EFFECT OF PHYSICAL LOAD ON 9th GRADE PUPILS’ HEART RATE DURING PHYSICAL EDUCATION CLASSES

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Abstract
One of the major issues of pedagogical nature is a lack of identification and assessment of objective physical load’s intensity during physical education classes. Upon analysis of knowledge and opinion of ninth form pupils regarding physical load during physical education classes it was established that the most energy consuming activity for the majority of pupils was a long distance running. Seeking to objectively evaluate physical load with a heart rate monitor “Polar FT 80” a heart rate (HR) of two healthy pupils of medium physical fitness was observed for three lessons, change in physical load was assessed, its intensity was identified. It was established that physical load during the classes being observed, the main activity of which was a long distance running was of a training type and increased in intensity with every lesson. During all of the lessons, the HR values fluctuated significantly (often increased and decreased). Pupils’ HR depended on a content of physical education classes, intensity of tasks and individually made efforts. Both observed pupils during each class were practising not less than half of the time in a hard intensity zone (HR – 146-185 bpm), while in a maximum intensity zone (HR – 186-202 bpm) – only a third of class. Received results reveal that during the introductory parts of the lesson, even though they were long, physical load was increased too fast (HR become frequent fast, i.e. in 2 minutes). During the main part of classes the pupils reached 3-6 HR tops. Individual recovery of the observed pupils’ HR after a maximum physical load was good. During the final part of the class, HR decreased gradually and reached the recommended norms.

KEYWORDS: heart rate, physical load, intensity zones, fatigue, physical education class.

Introduction
Physical education lesson is a pedagogical encounter and the main work unit of methodically developing education, which encompasses a conveyance of a certain amount of knowledge, promotion of pupils’ healthy behaviour, physical activeness, granting the joy of movement, seeking to form motives for physical activeness, introduce skills, habits, develop physical characteristics, complex skills, motivate spiritual and physical unity (Stonkus, 2002). Scientists have come to an agreement that physical education is one of the most significant means of education, stimulating good operation of a heart and a blood-vessel system (Simons-Morton et. al. 1987; Sallis, McKenzie, 1991). Heart condition will improve only if physical activeness of pupils will be average or high for a sufficient period of a class (Sallis, Patrick, 1994). A 30 minute physical activity of high intensity is recommended three times per week for 11-21 year olds (World Health Organization (WHO), 2012). Such is significant in order to maintain a good heart condition (Sallis, Patrick, 1994). Physical load should suit pupils’ age, physical fitness and health, therefore physical education teachers should purposefully manage pupils’ physical activity taking into consideration physical fitness, health, well-being of each pupil in order to develop and improve functional systems of pupils’ body and not to overload the heart. Teachers supervising the pupils from overwork are entitled to limit physical load: change exercises or games, reduce physical load, extend rest periods. Pupils should be aware of the physical load, be able to measure their heart rate. Signs of a fatigue are reflected in pupils’ behaviour and movement, they feel tired (Blauzdys, 2002), and however it has already been proven for an extended period of time that measuring the heart rate (telemetry method) is the main and a reliable method to estimate physical load (Saris, 1986). Li and Dunham (1993) used the telemetry method to analyse levels of physical activeness of 72 pupils at 7-11 forms during 24 physical education classes. The authors hypothesized that physical load rather significantly burdens the heart system if such reached 2880 load units (load units = 20 minutes X 144 bpm) during a class. It has been established that physical load achieved during football, tennis, rope jumping, dance classes fairly burdened the heart system compared to aerobics, volleyball, table tennis, basketball and softball. Physical load during 80 percent of the classes being observed is not sufficient to maintain a good heart condition. According to Stratton (1997), a sufficient amount of physical load in order to maintain and stimulate a satisfactory heart condition is when HR ≥150 is maintained for 20 minutes up to 50 percent of the lesson time. Having analysed British pupils of 9-15 years old during 66 physical education classes by the telemetry method, it was identified that 11-12 year old girls managed to maintain a heart rate of ≥150 for 50 percent of the class time during gymnastics and netball classes. Whereas, a heart rate of > 150 during European handball and badminton exceeded 40 percent of the class time. It has been proven that a sufficient period of class when HR reached > 150 was maintained during lessons with sport games (football, netball, European handball),
except for volleyball and badminton as well as dance, gymnastics and fitness classes. Previously cited authors (Bar-Or, 1983; Rowland, 1990) analysed and estimated HR during physical education classes in respect to age and gender. Unfortunately, efforts were unsuccessful in finding scientific research carried out in Lithuania which would analyse and estimate HR during physical education classes. There is a gap in research which would analyse pupils’ knowledge and opinion about physical load.

**Aim of the research** – to analyse knowledge and opinion of 9th form pupils in regards to physical load during physical education classes and objectively evaluate its effect on a heart rate.

**Object of the research** – knowledge and opinion of 9th form pupils in regards to physical load and its effect on a heart rate during physical education classes.

**Methods of the research:** questionnaire, heart rate measurements, pedagogical observation, statistical analysis.

**Organisation of the research.** During 2012, knowledge and opinion of physical load during the physical education classes were analysed by handing out the questionnaires to 175 pupils of nine forms at two secondary schools of Klaipeda city. Having found that the majority of pupils feel mostly energy consumed after long distance running, a heart rate has been measured by the pulse meter „Polar FT 80“ for two healthy pupils of average physical fitness being not engaged in sports, but still active during three classes, a basis of which was comprised of long distance running. The pulse meter monitored a precise class duration, HR (every minute), lowest HR, highest HR, average HR, HR distributions in physical load intensity zones (in minutes and percents in relation to an entire time of physical education class). A time spent exercising at each intensity zone was calculated. Subject to a pulse meter’s „Polar FT 80“ HR intensity rating scale, a period of class time during which the pupils physical activity was in a hard and maximum intensity zone was calculated (when HR ≥ 146) (Table 1), even though it is four heart beats less than recommended by Stratton, (1997) and two beats per minute more than recommended by Li and Dundam (1993). A pedagogical observation was carried out, during which a precise lesson content as well as pupils’ physical activities were recorded simultaneously.

**Results of the research**

Upon analysing the questionnaire results obtained from ninth form pupils it has been established that a majority (73,5% of females and 78,0% of males) of observed IX form pupils never measure their HR during physical education classes (Fig. 1.). Almost two third (55,9% of females and 60,9% of males) are aware that HR majorly increase during the main section of a class (Fig. 2.). Two third of pupils (64,7% of females and 60,9% of males) do not know the maximum HR values and only one fifth knows that maximum pulse rate is 160-200 bpm and more, while the remaining part believed it is lower (Fig. 3.). The most energy consuming activity for almost two third of pupils (35,3% of females and 21,9% of males) is a long, unemotional activity requiring maximum efforts – long distance running. Swimming was specified by 29,5% of females and 19,6% of males (Fig. 4.). Half (50%) of the girls and almost forty percent (38,6%) of boys indicated that they feel mostly tired after long distance running and running in general. 34,7% of males noted that they feel mostly tired after various sport games (Fig. 5.), however, probably due to their emotional effect and variety, none of the pupils specified that such type of physical activity is considered difficult (Fig. 4.).

![Fig.1. Heart rate measurement during physical education lessons](image-url)
Seeking to objectively evaluate how physical load is categorized during physical education lessons, during which the main activity was long distance running, HR was calculated and pedagogical observation conducted. It was revealed that an identical lesson duration (44 min.) was maintained throughout all of the three lessons and their sections: introductory part of the lesson took 12 min., main – 28 min., and the final – 4 minutes. During the first and the second lesson the pupils were getting ready for a long distance running, and during the third lesson a testing was performed – pupils were running a 2000 m. distance. Pupils’ HR reaction to physical load is presented in Figures 6, 7 and 8.

During the introductory part of all of the three lessons, pupils were walking, exercising and running. Since the boy’s pulse even at the start of the first lesson was significantly higher compared to a girl’s, his pulse at the 2-8 minute of the lesson was also significantly higher than a girl’s, even though both pupils made almost equal amount of effort (Fig. 6). Boy’s HR at 4-6 minute was close to and in the moderate intensity zone (121-151 bpm). Physical load increased too fast; therefore the boy apparently got tired and was actively resting between the 7 and 8 minute (walked without performing any exercises). At the beginning of the second and third lesson, HR of the boy and girl depended on intensity of physical activity during the break (prior to a lesson). Fig. 6-8 reveal that throughout all of the lessons at the third-fifth minute HR experienced a sudden jump. Pedagogical observation show that at that time pupils were mostly running with various jump elements.
During the main part of the first lesson the pupils were running a distance of 50 meters for four times. A girl’s HR was not as even as compared to a boy’s. After breathing and relaxation exercises all of the pupils were playing football. Pedagogical observation reveals that the girl was not very fond of playing it. She was appointed as a goalkeeper for two minutes (twenty-first – twenty-third minute). The girl standing at the gates was resting passively, therefore her pulse dropped down significantly. During the main section of the second lesson the pupils were running for 12 minutes at a chosen speed. After the running exercise, stretch exercises were performed followed by exercises to strengthen abdominal muscles.
Pedagogical observation and change in HR during the main parts of the first and second lessons reveal that heart and blood vessel system’s reaction of the girl and boy being observed to the physical load depended not only on physical activity, but also on intensity of individual exercising and effort made during the task. During the third class when running a 2000 meter distance for evaluation it was obvious that the pupils being observed were really making every effort possible, however the Fig. 8 reveals that the boy maintained a better individual pace compared to a girl. The boy was able to run for 5 minutes at a heart rate of 202 bpm, while the girl maintained the highest running pace only for 2 minutes (Table 2). Her achieved maximum pulse rate during the previously mentioned period reached 188 bpm, later on her running speed (pace) has dropped down so as the pulse.

Throughout all of the three final parts of the lessons stretch, relaxation and breathing exercises were performed, lesson was discussed, due to which HR decreased gradually and returned to recommended norms (110 bpm).

Analysis of a fluctuation in a heart rate reveals that during the three observed physical education classes the pupils have been engaged in sports in a very low intensity zone for 3–6 minutes, 4–5 min. – low intensity zone, and from 7 to 14 min. – average intensity zone. For the major share of time (from 20 to 29 min.) the pupils were engaged in sports in a high intensity zone. During the third lesson when running a 2000 meter distance the girl’s and the boy’s hearts respectively were working in a maximum intensity zone for two and six minutes (Table 1).

### Table 1. Lesson time distribution in physical intensity zones

<table>
<thead>
<tr>
<th>Intensity zones</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; lesson</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; lesson</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; lesson</th>
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<tbody>
<tr>
<td></td>
<td>Male min.</td>
<td>%   Female min.</td>
<td>Male min.</td>
</tr>
<tr>
<td>Quiet (0-90 bpm)</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Very light (90-109 bpm)</td>
<td>6</td>
<td>13,6</td>
<td>6</td>
</tr>
<tr>
<td>Light (110-125 bpm)</td>
<td>5</td>
<td>11,4</td>
<td>6</td>
</tr>
<tr>
<td>Moderate (126-145 bpm)</td>
<td>8</td>
<td>18,2</td>
<td>7</td>
</tr>
<tr>
<td>Hard (146-185 bpm)</td>
<td>25</td>
<td>56,8</td>
<td>22</td>
</tr>
<tr>
<td>Maximum (186-210 bpm)</td>
<td>0</td>
<td>0</td>
<td>0</td>
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### Table 2. The main HR values

<table>
<thead>
<tr>
<th>Main heart rates</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; lesson</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; lesson</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest heart rate (bpm)</td>
<td>Male</td>
<td>91</td>
<td>Female</td>
</tr>
<tr>
<td>Highest heart rate (bpm)</td>
<td>Male</td>
<td>178</td>
<td>Female</td>
</tr>
<tr>
<td>Heart rate average (bpm)</td>
<td>Male</td>
<td>139</td>
<td>Female</td>
</tr>
</tbody>
</table>

One of the major issues is a lack of intensity identification in physical load and evaluation of workload during physical education lessons. Today as well as earlier a pedagogical observation and HR measurements are used to analyze and evaluate physical activities during physical education lessons (LaPorte et al., 1979). The amount of physical load depends on a type of physical activeness, duration, intensity and rest periods during physical exercising tasks. Physical load can have a major effect on pupils’ blood system, breathing, hormone and other systems, therefore a teacher’s duty is to responsibly select and impose the physical load. Pupil’s body during the introductory part of a lesson should be gradually and purposefully prepared for the intended physical load in order the pupil is prepared for the main section of a lesson in a way his functional systems of the body are able to adjust to physical load, experience exercising effect, and, compared to other lesson parts, would receive the highest physical load (Blauzdys, 2002). Until blood circulation system is fully formed during the pubertal period, HR fluctuation during physical exercising plays a significant role (Washington et al., 1994; Winsley et al., 2003). HR starts to increase with the beginning of a workload (Davies et al., 1972) and maintains a constant condition for 3–5 min (Astrand, Rodahl, 1970), therefore having summarised the research results it is possible to conclude that running exercises with jump elements during the observed lessons are completely unsuitable during a warm-up period, as it increased a heart rate of the pupils being observed too fast.
HR increases gradually with an increase in physical load intensity (Rowland, 1996). During a warm-up period due to activation in sympathetic effect and elimination of parasympathetic effect HR increases, while during the period of strength regaining the effect is adverse – HR reduces (Perini et al., 1989; Pierpoint et al., 2000). Hormonal and internal systems have a great importance on HR fluctuation especially during workload of high intensity (Wallin et al., 1987). Stimulation and improvement of a heart activity during physical education lessons is necessary in order pupils could experience to what extent they can engage in sports during physical education classes without harming their health as well as it helps to develop physical education class programs (content) (Stratton, 1996). Having summarised HR measures and fluctuation results during the three physical education lessons, it is possible to conclude that having a moderate physical intensity heart and blood system of a girl and a boy reacted to physical load during physical education classes rather similarly and did not exceed recommended norms, except for the introductory part of the lesson. No evident differences gender wise were observed. Pupils’ heart rate depended on a task’s intensity, individual pupils potential and effort made during performance of tasks assigned. HR fluctuating values at the beginning of a workload and during the strength regaining period depended on a work intensity (Orizio et al., 1988; Perini et al., 1989). During the final part of the lesson workload intensity should decrease gradually and at the end of such should not be higher than 110 bpm or exceed 20% compared to pulse prior to a class (Blauzdys, 2002), therefore it is possible to conclude that physical activities and duration of the final lesson periods were properly organized.

Heart system operation depends on many factors: lesson’s objectives, content, teaching methods, measures, pupils’ age, abilities and preparation as well as equipment. All of the above listed factors could influence quality of a heart’s system (Stratton, 1997). Our conducted research results disagree with Stratton (1997) conclusions that during athletics performed in physical education classes it is difficult to maintain a period 20 minutes and more when HR reaches or is higher than 150 beats per minute. The objective of Stratton (1997) research during athletics exercising was to develop pupils precision and quickness skills when performing specific exercises. A great importance was placed on pupils’ safety, they were short of necessary equipment, and therefore pupils stood in a line to perform their exercises. Our observed classes had longer running periods; therefore we cannot expect similar results content and method wise. On the other hand, our conducted research observed only two pupils and it is necessary to agree with the previously named scientist that it is complicated to assign physical load to all of the children at once.

**Conclusions**

1. Questionnaire results revealed that almost two third of pupils are aware of HR fluctuation during physical load, however only one fifth knew maximum HR values during physical education classes, as majority of pupils have never measured HR during physical education lessons. From all of the proposed types of physical activeness the majority of pupils specified that long distance running and swimming are the most difficult ones. Half of the girls and almost a quarter of boys feel mostly tired after long distance running.

2. Having objectively evaluated HR change throughout the three physical education classes, where the main type of activity was a long distance running, it was established that physical load was of a training nature and was intensified with every lesson. Both observed pupils of an average fitness (girl and boy) were engaged in the hard intensity zone (HR – 146-185 bpm) for not less than half of the class time throughout all of the classes, while during the third – even in a maximum intensity zone (HR – 186-202 bpm). Pupils’ HR depended on lesson content and exercise intensity as well as on individually made effort. During all of the classes HR curve is very uneven (often increases and decreases). Pulse’s top values were reached during the most intensive exercises, while during teacher’s explanations and regrouping pupils and during active rest periods, HR dropped down. During the introductory parts of the lessons, intensity of physical load was increased too suddenly (HR became frequent suddenly, i.e. within 2 minutes), even though such periods of a lesson were extensive (12 min.). During the main parts of classes the pupils reached 3-5 top pulse values. HR recovery after the maximum physical load of the observed pupils was satisfactory. HR decreased gradually during the final parts of the lessons and returned to recommended norms.
Kūno kultūros pamoka – pedagoginis susitikimas ir pagrindinis planingai ugdančio mokymo darbo vienetas, į kurį įeina tam tikro žinių kiekio mokiniams perteklimas, mokinių sveikos elgesenos, fizinio aktyvumo, teikiančio judėjimo džiaugsmą, siekiant suformuoti fizinio aktyvumo motyvus, įdiegti įgūdžius, įpročius, išugdyti fizinės spjautos, sudėtingus gebimus, skatinti dvasinę ir fizinę veiklą. 

Mokytojas, stebėdamas mokinius, kad ugdant jų sveikatos organizaciją, galima naudotis dažnio kaitai arba įvairioms skirtingoms mokyklos veiklos formoms atitinkant mokinių sąlygas. Taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių sveikatai, taip pat galima naudotis fizinio aktyvumo mokymo įtaka mokinių svei...
Patikimą metodas fiziniam krūviui įvertinti (Saris, 1986). Deja Lietuvoje nepavyko aptikti tyrimų kuriuose būtų tiriamos mokinių žinios ir nuomonė apie fizinį krūvį bei vertinamas jo poveikis ŠSD kaitai kūno kultūros pamokose.

**Tyrimo tikslas** – ištirti IX klasės mokinių žinias ir nuomonę apie fizinį krūvį bei nustatyti jo poveikį širdies susitraukimų dažnio kaitai kūno kultūros pamokose.

**Tyrimo objektas** – IX klasės mokinių žinios ir nuomonė apie fizinį krūvį bei jo poveikis širdies susitraukimų dažniui kūno kultūros pamokose.

**Tyrimo metodai**: anketinė apklausa, ŠSD matavimas, pedagoginis stebėjimas, matematinė statistinė analizė.

**Tyrimo organizavimas**: 2012 metais Klaipėdos miesto dėvėjose bendrojo ugdymo mokyklose, anketinė apklausa tirtos 175 devintų klasių mokinių žinios ir nuomonė apie patiriamą fizinį krūvį kūno kultūros pamokose. Nustatė, kad daugiausiai mokinių labiausiai pavargsta ilgai bėgami (ilgus bėgimo nuotolius), pulso mačia „Polar FT 80“ tris pamokas tirtas dvidešimt devynių minučių fizinio pajėgumo mokinių širdies susitraukimų dažnis. Pulso mačiai buvo fiksuojama ir apskaičiuota tiksliausiai ŠSD trukmė, ŠSD (kas vieną minutę), mažiausiai ŠSD, didžiausiai ŠSD, ŠSD vidurkis, ŠSD pasiskirstymas fizinio krūvio intensyvumo zonoje (iminėmis ir procentais santykijoje su visu kūno kultūros pamokos laiku). Pamokų metu buvo stebima mokinių veikla ir fiksuojamas tikslus ŠSD trukmės, kurio pagrindą sudarė ilgesnės trukmės bėgimas.

Anketinės apklausos rezultatai atskleidė, kad tik dešimtadalis devintos klasių mokinių supranta kaip keičiasi jų ŠSD fizinio krūvio metu, du trečdaliai žino koks yra maksimalus ŠSD. Dauguma mokinių ŠSD kūno kultūros pamokose niekada nesakiaiavo. Pusė merginų ir beveik ketvirtadalis vaikinių nuodė, kad didžiausių nuovargį kūno kultūros pamokose jaučia po ilgų nuotolių bėgimo.

Objektyviai įvertinus ŠSD kaitą trijose kūno kultūros pamokose, kuriose pagrindinė veikla – ilgų nuotolių bėgimas, nustatyta, kad fizinis krūvis buvo treniruojamojo pobūdžio ir kiekvieną pamoką intensyvėjo. Abu tirti vidutinio fizinio pajėgumo mokinių (mergina ir vaikinas) kiekvienoje pamokoje didelio intensyvumo zonoje (ŠSD – 146-186 tv./min.) dirbo ne mažiau kai puše pamokos laiko, o trečiąjį – net maksimalaus intensyvumo zonoje (ŠSD – 186-202 tv./min.). Mokinių ŠSD priklauso nuo pamokų turinio ir užduočių atlikimo intensyvumo, o taip pat nuo individualių jėtų pastangų. Visose pamokose ŠSD kiekvienoje pamokos laikotarpiuose (dažnai kyla ir vėl nusileidžianti). Pulso kreivių „viršūnes“ buvo pasiektos praktinės atlikimo metu, o mokytai aškinant, perrikiuojant mokinius ar jiems aktyviai įsibėginti, ŠSD sumažėdavo. Parengiamosios pamokų dalys fizinio krūvio intensyvumas buvo didinamas per greitai (ŠSD dažnai tyla t. y. per 2 minutes), nors šios pamokos dalys buvo ilgos (12 min.). Pagrindinėse pamokų dalys mokinių pasiekė 3-5 pulso „viršūnes“. Tirtų mokinių ŠSD atstumytas po maksimalaus fizinio krūvio buvo geras. Pamokų baigiamosios dalys šį įvertinti kaip mažėjo ir atsistikidavo iki rekomenduojamų normų.