Effects of the Practice of Self-Selected and Programmed Physical Activity on Anthropometric and Biochemical Components

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ABSTRACT

Neto CF, Neto GR, Júnior ATA, Cirilo-Sousa MS, Sousa JBC, Batista GR, Reis, VM. Effects of the Practice of Self-Selected and Programmed Physical Activity on Anthropometric and Biochemical Components. JEPonline 2017;20(2):35–44. The purpose of this study was to analyze the effects of 16 wk training with self-selected intensity in sports and programmed physical fitness activities on anthropometric and biochemical components. High school adolescents were divided into two experimental groups: (a) self-selected physical activity in sports (PAS) with 55 students (15.7 ± 0.7 yrs); and (b) physical fitness training (PFT) with 53 students (16.0 ± 0.7 yrs). Both activities were performed 3 times-wk⁻¹ during 60 min classes. Data were collected before and after the 16-wk intervention. Multivariate analysis indicated the effect of time for all the biochemical measurements and only two anthropometric measurements, which were height (P = 0.001, η² = 0.40) and body mass index
Moreover, there were no effects of the intervention type (group effect) nor interactive. For the PFT group, significant differences (pre x post) were found in the measurements of glucose, total cholesterol, and low density lipoprotein (LDL). For the PAS group, differences were observed for the measures of LDL, very low density lipoprotein, and triglycerides. According to these findings, the self-selected physical activities in sports and programmed physical fitness training had very similar effects on the subjects’ biochemical and anthropometric components.

**Keywords:** Anthropometric and Biochemical Variables, High School Physical Education

**INTRODUCTION**

The practice of systematic physical activity is associated with an improved health status and quality of life. In comparison to sedentary individuals, the most notable characteristics that result from an increase in physical activity include an improvement in body mass (BM), decrease in low density lipoprotein (LDL), an increase in high density lipoprotein (HDL), lower triglycerides (TG), and better blood glucose (GL) control (8). Other important benefits are the maintenance of good levels of physical fitness, thus providing increased opportunities for social integration (1) as well as the prevention of premature death from cardiovascular disease, diabetes, some cancers, and osteoporosis (10).

According to Rippe and Hess (19) and Conte et al. (6), general physical activities have a positive impact on plasma biochemical parameters that lead to the reduction of adipose tissue and the increase in work capacity. Guedes et al. (11) claim that anthropometric measurements of children and young people are important for they are one of the main indicators for monitoring changes related to the levels of growth, development, and maturation.

In this regards, the World Health Organization (WHO) (23) set the standard that children and adolescents should participate in moderate intensity aerobic physical activity (such as running, hopping, skipping, jumping rope, swimming, dancing, and bicycling) for at least 60 min·d⁻¹ or vigorous intensity physical activity for at least 3 d·wk⁻¹. In general, although it appears that higher volumes or intensities of physical activity are likely to have a greater benefit, the research in this area is still limited and the results are not convergent (13,22).

However, the prescription of high intensity exercise is also considered an important factor in decreasing compliance in physical activity programs (18). Dishman et al. (7) and Parfitt et al. (18), in particular, suggested in their work that the participants of physical activities are able to self-select physiologically suitable stimuli for the occurrence of organic beneficial changes to their health rather than imposing a specific intensity for different individuals (7,18). No doubt this is why the research on self-selecting an exercise intensity is more common with young and older adults (4,14), but lacking in children and adolescents.

This study is designed to better understand the effect of the self-selection not only for the intensity, but also for the type of exercise in the school environment where the activities are meant for content assigned for young adolescents. We hypothesized that the practice of programmed physical activity results in better biochemical and anthropometric components.
compared to the self-selected physical activity approach. Thus, the purpose of this study was to analyze the effect of 16 wks of training with subjects self-selecting physical activities in sports versus programmed physical activities in fitness within the Physical Education classes on anthropometric and biochemical components.

METHODS

Subjects
This study was approved by the Human Research Ethics Committee (HREC) of the Federal University of Paraíba – UFPB, Protocol No. CEP / CCS No. 0269, 2011 in accordance with the declaration of Helsinki and resolution No. 196/96 of the National Health Council. A total of 108 high school students (1st, 2nd, and 3rd yr), aged between 15 to 17 yrs, from the Federal Institute of Education, Science and Technology of Paraíba (IFPB) / João Pessoa, Brazil, participated in this study. According to Tanner Stages of Sexual Development (21), all the subjects were pubescent and post-pubescent. The sample consisted of two randomly assigned experimental groups: (a) the self-selected physical activity (PAS) with 55 students (aged 15.7 ± 0.7 yrs; 27 men and 28 women) who practiced self-selected sport modalities; and (b) physical fitness training (PFT) with 53 students (aged 16.0 ± 0.7 yrs; 30 males and 23 females) who engaged in programmed physical fitness training in accordance with the WHO recommendations (23). Inclusion criteria encompassed the following aspects: (a) regularly enrolled in the IFPB; (b) participation in physical education classes; (c) not afflicted with infectious diseases; and (d) authorized by the parents to take part in the research. After having the parental consent form signed, they were enrolled in the study. Any student during the 16-wk intervention who presented with a skeletal muscle injury or had an attendance frequency less than 75% was excluded from the research.

Study Design
Initially, the students were invited in their classrooms during regular hours to take part in the research. They were informed of the laboratory tests, diagnostic tests of clinical history, and anthropometric tests before and after the 16-wk intervention period. After explaining the procedures, the students who wanted to participate in the study were randomly assigned to two types of activities: (a) self-selected physical fitness activities in sports, which were performed 3 times·wk\(^{-1}\) for 60 min. The activities comprised 20 to 25 min stretching as a warm up, dynamic joint movements and racing with varying sports fundamentals, which were determined at each session by the students’ enthusiasm, choice of modality (basketball, handball, volleyball, swimming and futsal), and rhythm. From the selected sports, competitive recreational games were engaged that lasted between 25 to 35 min. During the games, students were replaced when they showed either low physical performance (as evidenced by fatigue or continuous error) or psychological state of mind (such as an unfair attitude). Finally, the students had 5 to 10 min of relaxation activities that included stretching, relaxation through static sound stimuli (sounds of nature) or just walking slowly as decided by the group; and (b) physical programmed activity (fitness) was performed in accordance with the WHO (23), which recommends the accumulation of at least 60 min of aerobic physical activity per day that included 3 d of vigorous-intensity and muscle-strengthening activities. The activities were developed under a vigorous-intensity of 70% to 80% of maximum heart rate (220-age) (10) that followed the recommended levels of physical activity for children and young people (23). The activities were performed for 60 min, 3 times·wk\(^{-1}\). They consisted of 20 to 30 min of step up and down exercise and/or walking and jogging that were consistent with either the
continuous or interval aerobic method of training, and neuromuscular exercises of 20 to 30 min of dynamic and static strength exercises, muscular endurance, dynamic and static flexibility exercises via a circuit and interval methods. Lastly, the cooling-down phase lasted ~5 to 10 min that involved relaxation with activities of static stretching (10 to 30 sec per movement).

Procedures

Analysis of Biochemical Parameters
Blood collection was performed by nursing professionals. Analysis was of blood samples were conducted by biochemists and pharmacists in a clinical laboratory that specialized in working with children. The colorimetric enzymatic method was used for the analysis of glucose (GL), high density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL), and triglycerides (TG). The modified urease method was used for total cholesterol (TC). After 12 hrs of fasting, blood samples were collected between 7:00 a.m. and 9:00 a.m. by venipuncture.

Assessment of Anthropometric Measures
Body mass (BM) was evaluated by using a digital platform scale (Filizola® ID 1500, Brazil) with an accuracy of 0.1 kg. Height was determined by means of a stadiometer (Cardiomed®, Brazil) with an accuracy of 0.01 mm (given that these values were used to obtain body mass index (BMI). Triceps and subscapular skinfolds were measured with a caliper (Cescorf®, Brazil) with 0.1 mm accuracy, precisely gauged from a single measurement. Each subject was weighed and measured according to the techniques of Marfell-Jones and colleagues (15). The sum of the triceps and subscapular skinfold thicknesses was obtained by the algebraic sum of the measures. Body density was calculated based on the equations of Boileau et al. (2) and the fat percentage (BF%) was obtained by the Siri’s formula. To calculate the body fat mass (BFM), the following formula was used: BFM (kg) = BM x (% F / 100), and lean body mass was estimated by calculating: LBM (kg) = BM – BFM (3).

Statistical Analysis

After checking data normality by using the Kolmogorov-Smirnov and homogeneity by the Levene’s test, analysis was performed by using a two-way ANOVA on the effect of time (pre x post), group (PAS x PFT), and the interaction effect (time x group). To estimate the effect size ($\eta^2$), values greater than 0.20, 0.50, 0.80, and 1.30 represent small, medium, high, and very high, respectively. After checking data normality by using the Kolmogorov-Smirnov and homogeneity by Levene’s test, the analysis was performed by using two-way ANOVA on the effect of time (pre x post), group (PAS x PFT), and the interaction effect (time x group). To estimate the effect size ($\eta_p^2$), values greater than 0.01, 0.06, 0.14 represent small, medium, and high, respectively (5). Also, an intragroup t-test with percentage variation between measurements ($\Delta\%$) was performed, and to measure the effect size the Cohen’s d ($d$) was used with 0.20, 0.50 and 0.80 for small, medium, and high effect. The level of significance was set at P<0.05 and the SPSS 20.0 for Windows software was used for all statistical analysis.
RESULTS

The evaluation of the biochemical variables pointed out significant effect (P<0.05) of time for all measures, with high effect size observed for LDL F (1, 106) = 47.28, P = 0.001, $\eta^2_p$ = 0.30 and total cholesterol F (1, 106) = 18.15, P = 0.001, $\eta^2_p$ = 0.15, VLDL F (1, 106) = 16.83, P = 0.001, $\eta^2_p$ = 0.14. The glucose F (1, 106) = 14.71, P = 0.001, $\eta^2_p$ = 0.12 and triglyceride levels F (1, 106) = 13.77, P = 0.001, $\eta^2_p$ = 0.11 showed a trivial effect size. And HDL F (1, 106) = 4.17, P = 0.043, $\eta^2_p$ = 0.04 a medium effect. There were no significant values for the group effect. Regarding the interactions of time with the group, only for VLDL F (1, 106) = 7.39, P = 0.008, $\eta^2_p$ = 0.06 and triglycerides F (1, 106) = 6.58, P = 0.012, $\eta^2_p$ = 0.06 showed an interactive effect between time and group.

With reference to the intra-group differences, Table 1 shows the results of the statistical analysis (with percentage variation). The PFT group showed significant differences (pre x post) for measurement of glucose ($t$(52) = 3.862, P = 0.001, $d$ = 0.61), total cholesterol ($t$(52) = -5.911, P = 0.001, $d$ = 0.45) and LDL ($t$(52) = -6.670, P = 0.001, $d$ = 0.58). For the PAS group, differences were observed in the measures of LDL ($t$(54) = -3.870, P = 0.001, $d$ = 0.39), VLDL ($t$(54) = 4.389, P = 0.001, $d$ = 0.42) and TG ($t$(54) = 4.111, P = 0.001, $d$ = 0.44).

**Table 1. Descriptive Values and Inferential Test (paired t-test) for the Biochemical Variables.**

<table>
<thead>
<tr>
<th></th>
<th>PFT (n = 53)</th>
<th></th>
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<th>PAS (n = 55)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Δ%</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>GL (mg·dL(^{-1}))</td>
<td>78.9 ± 5.7</td>
<td>75.9 ± 3.7^*</td>
<td>-3.80%</td>
<td>77.9 ± 6.2</td>
<td>76.4 ± 5</td>
</tr>
<tr>
<td>TC (mg·dL(^{-1}))</td>
<td>129.2 ± 24.1</td>
<td>140.9 ± 22.5^*</td>
<td>9.06%</td>
<td>129.2 ± 32</td>
<td>139.6 ± 30.2</td>
</tr>
<tr>
<td>HDL (mg·dL(^{-1}))</td>
<td>49.9 ± 15.1</td>
<td>47.2 ± 9.7</td>
<td>-5.41%</td>
<td>46 ± 9.4</td>
<td>45.1 ± 8.2</td>
</tr>
<tr>
<td>LDL (mg·dL(^{-1}))</td>
<td>67.8 ± 17</td>
<td>79 ± 19.9^*</td>
<td>16.52%</td>
<td>71.8 ± 19.4</td>
<td>81.4 ± 26.73^*</td>
</tr>
<tr>
<td>VLDL (mg·dL(^{-1}))</td>
<td>14.8 ± 5.5</td>
<td>14.3 ± 6</td>
<td>-3.38%</td>
<td>16 ± 6.8</td>
<td>13 ± 4.9^*</td>
</tr>
<tr>
<td>TG (mg·dL(^{-1}))</td>
<td>73.9 ± 27.8</td>
<td>71.3 ± 30</td>
<td>-3.52%</td>
<td>79.6 ± 34.5</td>
<td>65.5 ± 24.8^*</td>
</tr>
</tbody>
</table>

\*Significant difference between pre and post-test (P<0.05); **PFT** = physical fitness training; **PAS** = self-selected physical activity; **GL** = glucose; **TC** = total cholesterol; **HDL** = high density lipoprotein; **LDL** = low density lipoprotein; **VLDL** = very low density lipoprotein; **TG** = triglycerides.

For the anthropometric variables, the analysis of time effect pointed out significant values (P<0.05) for height F (1, 106) = 67.20, P = 0.001, $\eta^2_p$ = 0.40, with a high effect size. The same occurred for body mass index (BMI) F (1, 105) = 10.88, P = 0.001, $\eta^2_p$ = 0.10, with medium effect. The others showed no significant time effect. There were no significant values for the group effect in any variable. After evaluating the interactive effect of these measures, significant values for this effect were not found. When comparing the intra-group measures, significant differences were shown for height ($t$(52) = -8.355, P = 0.001, $d$ = 0.13) and BMI ($t$(52) = 2.379, P = 0.021, $d$ = 0.22) in the PFT group (EG). Statistical changes in the same
variables for height \( t(53) = -4.790, P = 0.001, d = 0.12 \), BMI \( t(53) = 3.789, P = 0.001, d = 0.08 \) were observed in the PAS group.

**Table 2. Descriptive Values and Inferential Test (paired t-test) for the Anthropometric Variable.**

<table>
<thead>
<tr>
<th></th>
<th>PFT (n = 53)</th>
<th></th>
<th>PAS (n = 55)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Δ%</td>
<td>Pre</td>
</tr>
<tr>
<td>BM (kg)</td>
<td>61.5 ± 13</td>
<td>60.6 ± 12.1</td>
<td>-1.46%</td>
<td>63.2 ± 18</td>
</tr>
<tr>
<td>Ht (cm)</td>
<td>169.2 ± 8.3</td>
<td>170.4 ± 8.3</td>
<td>0.71%</td>
<td>168.5 ± 9.1</td>
</tr>
<tr>
<td>BMI (kg·m(^{-2}))</td>
<td>21.4 ± 3.9</td>
<td>20.4 ± 4.5</td>
<td>-4.67%</td>
<td>22 ± 4.8</td>
</tr>
<tr>
<td>AS (cm)</td>
<td>171.3 ± 10.2</td>
<td>171.7 ± 11.1</td>
<td>0.23%</td>
<td>170.8 ± 11.1</td>
</tr>
<tr>
<td>%BF (%)</td>
<td>24 ± 6.7</td>
<td>24.1 ± 6.5</td>
<td>0.42%</td>
<td>24.4 ± 6.8</td>
</tr>
<tr>
<td>Σdoc (mm)</td>
<td>33 ± 16.1</td>
<td>31.4 ± 13.3</td>
<td>-4.85%</td>
<td>36.6 ± 19.4</td>
</tr>
<tr>
<td>BFM (kg)</td>
<td>15 ± 5.9</td>
<td>15 ± 6.2</td>
<td>0.00%</td>
<td>15.4 ± 6.1</td>
</tr>
<tr>
<td>LBM (kg)</td>
<td>46.4 ± 9.8</td>
<td>45.5 ± 7.8</td>
<td>-1.94%</td>
<td>47.8 ± 15.4</td>
</tr>
</tbody>
</table>

*Significant difference between pre and post-test (p<0.05); **PFT** = physical fitness training; **PAS** = self-selected physical activity; **BM** = body mass; **Ht** = height in cm; **BMI** = body mass index; **AS** = arm span in cm; **%BF** = percentage of body fat; **Σdoc** (TR and SS) = sum of triceps and subscapular skinfolds; **BFM** = body fat mass; **LBM** = lean body mass

**DISCUSSION**

This study examined, in the context of physical education classes, the effect of programmed physical activities (for fitness) and self-selected physical activities (in sports) on biochemical components and body composition in adolescents. Taking into consideration the observed results, it is clear from the 16-wk intervention that there is no difference between programmed physical activities based on achieving an increase in fitness and self-selected physical activities based on sports. However, it is noteworthy that regardless of the type of intervention used the monitoring of variables before and after the experiment indicated that the time variable influenced most of the measured variables. Thus, the groups and their interaction with time were not preponderant factors in the observed changes. This result was mainly observed for the biochemical variables. This point is important in that it states how vital the practice of physical activity is whether it is self-selected or programmed.

The findings also emphasize that most of the biochemical variables in both groups had their values increased after the study. Yet, despite this result, it is evident that the values are classified as healthy according to Ferranti et al. (9). The research also highlights that the concentration of glucose and triglyceride levels decreased in the young subjects who practiced self-selected physical activities in sports. Such levels were also lower for the subjects who chose a programmed physical activity in fitness, which indicates that both activities produced a positive effect.

In this context, the results of the study by Ishibashi, Junior, and Júnior (12) corroborate our findings. The authors analyzed obese adolescents 9 to 15 yrs old in order to evaluate insulin resistance. They applied two interventions with a 12-wk exercise period. One group practiced isolated aerobic exercise while the other group performed aerobic exercises in association with resistance exercises. When comparing the pre-training and post-training values the
authors observed changes in insulin resistance in both groups, but there was no significant difference between the groups. Nevertheless, an overall decrease in blood glucose in both groups of subjects was acknowledged, which indicates the importance of practicing physical exercise (particularly, aerobic, anaerobic or mixed activities).

Although the purpose of the study by Ishibashi et al. (12) is different from the present study, both studies show the importance of varied application of physical activities to biochemical components. The anthropometric variables involved in this study with Brazilian adolescents were not influenced by time and type of intervention, and as well there was no interaction between these factors. Only the subjects’ height and BMI showed significant changes in both groups. However, by means of a purely descriptive observation, these values varied very little between the phases of measures (pre x post). This difference may be explained by the fact that the tested sample was in its growth phase. Another important finding in this study is that there was no impact of the intervention from either self-selected or programmed physical activities on the subjects’ anthropometric components. Furthermore, the ratings of the sum of skinfolds and fat percentage were high for both the programmed exercise in fitness and for the self-selected activities in sports, since the highest frequencies concentrated in the moderate, moderately high, and high categories. In the present study, the dependent variables showed low correlations among the cut-off points for both groups. This indicates that the variables are not related to each other and are independent from each other for the programmed exercise in fitness as well as for the self-selected exercise.

Neto et al. (17) studied 249 adolescents of both sexes between the age of 12 and 16 yrs. They concluded that, regardless of BMI, there was an inverse relation between fitness (assessed by the multistage 20 m shuttle run test) and blood concentrations of total cholesterol and triglycerides. In this regards, our findings are important because they showed the differences and benefits of the two types of intervention. It is noteworthy that because the results suggest that the biochemical components and body composition were influenced by time, one must consider that these changes can be attributed to the influence of physiological and anatomical changes that result from hormonal discharges, which are increased at this stage of growth as well as by the amount of physical activity (16).

Additionally, Sabia, Santos, and Ribeiro (20) developed a study with the purpose of comparing the effects of continuous aerobic and intermittent anaerobic physical exercises associated with nutritional guidance on body composition, biochemical measures, and physical capacity of 28 obese adolescents. The subjects were randomly divided into two groups to perform continuous walking exercise and intermittent running exercises. The authors found decreased BMI and skinfold thickness with a significant difference in both groups, a significant reduction in serum levels of HDL and LDL cholesterol, total cholesterol, and increased triglycerides and blood glucose in the continuous walking group. They concluded that the physical activity and dietary guidance proposed for the two groups were sufficient and satisfactory, thus promoting weight reduction, improved body composition, lipid levels, and increased aerobic capacity of adolescents. These findings are in agreement in part with the present study, since there were positive changes in BMI, LDL, and total cholesterol.

For the young subjects in the present study, the practice of both programmed and self-selected physical activities resulted in similar effects. This finding illustrates that an exercise
program, especially in high school, should be diverse, stimulating both the practice of fitness and other self-selected sports modalities. The intragroup differences observed for measures of height and BMI are not attributed to applied interventions (PFT or PAS) since, despite the characterization of the sample in pubertal and post-pubertal stages, the multivariate analysis indicated the effect of time (16 wks) only on these measures. However, the size effect values were not high and the variation between the measurements before and after the intervention was very low.

From this perspective, it is evident that there is the need to plan high school fitness and self-selected exercise content that respect the students’ pleasure in practicing it and the school phase they are in. This study had several limitations that should be taken into consideration regarding similar future research. It did not include a control group, and there was no control over the subjects’ food ingestion or a nutritional guideline.

CONCLUSION

According to the findings in this study, the self-selection of physical activities in sports versus programmed physical activities in fitness had no significant impact on the anthropometric and biochemical components of high school adolescent students. Thus, this study demonstrates the importance of physical activities for the maintenance of these components within normal standards of health, regardless of the chosen method.

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