and the participants in the control group. There was no significant difference between the 2 groups with respect to gender, age, school type, ethnicity, deprivation, and BMI.

The control group was similar to the general population with respect to ethnicity (control group White/non-White 84%/16% and general population in England White/non-White 82%/18%; https://www.ethnicity-facts-figures.service.gov.uk/, accessed October 17, 2023). In the control group, 47% of children were in the lowest 5 deciles (most deprived) and 53% were in the highest 5 deciles (least deprived) of the IMD index and thus similar to the proportions in the general population.

Comparison Between CWE and Children in Control Group Regarding Sedentary Behavior and PA

Table 2 shows a comparison between the 2 groups with respect to accelerometer measured ST and PA during weekdays and weekend days.

Fifty-one CWE and 38 controls had valid data from the accelerometer for weekdays, and 47 CWE and 33 controls had valid data for the weekend days. CWE wore the accelerometer for just over 13 hours on a weekday and around 12 hours on a weekend day. The control participants wore the accelerometers for approximately 20 minutes more than CWE on a weekday and 30 minutes more on a weekend day (Table 2). CWE spent 71% of their weekday and weekend day sedentary, whereas control participants spent 68.5% of their wear time sedentary. There were no significant differences between CWE and control participants in time spent sedentary on weekdays or weekend days (Table 2). CWE spent significantly less time in light, vigorous, and moderate to vigorous PA on a weekday (Table 2). Sixteen percent of control children met the World Health Organization PA guidelines (https://www.who.int/news-room/fact-sheets/detail/physical-activity, accessed April 24, 2024) compared with 10% of CWE.

Factors Associated With Accelerometer Assessed ST and PA

Table 3 shows the factors significantly associated ($P < .05$) with accelerometer assessed ST and PA in the multivariable analysis. All considered factors and associated p values are in Supplementary Material S4a (available online; epilepsy group) and Supplementary Material S4b (available online; control group).

In the epilepsy group, the factor most consistently associated with ST and PA was age. Older children accumulated significantly more ST, and younger children spent significantly more time in most types of PA. Children in special schools engaged in significantly less moderate PA than children in mainstream schools on both weekdays and weekends. Additionally, children with an earlier onset of seizures engaged in significantly less moderate and vigorous PA on weekdays than children with a later onset of seizures. In contrast to the epilepsy group, younger age was only associated with increased light PA on weekdays in the control group. Additionally, being female was associated with less light PA on weekdays and less moderate PA on weekends in the control group.

Gender—Between-Group Analysis on Accelerometer

Males with epilepsy engaged in more sedentary behavior and less PA than males in the control group. However, the only statistically significant difference was for light weekday PA ($P = .035$; see Supplementary Material S4c [available online]). For females, the epilepsy group engaged in more sedentary behavior than the control group, but the differences did not reach statistical significance. For PA, females in the epilepsy group engaged in less activity than the control group for most intensities but there were no statistically significant differences between the groups.

Comparison Between CWE and Children in Control Group on Survey Measures

CWE reported less PA (PAQ-A total score) than participants in the control group ($P = .006$). At the individual question level, CWE reported less physical active for: "Active travel to school" ($P < .001$), "Active during physical education classes" ($P = .014$), and "Active travel from school" ($P < .001$) (see Supplementary Material S5a [available online]). There were no differences between the groups regarding the domains of activities engaged in

Table 1 Characteristics of Children in PACE Study

	Participants with Epilepsy (n = 60)	Controls (n = 49)	*P*
School type			
Mainstream	53	47	.139
Special	7	2	
Age, mean (SD), y	12.9 (1.41)	12.8 (1.39)	.815
Range	11–16	11–15	
Gender			
Female	25 (41.7%)	25 (51%)	.330
Male	35 (58.3%)	24 (49%)	
Ethnicity			
White	52 (86.7 %)	41 (83.7%)	.660
Non-White	8 (13.3%)	8 (16.3%)	
Index of multiple deprivation, mean (SD)	5.9 (3.02)	6 (3.03)	
Low (1–5)	28	23	.977
High (6–10)	32	26	
Body mass index centile categories			
Underweight	3 (5%)	2 (4.1%)	NA
Healthy weight	40 (66.7%)	34 (69.4%)	
Overweight	11 (18.3%)	9 (18.4%)	
Very overweight	6 (10%)	(8.2%)	
Body mass index categories			
Healthy weight	40 (66.7%)	34 (69.4%)	.762
Unhealthy weight	20 (33.3%)	15 (30.6%)	
Reported neurodevelopmental diagnosis	4	1	.376
ADHD	10	0	.002
Autism	1	0	1.000
DCD	11	1	.011
Seizure frequency			
Weekly or more often	26 (43.3%)	NA	NA
Monthly or less often	34 (56.7)	NA	NA
Seizure type			
1 seizure type	27	NA	NA
2 seizure type	18	NA	NA
3 seizure type	15		
Seizures reported while wearing activity tracker			
Yes	14 (23.3%)	NA	NA
No	46 (76.7%)	NA	NA
Age of onset of epilepsy, mean (SD), y	8.05 (3.93)	NA	NA
Range	0.01–15	NA	NA
Number of current ASMs			
Mean (SD)	1.72 (1.12)	NA	NA
Range	1–5	NA	NA
Polypharmacy (prescribed more than one ASM)			
Yes	30 (50%)	NA	NA
No	30 (50%)	NA	NA

Abbreviations: ADHD, attention deficit hyperactivity disorder; ASM, anti-seizure medicine; DCD, developmental coordination disorder; NA, not applicable; PACE, Physical Activity in Children with Epilepsy.

(Supplementary Material S5a [available online]). There were also no significant differences on the report time in any of the subdomains of sedentary behaviors (ASAQ) for weekdays or weekends (see Supplementary Material S5b [available online]).

QoL for CWE and Children in Control Groups

There was a positive correlation between PA (of all intensities) and self-reported QoL in CWE. Lower QoL was associated with higher

Table 2 Accelerometer Data for CWE and Controls on Weekdays (n = 51 CWE and n = 38 Control) and Weekend Days (n = 47 CWE and n = 33 Control)

	CWE Mean (SD)	Control Mean (SD)	*P*	Mean difference	Effect size Cohen *d* 95% CI
Weekday wear minutes per day	802.31 (117.70)	822.09 (79.45)	.374	−19.779	−0.612 to 0.230
Weekend day wear minutes per day	736.81 (140.83)	767.41 (108.22)	.297	−30.600	−0.684 to0.209
Weekday sedentary minutes per day	577.29 (115.59)	561.83 (78.879)	.480	15.456	−0.269 to 0.572
Weekend day sedentary minutes per day	526.59 (136.04)	534.17 (109.03)	.791	−7.580	−0.505 to 0.385
Weekday light physical activity minutes per day	189.15 (51.74)	215.01 (53.94)	.024*	−25.864	−0.916 to −0.630
Weekend day light physical activity minutes per day	181.30 (58.71)	202.98 (64.58)	.123	−21.683	−0.802 to 0.095
Weekday moderate physical activity minutes per day	18.10 (7.01)	21.20 (8.09)	.057	−3.098	−0.837 to 0.012
Weekend day moderate physical activity minutes per day	13.13 (8.76)	13.64 (11.86)	.825	−0.511	−0.495 to 0.395
Weekday vigorous physical activity minutes per day	17.04 (11.53)	23.08 (14.60)	.032*	−6.04	´−0.892 to −0.040
Weekend day vigorous physical activity minutes per day	15.00 (14.61)	15.97 (25.24)	.776	−0.965	−0.510 to 0.381
Weekday MVPA minutes per day	35.14 (16.87)	44.28 (19.27)	.020*	−9.14	−0.935 to −0.082
Weekend day MVPA minutes per day	28.13 (22.04)	29.61 (25.45)	.783	−1.476	−0.508 to 0.383

Abbreviations: CI, confidence interval; CWE, children with epilepsy; MVPA, moderate to vigorous-physical activity.
*$P < .05$.

sedentary behavior. For weekend moderate to vigorous PA, the relationship reached statistical significance ($P = .008$; see Supplementary Material S6 [available online]). Similar relationships were found for participants in the control group. A positive relationship was also noted between survey measured PA on the PAQ-A and QoL in CWE ($P = .002$) and the control group ($P = .012$).

Discussion

This study provides novel pilot data on accelerometer assessed PA in secondary school-aged CWE in comparison with age- and gender-matched controls, as well as data on factors associated with PA in this age group. Data from the accelerometers indicate that young people with epilepsy engage in less PA than peers across a range of PA intensities. The survey data also revealed less self-reported PA among the CWE. Chronological age would appear to be an important factor for PA in CWE, such that PA levels reduce with increasing age, even after considering other possible contributory factors.

This is one of the first studies to provide accelerometer measured PA in CWE and thus comparisons with previous studies are difficult. The fact that young people with epilepsy of secondary school age engage in less accelerometer assessed PA than their peers has potential negative implications. Physical inactivity is associated with many noncommunicable diseases and has significant economic costs for health care systems and wider society (14,31). Additionally, research has established that levels of PA in childhood track into adulthood (45), highlighting the need to facilitate behavior change as early as possible. In addition to the physical benefits (48), engaging in PA is also associated with improvements in cognitive functioning (5) and has mental health benefits (4), both of which are often challenges for young people with epilepsy.

The survey data provide novel contextual information on PA and suggest that young people with epilepsy may not be engaging in PA to the same degree as peers, which is in line with a previous survey-based study of CWE compared with peers (37) and sibling controls (52). Differences were noted surrounding activity during travel to and from school and during physical education classes. Regarding travel to school, it may be that caregivers are reluctant to let CWE walk/cycle to school unaccompanied due to the perceived risk of having seizures. A potential solution would be to travel with a caregiver or peers; however, or look to “compensate” (ie, fit in extra PA) elsewhere in the day. Regarding physical education classes in school, extra training may be needed for school staff so that they understand that CWE can engage in the same activities as peers once an appropriate risk assessment has been undertaken. The differences noted in the survey data for travel to school and physical education classes might, at least partly, explain the lack of significant differences between CWE and control participants in time spent on accelerometer measured PA at weekends. However, more research is needed to explore why differences exist between weekday and weekend activity levels.

This study also reports on factors which are associated with PA. We observed a negative association between age and PA in CWE. This reduction in PA with age has also been noted in the general population of adolescents (19) regarding moderate to vigorous PA, and thus, it will be important to see if there are epilepsy specific issues at play and if the reduction in PA of all intensities happens at a similar rate. It might be that as sports/activities become more formalized during the adolescent years, young people with epilepsy are restricted from accessing these more structured sporting activities due to barriers including lack of knowledge of epilepsy and seizure management. The data from the measure of QoL suggest that engaging in more PA is associated with better QoL, and this is an observation seen in other clinical and nonclinical populations (35). Given that QoL is so reduced in young people with epilepsy (42), increasing PA is likely to have benefits across a range of QoL domains.

In terms of feasibility, data from the current study suggest that using accelerometers is a feasible way to measure PA in young people with epilepsy. This is line with a previous study which suggests that CWE would wear pedometers to measure PA (7,49). However, the fact that 10 CWE dropped out from the study after expressing interest, citing wearing of the accelerometer as an explanation, means alternative methods should be explored. The literature has seen a move toward wrist-worn accelerometery in part because it is less visible and has shown high compliance with adolescence (10). Thus, future research in CWE should consider using wrist-worn accelerometers.

Table 3 Factors Significantly Associated With Sedentary Behavior and PA in Children With Epilepsy and Children in Control Group on Multivariable Analysis

Variable	Sedentary weekday	Sedentary weekend	Light PA weekday	Light PA weekend	Moderate PA weekday	Moderate PA weekend	Vigorous PA weekday	Vigorous PA weekend
Participant age	.001; 37.444 (95% CI, 15.881 to 59.007)[a]	.021; 32.875 (95% CI, 5.249 to 60.500) [a]	.006; −14.147 (95% CI, −24.391 to −4.443)[a] .003; −16.428 (95% CI, −26.298 to −5.928)[b]	<.001; −21.706 (95% CI, −32.840 to −10.573)[a]		.001; −2.775 (95% CI, −4.413 to −1.136)[a]		.017; −3.708 (95% CI, −6.720 to −0.695)[a]
Gender			.007; −39.854 (95% CI, −68.104 to −11.604)[b]		.048; −5.171 (95% CI, −10.284 to −0.059)[b]			
School type					.028; −6.876 (95% CI, −12.991 to −0.762)[a]	.009; −9.003 (95% CI, −15.653 to −2.352)[a]		
Mental health/ behavior				.044; −3.247 (95% CI, −6.409 to −0.085)[b]				
Motor coordination			.045; 1.024 (95% CI, .025 to 2.024)[b]				.040; 0.347 (95% CI, 0.017 to 0.676)[b]	
Age of seizure onset					.037; −0.059 (95% CI, −1.084 to −0.035)[a]		.004; −1.229 (95% CI, −2.036 to −0.423)[a]	
Epilepsy medication			.027; −30.371 (95% CI, −57.141 to −3.600)[a]			.007; −6.337 (95% CI, −10.848 to −1.27)[a]		

Abbreviations: CI, confidence interval; PA, physical activity. Note: Data are presented as (*P* values) and regression coefficient (95% CI).
[a]Children with epilepsy. [b]Children in control group.

Study Limitations

There are several limitations that should be considered when interpreting the findings of the current study. First, we had difficulties recruiting CWE and controls who attend special schools. Our limited sample size should be considered when interpreting the results of our statistical analysis. In order to account for the potential impact of COVID-19 restrictions, we used a healthy control group. Despite this, it is still possible that COVID-19 restrictions impacted on the groups differently. We had also initially hoped to assess the children's cognitive abilities via formal cognitive testing. Unfortunately, this proved impossible as we had to abandon in-person visits in order to adhere to COVID-19 guidelines at the time of testing. Furthermore, the analyses were unable to consider the potential impact of variation in biological maturity status of the children had on the results of the study. Strengths of this study included age- and gender-matched controls and the use of accelerometers to assess PA.

Clinical Implications and Future Research

Clinicians (eg, pediatricians, pediatric neurologists, and epilepsy nurses) working with the pediatric epilepsy population should routinely ask about levels of PA in CWE and potential barriers for participating. There is also a clear need for epilepsy professionals to liaise with parents and schools to ensure that CWE can engage in PA outside and inside schools so that CWE are not excluded from PA.

There is a need for more data on PA with larger samples but also considering younger children and children attending special schools. In terms of CWE attending special schools, it is likely that to gather this data there we will need to further engage with special schools regarding recruitment and consider whether waist-worn accelerometers are the most appropriate way to collect data in this group. Interventions to promote PA in CWE should be developed with the young people and outcome measures should include not only PA measures but also QoL and mental health measures.

Conclusion

Secondary school age CWE (aged 11–15 y) in the United Kingdom engaged in less PA than peers across a range of intensities on weekdays. There is a need for further research to better understand PA in CWE across the age ranges to inform the development of interventions to increase PA in this group.

Acknowledgments

The PACE team would like to thank all participating children and their caregivers. We would also like to thank supporting doctors and nurses at the 2 participating hospitals who supported recruitment. **Funding**: The study was funded by the Waterloo Foundation, the Wyfold Charitable Trust and Young Epilepsy. **Author Contributions:** Idowu and Pearson are joint first authors.

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