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Swedish Adolescents With Impairments Showed Lower Levels of Physical Activity, Fitness and Sports Participation

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ABSTRACT

Aim: Evidence on physical activity (PA), sedentary time, and fitness in adolescents with impairments has been limited. We aimed to compare outcomes in Swedish adolescents with and without impairments and between impairment types.

Methods: This cross-sectional study, from September to December 2019, comprised of adolescents from 34 mainstream schools within 3 h' drive of Stockholm, Sweden. Parents reported impairment status. PA and sedentary time were measured with accelerometers during school and leisure time on weekdays and weekends. Fitness was estimated using the Ekblom-Bak submaximal cycle test, sports participation was self-reported and multilevel mixed models were used for analyses.

Results: We enrolled 972 adolescents (51% girls), with a mean age of 13.4 ± 0.3 years. Just under a third (31%) had impairments. Adolescents with impairments showed lower PA levels, less adherence to recommendations, lower fitness and less participation in organised sports than those without impairments. Those with learning or visual impairments engaged in less vigorous activity and the former had lower fitness levels.

Conclusion: Adolescents with impairments were less physically active, more sedentary and had lower fitness than peers without impairments. This emphasises the need for equitable opportunities for PA, to support long-term health and well-being in adolescents with impairments.

1 | Introduction

Approximately 240 million children and adolescents globally live with disabilities [1]. Rates of disabilities in Europe have varied, for example, from 8% to 28% among adolescents [2]. Self-reported data on 13-year-old Swedish adolescents showed that 24% of girls and 21% of boys were living with disabilities [3]. Swedish adolescents with mild impairment attend mainstream schools, and adapted curriculums or special classes are possible [4].

Living with disabilities often involves impairments that limit participation in society, and this contributes to social inequalities [5]. Physical activity (PA) has been linked to numerous

Abbreviations: MVPA, moderate-to-vigorous physical activity; PA, physical activity.

Summary

- Data have been lacking on physical activity and sedentary time among Swedish adolescents with and without impairments.
- We studied 972 adolescents from 34 Swedish mainstream schools and those with impairments showed lower PA levels, less adherence to recommendations, lower fitness and less participation in organised sports than those without impairments.
- Adolescents with learning or visual impairments engaged in less vigorous activity and the former had lower fitness levels.

health benefits in all groups of children and adolescent [6]. However, a review found that children with impaired vision typically engaged less in PA and had lower fitness [7].

Adolescents with impairments may face several challenges in engaging in PA. These include reduced motor competency in those with physical impairments [8]. They also include difficulties in processing instructions in those with cognitive impairments [9] and social exclusion in those with sensory impairments [10].

Despite this, there has been a lack of studies that have assessed PA and fitness levels among adolescents with different types of impairments, especially in mainstream schools. This information gap makes it challenging to produce evidence-based tailored interventions [11].

Robust evidence is needed and reliable measurement methods should be used, such as accelerometers to explore differences in PA and fitness levels across impairment groups [12]. Accelerometers also provide detailed information on PA patterns, including intensity levels, during various periods, such as school and leisure time. This evidence can help to identify key time periods where interventions can be used to improve PA and fitness in adolescents.

The main aim of this study was to investigate differences in PA patterns, sedentary time, and fitness levels between Swedish adolescents with and without impairments who attended mainstream schools. We wanted to compare various time periods, such as school and leisure time on weekdays and weekends. A secondary aim was to investigate whether these associations varied by the type of impairment, including motor, learning, and visual impairments, when adolescents were compared with peers without impairments.

2 | Materials and Methods

2.1 | Study Design, Setting and Participants

This cross-sectional study was part of the Physical Activity for Healthy Brain Functions in School Youth project. All 558 schools within a 2–3 h drive of Stockholm, Sweden, were invited to take part in the study during spring 2019, and 84 accepted the invitation. Due to time constraints, we capped the study at 40 schools, ensuring that the sample reflected a range of school sizes, geographic locations, and parental socioeconomic backgrounds. The data were collected between 26 September and 6 December 2019. Six schools withdrew before the study started, leaving 34 mainstream schools. All 1556 grade 7 Swedish-speaking students at these schools, who were 13–14 years of age, were invited to participate in the study, and 1139 (73%) agreed.

Variations in municipality type and socioeconomic background were considered to ensure that we had a diverse sample. Statistics from the Swedish National Agency for Education were used to identify the proportion of parents born outside Sweden who had children at the schools and the proportion who stayed in education for more than 12 years. Just over a quarter (28%) of the parents in the participating schools were born outside Sweden, compared to 23% of the 558 schools that were invited to take part. The figures for parents with education of more than 12 years were 60% in the final sample and 57% of those invited to participate.

2.2 | Data Collection

All students visited our research centre in Stockholm, Sweden, in their respective class groups. During the 2–3-h session, they completed a questionnaire, participated in a fitness test, and were provided with an accelerometer. Following the visit, their parents received an online questionnaire via email, which could be completed by one or both parents. The students were given gift vouchers worth 300 SEK, which were around $30 US dollars, to compensate them for their participation.

2.2.1 | Impairment

The online questionnaire was used to collect information on four categories of impairment from the children's parents or guardians. We use the word parents to describe those who responded to this questionnaire.

2.2.2 | Motor Impairment

The parents were asked whether their child had any movement or motor impairments, and the possible responses included a development coordination disorder, cerebral palsy, spina bifida, or a spinal cord injury. They could also reply that their child had impairments without a diagnosis or that they had another diagnosis. If at least one parent reported that the child had a motor or movement impairment, regardless of a formal diagnosis, the child was categorized as having a motor impairment.

2.2.3 | Learning Impairment

The parents were asked whether their child had any learning difficulties. The possible responses included autism, Asperger's syndrome, attention deficit hyperactivity disorder, attention

deficit disorder, Tourette syndrome, Down syndrome, dyslexia, dyscalculia, a language disorder, a developmental disorder, or another diagnosis. Parents could also indicate that their child had difficulties but no diagnosis.

Participants were categorized into three subgroups to reflect different types of learning impairments. Autism, Asperger's syndrome, attention deficit hyperactivity disorder, and attention deficit disorder were classified as attention and autism spectrum disorders. Dyslexia, dyscalculia, and language disorders were classified together. The final category was difficulties without a diagnosis.

None of the parents indicated that their child had Tourette syndrome or Down syndrome or developmental disorders, and these were not included in any sub-category. The results stratified by the sub-categories are detailed in Tables S1–S5.

2.2.4 | Visual and Hearing Impairment

The parents were asked if their child had any sight impairments, such as shortsightedness, or hearing issues. These were used to create impairment variables. Data on aids, such as spectacles and hearing aids, were also collected in a follow-up question.

2.2.5 | Any Type of Impairment

A variable was created for any type of impairment, which comprised the four impairment types. Participants could appear in multiple categories. Those with any type of impairment were then compared with the reference group with no impairments.

2.2.6 | PA Patterns

PA patterns were measured with Actigraph GT3X+ accelerometers (Ametris, FL, USA). The adolescents were asked to wear the accelerometer on their right hip during all waking time for seven consecutive days. This excluded water-based activities, such as showering. A sampling rate of 30 Hz was used, and the data were processed in 5-s bouts for analyses using the programme ActiLife version 6.13.3 (Ametris). Non-wear time was defined as 60 min of zero counts, with no spike tolerance. To ensure that only wake time was included, we used the students' self-reported wake time and bedtimes from the questionnaire, and this sleep filter was applied to the ActiLife programme. Days with more than 500 min of wear time were considered valid.

The accelerometer wear time was divided into sedentary time using counts per minute, up to 100: light PA (101-2295), moderate PA (2296-4011), and vigorous PA (≥4012). Moderate-to-vigorous physical activity (MVPA) was defined as 2296 or more counts per minute [13]. Meeting the PA recommendations was defined as having an average of 60 min of MVPA per day.

We created four time domains to represent mean minutes per day. These were the wake time across the whole week, school time on weekdays, and leisure time on weekdays or weekends. School schedules were used to identify when the adolescents were and were not at school. The accelerometer needed to be worn for at least three valid days, including one weekend day, to be included in the whole week assessment. A minimum of two valid weekdays was required for a typical school week.

2.2.7 | Fitness

Cardiovascular fitness was estimated using the Ekblom-Bak submaximal ergometer test, which has shown good validity in adolescents compared to maximal exertion tests. It has previously been described in more detail [14]. In brief, the adolescents were instructed to pedal for 8 min at 60 rpm. The first 4 min used a standardised work rate of 32 watts; then the rate was individually adjusted in the second 4 min to maintain a heart rate above 120 beats per minute. The heart rates were recorded during the final minute of each workload. Maximal oxygen consumption was estimated based on heart rate changes between the two workloads, factoring in gender and age, and expressed as mL/kg/min. The equation developed for females was used to estimate maximal oxygen consumption in prepubertal boys at Tanner stage one or two. These were based on self-reported Tanner stage drawings, as recommended by Björkman et al. [14].

2.2.8 | Organised Sports

The adolescents were asked about their participation in any sports clubs or organisations, such as football, swimming, dancing, scouts, or gym. There were also follow-up questions about the type and frequency of their participation.

2.2.9 | Other Variables

Age was calculated using the adolescents' birthdates, and they stated their gender in the questionnaire. Parental education was retrieved from Statistics Sweden and dichotomised into up to 12 years, corresponding to secondary education or less in Sweden, and more than 12 years. Weight and height were measured with a standard scale and stadiometer, respectively. The adolescent body mass index was determined as weight in kilograms divided by height in meters squared and categorised according to International Obesity Task Force cut-offs for age and gender [15]. Body mass index standard deviation scores were created and adjusted for age and gender [16].

2.3 | Statistical Analysis

The statistical analyses were performed in Stata SE 17.0 (StataCorp, Texas, USA). Descriptive statistics are presented as means, standard deviations, and proportions. The differences in means between the participants with and without impairments were compared using independent t-tests for numeric variables and the chi-square test for categorical variables.

The main analyses compared the any impairment group and no impairment group, and the outcomes were the different

intensity of PA, sedentary time, and fitness. Each of the impairment subgroups was also compared to the no impairment group with the same outcome variables. There were only 10 cases in the hearing group, and this was not sufficient to be included in the main analysis. The results are presented in Tables S6 and S7.

Multilevel mixed models were used to account for the clustering of students at the school level, with the schools modelled at level one and the students modelled at level two. The assumptions for mixed models were checked, and these showed a violation of the normal distribution and homoscedasticity. Therefore, robust estimates were used. The models focused on sedentary leisure time and non-leisure time during the whole week; outliers were identified and separate analyses were performed without outliers. As the results did not change, these outliers were not excluded from the final models. All models were adjusted for gender, parental education, age, and body mass index standard deviation scores. They were also adjusted for accelerometer wear time when the outcomes were accelerometer-based. To adjust for multiple comparisons, the false discovery rate approach, which was set at 5%, was used to adjust the significance level for all the mixed models. The new alpha was set at $p < 0.018$, and in other analyses, the alpha was set at $p < 0.05$. To analyze the effect size, unadjusted mean differences between participants with and without impairments were calculated using Cohen's *d*.

In addition, the moderating effect of gender and parental education was tested by adding an interaction term to the models: gender × impairment or parental education × impairment. If the interaction term was significant, the model was stratified by the effect moderator, namely gender or parental education.

2.4 | Ethics

The study was approved by the Swedish Ethical Review Authority (number 2019-03579) and was conducted in accordance with the Declaration of Helsinki. Written, informed consent was obtained from the parents, and assent was obtained from the participating students.

3 | Results

At least one of the parents of 972 of the 1139 adolescents (85%) answered the questionnaire, and 303/972 (31%) said that their child had some type of impairment (Table 1).

Of these 972, 3% had motor or movement impairments and 18% had learning difficulties. We found that 15% had visual impairments, and 94% of these used glasses or lenses, and 1.X% had hearing impairments. None of the adolescents used a wheelchair or walker or were blind or deaf. Half of the sample (51%) were girls. We noted that 15% of the total sample had overweight and 4% had obesity. A lower proportion of adolescents with impairments had parents with more than 12 years of education (66%), compared to 73% of those without impairments (Table 1).

We found that 797 (82%) participants with parental responses had valid accelerometer data for a whole week, 914 (94%) had valid data for a school week, and 806 (83%) had valid data for a weekend. The adolescents had a median of six valid days, and the mean wear time across the whole week was 794 min or just over 13 h per day. There were no significant differences between those with and without impairments when it came to valid days ($p = 0.072$) or wear time ($p = 0.302$), as seen in Table S1. The mean values for PA, sedentary time, and fitness can be found in Table S7.

3.1 | Participation in Organised Sports

Participation in organised sports was lower among adolescents with impairments, with 70% taking part, compared to 77% of adolescents without impairments ($p = 0.020$). The frequency was also lower (Table 1).

Adolescents with and without impairments who participated in organised sports spent more time in MVPA on weekdays and weekends than those who did not participate (Figure 1). In addition, when we compared adolescents who participated in organised sports, those with impairments had significantly lower MVPA during their leisure time on weekdays ($p < 0.001$) and weekends ($p < 0.001$) than those without impairments. These differences were not seen in the group that did not participate in organised sports.

3.2 | Adjusted PA Patterns and Fitness

The differences in PA and fitness between adolescents with and without impairment are presented as adjusted estimates in Figure 2. The exact results for the hearing and learning impairment subgroups appear in Tables S3–S6.

3.3 | Vigorous, Moderate and Light PA

Adolescents with impairments spent significantly less time in vigorous PA during all time domains. The same general pattern was observed when they were grouped according to types of impairments, with the exception of the motor impairment group, which showed no statistically significant difference. The only time domain with mixed results was school time, as groups with visual and learning impairments spent significantly less time in vigorous PA. Adolescents with any type of impairment spent significantly less time in moderate PA during their leisure time on weekdays. The results for other impairment groups and time domains were not statistically significant. There was no statistically significant difference in light PA in any of the time domains or impairment groups.

3.4 | Sedentary Time

Adolescents with any type of impairment spent significantly more time engaged in sedentary activities during the whole week, but this was not significant in the motor and visual impairment subgroups. In addition, those with any type of impairment spent more time on sedentary pursuits during their leisure time on weekdays, particularly if they had learning impairments.

TABLE 1 | Characteristics of the study sample.

	All	No impairment	Any type of impairment	
	N (%)	*N* (%)	*N* (%)	*p*
	972 (100)	669 (68.9)	303 (31.1)	
Age (mean ± SD)	13.4 ± 0.3	13.4 ± 0.3	13.3 ± 0.3	**0.045**
Gender				
Girls	497 (51.2)	341 (51.0)	156 (51.7)	0.844
Boys	474 (48.8)	328 (49.0)	146 (48.3)	
Parental education (years)				
≤ 12	275 (29.0)	175 (26.7)	100 (33.9)	**0.024**
> 12	675 (71.0)	480 (73.3)	195 (66.1)	
Body mass index				
Underweight	69 (7.1)	51 (7.7)	18 (5.9)	0.069
Normal weight	719 (74.1)	503 (75.4)	216 (71.3)	
Overweight	144 (14.9)	93 (13.9)	51 (16.8)	
Obesity	38 (3.9)	20 (3.0)	18 (5.9)	
Participation in organised sports				
No participation	231 (24.5)	146 (22.3)	85 (29.4)	**0.020**
Participation	711 (75.5)	507 (77.6)	204 (70.6)	
Frequency of participation				
1–2 times per week	199 (28.4)	112 (22.4)	87 (43.3)	**< 0.001**
3 times per week	169 (24.1)	118 (23.6)	51 (25.4)	
4 times per week or more	333 (47.5)	270 (54.0)	63 (31.3)	
Type of organised sports				
Individual	272 (40.7)	195 (39.9)	77 (43.0)	0.500
Team	301 (45.1)	220 (45.0)	81 (45.3)	
Both	95 (14.2)	74 (15.1)	21 (11.7)	
Fitness (estimated VO_{2max} mL/kg/min)	49.9 ± 9.8	50.8 ± 9.6	47.9 ± 10.1	**0.001**
Meeting physical activity recommendations	238 (29.9)	191 (34.6)	47 (19.2)	**< 0.001**

Note: Results significant at $p < 0.05$ are marked in bold.
Abbreviations: SD, standard deviation; VO_2max, the maximum amount of oxygen a body can use during intense exercise.

3.5 | Fitness Across Impairment Groups

The adjusted association between estimated maximal oxygen consumption and impairments is presented in Table 2. Those with any type of impairment had significantly lower fitness, including those in the motor and learning impairment subgroups.

3.6 | Moderation Analyses

Gender did not significantly moderate the association between impairment and PA in any of the models. Parental education only showed a significant interaction with impairment for light PA on weekends ($p = 0.004$). Specifically, adolescents with impairments whose parents had a short education had more light PA (9.9 min per day, $p = 0.035$) than adolescents without impairments in the same parental education group.

4 | Discussion

To our knowledge, this was the first Swedish study to use accelerometer data and fitness to assess adolescents with impairments who attended mainstream schools. We also further categorized participants into different impairment groups, which was a unique characteristic of our study. Overall, most of the adolescents did not meet the World Health Organisation PA recommendation of an average of 60 min of MVPA per day. This was particularly noticeable among those with

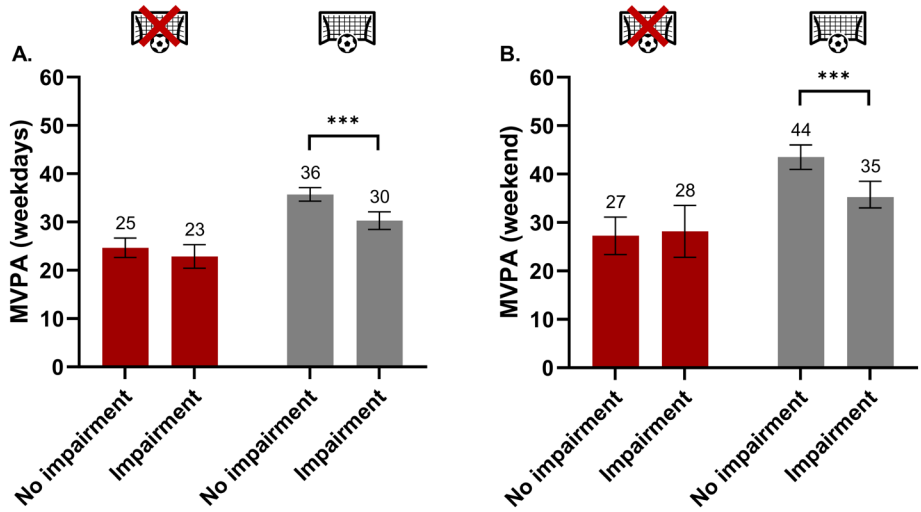

FIGURE 1 | Participation in organised sports and average minutes in MVPA during leisure time on weekdays (A) and weekends (B) for those with and without impairments. Significance *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

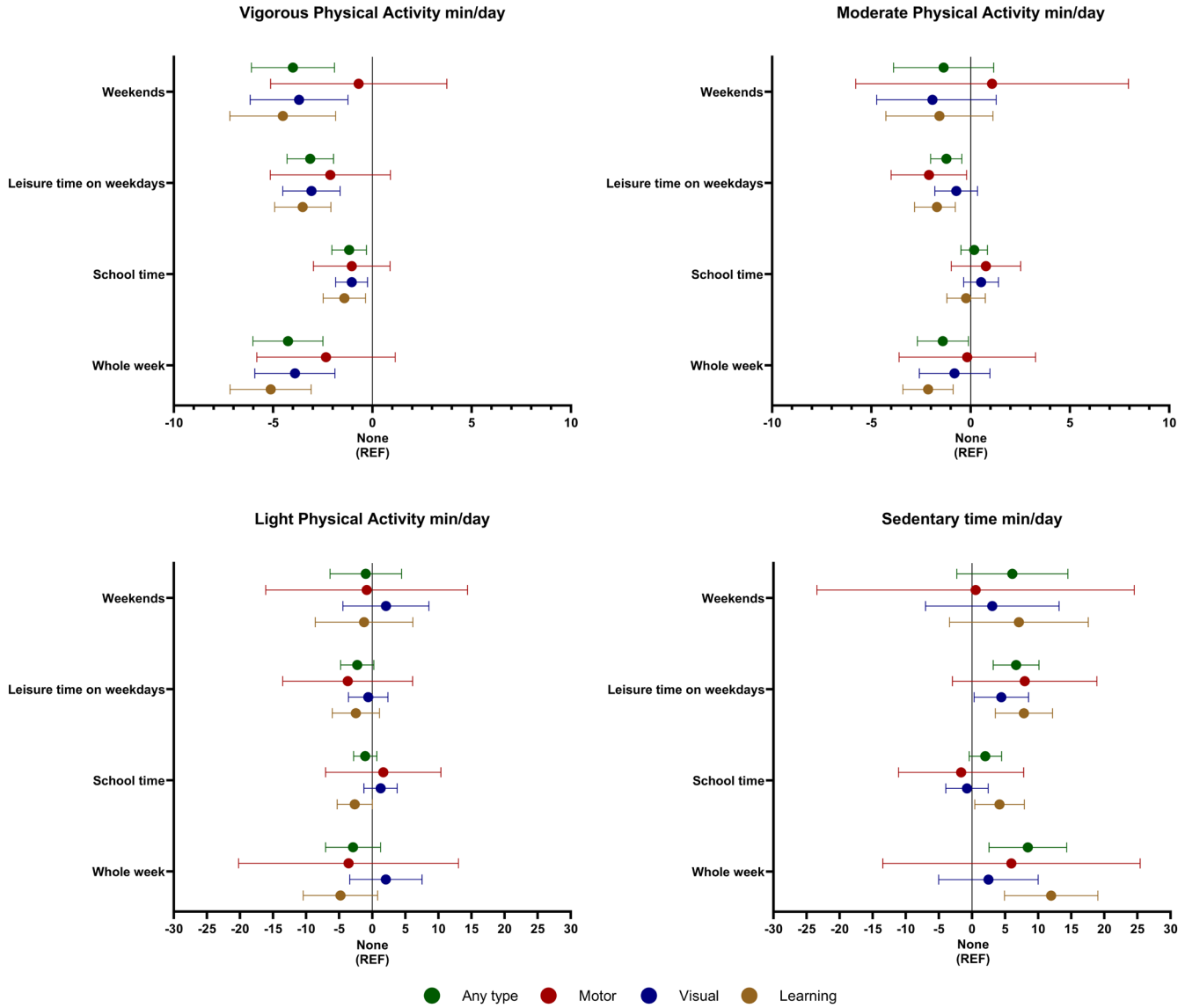

FIGURE 2 | Results from mixed models with the accelerometer measured time in each intensity type as outcomes. Presented as Beta values with 95% confidence intervals.

TABLE 2 | Results from mixed models with fitness as an outcome.

	Fitness (estimated VO_{2max} mL/kg/min)			
	n	**Beta (95% CI)**	***d***	***p***
No impairment	589	REF		
Any type of impairment	265	**−2.02 (−3.07, −0.96)**	0.30	< 0.001
No impairment	589	REF		
Motor impairments	24	**−4.75 (−7.86, −1.63)**	0.48	0.003
Visual impairments	134	−1.26 (−2.63, 0.11)	0.35	0.072
Learning disabilities	149	**−2.52 (−3.71, −1.33)**	0.27	< 0.001

Note: All models adjusted for gender, age, body mass index standard deviation scores, parental education and wear time. Results significant at $p < 0.05$ are marked in bold. It was possible for the same person to be included in different impairment categories. Beta: Non-standardised Beta with 95% confidence intervals. *d*: Cohen's *d*; VO_2max, the maximum amount of oxygen a body can use during intense exercise.

impairments. Adolescents with impairments were less physically active than those without impairments, which confirmed similar results from earlier studies in different regions of the world [17]. The differences were more pronounced in vigorous PA for adolescents with learning or impaired vision and light PA for those with learning impairments. Our results were in line with nationally representative estimates using self-reported PA, where fewer adolescents with impairments reported daily MVPA [18]. In addition, comparable results from device-measured PA have been reported from Finland. This study from another Nordic country showed that adolescents with similar impairments reported less MVPA than adolescents without impairments [19].

Our results showed similar levels of moderate PA during school time for those with and without impairments, and this suggested that school time was protective. Approximately half of the total time spent in moderate or vigorous PA occurred during school hours, highlighting the critical role that schools play in helping adolescents to meet the recommendation of the World Health Organization. The only difference was that adolescents without impairments performed more vigorous PA during school time, which was similar to the PA pattern during leisure time. The school schedules showed that physical education classes averaged 150 ± 21 min per week, which followed the curriculum requirements for a total of 280 h in total in grade 7 [20]. This is considered high from an international perspective [21]. Swedish adolescents with and without impairments usually take physical education classes together in mainstream schools. Adolescents with impairments have reported different experiences of physical education classes between schools. These have depended on factors such as the teachers' knowledge and attitudes [22], the availability of adapted equipment and facilities, and personnel support [23]. Nevertheless, mainstream schools provided physical education equally during our study, which could be one of the reasons why there were little differences in moderate PA during school time. However, vigorous PA was lower among those with impairment during school time, suggesting that teachers should promote equal participation in higher intensity activities.

Sports clubs provide promising settings for promoting sport for all and supporting social and mental well-being [24]. They also have the potential to advance equality by fostering inclusion and integration [25]. Taking part in sports offers numerous health benefits for adolescents with impairments, including improved fitness, enhanced self-esteem, pride, enjoyment, and overall satisfaction [26]. However, our study showed that fewer adolescents with impairments participated in organised sports, in contrast to the inclusive approach typically attributed to sports clubs. Furthermore, adolescents with impairments who participated in sports engaged in less MVPA during their leisure time than peers without impairments. One study stated that this lower participation rate resulted from structural inequalities, such as fewer opportunities to participate in organised sports. It also pointed to the lack of accessible fitness facilities [27] and sport coaches having inadequate training [28]. Our study indicated that organised sports and leisure time PA were not fully adapted to attract adolescents with impairments.

The adjusted mean difference in fitness between participants with and without impairment, which was 2.0 mL/kg/min, translates to a larger proportion of adolescents with impairments having low fitness. This difference might seem small, but over time this might result in lowered functional work tolerance and may hinder participation in games, sports, and other physical activities [29]. Furthermore, research on the fitness levels of adolescents with impairments has been limited, particularly across different types of impairment. This underlines the unique and important contribution made by our study.

4.1 | Strengths and Limitations

The strengths of the current study included carrying out a robust fitness test in a large sample of adolescents with impairments in mainstream schools. The methods were reinforced by using a device to measure PA and using school schedules to ensure precise time domains. One limitation of this study was that the schools were not randomly selected. While efforts were made to ensure socioeconomic diversity, self-selection bias may have affected the generalisability of the findings. Parents born outside Sweden accounted for 28% in the 34 participating schools, compared to 23% in the total sample of the 558 invited schools. We conducted additional analyses that were adjusted for foreign backgrounds, but these adjustments did not affect the results, and foreign background was not included as a confounding factor.

Another limitation was how we categorized the impairment groups, which meant that some participants were included in multiple groups. To minimize this limitation, the reference group comprised any participants without impairments. The relatively high prevalence of impairments found in this study might have been due to the definition of impairment and how

the categories were coded. However, reporting data from parents has commonly been used for research on pediatric populations [30]. Including milder or undiagnosed impairments may have diluted the results. Despite this, we believe it was important to separate the data into subgroups, even for the mildest impairments, as they were collected from mainstream schools. This meant that they reflected typical school populations. The heterogeneity of the impairments group, ranging from learning difficulties and autism to mild visual impairments, may have limited the subgroup comparisons and generalizability. Most participants had learning or visual impairments and certain subgroups, such as those with motor impairments, were small. This means that the results from these groups should be interpreted with caution and more research in these areas is warranted.

Accelerometers have good potential to identify PA during different time domains, but they have a few shortcomings. For example, accelerometer data may underestimate activities such as skating, cycling, and water-based activities or very high-intensity PA. Finally, this was a cross-sectional study, which made causal inference impossible. The results were also specific to Swedish adolescents and may be less transferable to those living in countries with different school systems.

5 | Conclusion

Adolescents with impairments were generally less physically active, had lower fitness levels, and participated less in organised sports than those without impairments. Even adolescents with milder impairments, such as visual impairments corrected by glasses, were less physically active. This raises concerns about their increased vulnerability to health risks. Adolescents with impairments who participated in organised sports were still significantly less active during their leisure time than those without impairments. These differences were not observed in adolescents who did not participate in organised sports. This raises concerns because adolescents with impairments also had lower cardiovascular fitness. The findings highlight the need for sports organisations and other stakeholders to address these inequalities. They can do this by developing targeted strategies to increase PA and improve fitness levels and sports participation among adolescents with impairments.

Author Contributions

All the authors contributed to the conception and design of the study. K.K. and B.H. performed the statistical analyses and wrote the methods and results sections. All the authors contributed to the interpretation of the results, drafted other parts of the paper, read the final version, and approved the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

References

1. United Nations Children's Fund, *Seen, Counted, Included: Using Data to Shed Light on the Well-Being of Children With Disabilities* (UNICEF, 2021).

2. M. Sentenac, T. Santos, L. Augustine, et al., "Chronic Health Conditions and School Experience in School-Aged Children in 19 European Countries," *European Child & Adolescent Psychiatry* 32, no. 9 (2023): 1711–1721, https://doi.org/10.1007/s00787-022-01987-8.

3. S. Sweden, "The National Public Health Survey [Online]," accessed 25 April, 2023, https://www.scb.se/en/finding-statistics/statistics-by-subject-area/public-health/public-health-development/the-national-public-health-survey/.

4. The National Agency for Special Needs Education and Schools, "The Swedish Education System, the Legal System and Financing [Online]," accessed 25 April, 2023, https://www.spsm.se/om-oss/other-languages/english/.

5. United Nations, "Convention on the Rights of Persons With Disabilities," accessed 4 April, 2023, https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-persons-disabilities.

6. V. J. Poitras, C. E. Gray, M. M. Borghese, et al., "Systematic Review of the Relationships Between Objectively Measured Physical Activity and Health Indicators in School-Aged Children and Youth," *Applied Physiology, Nutrition, and Metabolism* 41, no. 6 (2016): S197–S239, https://doi.org/10.1139/apnm-2015-0663.

7. L. B. Augestad and L. Jiang, "Physical Activity, Physical Fitness, and Body Composition Among Children and Young Adults With Visual Impairments: A Systematic Review," *British Journal of Visual Impairment* 33, no. 3 (2015): 167–182.

8. I. Rivilis, J. Hay, J. Cairney, P. Klentrou, J. Liu, and B. E. Faught, "Physical Activity and Fitness in Children With Developmental Coordination Disorder: A Systematic Review," *Research in Developmental Disabilities* 32, no. 3 (2011): 894–910, https://doi.org/10.1016/j.ridd.2011.01.017.

9. K. Schuchardt, M. Gebhardt, and C. Maehler, "Working Memory Functions in Children With Different Degrees of Intellectual Disability," *Journal of Intellectual Disability Research* 54, no. 4 (2010): 346–353, https://doi.org/10.1111/j.1365-2788.2010.01265.x.

10. A. Swift, E. G. Iriarte, P. Curry, R. McConkey, R. Gilligan, and M. Antunes, "How Disability and Other Socio-Economic Factors Matter to Children's Socio-Emotional Outcomes: Results From a Longitudinal Study Conducted in Ireland," *Child Indicators Research* 14, no. 1 (2021): 391–409, https://doi.org/10.1007/s12187-020-09768-y.

11. K. A. M. Ginis, H. P. van der Ploeg, C. Foster, et al., "Participation of People Living With Disabilities in Physical Activity: A Global Perspective," *Lancet* 398, no. 10298 (2021): 443–455.

12. C. Carty, H. P. van der Ploeg, S. J. H. Biddle, et al., "The First Global Physical Activity and Sedentary Behavior Guidelines for People Living With Disability," *Journal of Physical Activity & Health* 18, no. 1 (2021): 86–93, https://doi.org/10.1123/jpah.2020-0629.

13. K. R. Evenson, D. J. Catellier, K. Gill, K. S. Ondrak, and R. G. McMurray, "Calibration of Two Objective Measures of Physical Activity for Children," *Journal of Sports Sciences* 26, no. 14 (2008): 1557–1565, https://doi.org/10.1080/02640410802334196904797576.

14. F. Bjorkman, A. Eggers, A. Stenman, T. Bohman, B. Ekblom, and O. Ekblom, "Sex and Maturity Status Affected the Validity of a Submaximal Cycle Test in Adolescents," *Acta Paediatrica* 107, no. 1 (2018): 126–133, https://doi.org/10.1111/apa.14080.

15. T. J. Cole and T. Lobstein, "Extended International (IOTF) Body Mass Index Cut-Offs for Thinness, Overweight and Obesity," *Pediatric Obesity* 7, no. 4 (2012): 284–294.

16. J. Karlberg, Z. C. Luo, and K. Albertsson-Wikland, "Body Mass Index Reference Values (Mean and SD) for Swedish Children," *Acta Paediatrica* 90, no. 12 (2001): 1427–1434, https://doi.org/10.1080/08035250152708851.

17. K. Ng, C. Sit, K. Arbour-Nicitopoulos, et al., "Global Matrix of Para Report Cards on Physical Activity of Children and Adolescents With Disabilities," *Adapted Physical Activity Quarterly* 40, no. 3 (2023): 409–430.

18. K. Ng, J. Tynjälä, D. Sigmundová, et al., "Physical Activity Among Adolescents With Long-Term Illnesses or Disabilities in 15 European Countries," *Adapted Physical Activity Quarterly* 34, no. 4 (2017): 456–465, https://doi.org/10.1123/apaq.2016-0138.

19. K. W. Ng, P. Rintala, P. Husu, J. Villberg, T. Vasankari, and S. Kokko, "Device-Based Physical Activity Levels Among Finnish Adolescents With Functional Limitations," *Disability and Health Journal* 12, no. 1 (2019): 114–120, https://doi.org/10.1016/j.dhjo.2018.08.011.

20. The Swedish National Agency for Education, "Timplan för Grundskolan [Online]," accessed 6 April, 2023, https://www.skolverket.se/undervisning/grundskolan/laroplan-och-kursplaner-for-grundskolan/timplan-for-grundskolan.

21. K. Hardman, "Physical Education in Schools: A Global Perspective," *Kinesiology* 40 (2008): 5–28.

22. E. Apelmo, "What Is the Problem? Dis/Ability in Swedish Physical Education Teacher Education Syllabi," *Sport, Education and Society* 27, no. 5 (2022): 529–542, https://doi.org/10.1080/13573322.2021.1884062.

23. J. Haegele, X. Zhu, and S. Davis, "Barriers and Facilitators of Physical Education Participation for Students With Disabilities: An Exploratory Study," *International Journal of Inclusive Education* 22, no. 2 (2018): 130–141, https://doi.org/10.1080/13603116.2017.1362046.

24. M. Boelens, M. S. Smit, H. Raat, W. M. Bramer, and W. Jansen, "Impact of Organized Activities on Mental Health in Children and Adolescents: An Umbrella Review," *Preventive Medical Reports* 25 (2022): 101687, https://doi.org/10.1016/j.pmedr.2021.101687.

25. EuropeActive, "The 2021–2024 EU Work Plan for Sport".

26. B. Aitchison, A. B. Rushton, P. Martin, M. Barr, A. Soundy, and N. R. Heneghan, "The Experiences and Perceived Health Benefits of Individuals With a Disability Participating in Sport: A Systematic Review and Narrative Synthesis," *Disability and Health Journal* 15, no. 1 (2022): 101164, https://doi.org/10.1016/j.dhjo.2021.101164.

27. J. H. Rimmer, S. Padalabalanarayanan, L. A. Malone, and T. Mehta, "Fitness Facilities Still Lack Accessibility for People With Disabilities," *Disability and Health Journal* 10, no. 2 (2017): 214–221, https://doi.org/10.1016/j.dhjo.2016.12.011.

28. S. Geidne and K. Jerlinder, "How Sports Clubs Include Children and Adolescents With Disabilities in Their Activities. A Systematic Search of Peer-Reviewed Articles," *Sport Science Review* XXV, no. 1-2 (2016): 29–52.

29. K. Kjellenberg, O. Ekblom, C. Stalman, B. Helgadottir, and G. Nyberg, "Associations Between Physical Activity Patterns, Screen Time and Cardiovascular Fitness Levels in Swedish Adolescents," *Children (Basel)* 8, no. 11 (2021): 998, https://doi.org/10.3390/children8110998.

30. I. Mactaggart, C. Cappa, H. Kuper, M. Loeb, and S. Polack, "Field Testing a Draft Version of the UNICEF/Washington Group Module on Child Functioning and Disability. Background, Methodology and Preliminary Findings From Cameroon and India," *Alter* 10, no. 4 (2016): 345–360.

Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Appendix S1:** Supporting Information.