

Article

Longitudinal Changes in Adolescents' Sedentary, Light, Moderate and Vigorous Physical Activity Levels

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Abstract: Background and purpose: In recent years, sedentary behaviour (SB) has become a significant risk factor for health, alongside the decline of physical activity (PA) in the population. This study explored adolescents' PA and SB using a longitudinal design, from the age of 13 to 15, to elucidate any changes and when they potentially occur. **Method:** The data material from the accelerometer measurements was analysed using the program SPSS, version 28. Repeated measures ANOVA (and follow-up test with Bonferroni corrections) were used to assess changes in the four activity levels during the three years. Independent *t*-tests were used to examine gender differences in each year and at each activity level and to determine differences in activity level between participants with valid data for all three years and those with valid data only at 13 and/or 14 years of age. **Results:** Statistical analyses of the accelerometer measurements revealed a significant increase in time in the lowest activity level and a decrease in light, moderate and vigorous intensity PA levels during the three years. These changes were larger from 13 to 14, than from 14 to 15, years of age. However, no significant interaction was found between time and gender. Analyses also showed a significantly higher time spent in SB and lower time spent in moderate activity among girls compared to boys at 13, but not at the age of 14 and 15. **Conclusions:** The findings, which indicate a reduction in PA and increased sedentary time with increasing age, are discussed, which we argue are important to increase and solidify involvement in PA among adolescents. Emphasized here is the importance of communicating the diverse possibilities of movement and challenging understandings of what PA can be for youth.

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1. Introduction

A negative physical activity (PA)-level shift has garnered substantial concern among researchers worldwide [1–3]. The well-documented relationship between PA and health underscores the significance of focusing on these changes [1,4,5]. This study explores changes in PA among young individuals aged 13 to 15 years, utilizing accelerometers to assess time spent at various PA intensity levels, including sedentary behaviour (SB). The attention given to SB, as an independent risk factor, has increased in recent years, necessitating a nuanced understanding of changes in PA intensity levels during adolescence [3,6,7]. The importance of PA and the risks associated with inactivity have been widely communicated by national and international health authorities for the past few decades [8,9]. Despite this, a consistent decrease in PA levels with children's age has been observed over many years [3,9–11].

1.1. Research Related to Adolescents' PA Level

Cross-sectional mapping studies in Norway show a decline in PA levels as children grow older, with only 51% of boys and 40% of girls meeting the national recommendations

for daily PA at the age of 15 [3]. This reduction in PA levels extends into adulthood, with approximately 30% of adults meeting the recommended levels of PA [8]. Globally, the figures are even lower, with only 19% of adolescents meeting the national recommendations for moderate-to-high-intensity PA (MVPA) [9]. Several longitudinal studies of adolescent's PA behaviour show the same shift towards SB. Trang et al. [12] reported a 38% decline in MVPA levels of Vietnamese adolescents over 5 years. In line with the Norwegian mapping study, they also found that boys spent more time ($\times 2.9$) in MVPA than the girls. In Norway, Løgestad et al. [13] found a significant decrease in the moderate and/or vigorous activity level, from 67 min a day at 14 years of age, to 24 min a day at 19 years of age. Mikalsen et al. [14] found a significant decrease in the moderate and/or vigorous activity level from 90 min a day at 13 years of age, to 66 min a day at 15 years of age. Furthermore, Ball et al. [15] studied the PA level among Australian children, at 6 and 12 years of age, and found a decrease in MVPA, and an increase in SB, over a period of three years. Steene-Johannessen et al. [3] found, in 2019, a decrease in daily light PA (LPA) from 35% to 19%, and an increase in daily SB from 53% to 73% among Norwegian adolescents from 13 to 18 years.

In relation to existing knowledge about longitudinal changes in adolescents' activity level, there is a lack of studies that include adolescents' different activity levels in the transition phase from primary school to lower secondary school, using a longitudinal design. This transition creates large changes, on both environmental and personal levels, and also according to the maturing and puberty that occur during this period [14,16–18]. According to the Norwegian "Ungdata" study [19], 82% participate in organized sports activities weekly at the entrance to the teenage years, while at the age of 17 only 33% report the same. This decrease in organized sport-related PA coincides with previous findings in a review study [20]. These changes may affect the adolescent's activity level negatively.

To understand the development of adolescents' PA behaviours, correlates of PA and SB have been investigated in many studies [7,21,22]. Various factors across multiple domains have been identified. However, the plasticity of these factors [23] and the dynamic interplay between the domains they are organized into [7,21], highlight the need for continued interpretation and discussion, to better comprehend PA and SB. Throughout the longitudinal investigation of PA and SB in the present study, spanning the formative years of adolescence from 13 to 15, gender and age are considered as main variables that inform our understanding of the development of PA and SB. However, the discussion will be inspired by a relational developmental systems perspective (RDSs perspective) [18], highlighting the interactive individual–environment relation.

1.2. Aim of Study

Even if systematic reviews have shown that there have been studies of adolescents' PA levels during adolescence [6,7,16], no study has examined objectively the measures of PA levels among the same adolescents from 13 to 15 years of age—a period that involves an important transition phase from primary school to secondary school. In alignment with Reilly's recommendation [23] for longitudinal studies using objective measures of PA, this longitudinal study aims to examine the changes in adolescents' sedentary, light, moderate, and vigorous PA, from the age of 13 to the age of 15. The changes in the adolescents' PA behaviour will be further examined in relation to gender.

Our hypothesis is that the adolescents' sedentary behaviour increases during the period from 13 to 15 years, and their PA behaviour with light, moderate and vigorous intensity decreases.

2. Materials and Methods

A longitudinal design with accelerometer measurements of PA levels among the same adolescents for three years was used. The study was approved by the Norwegian Centre for Research Data [NSD, 23.03.2017, 52552/3/AGH]. Both parents and pupils provided informed written consent for participation. The study was conducted following the Declaration of Helsinki.

2.1. Participants

Two medium-sized municipalities in mid-Norway were chosen with the assistance of a stratified selection. All the schools in the two municipalities were contacted, and all the pupils born in 2004 were invited to participate in the study. At the start of the data collection in 2017, the sample consisted of 320 13-year-old adolescents, and 301 had valid data at 13 years of age. However, only 162 (98 girls, 64 boys) of these adolescents had valid activity measurements from all three measurement periods, representing a 51% response rate. Based on power calculations [24] related to a previous study with standard deviation ($SD = 0.23$) and expected differences between groups ($1 = 0.39$, $\alpha = 0.05$, $\beta = 0.8$), at least 30 participants were needed to fulfil the criteria for observed power, and our study included a much higher number of participants.

2.2. Procedures

All the accelerometer measurements were taken within the same period in April 2017, 2018, and 2019. These data were measured using the accelerometer ActiGraph GT1M (ActiGraph, LLC, Pensacola, FL, USA), a reliable instrument for the measurement of PA [25,26]. The pupils were instructed to carry the accelerometer on their right hip for seven days, except during water activities, as the monitors do not tolerate water [11], and at night when sleeping. In keeping with large Norwegian-population studies, the criterion for valid measurements was set at data over eight hours daily for at least two days [3,11]. The storage interval for the raw data was set at 10 s. The same test leader carried out all data collection from all measurements. The same equipment was used throughout, and the procedures used were constant.

Data from the collection were downloaded to Actilife v6.13.3 (ActiGraph, LLC, Pensacola, FL, USA), where they were filtered. According to the protocol [3,8], sedentary activity was characterized as 0–99 counts per minute, light activity was characterized as 100–1999 counts per minute, moderate activity was characterized as 2000–5999 counts per minute, and vigorous activity was characterized as 6000 counts per minute and above. For the adolescents' data to be valid, they must have a total of 480 min of counts [3]. Periods of more than 20 min with no counts were not included, nor was activity between 00.00 and 06.00.

2.3. Statistical Analysis

The data material was analysed using the Statistical Package for the Social Sciences (SPSS Inc., version 28.0, Chicago, IL, USA). Repeated measures ANOVA (and a follow-up test with Bonferroni corrections) were used to assess changes in the four activity levels during the three years. Independent *t*-tests were used to examine gender differences in each year and at each activity level and to determine differences in activity level between participants with valid data for all three years and those with valid data only at 13 and/or 14 years of age. The effect size was evaluated with η^2p (partial eta-squared), where $0.01 < \eta^2 < 0.06$ indicated a small effect, $0.06 < \eta^2 < 0.14$ indicated a medium effect, and $\eta^2 > 0.14$ indicated a large effect (26). The significance level was set at $p < 0.05$, $p < 0.01$, and $p < 0.001$, respectively.

3. Results

The descriptive data about the adolescent's different activity levels are presented in Table 1.

Figure 1 shows a significant increase in time spent in SB over time from 13 until 15 years of age, with a large effect ($F_2 = 60.171$, $p < 0.001$, $\eta^2 = 0.275$, $1 - \beta = 1.000$). In general, there was an increase in SB per day from 57% to 63% during the whole period, constituting an overall increase of 10.5%. However, there was no significant interaction between time and gender ($F_2 = 0.300$, $p = 0.741$, $\eta^2 = 0.002$, $1 - \beta = 0.098$). Follow-up analyses with Bonferroni corrections indicated that time spent in SB increased significantly from 13 to 14 years of age, by 4.1% (95% CI = -4.5 to -2.8 , $p < 0.001$). Time spent in SB also

increased significantly ($p < 0.001$) from 14 to 15 years of age, by 1.8% (95% CI = -3 to -0.5 , $p = 0.002$). Further analyses identified a significantly higher time spent in SB among girls compared to boys at the age of 13 ($t_{160} = 3.2$, $p = 0.002$), but there were no significant differences between girls and boys at the ages of 14 and 15 ($p > 0.05$).

Table 1. Descriptive data about the adolescent's percentage of time (%) in different activity levels.

	N	Minimum	Maximum	Mean	Std. Deviation
Sedentary	162	40.20	71.20	57.14	5.12
Light	162	21.27	38.20	29.50	3.08
Moderate	162	4.26	22.70	11.12	2.97
Vigorous	162	0.06	6.16	1.879	1.23
Sedentary	162	43.81	76.64	61.13	5.65
Light	162	19	39	27.11	3.46
Moderate	162	2.67	17.76	9.81	3
Vigorous	162	0.03	8.50	1.44	1.22
Sedentary	162	43.47	98.85	62.91	6.49
Light	162	0.78	35.45	25.59	3.89
Moderate	162	0.35	25.03	9.97	3.77
Vigorous	162	0.00	9.79	1.52	1.67

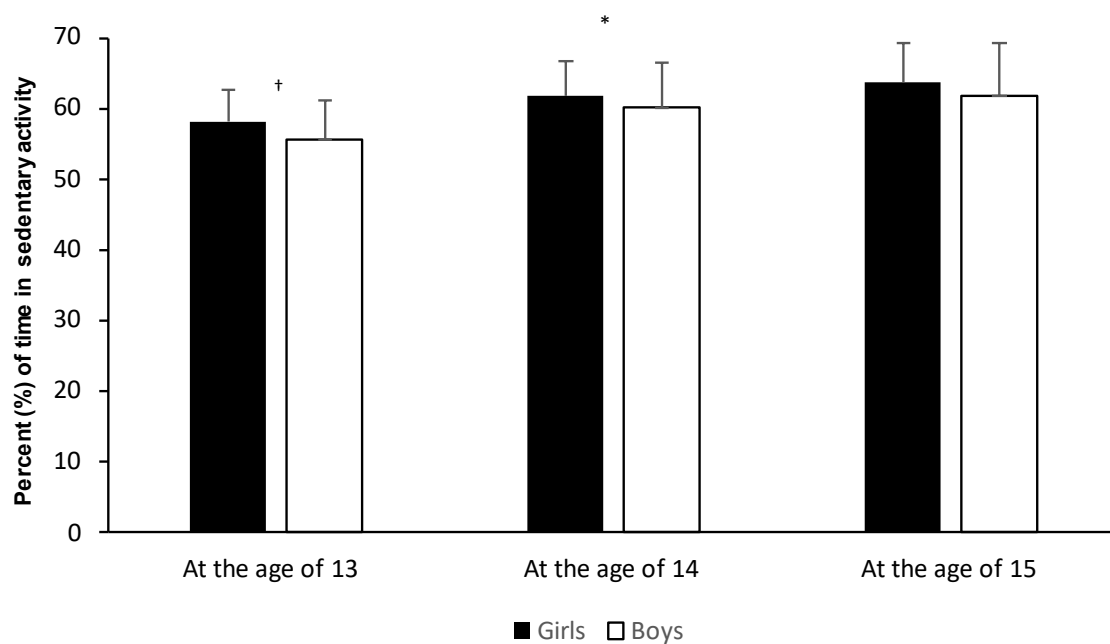


Figure 1. Percent of time spent in sedentary activity at 13, 14, and 15 among the same girls and boys. * Significant difference in the percentage of time spent in sedentary activity at the age of 13, 14, and 15, at a 0.001 level. † Significant difference in the percent of time spent in sedentary activity between girls and boys, at a 0.01 level.

Figure 2 shows a significant decrease in time spent in light activity over time from 13 to 15 years of age, with a large effect ($F_2 = 76.295$, $p < 0.001$, $\eta^2 = 0.324$, $1 - \beta = 1.000$). In general, there was a decrease in light activity per day from 30% to 26% during the whole period. This constitutes an overall decrease of 13.3% in light activity. However, there was no significant interaction between time and gender ($F_2 = 0.072$, $p = 0.931$, $\eta^2 = 0.000$, $1 - \beta = 0.061$). Follow-up analyses with Bonferroni corrections showed that time spent in light activity decreased significantly from 13 to 14 years of age, by 2.4% (95% CI = 1.6 to 3.1, $p < 0.001$). Time spent in light activity also decreased significantly ($p < 0.001$) from 14 to 15 years of age, by 1.6% (95% CI = -2.4 to -0.4 , $p < 0.001$). In addition, further analyses revealed a significantly lower time spent in light activity among girls compared to boys

at the age of 14 ($t_{160} = -2.7, p = 0.008$), but no significant differences in light activity were identified between girls and boys at the ages of 13 and 15 ($p > 0.05$).

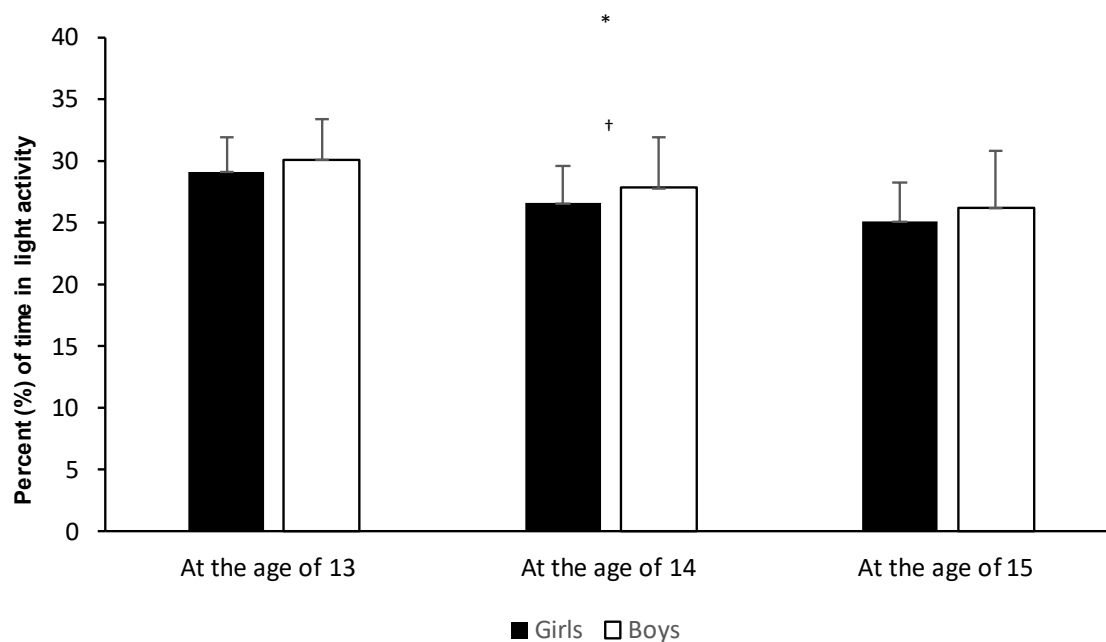


Figure 2. Percent of time spent in light activity at the age of 13, 14, and 15 among the same girls and boys. * Significant difference in the percentage of time spent in light activity at the age of 13, 14, and 15, at a 0.001 level. † Significant difference in the percent of time spent in light activity between girls and boys, at a 0.01 level.

Figure 3 shows a significant decrease in time spent in moderate activity over time from 13 until 15 years of age, with a medium effect ($F_2 = 13.278, p < 0.001, \eta^2 = 0.077, 1 - \beta = 0.998$). In general, there was a decrease in moderate activity per day from 11.1% to 10% during the whole period. This constitutes an overall decrease of 11% in moderate activity. However, no significant interaction between time and gender was identified ($F_2 = 1.063, p = 0.347, \eta^2 = 0.007, 1 - \beta = 0.236$). Follow-up analyses with Bonferroni corrections showed that time spent in moderate activity decreased significantly from 13 to 14 years of age, by 1.4% (95% CI = 0.7 to 2.1, $p < 0.001$). However, there was no significant change in time spent in moderate activity ($p > 0.05$) from 14 to 15 years of age (95% CI = -0.9 to $0.6, p = 1.000$). Further analyses revealed a significantly lower time spent in moderate activity among girls compared to boys at the age of 13 ($t_{160} = -2.7, p = 0.008$), but no significant differences in time spent in moderate activity between girls and boys at the ages of 14 and 15 ($p > 0.05$).

Figure 4 shows a significant decrease in time spent in vigorous activity over time from 13 to 15 years of age, with a small effect ($F_2 = 5.391, p = 0.005, \eta^2 = 0.033, 1 - \beta = 0.842$). In general, there was a decrease in vigorous activity per day from 1.9% to 1.5% during the whole period. This constitutes an overall decrease of 21.1% in vigorous activity. However, there was no significant interaction between time and gender ($F_2 = 1.856, p = 0.158, \eta^2 = 0.012, 1 - \beta = 0.386$). Follow-up analyses with Bonferroni corrections showed that time spent in vigorous activity decreased significantly from 13 to 14 years of age, by 0.5% (95% CI = 0.1 to 0.8, $p = 0.002$). However, time in vigorous activity did not change significantly ($p > 0.05$) from 14 to 15 years of age (95% CI = -0.5 to $0.2, p = 0.817$). Further analyses revealed no significant difference in time spent in vigorous activity between girls and boys at all ages ($p > 0.05$).

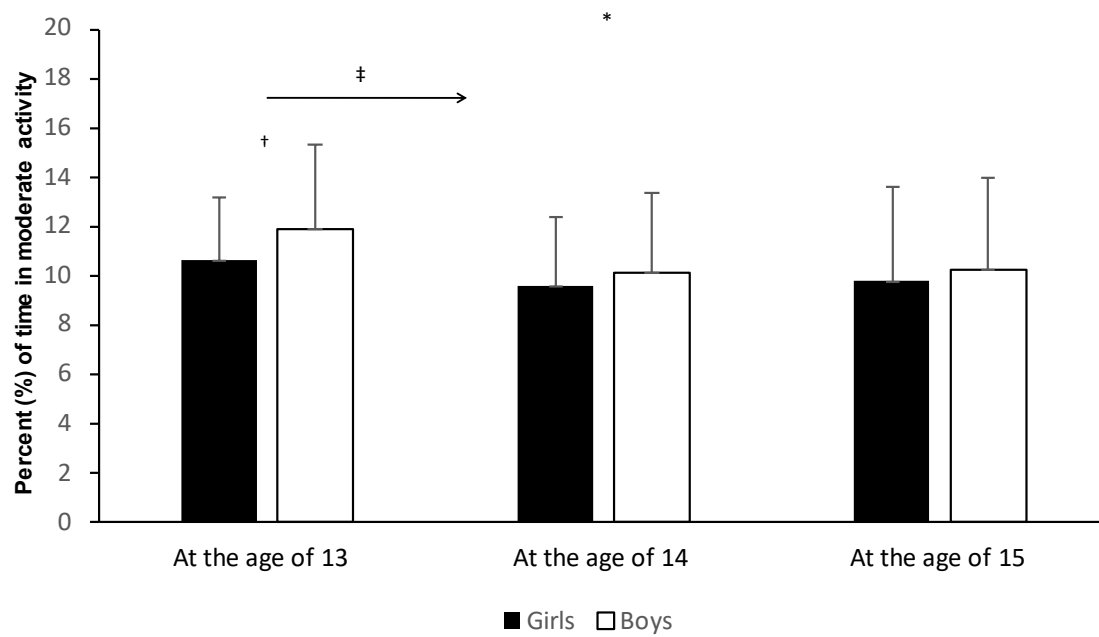


Figure 3. Percent of time spent in moderate activity at the age of 13, 14, and 15 among the same girls and boys. * Significant difference in the percentage of time spent in moderate activity at the age of 13, and, respectively, 14 and 15, at a 0.001 level. † Significant difference in the percent of time spent in moderate activity between girls and boys, at a 0.01 level. ‡ Significant difference in the percentage of time spent in moderate activity between the age of 13 and, to the right of the arrow, at a 0.01 level.

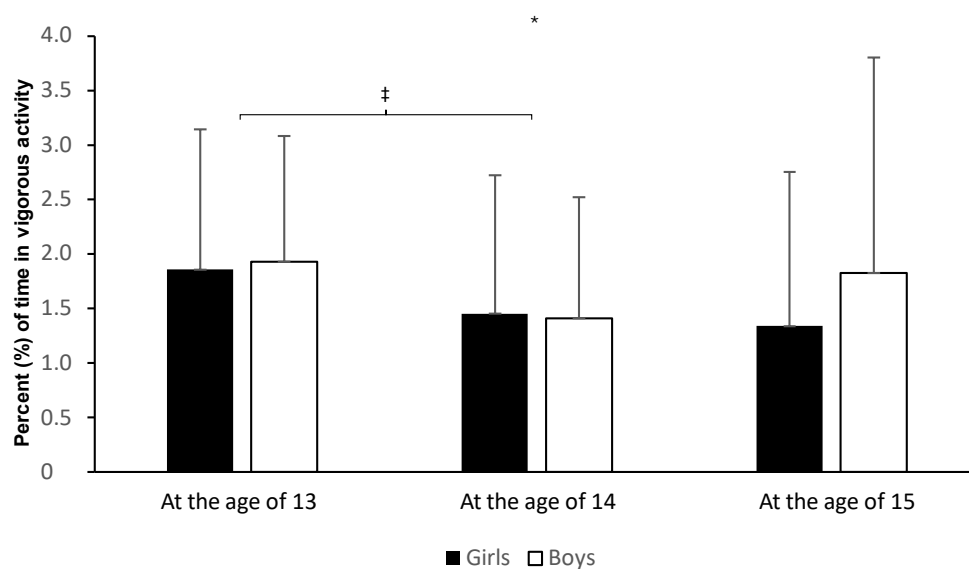


Figure 4. Percentage of time spent in vigorous activity at 13, 14, and 15 among the same girls and boys. * Significant difference in the percentage of time spent in vigorous activity at the age of 13, 14, and 15, at a 0.001 level. ‡ Significant difference in the percent of time spent in vigorous activity between the age of 13 and 14, at a 0.01 level.

4. Discussion

The study aimed to examine changes in adolescents' sedentary, light, moderate, and vigorous PA, from a longitudinal perspective, from the age of 13 to the age of 15. The findings related to the four intensity levels will be discussed primarily according to previous research on adolescents' PA behaviour and public health recommendations for PA.

The first main finding was that time spent in SB increased significantly with a large effect—mostly from 13 to 14 years of age, but it also increased significantly from 14 to 15 years

of age. Sedentary time was also the activity level with the largest changes among the adolescents. Furthermore, it was found that girls spent significantly more time in SB than boys at the age of 13.

This finding is concerning from a health-related perspective. From a biomedical standpoint, SB itself constitutes a risk factor for a range of health issues, such as poorer cardiometabolic health, musculoskeletal pain, increased obesity, and less sleep [8,27]. From a psychosocial perspective, increased levels of SB can also have negative implications. A systematic review study by Carson et al. [6] revealed that longer durations of television viewing and video-game use were associated with unfavourable behavioural conduct and social behaviour, lower self-esteem, and a higher prevalence of depression. Our first main finding may thus be considered to substantiate the need for guidelines to limit sedentary time, particularly passive screen time during leisure, as presented by the World Health organization in 2020 [28], and the Norwegian health authorities in 2023 [29,30].

The second main finding was a significant decrease in time spent in LPA with a large effect—primarily from 13 to 14 years of age, but also from 14 to 15 years of age. Additionally, girls spent significantly less time in light activity than boys at the age of 13 and a significantly higher amount of time in sedentary activity than boys at the same age. These changes in sedentary and light PA are consistent with results from the 2019 Norwegian Ungdata studies [19,31], which reported a reduction from 35% to 19% in total daily light-PA level and an increase in SB from 53% to 73% per day among adolescents aged 13 to 18 in 2019. The consecutive reports show alterations in adolescents' PA habits during the teenage years, most notably, fewer participating in organized sports and more engaging in self-organized PA. These alterations may represent structural changes in the adolescents' everyday life, which allows for less time spent in PA with a higher intensity level.

The third main finding was a significant decrease in time spent in moderate activity from 13 to 14 years of age with a medium effect. In addition, girls spend significantly less time in moderate activity than boys at the age of 13. Our finding of a decrease in time spent in moderate activity is supported by several other longitudinal studies of adolescents' MVPA levels in Norway and other countries, indicating a decline during adolescence [12–15]. It could be argued that the MVPA level includes both minutes of moderate and of vigorous activity. Still, as shown in Figures 3 and 4, adolescents have approximately seven times more minutes of moderate activity compared to vigorous activity. Furthermore, our findings and other research results [12–15,32] may be considered to contradict Reilly's [23] critique of the hypothesis that MVPA declines particularly markedly during adolescence. Our accelerometer-based study aligns with the hypothesis that MVPA declines particularly sharply during adolescence.

The fourth main finding was a significant decrease in time spent in vigorous activity from 13 to 14 years of age with a small effect. Relatively large standard deviations indicate large differences between time spent in vigorous activity levels among adolescents. However, there were no differences related to gender, in contradiction to the other activity levels. Even if the decrease in vigorous activity per day had the lowest number with the activity levels during the whole period (from 1.9% to 1.5%), this change was the relatively largest change, with an overall decrease of 21.1%.

The alterations in time spent in moderate PA and vigorous PA are following previous Norwegian research investigating the PA levels of young individuals [3,11,31]. Our observations of a more pronounced decrease in activity between the ages of 13 and 14 compared to 14 and 15 are substantiated by the literature highlighting transitions as notably challenging periods [23,32,33]. Indeed, the transition from primary school to secondary school at the ages of 13 to 14 gives rise to significant structural, cultural, and individual changes. Huseby and Tangen [34] discuss the shift from recreational emphasis to academic seriousness in PE, while Dyrnes and Brännström [35] comment on new practices and routines in secondary school, including students' behaviour during the self-organized time at recess.

The shift towards increased SB among young adolescents can be considered within the framework of various theoretical models, in which divergent factors yield varying levels

of complexity in comprehension [36]. For instance, social–ecological theory models [36] like Lerner et al.’s relational developmental systems theory [18] bring in the relational significance of more peripheral variables for the individual, such as school policy decisions, with regard to school structure at the municipal and county levels. During the past decades, school centralization has been a salient political decision in many Norwegian municipality. The transition from a local primary school to a more distant secondary school also implies that the daily commute between school and home is replaced by car or bus transport for many adolescents. This transition, from several smaller primary schools to much larger secondary schools with more students they do not know, creates large changes, on both environmental and personal levels, also related to the maturing and puberty that occur during this period [16,24,37]. Furthermore, by growing out of organized children’s sports and into organized youth sports, both structural and value-based conditions will change during the early teenage years [38]. Youth sports’ increased focus on specialization and performance can thus be assumed to influence this age group’s dropout from organized sports contexts. According to the Norwegian “Ungdata” study [19], 82% participate in organized sports activities weekly at the entrance to the teenage years, while at the age of 17 only 33% report the same. This decrease in organized sport-related PA coincides with previous findings in a review study by Back et al. [20]. In a study by Mikalsen and Lagestad [37], they found that comprehensive changes in transitional phases, as described above, may make young teenagers more vulnerable with respect to a previous way of life and established PA habits.

Socioeconomics is another well-documented factor that correlates with PA [15,22]. Both school policy and financial aspects are essential in educational dialogues concerning the factors influencing and shaping the PA behaviour of children and adolescents, as school policy and financial aspects serve as decisive determinants in their daily lives. Furthermore, managing such factors can be perceived as indicators of values and value-based priorities in the (local) society. The upbringing and development of children and young individuals are thus, from a RDS perspective [18], interwoven with these political and economic structures. Lerner [18] even asserts that individuals and society mutually influence each other and constitute inseparable entities. Therefore, the RDS perspective serves as an inspiration for the subsequent discussion on the substantial increase in sedentary activity and the reduction in all three highest activity levels during adolescence.

4.1. Adolescents’ PA Changes Viewed from an RDS Perspective

During this developmental stage, adolescents undergo significant transformations internally and within their environmental frameworks. Through continual maturation processes and meaning-making experiences, they construct and advance their cognitive, affective, relational, and ethical understandings of both the world and themselves [18]. This process also extends to activities about physical movement. According to Heidegger [39], human intentionality, defined as the persistent direction towards a goal, underpins a meaning-making procedure. Perceived as ‘thrown into’ the world, as described by Heidegger [39], developmental and learning processes occur in conjunction with contemporary value-related perspectives and behavioural norms. For adolescents, this implies that meaningful experiences derived from PA are refined and shaped through interactions with the prevailing understandings and practices within their varied PA contexts. As active participants in society, individuals play diverse roles in this interaction. For parents, coaches, and educators engaged in PA or PE in schools, their influential role is underscored in terms of fostering communication and challenging prevailing conceptions regarding the potential nature of PA and outdoor pursuits. Embracing Larsson and Quennerstedt’s [40] post-structuralist approach to PA, the human individual is perceived as having boundless prospects to discover novel forms and avenues of movement that can enrich adolescents’ life experiences in relation to PA. When examining the increase in sedentary activity and the reduction in all three other forms of PA with higher intensity levels during the transition from primary to secondary school, it is evident that such trends may be linked to many

factors, as previously mentioned. But they could also be linked to the many ways the individuals, within mutual influential relationships with their environment, are able to experience PA as personally relevant. Concurrently, the literature in the domain of PE in Norway over the last two decades [41,42] can offer meaningful insights into whether established perspectives and practices in PE and sports have been concretized—either explicitly or implicitly—in a manner that potentially undermines adolescents' capacity to shape their meaning experiences regarding PA. In circumstances in which school and leisure time predominantly endorse elitist or normative PA practices, many students may perceive these as exclusionary conditions [41–44].

4.2. Strengths and Limitations of the Study

The present study possesses several strengths worth mentioning. For a longitudinal study, it includes many participants from different types and sizes of schools, and from both rural and urban areas. The study also uses accelerometer data from more than two measurement times [23]. Furthermore, the study's use of accelerometry is based on high-quality standard procedures that are not self-reported and which are both validity- and reliability-tested for measuring PA among children [8,45,46].

Nevertheless, the present study is not without certain limitations. Although accelerometry is the preferred measurement when assessing PA in free-living situations [47,48], it underestimates activities related to cycling or riding vehicles [49], and swimming and other water activities, which might lead to an underestimation of adolescents' overall PA level. However, in terms of swimming, only 8% had been to a swimming pool twice or more during the data collection period, at the age of 13. Furthermore, the accelerometer measures only took place within one week, which did not coincide with any holidays, and the weather conditions were approximately the same. Moreover, this study's dropout rate of 49% is rather high. However, independent *t*-tests showed that sedentary, light, moderate, and vigorous activity were not significantly different between the 162 participants with valid measurements at all three times and the 139 participants only with valid data at the age of 13 or 14 ($p > 0.05$). Looking into the activity levels, the dropout seems random according to the participants' gender, place of residence and socioeconomic status. On the other hand, the participants are technically only representative of Norwegian adolescents of that region.

5. Conclusions

This study's primary results indicate an increase in sedentary activity during the ages of 13 to 15, alongside a decrease in the duration of the three highest activity levels. Notably, the most substantial relative decrease was observed at the highest activity level, i.e., vigorous activity. Our findings thus confirm our research hypothesis. Furthermore, our research aligns with a prevailing trend observed in national and international studies regarding PA behaviour among children and young individuals.

These alterations in adolescents' PA habits may be discussed from the perspective of several different theoretical models [36]. However, we have chosen to reflect the relation from a developmental systems' perspective [18], with emphasis on PA involvement reflecting the mutually influential relationship between individuals and their environment [18,39]. This implies that the intrinsic values and qualities of the activity, in conjunction with the individual's assumptions, desires, and needs, intersect and influence each other.

Therefore, for educators involved in PA and PE in educational institutions, we emphasize the necessity of accentuating the vast potential for varied forms and directions of bodily movements and of challenging perceptions of what PA and outdoor activities in school and PE can entail for the students [40]. Second, we underscore the importance of meaningful experiences as a prerequisite for engaging in PA [50]. We also emphasize that meaningful experiences are rooted in an understanding of purpose, personal significance, and the contextual relevance of the activity in one's life. For educators and trainers, emphasizing social interaction, challenge, enjoyment, motor skills, personally relevant learning, and the

joy of teaching or training sessions can also serve as differentiating qualities in fostering the relationship of young individuals with PA and an active lifestyle throughout adolescence.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Data Protection Official (Norwegian Centre for Research Data (Norwegian National Research Ethics Committees, 2014).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on reasonable request from the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

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