

Physical activity in school for 11–12 year-olds

Abstract

Background. «Outdoor school» is a method, which moves the teaching out into the open. There has been little research into the relationship between outdoor school, physical activity and improved fitness.

Material and methods. We have compared the level of activity (measured as heart rate) in a class of sixth-grade pupils during an ordinary school day and a day outdoors. The pupils' heart rates were measured during the entire school day.

Results. The average heart rate for the pupils was 104 beats/minute during an ordinary school day and 136 beats/minute during a day outdoors. The average percentage of time with a heart rate ≥ 160 beats/minute was 5 % for an ordinary school day and 18 % for a day outdoors ($p < 0.001$).

Interpretation. Outdoor school can result in a significant increase in physical activity compared to that on ordinary school days. Thus, the organization of outdoor school days may have a positive effect on pupils' aerobic capacity, which is an important factor in physical fitness.

Ivar Grønningsæter

igro@hib.no

Oddrun Hallås

Torbjørn Kristiansen

Idrettsseksjonen

Folkvard Nævdal

Pedagogikkseksjonen

Avdeling for lærerutdanning

Høgskolen i Bergen

Landåssvingen 15

5096 Bergen

Physical activity is often used as a collective term for various types of physical motion that increase the energy metabolism (1). More physical activity for everyone is a government priority (2). The challenge is to organize kindergarten, school and work in ways that lead to more physical activity (2). National guidelines for physical activity recommend a minimum of 60 min physical activity of moderate to high intensity daily for children and young people (2).

Baquet and colleagues (3) maintain that in children, intensities higher than 80 % of the maximum heart rate (MHR) are needed to obtain significantly improved peak oxygen uptake. With an MHR of 200, this level equals a heart rate of 160 beats per minute (bpm). Fredriksen and colleagues (4) have reported that in Oslo primary school pupils aged 10–13 years have an MHR of about 200 bpm.

Physical activity during the school day is primarily linked to transport to and from school, physical education lessons and activity during breaks. In addition, other lessons, outings and special arrangements contribute to varying degrees (5).

Outdoor school in Norway has been a method of education since the mid 1990s (6). A national study in spring 2000 showed that a half day or more a week of outdoor schooling made up 37 % of school time for grades 1–4, 6 % for grades 5–7 and 1 % for grades 8–10 (7). Physical testing of pupils has not been included as a central variable in any Norwegian studies comparing ordinary school and outdoor school (5). A Danish study measured the activity level of third-grade pupils on school and nature days using an accelerometer. «Forest days» showed significantly higher activity than ordinary school days (8).

We wanted to compare the level of activity (measured as heart rate) in a class of sixth-grade pupils during an ordinary school day and a day outdoors. For the ordinary

school day we have defined two types of activity: classroom teaching and physical education. For the day outdoors, the types of activity are lessons within the school grounds and outside the school grounds (necessitating transportation). We may thus compare four types of activity: ordinary school day, outdoor school day, ordinary school day without physical education, outdoor school day without transportation.

Material and methods

Design

In this study, the ordinary school day was defined as six 45 min lessons, five of which were in the classroom and one in the gym; two breaks of 10 min each and one long break of 45 min. The recorded time for such a day was 4 hrs 40 min.

Outdoor school here refers to a school day when the pupils had to be physically active, do practical tasks and use their whole body to acquire knowledge. The pupils packed various pieces of equipment in their classroom (15 min). They then walked about 2 km through a varied landscape to their outdoor school area. The temperature this day was around 0 °C and about 5 cm of snow had newly fallen. The area had been set up for the pupils to spend about 3 hrs on school activities related to Lapp culture and the time of the Vikings. Their task was to set up a lavvo (Lapp summer tent), build a simple Viking dwelling of long poles, make a fire-place and cook Lapp food on a bonfire. They then returned to school to round off the day in their classroom. The recorded time for this day was 5 hrs.

The pupils wore a chest belt with a transmitter and a heart rate monitor. The heart rate monitors were labeled so that each pupil used the same monitor on both days. The project leaders coded and started the monitors and covered them with elastic tape to

Main message

- Outdoor school may be one way to reach the goal «more physically active children»
- Outdoor school days result in a significantly higher mean heart rate than ordinary school days
- More research is needed on the effect of outdoor school

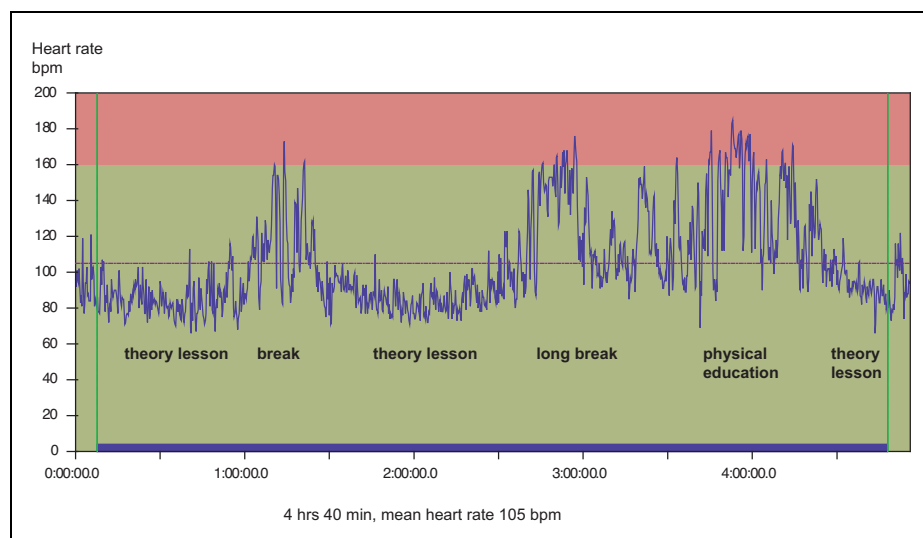


Figure 1 Heart rate curve for boy No. 10 on the ordinary school day. The X-axis shows the time in hours, minutes and seconds. The period from the start of lessons at 0900 to their completion at 1340 is marked by the blue bottom line. The red line on 105 bpm shows the MHR in this period. The red area shows where the intensity is over 80 % of the MHR

prevent the pupils from touching the buttons or checking their own pulse. This was done to counteract the Hawthorne effect (9). The project leaders stopped the monitors and collected the chest belts with the transmitters at the end of each day. The labels on the monitors (apart from information on the sex of the participant) were removed at the end of the last day of the experiment.

Sample selection

Sixth-grade pupils (11–12 years) were chosen for the experiment. The class had used outdoor school as a method of learning for several years. The pupils, staff and parents had approved the experiment by signing an information sheet. Participation was voluntary and anonymous and the pupils were

free to withdraw at any stage. Four girls and 14 boys, totally 20 pupils, participated. Due to some rejected measurements, the final sample consisted of three girls and 11 boys.

Operationalization

Recording the heart rate is a useful measure of activity level. Heart rate increases almost linearly as a function of activity level from rest to a level that correlates with peak oxygen uptake (10). At this point, the heart rate has reached its maximum level and cannot increase even with more activity. To record heart rate we used Polar Accurex Plus heart rate monitors and Polar WearLink 31 chest belts (Polar Electric Oy) with electrodes and coded transmitters. This type of chest belt was easy to adjust to the size of the pupils.

The monitors were synchronized and programmed to record the heart rate every 15th second. Polar heart rate monitoring equipment has previously been reported as valid and reliable for recording of heart rate in children (11, 12).

Statistical analysis

Our starting point is that 160 bpm corresponds to 80 % MHR. The Polar Training Advisor was used to calculate the mean heart rate and mean percentage of time with intensity ≥ 160 bpm for each pupil. The SPSS statistical programme was used. Means and standard deviations (SDs) were calculated and in-pupil differences were assessed with a paired t-test (often used to assess in-patient differences when the same test is done under two different conditions). The test uses the difference between the mean score in the two test situations and includes the SD in the distribution of the individual differences between the two situations. The fact that the sample is not two independent, but rather two identical «groups» is thereby taken into consideration.

Results

The mean heart rate was lower on the ordinary school day than on the day outdoors (tab 1). The time pupils had a heart rate equal to or above 160 bpm was less for the ordinary school day than for the day outdoors (tab 2).

Boy No. 10 was typical for his class (fig 1, fig 2). His mean heart rate for the ordinary school day was 105 bpm (range 66–188). The mean for the day outdoors was 135 bpm (range 79–185).

Discussion

We find that pupils are more active (measured as mean heart rate), and this varies less, on the day outdoors than during the ordinary school day. This is probably linked to the way the school day is organized. On the day outdoors, the pupils are not bound by the classroom. Most of the day is spent on practical work, and everyone must walk to and from the outdoor school area.

The mean heart rate is 90–118 bpm for the ordinary school day and 125–145 bpm for the day outdoors. Even if pupils have the same level of activity in the classroom, participation in physical education lessons and the level of activity during breaks can vary enormously. This is shown in the heart rate curves for individual pupils. On the day outdoors, it took the pupils about 85 min to walk together to and from the outdoor school area, and the level of activity was relatively high for everyone. The location of this area is an important consideration. It may be close by or far from the school grounds. Even if we removed the walk to and from the outdoor school area, the mean heart rate is still clearly higher for the day outdoors than for the ordinary school day.

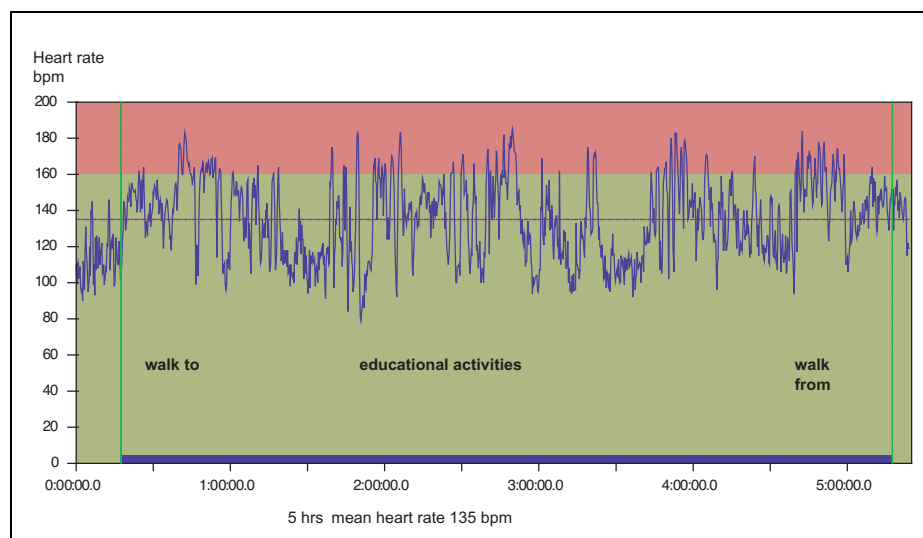


Figure 2 Heart rate curve for boy No. 10 on the outdoor school day. The X-axis shows the time in hours, minutes and seconds. The period from when the pupils started out from school at 0920 until they returned at 1420 is marked by the blue bottom line. The red line on 135 bpm shows the MHR in this period. The red area shows where the intensity is over 80 % of the MHR

Table 1 Differences in mean heart rate by type of activity (N = 14)

| Activity type | Mean bpm | Standard deviation | Difference ¹ | Standard error | P-value ² |
|---|----------|--------------------|-------------------------|----------------|----------------------|
| Ordinary school day | 104 | 7.2 | 32 | 1.8 | < 0.01 |
| Outdoor school day including transportation (e.g. a walk) | 136 | 5.5 | | | |
| Ordinary school day without physical education | 99 | 6.9 | 30 | 1.7 | < 0.01 |
| Outdoor school day without transportation | 130 | 6.3 | | | |
| Ordinary school day | 104 | 7.2 | 25 | 1.7 | < 0.01 |
| Outdoor school day without transportation | 130 | 6.3 | | | |

¹ Corrected for round-off error

² T-test

Table 2 Differences in mean percentage of time with high intensity recorded as heart rate ≥ 160 bpm by activity type (N = 14)

| Activity type | Mean percentage time | Standard deviation | Difference | Standard error | P-value ¹ |
|--|----------------------|--------------------|------------|----------------|----------------------|
| Ordinary school day | 5.1 | 2.3 | 12.5 | 1.4 | < 0.01 |
| Outdoor school day with transportation (e.g. a walk) | 17.8 | 5.5 | | | |
| Ordinary school day without physical education | 1.7 | 1.8 | 8.5 | 1.2 | < 0.01 |
| Outdoor school day without transportation | 10.1 | 4.9 | | | |
| Ordinary school day | 5.1 | 2.3 | 5.0 | 1.2 | < 0.01 |
| Outdoor school day without transportation | 10.1 | 4.9 | | | |

¹ T-test

Pupils are more physically active in the outdoor school area than at school, even when the ordinary school day includes a physical education lesson. The difference is even greater when the day outdoors is compared to the activity type ordinary school day without physical education. Most ordinary school days are of this type.

The day outdoors has also the greatest percentage of time with activity of an intensity equal to or higher than 80% of MHR. This corresponds to 160 bpm in our study. According to Baquet, an intensity of more than 80% of MHR is needed to reach a significant increase of peak oxygen uptake for this age group (3). On the day outdoors the pupils had such high intensity on average 18% (55 min) of the entire day. Even for the activity type «day outdoors within the school grounds» the pupils had on average 10% of their time at this intensity, for the ordinary school day 5% of the entire day had such an activity level.

For the day outdoors the percentage of time with a heart rate ≥ 160 bpm has a greater SD than the ordinary school day. The reason for this is that active time was not recorded before the heart rate had reached 160 bpm. On an ordinary school day, pupils

who exceed this level have less variation in the percentage of time with such a high rate, because it mostly occurs for short periods during the physical education lesson or breaks. But on a day outdoors, many reach this level of activity and for some it continues over time, especially if a walk to the area is included. The difference in SD (for the percentage of time with intense activity) between the two methods of schooling shows that outdoor school promotes a level of activity that may increase the peak oxygen uptake. The activity type «ordinary school day without physical education» makes the situation worse.

Conclusion

Providing possibilities for more physical activity at school is a government priority (2). In national guidelines the aim is for children and young people to be physically active with moderate to high intensity for at least 60 min daily (2).

Outdoor school can ensure increased physical activity over a longer period of time than ordinary school days. Thus, outdoor school days may make an important contribution to ensuring pupils' physical activity with moderate to high intensity.

Our study is built on two days of recording in a class and should be interpreted with this in mind. More studies are needed on the association between outdoor school, activity level and physical fitness for different age groups.

Literature

1. Bouchard C. Physical activity, fitness and health. Campaign, IL: Human Kinetics Publishers, 1993.
2. Utdannings- og forskningsdepartementet. Handlingsplan for fysisk aktivitet 2005–09. Sammen for fysisk aktivitet. Oslo: Utdannings- og forskningsdepartementet, 2005.
3. Baquet G, Van Praagh E, Berthoin S. Endurance training and aerobic fitness in young people. Sports Med 2003; 33: 1127–43.
4. Fredriksen PM, Ingjer F, Nystad W, Thaulow E. Aerob kapasitet hos barn og unge – nordiske resultater gjennom 45 år. Tidsskr Nor Lægeforen 1998; 118: 3106–10.
5. Sosial- og helsedirektoratet. Fysisk aktivitet i skolehverdagen. Oslo: Sosial- og helsedirektoratet, 2004.
6. Jordet AN. Nærmiljøet som klasserom. Oslo: Cappelen Akademiske, 1998.
7. Bjelland M, Klepp KI. Skolemåltidet og fysisk aktivitet i grunnskolen. Oslo: Institutt for ernæringsforskning, 2000.
8. Mygind E. Elevers aktivitetsnivå på skole- og naturdage. Focus Idræt 2002; nr. 3: 97.
9. Franke RH, Kaul JD. The Hawthorn experiments: First statistical interpretation. Am Sociol Rev 1978; 43: 623–43.
10. Bahr O, Hallén I, Medbø S. Testing av idrettsutøvere. Oslo: Universitetsforlaget, 1991.
11. Strand B, Reader S. Using heart rate monitors in research on fitness levels of children in physical education. J Teach Phys Educ 1993; 12: 215–20.
12. Mitchell B, Brett M, Strasburger J et al. Heart rates during an intensity-controlled one-mile run in 11- to 14-year-old children. Meas Phys Educ Exerc Sci 2001; 5: 109.

The manuscript was received 13.7. 2006 and accepted 15.7. 2007. Medical editor Preben Aavitsland.