



**Research Report of the Month**  
**AUGUST 2003**

Bequet, G., Berthoin, S., & Praagh, E.V. (2002).

**Are intensified physical education sessions able to elicit heart rate at a sufficient level to promote aerobic fitness in adolescents?**

Research Quarterly for Exercise and Sport, 73, pp. 282-288.

This report contains a substantial amount of technical detail concerning exercise physiology. Some of the primary variables are expressed in terms of indices and ratios that are quite complex. Accordingly, for the purpose of creating an annotation that will be accessible to readers who bring a wide range of backgrounds in exercise physiology, I will translate most of the technical material into plain language. In doing so, it is inevitable that both the elegance of the measures and a degree of precision will be lost – though I hope not to commit any gross inaccuracies. No disrespect is intended either to the authors or to readers who are well versed in the relevant subject matter fields. In my judgment, the questions raised, the methodologies employed, and the findings derived seem sufficiently important to risk such an attempt to extend the audience for the report.

To say that I think the study is important, however, is not an explanation of why I think it to be so. To be honest about that, I have vacillated between regarding it as a particularly creative effort to answer the question, "Can PE classes really improve aerobic fitness in adolescents?" on the one hand, and understanding it as an unintended excursion into science fiction in which the authors offer us a chilling vision of what middle school physical education might look like in the year 2004, on the other hand. I will try to put aside those extreme responses, however, and just try to tell the story as laid out in the report – leaving you to decide your own response.

### **The Study**

Many observers, both casual and systematic, have suggested that in the vast majority of physical education (PE) classes taught in schools the total amount of moderate-to-vigorous physical activity is so small that it could not possibly have a detectable impact on cardiovascular fitness (specifically, on capacity for aerobic activity). Further, it is widely accepted that to be effective, any regimen of physical activity implemented in PE would have to be individualized for each student so that the intensity of the exercise would not be too high for pupils with lower initial fitness, or too low for pupils with higher initial fitness. As experienced teachers are aware, such fine degrees of individualization are exceedingly difficult to achieve in classes with heterogeneous student populations. Finally, many PE teachers who deal with adolescents have reported that the most common activity presently in use for aerobic training, running, is not well regarded by at least some students in each class, and, when used extensively (lots of time devoted to jogging around a track) is actively disliked by many more because they find it excruciatingly boring.

Accordingly, the authors (all three are university faculty members in France) created a program of exercise that could be used in school PE with adolescent students, and that was specifically designed to confront those problems. That is, the program (1) had to be of sufficient intensity to raise heart rates to a level that allows confident prediction of improvement in aerobic fitness (and do so over a sufficient period of time in each class), (2) had to be regarded as interesting (or, at the least, not boring) by students, (3) had to provide a means for adjusting intensity to the aerobic capacity of each student at entry into the training program, (4) had to allow carefully graduated (but still individualized) increases in intensity over time, and (5) had to be so arranged as to allow all students to exercise at the same time (for efficiency) and in ways that could be closely supervised and tightly controlled (maintaining consistency of effort). Indeed, a very large order!

## Participants and Context

Three hundred forty-five male and female secondary school children (adolescents with an age range of 11 to 16 years) participated in the study. The setting was in required physical education classes meeting twice each week for a total of 3 hours (one lesson of 2 hours in length and the other lasting 1 hour). Apparently this arrangement is standard for all French adolescents in public schools. The report offers no further description of the educational and physical context, teachers and pupils, or the existing PE curriculum.

## Design and Method

The students were divided (by procedures not specified) into three groups: a high-intensity running group (HIRG), a high intensity running with interspersed jumping activities group (HIJG), and a control group (C). Pretest measures for age, body mass, height, and % body fat indicated only one significant difference among the groups (the C group girls had a slightly higher % body fat, but as that variable had no correlation with any of the outcome measures that difference was regarded as unimportant).

A pretest measure also allowed the investigators to estimate the distance each student would have to run if they were to be exercising below, at, or above their existing level of aerobic capacity. In other words, exercises could be individualized to match each adolescent's level of fitness. For 10 weeks, the two experimental groups were given 30 minutes of high-intensity running (HIRG) or high intensity running with interspersed jumping tasks (HIJG) within each 2-hour class (the remainder of the class time continued with the usual non-aerobic activity curriculum – nominally gymnastics and badminton). The control classes continued with lessons that had improved motor skills as the general objective.

All students (including those in the C group) wore heart rate monitors during PE lessons. For the experimental groups, both individualization of exercise intensity and control of activity were achieved by means of the physical layout for running. Adjacent running lanes were laid out with a finishing line set at the diagonal (think about Mosston's famous slanted high jump bar). Thus, the student with the lowest initial capacity could be placed in the lane requiring the shortest run (22.22 meters) and the student with the highest initial capacity could be placed where the longest run was required (26.66 meters), and the rest arranged in between according to their individual capacities. The distance of the diagonal finish line from the start was determined so that by the time all students, running fast enough to cover their assigned distance in 10 seconds, reached their individual finish line their hearts would be beating at 100% of their initial capacity (students with more capacity simply had to run farther in 10 seconds to reach that point of intensity). The diagonal finish then could be pushed out over the ten weeks of the study to demand 110% and then 120% of that initial heart rate.

All students would stay in their lanes after finishing the 10-second run down their lane, turn around, rest for 10 seconds, and then, using the diagonal as the starting line, run back to the original non-diagonal starting line – thereby maintaining the same individualized distance for each student. Students in HIJG simply inserted some skipping and jumping exercises into their running routines. The exercises for both experimental groups were repeated through 3 sets of 10 such runs (plus 5 minutes of stretching) in each 30-minute lesson.

## Results

It is important to understand that the outcome measure did not involve indicators of change in fitness. The outcome of interest was whether or not students could, in fact, get their individual heart rates up to the level at which it would be possible to assume (based on a substantial body of prior research) that there would be a physiological training effect. In simple terms, if it were impossible to provide exercise of sufficient intensity to achieve that goal, there certainly would be no point in testing for actual changes in aerobic capacity. Thus, the question here was only "Is it possible to get the heart rates up to the desired level in a controlled and individualized fashion within the context of a PE class?"

The answer was a clear "yes." Heart rates in the experimental groups were significantly higher than those for students in C. In the experimental groups, girl's heart rates were significantly higher than those of boys, and they spent a larger percentage of lesson time with their hearts above the training thresholds. There were no significant differences between HIRG and HIJG heart rate averages for either boys or girls.

Thus, with a running track especially designed for short intermittent runs, adolescents in normal (French) PE classes were able to run 30-minute exercise bouts at the same relative velocity for the same duration of time, but over individualized distances. The intensity of aerobic demand thereby achieved would be sufficient to predict improvements in aerobic fitness. Although the report provides little detail, it seems reasonable to assume that the nature of the exercise regimens was such (varied, challenging, and novel) that students showed a high degree of compliance over the 10-week period of the study.

## Discussion

In the ensuing discussion, the authors are very clear about how they understand the meaning of the results.

"Physical education is essential to promote long-term health and fitness, and physical education must promote adolescents' physical activity during school programs. They have to be engaged in moderate-to-vigorous physical activity to fully benefit from training activities. It must be emphasized that school is the only time when all adolescents must practice a compulsory physical activity or be physically active. However, setting up three physical education sessions per week requiring moderate-to-vigorous level exertion is difficult for physical educators. The intensified sessions proposed in the present study, if performed regularly over a period of time, may result in improvements in aerobic fitness." (p. 287)

The question that seems important here is "How do you understand those results?" Do you think exercise variety of the kind demonstrated here enhances the attractiveness of the high-intensity program so that it will be, as the authors assert, "more motivating for children?" More to the point for discerning the implication of the findings, do you think, as do the authors, that the addition of such training sessions in PE classes would "...teach children to be physically active and reach fitness goals in physical education lessons?"

Certainly the hard numbers support the possibility of a physiological outcome – improvement of aerobic fitness. Likewise, it seems clear that the students were fully involved, as a whole class, in an intense physical training activity – one that was neatly individualized to their fitness status. Finally, there is no indication that girls were disadvantaged in any way by the nature of the training activities. All of that seems generally positive, and no unintended negative consequences were reported.

So what do you think? Have the authors offered us a glimpse of a possible future for physical education? Is it a future to be desired, or do you detect an Orwellian (1984) shadow over the gym in 2004? Think about it, talk to colleagues about it, and if you have the time and inclination, share your conclusions with me via e-mail.

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