A Study on Improving Middle-and-Long Distance Running Performance of College Students with Segmented Intensity Indicator Training Method

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Abstract
The track and field teams in colleges and universities are made up of the specially recruited athletes and normally recruited athletes, which are established in order to take part in the matches on and off campus or home and abroad. Extracurricular track and field training is the essential part of the physical education in colleges and universities, indicating the level of physical education on campus. To improve specific endurance, intensity timed running shorter than specific distance is adopted. Super intensity running shorter than specific distance is important in improving middle-distance performance. When using speed agility run, repeated run and regular standard-speed run in exercise, if the specific temporal requirement were not calculated before, it is easy to cause unreasonable physical power distribution. In unplanned run, the speed of each segment can not reach personal specific level. The effect of exercise is bad when your strength is consumed blindly, thus the performance will not improve. Therefore, reasonable time of each segment should be calculated before run and in every exercise, which is important for athletes to create the best performance. The purpose of the study is to explore the use and application of segmented intensity indicator middle and long distance training in colleges. By studying middle and long distance athletes in 6 colleges using segmented intensity indicator training method and comparing the performance before and after the training, the author concludes that this method could effectively improve college middle- and -long distance running performance. On the basis of the training directed by the method of segmented intensity indicator, the extent of the performing improvement before and after the training, and the statistic analysis of this difference of the extent, it is concluded that this study is of great benefit to the training of middle-and-long distance running and achieves good performance.

Keywords: Segmented Intensity Indicator, Training, Middle-and- Long Distance Running, Athletes

1. Introduction

The Educational Committee of Hebei Province organizes the track and field College Students’ Sports every four years, which is the examination of the level of the training of track and field athletes or amateur training in colleges and universities. The College Students’ Sports have been held five times from the year 2000 to 2012, and various teams from different colleges or universities manifest their development of track and field sports. Middle and long distance running performance in the colleges of China fell behind other countries[1]. In the track and field event of the 21th Universiade, only Dong Yanmei got in the top 8 of women’s 5000m and 10000m running[2]. Recently, colleges are facing the problem that how to improve middle and long distance running to catch up with the advanced world level. That is also the formidable task of our middle and long distance training. As a competitive sports item, middle and long distance running have developed various kinds of training methods and means so far. Every improvement of performance is the birth of new training means and methods[3]. Famous long distance running coach Ma Junren has reached the world top by large load training method and recovery training method[4]. The high and cold “refrigeration” training method of Coach Wang Dexian has received good results, too. The 2004 Athens Olympic Games 10,000m champion Xing Huina is the best example[5]. It is put forward in the paper “Effects of Altitude Training on Serum Hormone of Middle and Long Distance Running Athletes” by Feng Lianshi, Hong Ping, Zong Pifang, Guo Jun and Li Futian that the effectiveness of altitude training is of great concern by the researchers, athletes and coaches of different countries[6,7,8,9]. The plateau’s special geographical and climatic features make
the athletes’ bodies adapt to the changes, on which quite a lot of laws come to be grasped and applied in the practice of altitude training[10,11,12]. This paper proposes the method of segmented intensity indicator in order to explore the effective ways to appropriate to the conditions of Handan College. Segmented intensity indicator training method refers to that athletes are trained in middle and long distance running at certain exercise density and certain exercise speed as well as the percentage of every exercise density and speed in the exercise(or all the exercise) in a distance longer or shorter than a specific distance. Obviously, the middle and long distance training conditions (site, equipment, athletes, coaches and researchers) in colleges can not be compared with national team. But it is possible to improve middle and long distance running performance if college middle and long distance athletes could take advantages of their high cultural quality and coaches could work hard on new training means and methods. The purpose of the study is to explore the use and application of segmented intensity indicator in the college middle and long distance training. The means and indicators were proved to be practical by the 6-month-training and race performance (in Table 1) of 6 athletes in Games for University Students.

2. Object and Method

2.1. Object

There are altogether 6 middle-distance athletes (including 3 male athletes and 3 female athletes) in the track and field team of Handan College. Two of them are second grade athletes. Several of their indicators are examined such as age, height, major events, secondary events, 100-meter event, 400-meter event, standing triple-jump, and vital capacity and so on. Athletes’ physical indicators and special qualities (see Table 1).

2.2. Method

2.2.1. Document-data method

This paper introduces other training means and methods in improving middle and long distance performance based on a large amount of related documents and papers home and abroad.

2.2.2. Correlation method, Statistical method

<table>
<thead>
<tr>
<th>Name</th>
<th>Sex</th>
<th>Age</th>
<th>Height cm</th>
<th>Main items m</th>
<th>Vice items m</th>
<th>Time of enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Su Nianpeng</td>
<td>male</td>
<td>21</td>
<td>178</td>
<td>1500</td>
<td>800</td>
<td>2008.9</td>
</tr>
<tr>
<td>Zhao Yi</td>
<td>male</td>
<td>22</td>
<td>175</td>
<td>1500</td>
<td>800</td>
<td>2010.9</td>
</tr>
<tr>
<td>Du Yazhou</td>
<td>male</td>
<td>22</td>
<td>170</td>
<td>5000</td>
<td>10000</td>
<td>2011.9</td>
</tr>
<tr>
<td>Gao Jing</td>
<td>female</td>
<td>22</td>
<td>163</td>
<td>5000</td>
<td>10000</td>
<td>20109</td>
</tr>
<tr>
<td>Wand Shasha</td>
<td>female</td>
<td>21</td>
<td>163</td>
<td>1500</td>
<td>800</td>
<td>2009.9</td>
</tr>
<tr>
<td>Ding Xuejing</td>
<td>female</td>
<td>19</td>
<td>162</td>
<td>800</td>
<td>400</td>
<td>2008.9</td>
</tr>
</tbody>
</table>
Table 2 Comparison of Segmented Intensity Performances

<table>
<thead>
<tr>
<th>Name</th>
<th>100cm/s before</th>
<th>100cm/s after</th>
<th>400m/s before</th>
<th>400m/s after</th>
</tr>
</thead>
<tbody>
<tr>
<td>Su Nianpeng</td>
<td>12.5 (8.45)</td>
<td>11.8 (8.67)</td>
<td>54.2 (7.10)</td>
<td>53.2 (7.00)</td>
</tr>
<tr>
<td>Zhao Yi</td>
<td>12.6 (8.34)</td>
<td>11.7 (8.76)</td>
<td>54.5 (7.10)</td>
<td>53.5 (7.00)</td>
</tr>
<tr>
<td>Du Yazhou</td>
<td>13.4 (7.85)</td>
<td>12.8 (8.10)</td>
<td>56.5 (7.10)</td>
<td>54.1 (7.00)</td>
</tr>
<tr>
<td>Gao Jing</td>
<td>15.4 (6.78)</td>
<td>14.4 (7.10)</td>
<td>73.0 (7.00)</td>
<td>68.0 (6.80)</td>
</tr>
<tr>
<td>Wand Shasha</td>
<td>15.1 (7.34)</td>
<td>14.0 (7.55)</td>
<td>68.0 (7.00)</td>
<td>64.1 (6.80)</td>
</tr>
<tr>
<td>Ding Xuejing</td>
<td>14.2 (6.90)</td>
<td>13.2 (7.20)</td>
<td>60.2 (7.00)</td>
<td>61.7 (6.80)</td>
</tr>
</tbody>
</table>

1. (Before) refers to the performance before training; 2. (After) refers to the performance after training.

Table 3 Performances Before and After the Training

<table>
<thead>
<tr>
<th>Name</th>
<th>Main items</th>
<th>Performance before training</th>
<th>Performance after training</th>
<th>Track-and-field competition in May 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Su Nianpeng</td>
<td>1500 800</td>
<td>4:35:0 2:05:0</td>
<td>4:18:46 2:00:96</td>
<td></td>
</tr>
<tr>
<td>Zhao Yi</td>
<td>1500 800</td>
<td>4:30:0 2:07:0</td>
<td>4:20:11 4:20:11</td>
<td></td>
</tr>
<tr>
<td>Du Yazhou</td>
<td>5000 10000</td>
<td>18:05:0 40:35:0</td>
<td>16:40:32 35:52:32</td>
<td></td>
</tr>
<tr>
<td>Gao Jing</td>
<td>5000 10000</td>
<td>22:35:0 44:15:0</td>
<td>20:07:39 41:43:55</td>
<td></td>
</tr>
<tr>
<td>Wand Shasha</td>
<td>1500 800</td>
<td>5:35:0 2:45:0</td>
<td>5:13:35 2:29:66</td>
<td></td>
</tr>
<tr>
<td>Ding Xuejing</td>
<td>800 400</td>
<td>2:35:0 1:03:0</td>
<td>2:29:10 1:00:77</td>
<td></td>
</tr>
</tbody>
</table>

In order to analyze the influence of segmented intensity training method over the athletes’ performances, an examination of the unknown pairing sample t of population variance is carried out about the athletes’ main and additional performances before and after the training.

Null hypothesis $H_0: \mu = \mu_0$  $H_1: \mu \geq \mu_0$

Test statistic $t = \frac{\overline{d}}{s/\sqrt{n}}$  \hspace{1cm} (1)

And: $\overline{d} = \frac{\sum d}{n}$  \hspace{1cm} (2)

$s = \sqrt{\frac{\sum d^2 - (\sum d)^2}{n - 1}}$  \hspace{1cm} (3)
t statistical test associated probability \( P = 0.03, P < 0.05 \).

At the level of \( a = 0.05 \), null hypothesis is rejected; therefore the training method proves to be greatly different in effectiveness.

3. Results and analysis

3.1. Theoretical foundation of improving middle and long distance performance in colleges with segmented intensity indicator training method

During the training and matches the middle and long distance running athletes consumes a lot physically and psychologically[13]. In the intense training or close matches, the degree of psychological training plays a vital role. Psychological training employs various effective ways to foster the athletes’ persistent will so as to make them bring into full play their athletic abilities. In the training of middle and long distance running, long duration of alternative running of different speeds is adopted, which is also called segmented intensity running[14,15]. Since the distance of running with various speed can be exactly measured, the coaches can make specific requirements about the distance and speed of the fast running and slow running. The standard is not set to the degree of the athletes’ fatigue rate. Thus the training is rather difficult[16]. There are two kinds of segmented intensity training. One is short segment and short interval with more repetition, such as ten to twenty times of 100meters fast running plus 100meters slow running, 200meters fast running plus 100meters slow running, or 400meters fast running plus 100meters slow running[17]. The other is long segment and short interval with less repetition, such as four to eight times of 1000meters fast running plus 200meters slow running, or 2000meters fast running plus 400meters slow running. This method is beneficial to the changes of the athletes’ transferring ability of metabolic modes and will-development. The key to the development of the endurance of the middle and long distance running athletes lies in how to control the proportion of aerobic, anaerobic, and mixed metabolic function training according to different people and events, and how to work out the speed, distance and interval scientifically[18]. Only enlarge the proportion of anaerobic training and mixed energy supplies on the basis of stressing aerobic metabolic training by means of specific event features can the potentials of the athletes be brought into play to the maximum. Specific endurance determines middle and long distance performance. To improve specific endurance, intensity timed running shorter than specific distance is adopted. Super intensity running shorter than specific distance is important in improving middle-distance performance. When using speed agility run, repeated run and regular standard-speed run in exercise, if the specific temporal requirement were not calculated before, it is easy to cause unreasonable physical power distribution. In unplanned run, the speed of each segment can not reach personal specific level. The effect of exercise is bad when your strength is consumed blindly, thus the performance will not improve. Therefore, reasonable time of each segment should be calculated before run and in every exercise, which is important for athletes to create the best performance. In addition, we are training college students with relatively high ideological and cultural quality who are self-conscious, quick to understand and accept. Therefore, content and requirements should be announced before every training, especially everyone should reach the intensity indicators.

3.2. The use and application of segmented intensity indicator in the middle and long distance training [1]

3.2.1. Plan of segment average score

Formula: \( T_n = \frac{T}{S} \times n \) (4)

\( T = \) total scores, \( S = \) total distance (unit 100m), \( n = \) segment distance (unit 100cm), \( T_n = \) segmented average scores.
For example: total score of 800m is 2:16.5, question: what is the segmented average score of 500m?
Obtain: $T=2:16.0$, $S=8$, $n=5$, then put them into the formula: $T_n=T/S\times S=2:16/8\times 5=1:25.0$.

### 3.2.2. Calculation of super intensity segmented scores

Formula:

$$T_{np} = T_n - T_n \times p/100 = 100 - p/100 \times T_n$$  \hspace{1cm} (5)

$p$ = percentage of super intensity ($p=1,2,3,4...$), $T_{np}$ = Super intensity segmented scores.

For example: the score of 800m is 2:16.0, the average score of 500m is 1:25.0, question: what is the segmented score of 500m in super intensity 3%?
Obtain $T_n = 1:25.0$ , $p = 3$, then put them into the formula:

$$T_{np} = (100 - 3)/100 \times 1:25.0 = 1:22.45$$

### 3.2.3. Segmented time and power distribution calculation training method in middle distance running

We have found in practice that the speed changes by the change of physiological mechanism in the process of middle distance running, rather than stays in the average speed all the way. The time difference in every segmented distance is bigger in middle distance running (800m, 1500m, 3000m) than in long distance running (5000m, 10000m). Athletes can not get expected results or even backup with unreasonable physical power distribution, so the requirement of strength distribution should be very scientific. Beginners are too easy to make such mistakes: fast in the beginning and slow in the end with unplanned running. The result is that the physical power is consumed badly; causing mental tension, slow improvement in performance together with mental fear and boredom. This condition is especially common in athletes who have not been through systematic training. Athletes in high levels have little difference in performance of each segmented distance in middle distance running and in the middle of long distance running which may have some difference in the beginning and the end. Both beginners and high level athletes should calculate the reasonable time of each segment before running and in every exercise to save physical power and get good scores. This is very important for participants to get best scores.

800m segmented time calculus (in Table 4)

<table>
<thead>
<tr>
<th>Athlete</th>
<th>level</th>
<th>200m</th>
<th>400m</th>
<th>600m</th>
<th>800m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>athletes</td>
<td>$T_{200}=4.0$</td>
<td>$T_{200}+1.0$</td>
<td>$T_{200}+2.5$</td>
<td>$T_{200}+0.5$</td>
</tr>
<tr>
<td>Intermediate athletes</td>
<td>$T_{200}=2.0$</td>
<td>$T_{200}+0.5$</td>
<td>$T_{200}+2.5$</td>
<td>$T_{200}+0.5$</td>
<td></td>
</tr>
<tr>
<td>Advanced athletes</td>
<td>$T_{200}=1.0$</td>
<td>$T_{200}+0.5$</td>
<td>$T_{200}+2.0$</td>
<td>$T_{200}+0.5$</td>
<td></td>
</tr>
</tbody>
</table>

$T_200$ = average time of 200m ($T/4$); $2.T$ = time of 800m

For example: if a female athlete’s 800m time is 2:30.0 (150s), what is her reasonable segmented time?
Obtain: the average time of 200m is $150/4=37.5s$, put it into the primary athletes column in the calculated table, and then we can calculate every segmented time. (In Table 5)

<table>
<thead>
<tr>
<th>Distance</th>
<th>200m</th>
<th>400m</th>
<th>600m</th>
<th>800m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segmented Time/s</td>
<td>37.5 – 4.0 = 33.5</td>
<td>37.5 + 1.0 = 38.5</td>
<td>37.5 + 2.5 = 40.0</td>
<td>37.5 + 0.5 = 38.0</td>
</tr>
</tbody>
</table>

Table 5 calculate every segmented time.
State: If athletes could finish the race basically according to the segmented time calculation in a competition, the physical power distribution is basically correct. If not, the strength distribution is unreasonable.

1500m segmented time calculus (in Table 6)

<table>
<thead>
<tr>
<th>Athlete level</th>
<th>400m</th>
<th>800m</th>
<th>1200m</th>
<th>1500m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary athletes</td>
<td>T 400 − 8.0</td>
<td>T 200 + 2.0</td>
<td>T 400 + 7.0</td>
<td>T 300 − 1.0</td>
</tr>
<tr>
<td>Intermediate athletes</td>
<td>T 400 − 4.5</td>
<td>T 400 + 2.0</td>
<td>T 400 + 4.0</td>
<td>T 300 − 1.5</td>
</tr>
<tr>
<td>Advanced athletes</td>
<td>T 400 − 2.7</td>
<td>T 400 + 1.7</td>
<td>T 400 + 2.7</td>
<td>T 300 − 1.7</td>
</tr>
</tbody>
</table>

1. $T_{400} =$ average time of 400m ( $\frac{T}{15 \times 4}$ );
2. $T =$ time of 1500m; 3. $T_{300} =$ average time of 300m ( $\frac{T}{15 \times 3}$ ).

For example: if a male athlete’s 1500m time is 4:45.0 (285.0), what is his reasonable segmented time?

Obtain: the average time of 400m is $285.0 \div 15 \times 4 = 1:16.0$, the average time of 300m is $285.0 \div 15 \times 3 = 57.0$, put it into the primary athletes column in the calculated table, results are in Table 7.

<table>
<thead>
<tr>
<th>Distance</th>
<th>400m</th>
<th>800m</th>
<th>1200m</th>
<th>1500m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segmente d time</td>
<td>1:16.0 − 8.0 = 1:08.</td>
<td>1:16.0 + 2.0 = 1:18.</td>
<td>1:16.0 + 7.0 = 1:23.</td>
<td>57.0 − 1.0 = 56.0</td>
</tr>
</tbody>
</table>

According to the segmented calculate methods above, to achieve expected specific indicators, coaches should give exact demands to students or athletes. They should exercise according to the segmented data above, neither slower than the required speed of every segmented, nor faster so much that removes from individual specific level than the required speed which leads to blindly physical power consuming. We can check whether the physical power distribution is reasonable and find out the problem of each segment then correct them through test or competition.

4. Training method in calculations of main item and short wing coefficient

It has been proved by test that main item performance is limited by short wing performance. Smaller ratio of short wing item scores and the main item scores may create favorable conditions to improve scores of main item. The training of modern middle and long distance running takes speed as the core, improving long distance running by short distance running and combining long and short distance. Therefore, in the regular exercise, we should value the improving of short wing item when improve specific endurance. We can calculate athletes’ main item potential based on the change of short wing scores, thus find out the weak points and then take measures in exercise to improve main item scores.

4.1. calculations of main item and short wing coefficient

4.1.1. Calculate the ratio of 400m and 800m

$$r = \frac{T_{400}/s}{T_{800}/s} = (\text{ratio})$$  \hspace{1cm} r = 0.44 \pm 0.01  \hspace{1cm} (6)
For example: if the time of 400m is 53.5s, calculate the time of 800m.

Put into the ration formula: \[ \frac{53.5}{T_{800}} = r = 0.44 \pm 0.01 \]

\[ T_{800}(s) = 1:58.89 \div 2:04.42 \]

### 4.1.2. Calculate the ratio of 3000m and 5000m

\[ \frac{T_{3000}}{T_{5000}} = r \text{ (ratio)} \]

\[ r = 0.59 \pm 0.02 \]

### 4.1.3. Calculate the ratio of 5000m and 10000m

\[ \frac{T_{5000}}{T_{10000}} = r \text{ (ratio)} \]

\[ r = 0.48 \pm 0.01 \]

In the training of long distance athletes, exercise can combine speed endurance level developed by segment shorter than specific distance and sprint training right after long distance specific running based on the development of certain endurance, thus improving long distance performance by short distance. This exercise mode can comprehensively improve the athletes’ ability of the phosphagen, glycolysis, aerobic metabolism and mixed function of aerobic and anaerobic metabolism. What is more, it can improve athletes’ specific endurance and ability to sprint, and improve the specific level through the training of short wing item.

### 5. Conclusions

By using segmented intensity indicator training method, increase in performance before and after training (in Table 1) and the analysis of statistical tests for the difference in performance before and after training (\( P < 0.05 \)) indicate that this research has significant improvement in training. It is feasible to apply in future middle and long distance training.

### 6. References


