# PROFILES OF INTENSITY LOADS IN PHYSICAL EDUCATION CLASSES IN POLAND

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The aim of the research was to compare the health-related effectiveness of various types of physical education lessons on the cardio-respiratory system. The research was carried out in the years 2002 and 2003 in two junior high schools in Poznań. There were four types of classes examined: outdoor athletics, volleyball, basketball and fun games, each type lasting 45 minutes. Heart rates of two randomly selected pupils aged 15–16 were recorded during class, with the use of Polar heart rate monitors. According to the findings of a cross-national study, Polish youth do not have enough *moderate-to-vigorous* activity on a daily basis (Cabak & Woynarowska, 2004). In our research the most effective in stimulating cardio-respiratory fitness appeared to be outdoor athletics classes in boys and girls, and basketball in boys. Our data support the earlier findings of other studies (Stratton, 1997; Fairclough & Stratton, 2005).

*Keywords: Intensity loads, cardio-respiratory fitness, physical education, youth.*

## INTRODUCTION

Physical activity remains one of the fundamental stimuli for the biological, psychosocial and motor development of young children. A sedentary life style and, generally, physical inactivity have been identified in numerous studies as causes of diseases collectively called the metabolic syndrome. Various studies have proven a connection between the level of activity and body fat (Hill, 1999; Owens, 1999; Moore, 2003; Boreham, 2001) as well as the incidence of heart diseases, metabolic problems, and type II diabetes (Ball, 2003; Janz, 2002; Kozieł et al., 2000, also see review of evidence in Vuori, 2004). Especially the problem of obesity in younger age categories appears to be growing in most of the industrialized countries, including Poland.

The quantity and quality of exercise influence the morphological (body composition, metabolism, oxygen uptake and consumption), somatic (body mass and height) and neurological (co-ordination, reaction time) characteristics of individuals. Recent studies have concerned relations between physical activity and motor and cardiovascular fitness, fatness, body mass, BMI and other body components in certain developmental stages, but with no educational interventions (Boreham, 2001; Eliakim, 2002; Barkey, 2003; Chromiński, 1985; Raczek, 1997; Gołąb, 2002). Earlier studies concerned mainly the effectiveness of exercise on reducing body fat mass (Boileau, 1985; Ilyes, 1992; Mulder, 1983), alongside the effectiveness of medical treatment and special diet in obesity (Gately, 2000; Eliakim, 2002; Kasprzak et al., 2000).

A reduced level of physical activity negatively influences motor fitness (Corbin, 1996; Mota, 2002; Przewęda & Trześnowski, 1996; Przewęda & Dobosz, 2003; Raczek, 1986). In their research Magiera et al. (2002) observed a very low level of cardio-respiratory fitness among Polish pupils. Osiński (1988) found a relation between poorer results in motor abilities and pubescence and secular trends in body mass and height. A similar association was found by Gołąb et al. (2002).

At the same time, insufficient intensity of physical education classes in school appears to affect obesity. Research projects in Poland (Woynarowska, 1982; Raczek, 1986; Perkowski, 1995, 1998; Pańczyk, 1998, 1999; Bronikowski, 2004), and in other countries (Burton, 1996; Stratton, 1997; Boreham, 2001) have indicated this growing problem.

Stratton (1997) found in his study of British public school children aged 9–15 that almost 80% of the lesson time does not meet the National public health service criteria of using 50% of total PE lesson time by carrying out exercises with a heart rate intensity of HR ≥ 150 b/min. He also indicated that the amount of time spent in sufficient moderate-to-vigorous physical activity (MVPA) had been increasing until the pupils' age of 11–12, and then was systematically decreasing to 10% of lesson time with the required intensity among 15 years old children. As a possible explanation of this fact Stratton suggested problems connected with changing of schools at the age of 12. The worsening results may be connected with negative changes in the quality of lessons provided in later years of education. Burton (1996) established that during physical education lessons the average heart rate for 9–13 years old American pupils was 142 beats per minute, and 45% of lesson time failed to achieve this level. Children from French

schools, according to research conducted by Baquet et al. (2002), exercised with an intensity lower then 50% HR max for almost 40% of lesson time. For only 25% of the total lesson time did they exercise with an intensity of over the level of 60% HR max, and 10% of the time with an intensity of above the 75% HR max.

Studies conducted in Poland do not produce a dramatic image, but certainly some questions and concerns may arise. Perkowski (1998) found that the average HR during physical education lessons in Poland was 149 b/min within 38% of the activity time with an intensity of between 140–170 b/min (*moderate-to-vigorous* activity). Pańczyk (1998, 1999) reports the average HR of 159 b/min for outdoor physical education classes, while in indoor classes the average HR was 142 b/min. In our own research the average HR during the indoor classes was estimated at the level of 138 b/min for 13 years old boys, and at the level of 145 b/min for girls (Bronikowski, 2004). The majority of physical education classes do not provide physiological support for developing physical fitness, especially cardio-respiratory fitness and endurance. According to Stratton (1997), Pańczyk (1999), Perkowski (1998), Raczek (1986), Osiński (2001) only exercising with and above *moderate-to-vigorous* (over 140 b/min) and *vigorous* (over 160 b/min) physical activity can have a positive effect on cardio-respiratory fitness and support proper biological development.

The aim of the paper was to assess the levels of intensity of workloads using heart rate telemetry during various types of physical education classes in Polish schools. For the purpose of the work, the total exercising time of the class was divided into 5 pre-determined zones of intensity. The analysis of intensity represented by a curve was also presented.

## MATERIAL AND METHOD

The subjects of this study were 14 boys and 12 girls randomly selected from two classes of 15–16 years old pupils from two junior high schools in Poznań and were part of a larger study project carried out in order to assess the cardio-respiratory effectiveness of physical education lessons. This study was supported by Polish scientific committee grant no PO5D 04623.

Body mass and height were measured using standard anthropometric methods and are presented in TABLE 1.

The heart rate was measured with Polar sport-testers S 601i. Monitoring devices were worn during each lesson for its entire duration by two subjects. Later the collected data was downloaded for statistical and graphic analysis. To establish the significance of differences between boys participating in the lessons, a one-way ANOVA analysis was carried out. The same procedure was adopted separately for girls who participated together in one lesson. The level of significance was established at $p < 0.05$. From this data the percentage of lesson time, mean values and time allocation of intensity in five pre-determined heart-rate zones were calculated, following Swaim and Edwards (2002) who established five zones of intensity accordingly to % Max HR and fuel usage. Those zones were adopted in the study:

1) 50–60% Max HR (under 119 b/min);
   fuel usage: 10% carbohydrates, 50–75% fat, 5% protein, app. 5 calories per minute;
2) 61–70% Max HR (120–139 b/min);
   fuel usage: 10% carbohydrates, 50–75% fat, 5% protein, app. 5–8 calories per minute;
3) 71–80% Max HR (140–159 b/min);
   fuel usage: 60% carbohydrates, 35% fat, 5% protein, app. 8–10 calories per minute;
4) 81–90% Max HR (160–179 b/min);
   fuel usage: up to 80% carbohydrates, 15–45% fat, 5% fat, app. 10–15 calories per minute;
5) 91–100% Max HR (180 b/min and above);
   fuel usage: 90% carbohydrates, 5% protein, 5% fat, app. 15–20 calories per minute.

To establish the maximal heart rate for this age category we used the Ball State University formula, where the HR max for females = 209 – (0.7)(age), gave approximately 198 b/min for girls; and for males HR max = 214 – (0.8)(age), gave approximately 202 b/min for boys (Swaim & Edwards, 2002).

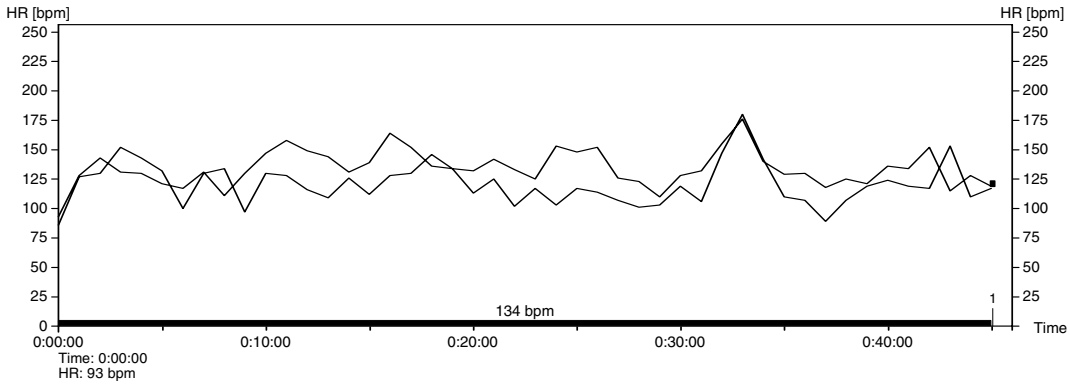
**TABLE 1**
Characteristics of the sample group (mean ± SD)

| Characteristics | Boys (N = 14) | | | Girls (N = 12) | | |
|---|---|---|---|---|---|---|
| | Min | Mean | Max | Min | Mean | Max |
| Body mass [kg] | 55.0 | 61.6 | 75.0 | 43.0 | 54.4 | 64.0 |
| Body height [cm] | 168 | 176 | 186 | 156 | 166 | 174 |

## RESULTS

Monitoring of heart rates showed there were differences in exercising time in five zones of intensity in various types of physical education lessons. Fig. 1a below shows average heart rate curves; Fig. 1b shows a time allocation in five zones of intensity in all types of physical education lessons monitored.

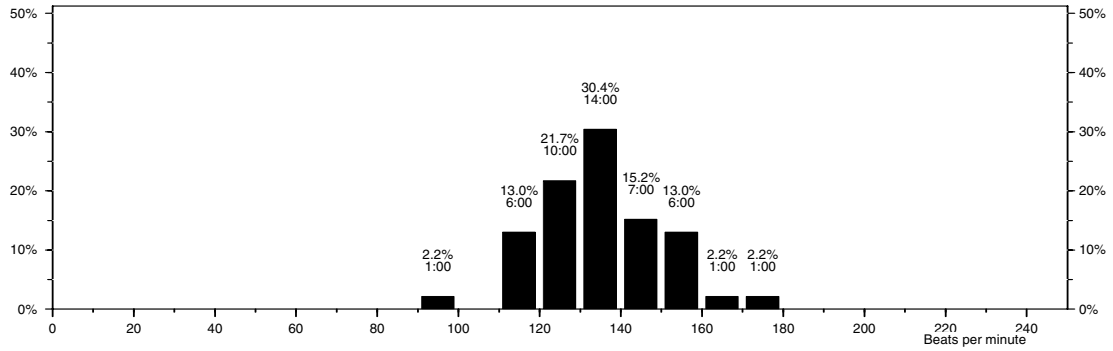
**Fig. 1a**
Average heart rate curve during a lesson of fun plays in 16 years old girls ($p < 0.001$)




| No | Exercise | Date | Cursor HR | Heart rate | Duration | Note |
|---|---|---|---|---|---|---|
| 1. — | 2003-05-26 09:53 | 2003-05-26 | 86 | 121 / 180 | 0:45:07.5 | |
| 2. ▭ | 2003-05-26 09:53 | 2003-05-26 | 93 | 134 / 176 | 0:45:03.6 | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

Fig. 1a illustrates an average heart rate (HR) in a lesson of simple fun plays and games in girls. The average heart rate was 134 b/min, reaching its peak 176 b/min at around the 30–35$^{th}$ minute of the lesson. Fig. 1a presents ups and downs in the curve indicating resting breaks between consecutive plays, usually used by a teacher for explanation of rules and fibula of a play. There were no significant differences in the intensity levels between two girls wearing sport-testers ($p < 0.001$) during the same lessons.

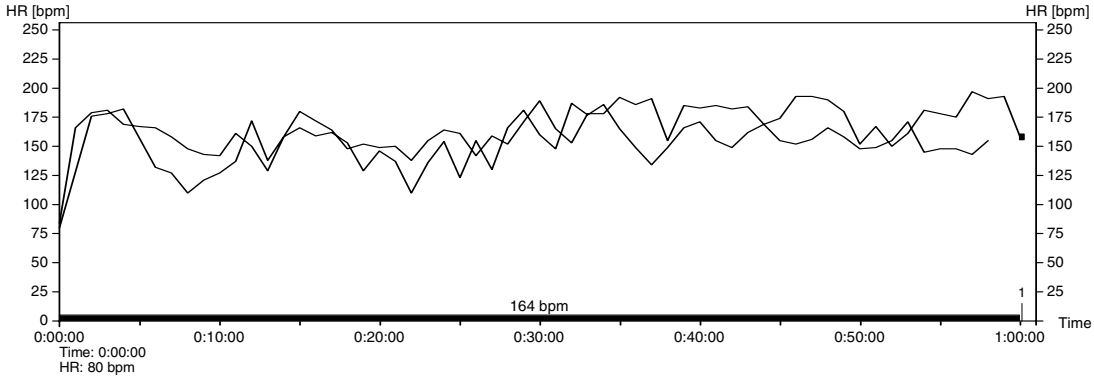
**Fig. 1b**
The percentage of lesson time spent with varying intensity during a class of fun games in 16 years old girls (%)




| | | | 2003-05-26 | | 134 bpm | | |
|---|---|---|---|---|---|---|---|
| Person | Michal | Date | | Heart rate average | 176 bpm | | |
| Exercise | 2003-05-26 09:53 | Time | 0:45:03.6 | Heart rate max | | | |
| Sport | Running | Duration | | | 0: )0 (0:45:00.0) | | |
| Note | | | | Selection | | | |

Fig. 1b shows that during the monitored lesson of fun plays girls exercise 52% of the total lesson time with the intensity of zone II (120–139 b/min). Exercising time spent in zone IV (140–159 b/min) was almost 4.5%, and no exercising time of zone V of maximal intensity was noticed. Altogether the amount of time above the level of 140 b/min (recommended as stimulating cardio-respiratory functions) was almost 32.5%, which was nearly 15 minutes (Fig. 1b). During the lesson of fun plays the 16 years old girls burnt 385 kcal/45min (±60) on the average.

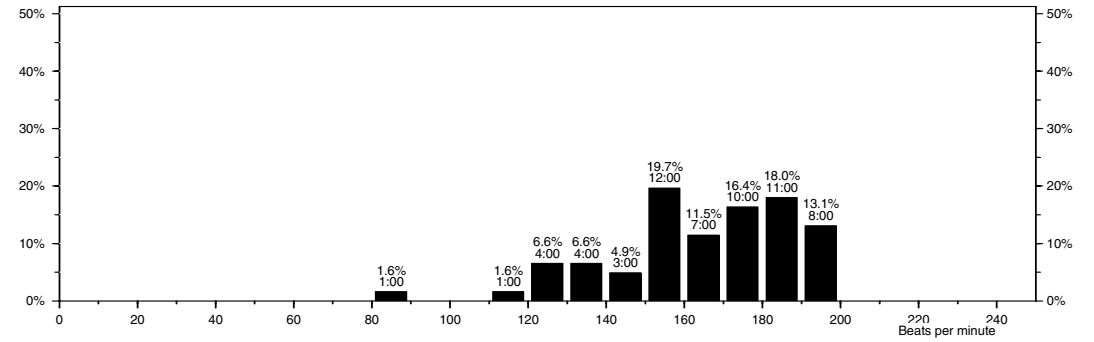
**Fig. 2a**
Average heart rate curve during an outdoor track and field lesson in 16 years old girls (p = 0.012)




| No | Exercise | Date | Cursor HR | Heart rate | Duration | Note |
|---|---|---|---|---|---|---|
| 1. | 2003-05-21 13:04 | 2003-05-21 | 84 | 154 / 187 | 0:58:48.2 | |
| 2. | 2003-05-21 13:03 | 2003-05-21 | 80 | 164 / 197 | 1:00:06.8 | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

Fig. 2a presents an intensity curve of an outdoor track and field lesson in 16 years old girls. The average heart rate was 164 b/min. In the first part of the lesson (up to the 5th minute) a steep line up in the intensity curve reaching the value of 175 b/min was due to the introduction of a physical activity called "tugs of war". The response of the cardio-respiratory system (steep curving intensity line) indicates that such a workload was too demanding for this part of the lesson and therefore should not have been introduced, at least not at such an early stage of the warm up. The measured heart rate reached its highest value of 197 b/min between the 30th and 40th minutes of the lesson, which is in accordance with the theoretical assumptions of physical education lessons.

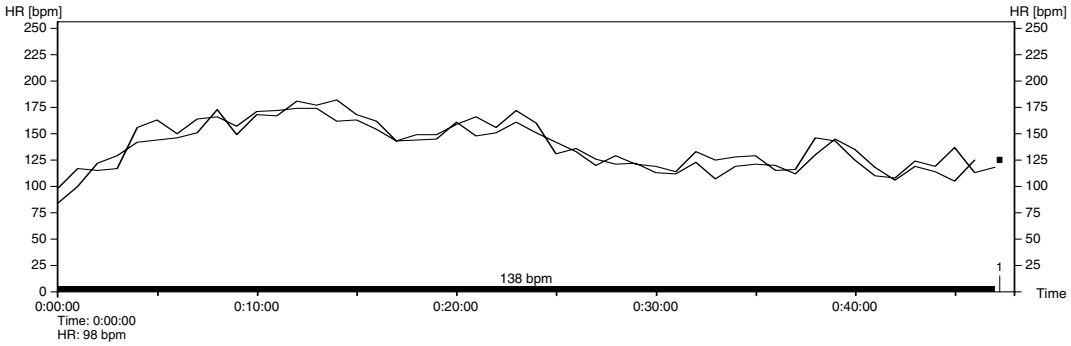
**Fig. 2b**
The percentage of lesson time spent with varying intensity during a lesson of outdoor track and field athletics in 16 years old girls (%)




| Person | Michał | Date | 2003-05-21 | Heart rate average | 164 bpm | | |
|---|---|---|---|---|---|---|---|
| Exercise | 2003-05-21 13:03 | Time | 13:03:07 | Heart rate max | 197 bpm | | |
| Sport | Running | Duration | 1:00:06.8 | | | | |
| Note | | | | Selection | 0:00:00 - 1:00:00 (1:00:00.0) | | |

The examined 16 years old girls exercised with the intensity of zone III (140–159 b/min) for about 25% of the total lesson time. They spent 27% of the total lesson time exercising in zone IV (160–179 b/min) and 31% in zone V (over 180 b/min). Altogether they exercised with an intensity suited to supporting cardio-respiratory fitness (over 140 b/min) for 83% of the lesson time. Preparation for such intensive exercise took 17% of the total time, with only 3.5% of the total time in zone I (under 119 b/min; Fig. 2b). The caloric cost of the outdoor track and field lesson in 16 years old girls was almost 470 kcal/45min ±105.

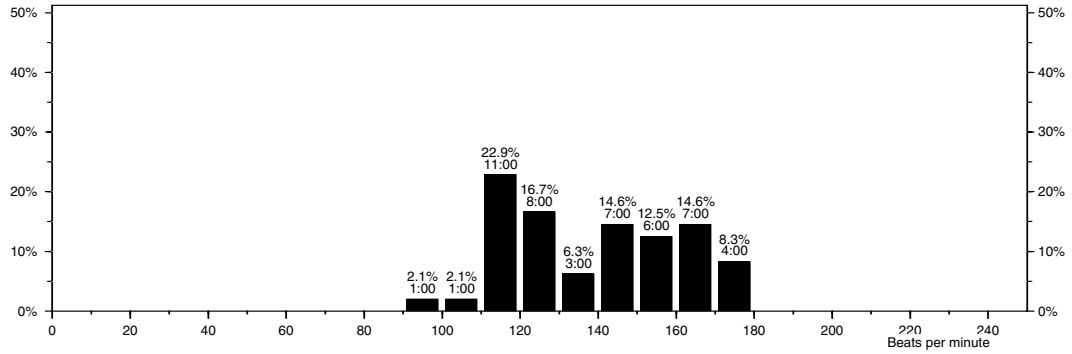
**Fig. 3a**
Average heart rate curve during a volleyball lesson in 16 years old girls (p = 0.083)




| No | Exercise | Date | Cursor HR | Heart rate | Duration | Note |
|---|---|---|---|---|---|---|
| 1. | 2003-05-19 09:09 | 2003-05-19 | 84 | 137 / 182 | 0:46:43.4 | |
| 2. | 2003-05-19 09:08 | 2003-05-19 | 98 | 138 / 174 | 0:47:16.3 | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

Fig. 3a shows a volleyball class attended by 16 years old girls. The intensity curve forms a characteristic slope, rising up to the 15th minute of the lesson. It is owing to the properly conducted warm up. Next, it is slowly falling toward the end of the lesson. The average heart rate was 138 b/min, reaching its highest value of 174 b/min in the first part of the lesson. Introduction of new material, connected with sampling and repetition, usually requiring little physical work caused a drop in the intensity level between the 15th and 30th minutes. This is understandable, as learning technical and tactical elements of team games always requires more accuracy and less speed. A game of volleyball introduced in the final part of the lesson did not increase the intensity back to the level of over 140 b/min.

**Fig. 3b**
The percentage of lesson time spent with varying intensity during a volleyball lesson in 16 years old girls (%)

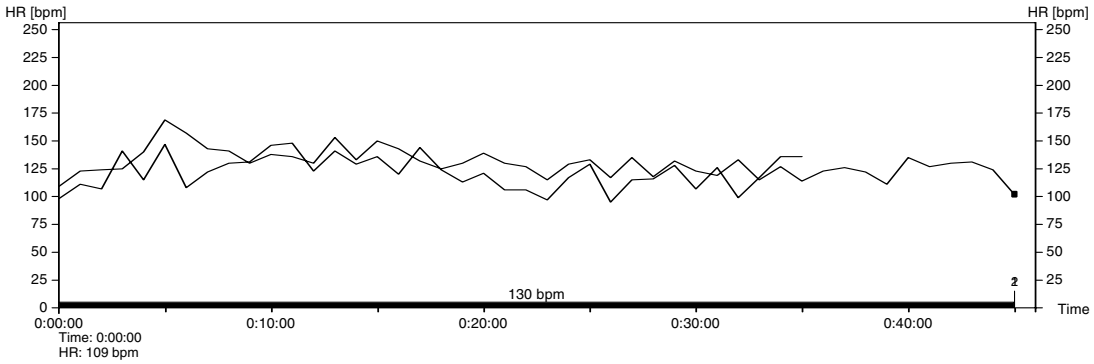



| Person | Michał | Date | 2003-05-19 | Heart rate average | 138 bpm | | |
|---|---|---|---|---|---|---|---|
| Exercise | 2003-05-19 19:08 | Time | 19:08:11 | Heart rate max | 174 bpm | | |
| Sport | Running | Duration | 0:47:16.3 | | | | |
| Note | | | | Selection | 0:00:00 - 0:47:00 (0:47:00.0) | | |

During the volleyball class 16 years old girls practiced with an intensity supporting the development of cardio-respiratory functions (over 140 b/min) for 50% of the lesson time. However, there were no loads in zones IV and V recorded, which may suggest that this type of lesson demands little or no maximal intensity (Fig. 3b). Energy expenditure during the volleyball class equaled 380 kcal/45min (±74).

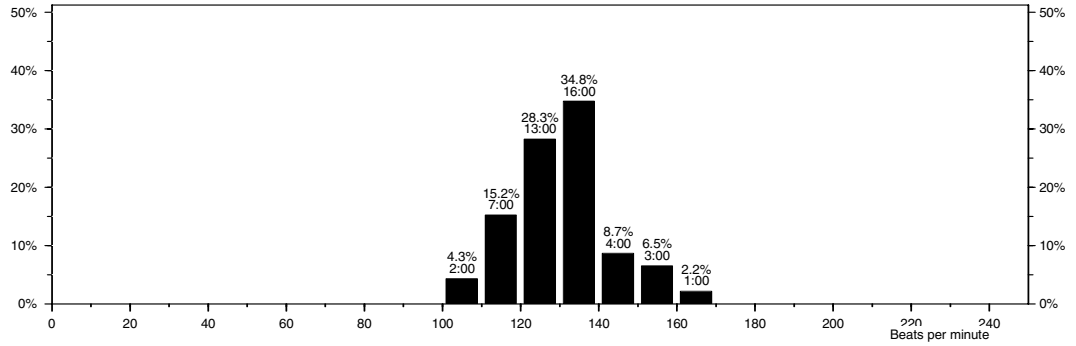
A similar situation was observed among 16 years old boys during a volleyball lesson. In Fig. 4a the intensity curve is gradually rising up to the value of 169 b/min in the 5th minute, and then systematically falling until the end of the lesson. Both, the shape of the intensity curve and the average heart rate of around 130 b/min proved similarities in the same type of lesson in both genders.

**Fig. 4a**
Average heart rate curve during a volleyball lesson in 16 years old boys (p = 0.013)




| No | Exercise | Date | Cursor HR | Heart rate | Duration | Note |
|---|---|---|---|---|---|---|
| 1. | 2003-05-06 16:25 | 2003-05-06 | 98 | 122 / 148 | 0:35:00.7 | |
| 2. | 2003-05-06 16:25 | 2003-05-06 | 109 | 130 / 169 | 0:45:02.1 | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

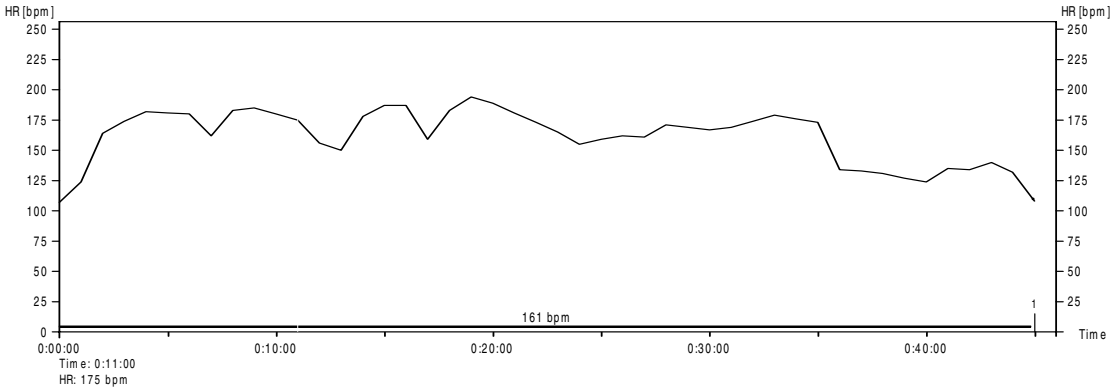
**Fig. 4b**
The percentage of lesson time spent with varying during a volleyball class in 16 years old boys (%)




| Person | Michał | Date | 2003-05-06 | Heart rate average | 130 bpm | | |
|---|---|---|---|---|---|---|---|
| Exercise | 2003-05-06 16:25 | Time | 16:25:10 | Heart rate max | 169 bpm | | |
| Sport | Running | Duration | 0:45:02.1 | | | | |
| Note | | | | Selection | 0:00:00 - 0:45:00 (0:45:00.0) | | |

Fig. 4b shows that during the volleyball lesson the examined boys exercised with an intensity of over 140 b/min for 17% of the total lesson time, but only for one minute in zone IV (160–179 b/min) and not even a minute in zone V. The relatively low intensity influenced a low caloric expenditure, which in boys amounted to 225 kcal/45min (±123). In the case of volleyball lessons conducted with 16 years old pupils of both sexes an explanation of low average heart rates and low energy costs could be provided by an understanding of emotional factors. It is common that during physical education lessons pupils of this age usually spend most of the time sampling and modifying well known tasks. No wonder there is little or none of the emotional arousal normally associated with new, challenging tasks. During monitored lessons it was rather boredom which kept the heart rate running low.

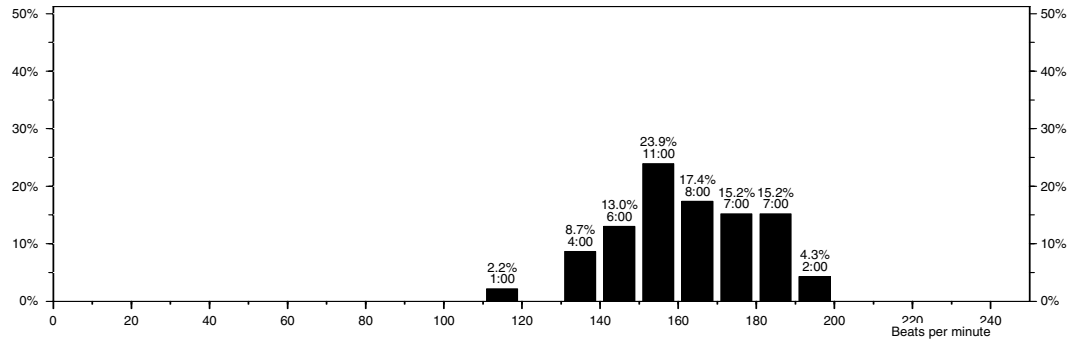
**Fig. 5a**
Average heart rate curve during an outdoor track and field lesson in 16 years old boys




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Person | pupil | Date | 2003-05-06 | Heart rate average | 161 bpm | | |
| Exercise | 2003-05-06 11:35 | Time | 14:10:12 | Heart rate max | 194 bpm | | |
| Sport | Running | Duration | 0:45:02.2 | | | | |
| Note | | | | Selection | 0:00:00 - 0:45:00 (0:45:00.0) | | |

Fig. 5a shows a steep increase of the heart rate curve up to 190 b/min during an outdoor lesson of track and field in 16 years old boys. The increase in the early phase of the lesson is due to the forms of running exercises introduced in the warm-up. In the later part of the lesson the intensity curve forms characteristic ups and downs between 155–185 b/min as a result of the running and resting system of organization of delivering teaching material. The average heart rate recorded during this lesson was 161 b/min.

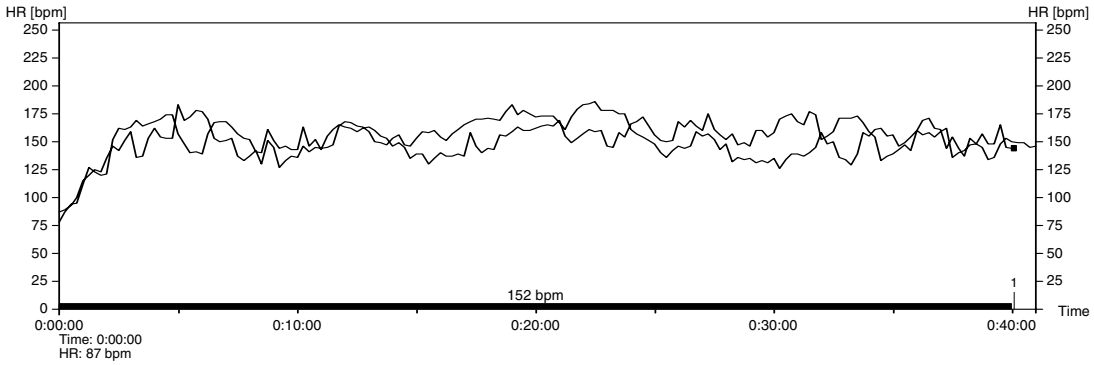
**Fig. 5b**
The percentage of lesson time spent with varying intensity during an outdoor track and field class in 16 years old boys (%)




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Person | Michal | Date | 2003-05-06 | Heart rate average | 161 bpm | | |
| Exercise | 2003-05-06 11:35 | Time | 11:35:14 | Heart rate max | 194 bpm | | |
| Sport | Running | Duration | 0:45:02.1 | | | | |
| Note | | | | Selection | 0:00:00 - 0:45:00 (0:45:00.0) | | |

Time allocation in five intensity zones during the track and field lesson in boys is shown in Fig. 5b. According to the data the amount of physical activity with a positive effect on cardio-respiratory fitness (zone III and above) in this type of lesson was 89% of the total lesson time, including exercising with a vigorous intensity of 160–179 b/min for 32% and 19.5% with a maximal intensity of over 180 b/min. Interestingly, only for about 10% of the total lesson time did the boys exercise with an intensity of lower than 140 b/min, mostly in the final phase of the lesson. Exercising with the intensity of zones III, IV and V caused fuel usage mainly from carbohydrates, which resulted in the generally high total caloric expenditure during this lesson – 520 kcal/45 min (±63).

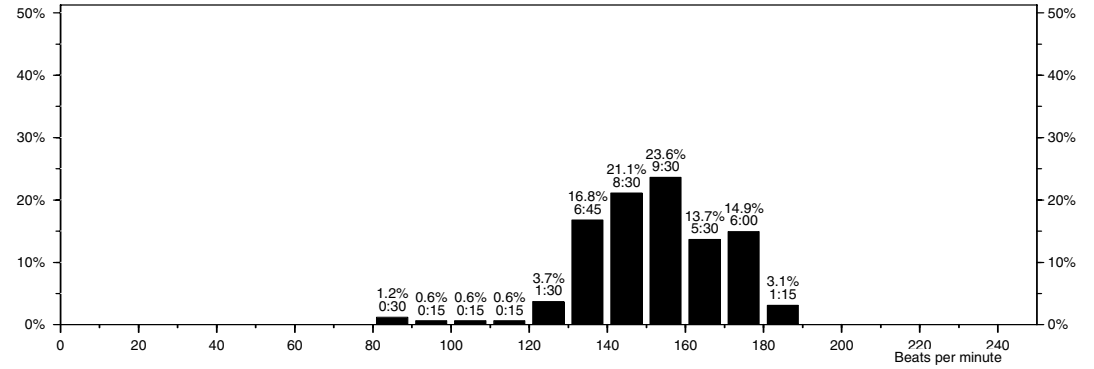
**Fig. 6a**
Average heart rate curve during a basketball lesson in 16 years old boys (p = 0.909)




| No | Exercise | Date | Cursor HR | Heart rate | Duration | Note |
|---|---|---|---|---|---|---|
| 1. | 2003-04-28 10:04 | 2003-04-28 | 78 | 152 / 177 | 0:45:43.2 | |
| 2. | 2003-04-28 10:05 | 2003-04-28 | 87 | 152 / 186 | 0:40:05.5 | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

During a basketball lesson the average heart rate in 16 years old boys was established at the level of 152 b/min. Fig. 6a illustrates the intensity curve gradually rising in the first 5 minutes of the lesson, and staying at a reasonably high level for the remaining part of the lesson. Well selected tasks kept the intensity high, especially practicing technical skills with balls in the climax part and a small-sided game in the final part of the lesson helped in achieving such high intensity.

**Fig. 6b**
The percentage of lesson time spent with varying intensity during a basketball class in 16 years old boys (%)




| Person | Michał | Date | 2003-04-28 | Heart rate average | 152 bpm | | |
|---|---|---|---|---|---|---|---|
| Exercise | 2003-04-28 10:05 | Time | 16:38:34 | Heart rate max | 186 bpm | | |
| Sport | | Duration | 0:40:05.5 | | | | |
| Note | | | | Selection | 0:00:00 - 0:40:00 (0:40:00.0) | | |

Basketball as an invasion game requires a great deal of position changing and moving, which influences the intensity profile of this activity. The amount of time considered to be sufficient for promoting cardio-respiratory fitness (above 140 b/min) in the examined basketball lesson of 16 years old boys equaled 76.5% of the total lesson time. More than 31% of that time the examined boys practiced with the intensity of zone IV (submaximal intensity) and within zone V (maximal intensity). Preparation for such intensity loads (a warming up phase with an intensity of lower then 140 b/min) lasted for 23.5% of the total lesson time (Fig. 6b). The examined basketball lesson in 16 years old boys caused an energy expenditure at the level of 460 kcal/45min (±88), which is probably related to the type of fuel used in such mixed aerobic and anaerobic activities.

An analysis of differences between the heart rates of pupils participating in the same lesson proved there were no statistically significant differences between the monitored girls during the fun play and games class

($p < 0.01$), outdoor athletics ($p = 0.012$) and volleyball classes $p = 0.083$. As for the boys the analysis showed no differences in volleyball class ($p = 0.013$). In the case of basketball lesson the difference was $p = 0.909$.

## DISCUSSION

The study investigated the amount of time spent in five zones of intensity during various types of physical education classes. A study carried out by Bebcakova et al. (2001) in Estonian children showed that in the warm-up part of PE classes almost half of the pupils reached a heart rate higher than 60% of HR max, which was the recommended value. However, it is worth mentioning that the pupils should reach such a level of intensity in the main part of the class (according to methodological guidelines), not in the warm-up phase. Our findings prove that the differences in the heart rates during physical education classes are affected by the sex and the type of activity. Most beneficial for health improvement appeared to be lessons of outdoor track and field in both 15–16 years old girls and boys, with high average heart rates and a great amount of time spent above 140 b/min (specially in zones IV and V). Also in the boys, the basketball class was considered to be sufficiently promoting cardio-respiratory fitness. Quite the opposite, the volleyball classes were recognized as the least effective in stimulating the development of oxygen transportation in both sexes.

Improvements in cardio-respiratory fitness require activities with an intensity sufficient for supporting the delivery of oxygen to the working muscles, with the frequency, duration and level of intensity adequate to the biological development and general motor capacities. According to our findings (supported also in other works: Stratton, 1997; Fairclough & Stratton, 2005; Bronikowski, 2004) invasion games such as basketball, football, handball, floorball and others, including small-sided games (2 vs. 2, 3 vs. 3), are reasonably effective in promoting cardio-respiratory fitness. An explanation may be found in the number of major muscle groups required in such sports due to the translocation (invasion into the opponents' part of the field) and a high level of general motor abilities. On the other hand, school physical education curricula include some activities considered to be insufficient for developing cardio-respiratory fitness (e.g. volleyball and other net games, forms of well-disciplined gymnastics, table tennis), which, however, should not be entirely excluded. They develop other important motor abilities such as flexibility or strength, which do not require great intensity and therefore do not elevate the heart rate so easily. They also develop other goals of physical education, considered to be equally important for life-time commitment to physical activity.

A recent health-related recommendation is concerned with the FIT formula, i. e. exercising at least three days per week (frequency), at the heart rate of 60–90 percent of maximal heart rate or 50 to 85 percent of maximal aerobic power or heart rate reserve (intensity), and for at least 20–60 minutes (time). The most recent guidelines for exercise prescription recommend the minimal threshold of 300 calories per exercise session performed three days a week, or 200 calories per session performed four days a week. However, there is evidence that aerobic benefits can be achieved even with accumulating several shorter bouts of activity throughout the whole day (Corbin, 1996). Strict following of methodological guidelines will improve the organization and intensity of the activity, and this can be easily achieved through appropriate and well-in-advance preparation of school physical education classes.

Lack of sufficient intensity during physical activity may, in the long-term, result in a range of health problems called the metabolic syndrome (for a review of all sorts of possible problems see Vuori, 2004). Health consequences related to obesity in young people concern many risk factors such as cardiovascular (dyslipidemia, elevated systolic and diastolic blood pressure), endocrine risk factors (insulin resistance, abnormal metabolism), life style factors (low fitness, low physical activity level, low movement competence), orthopedic risk factors (accelerated, abnormal growth), psychosocial factors (low self-esteem and socio-economic status). There are also strong indications of carrying obesity from youth into later stages of life (adulthood and elderly) and this is why the problem remains socially important.

## CONCLUSIONS

1. There should be more activities supporting cardio-respiratory fitness included in school physical education curricula. The most suitable for health-related fitness seem to be outdoor athletics classes, invasion team games and aerobic dance.
2. It is important to keep a reasonable ratio of high and low intensity activities in school physical education lessons and provide a wide range of activities to give pupils an option to choose the most suitable lifetime activity.
3. Better classroom organization and management will certainly improve the quality and intensity of any lesson, even those considered to be less effective in stimulating aerobic fitness such as volleyball, gymnastics and net team games.

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## PROFILY INTENZIVNÍ ZÁTĚŽE V HODINÁCH TĚLESNÉ VÝCHOVY V POLSKU

(Souhrn anglického textu)

Cílem průzkumu bylo srovnání zdravotní účinnosti různých typů hodin tělesné výchovy na kardio-respirační ústrojí. Průzkum byl prováděn v letech 2002 a 2003 na nižším stupni středních škol v Poznani. Zkoumány byly čtyři typy hodin: atletika, volejbal, basketbal a pohybové hry, přičemž každý typ měl trvání 45 minut. V průběhu hodiny byla u dvou náhodně zvolených 15–16letých žáků měřena srdeční frekvence, a to pomocí monitorů srdeční frekvence Polar. Podle výsledků celonárodního výzkumu nemá polská mládež dostatek každodenní střední až intenzivní aktivity (Cabak & Woynarowska, 2004). V našem průzkumu se hodiny atletiky, v případě chlapců a dívek, a basketbalu, v případě chlapců, jevily jako hodiny nejúčinněji stimulující kardio-respirační zdatnost. Naše údaje potvrzují dřívější výsledky jiných průzkumů (Stratton, 1997; Fairclough & Stratton, 2005).

*Klíčová slova: intenzivní zátěž, kardio-respirační zdatnost, tělesná výchova, mládež.*

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