Analysis on the Difference of Blood Lactate in Training and Competition of Non-professional Badminton Players

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Abstract
In this study, non-professional badminton player athletes in colleges and universities are our research object and we have the following main research. We have explored the difference between the badminton events and training of lactic acid, and analyzed the characteristics of non-professional athletes training lactate. The average blood lactate of competition and training of non-professional badminton player athletes is 7.8-12 mmol / L in the finals, and 10.7-15 mmol / L in long jump games and training. Through the analysis of the blood lactic acid in the competition and training of elite athletes, it is found that there are deficiencies in non-professional short-distance and long-jump athletes in high-intensity training. And the blood lactate in competition and training is affected by sports events, as well as the impact of training venues.

Keywords: Non-professional Athletes, Training and Competitions, Blood Lactate, Difference

Análisis de la Diferencia de Lactato Sanguíneo en el Entrenamiento y la Competencia de Jugadores de Bádminton no Profesionales

Resumen
En este estudio, nuestro objetivo de investigación son los atletas no profesionales que practican bádminton en colegios y universidades y tenemos la siguiente investigación principal. Hemos explorado la diferencia entre los eventos de bádminton y el entrenamiento del ácido láctico, y hemos analizado las características de los atletas no profesionales que entrenan el lactato. El promedio de lactato en sangre de la competencia y el entrenamiento de atletas no profesionales de bádminton es de 7.8-12 mmol / L en la final, y de 10.7-15 mmol / L en los juegos de salto de longitud y entrenamiento. A través del análisis del ácido láctico sanguíneo en la competencia y el entrenamiento de los atletas de élite, se encuentra que hay deficiencias en los atletas no profesionales de corta distancia y salto de longitud en el entrenamiento de alta intensidad. Y el lactato sanguíneo en la competencia y el entrenamiento se ve afectado por los eventos deportivos, así como por el impacto de los centros de entrenamiento.

Palabras clave: Atletas no profesionales, Entrenamiento y competiciones, Lactato de sangre, Diferencia.

1. Introduction
As early as 1976, Mareleta of East Germany published the research results on the relationship between blood lactate and exercise intensity. In the ensuing years, the BLA test has become a widely used technique for coaches and researchers in badminton training [1]. Now people use this indicator to guide the training, and control the intensity of exercise, performance evaluation, training programs and other badminton training load is usually composed of training intensity, as well as training and training frequency. In studying the relationship between these three factors and the performance of badminton, it is considered to evaluate the training intensity of one cycle needs to classify and record the training intensity in each training cycle, which is for coaches and researchers to be very difficult [2]. However, the intensity of exercise throughout the training cycle can be assessed by the blood lactate assay. His research concluded that training intensity is the most important factor in improving performance throughout the training cycle. With competition and training as the ultimate manifestation of sports training, the maximum blood lactate level in competitions and training has become an indicator of athlete's ability or whether athletes are doing their best in competitions and training. Therefore, there have been a lot of reports on the blood lactate level in badminton races and training [3]. And as early as 20 years ago, there were also reports on the lactic acid value of non-professional badminton player athletes in competitions and training. However, most of these reports are about the competitions and training held in
badminton. With the increasing competition and training in short badminton, it is also meaningful to study the BLA for short and long jumpers in non-professional badminton players. It can provide the basis for the training of non-professional badminton players [4].

2. The training and competition model construction of badminton athletes in non-professional athletes in colleges and universities

The training and competition of non-professional athletes is an inductive algorithm based on actual cases. Its working principle is to find the classification rules of non-professional athletes training and competition representation from a group of cases without regularity and non-order [5]. In order to quickly and accurately identify the lactic acid and the concise and clear rules of discrepancy between training and competition, this paper considers the dichotomous CART non-professional athletes training and competition model on each node, which can divide the existing sample set into the two sub-sample sets, and the newly formed non-professional athletes training and competition is always simple structure of the binary tree. Constructing CART non-professional athletes training and competition model, we should first determine the index sets and class variables that can be used for classification, and then check every possible division value of each indicator one by one, and sort all the partitions according to the amount of impurities they can reduce, and determine the largest reduction of impurities is the final division of the way. The reduction of impurities is usually defined as the difference between the Gini index before and after division in CART non-professional athletes training and competition. For the sample set of T, the Gini index is defined as follows [6]:

\[ Gini = T_i - \sum_{k=1}^{m} p_k \]  (1)

Where \( p_k \) is the probability of containing class k in T, and m is the total number of classes. T is divided into two independent subsets \( T_1 \) and \( T_2 \), which is assuming that each sample divided into two subsets probability p. In order to avoid over-fitting phenomenon between training and competition model of CART non-professional athletes, the classification rules extracted are long and difficult to be understood, and then the accuracy of classification of unknown noisy data is reduced when applied, and out of operational efficiency and time cost, we need to control the complexity of training and competition of non-professional athletes while keeping the accuracy of classification as high as possible. Therefore, this paper proposes and defines an improved pruning algorithm which considers the classification ability and the size of the non-professional athletes training and competition. The principle is as follows [7]:

1) Non-professional athletes of training and competition ability classification

Let N be the total number of training samples for training and competition of non-professional athletes, and n(t) be the number of instances of non-professional athletes training and competition node t in the training sample, and e(t) be the number of nodes in the training sample reaching node t and belonging to the total number of instances of the category, which is corresponding to node t that defines the classification accuracy of non-professional athletes training and competition as follows [8]:

\[ a(M) = \sum_{t=1}^{M} \frac{e(t) \times n(t)}{n(t)} \]  (2)

Among them, M is the number of all leaf nodes in training and competition of non-professional athletes. The greater the value of a(M) is, the higher the classification accuracy is, the better the classification performance of non-professional athletes in training and competition is [9].

2) Non-professional athletes of training and competition scale measurement

According to experience, when the non-professional athletes training and the number of leaf nodes in games are kept at 5~10, the classification result is the best. When it is less than 2 or more than 25, the practical application effect is poor. Therefore, the number of leaf nodes is equal to M, and the definition of non-professional athletes training and competition scale factor is as follows [10]:

\[ P(Y_k | X) = \frac{P(X_1, X_2, \cdots, X_n | Y_k) \cdot P(Y_k)}{P(X_1, X_2, \cdots, X_n)} \]  (3)

As can be seen, d(M) is the greater value that non-professional athletes less training and competition, and the rules drawn out the more easy to understand and apply. Improved pruning algorithm is to comprehensively consider the classification ability and tree size of non-professional athletes training and competition model, and
this paper defines the optimal tree based on non-professional athletes training and competition classification accuracy $a(M)$ and scale factor $d(M)$ of evaluation index $I(M)$, and the formula is as follows:\(^{(11)}\)

\[
I(M) = k_1 \cdot a(M) + k_2 \cdot d(M)
\]  \(\text{(4)}\)

Among them, $k_1$ and $k_2$ belong to the classification accuracy and scale factor weight. The optimal tree evaluation index $I(M)$ of each tree is compared with a series of candidate sub-trees cut from the training and competition of the original non-professional athletes. The one with the largest $I(M)$ value is the final optimal one professional athlete training and competition. For discrete sampling index values, the interval description method is usually used to calculate the ratio of the number of samples contained in the interval to the total number of samples as the conditional probability of the index $X_j$, when the corresponding category is $Y_k$.\(^{(12)}\)

Taking into account the practical application of blood lactic acid index data by the internal and external factors, there is a certain degree of volatility, and the interval near the boundary value of the index repeated in the course of the test is divided into uncertain intervals, and the paper proposed in the interval fuzzy indicators of each indicator degree summation to represent the actual membership degree of the samples in this interval to the interval, and establish a fuzzy Naïve Bayesian model that takes both randomness and fuzziness into account. Among them, the building fuzzy membership function is shown in Figure 1, which can set the sample in the range of the boundary of the fluctuation range of 0.02\(^{(13)}\).

![Figure 1. Fuzzy membership function of the training index for the interval](image)

We can calculate the fuzzy conditional probability of each index of non-professional athletes according to the above principle one by one, and the steps are as follows\(^{(14)}\):

1. All blood lactic acid index data are normalized to ensure that the range of indicators of the range of [0,1].
2. Divide the interval [0,1] equally into 5 sub-intervals with overlapping boundaries to construct the fuzzy membership function of the interval of BLA.
3. The fuzzy membership of 5 sub-intervals for each sample value of each lactic acid index in non-professional athletes is calculated.
4. Calculate the fuzzy conditional probability of each lactic acid index of 5 non-professional athletes to 5 sub-intervals and list the corresponding fuzzy conditional probability table.
5. Repeat step 3-4, with one by one to calculate the types of non-professional athletes under the conditions of fuzzy conditions, for the same list of the corresponding fuzzy conditional probability table.

In this way, the non-professional athletes can determine the conditions under the condition of the fuzzy conditions and the probability of ambiguity, and then calculate the prior probability multiplied by the maximum a posteriori probability corresponding to the type of non-professional athletes that is fuzzy simple Bayesian model output\(^{(15)}\).

3. The difference experiment of blood lactates in training and competition of non-professional badminton player athletes in colleges and universities

3.1. Sample data preprocessing

Based on the above introduction methods, the classification model was selected based on the BLA background sample values of 181 athletes tested by the Chinese cosmetics collaborative innovation research center in November 2014. The test subjects were mainly non-professional athletes. The classification results were determined by the authoritative experts in the field of Chinese medicine according to the questionnaire of non-professional athletes. This test uses the German company’s professional blood lactic acid CK test equipment
on the athletes tested above 17 lactic acid test. Test process is to ensure strict accuracy of the athletes blood lactate, for the external environment such as constant temperature conditions. The spearman rank correlation coefficients between each pair of 17 lactic acid markers in 181 test samples were calculated[16].

3.2. Non-professional athletes of classification method

Different types of non-professional athletes are in the blood lactic acid on the characterization. Outstanding athletes belong to healthy athletes, while other athletes belonging to ordinary non-professional athletes have some aspects of training problems, which can be reflected in the blood lactate index. According to the construction of classification model of 151 athletes, a CART non-professional athlete training and competition model with a classification accuracy of 84% and a leaf node number of 23 is constructed based on the sample data. In order to reduce the complexity of training and competition for non-professional athletes, we should improve generalization ability and prevent over-fitting, and the three candidate sub-trees were cut out from the original non-professional athletes training and competition, and the three candidates have optimal tree evaluation index (M). Then, a fuzzy naïve Bayesian model is established, and three types of non-professional athletes are Bayesian model variables of Y = (Y₁, Y₂, Y₃), of which Y₁ is excellent and Y₂ is entry-level. The fuzzy membership of five samples of blood lactic acid in each sample of three types of non-professional athletes were calculated respectively, and the corresponding fuzzy conditional probability was calculated. The fuzzy conditional probability table was listed. Take excellent as an example, the calculated fuzzy conditional probability table is shown in Table 1. The values of the parameters in the table represent the probability that the type of non-professional athletes is excellent, when the BLA values of the subjects fall in different ranges[17].

<table>
<thead>
<tr>
<th>[0,0.2]</th>
<th>0.1818</th>
<th>0.1298</th>
<th>0.5269</th>
<th>0.0851</th>
<th>0.0121</th>
<th>0.0648</th>
<th>0.8402</th>
<th>0.1158</th>
</tr>
</thead>
<tbody>
<tr>
<td>[0.2,0.4]</td>
<td>0.3059</td>
<td>0.2543</td>
<td>0.3212</td>
<td>0.2815</td>
<td>0.0176</td>
<td>0.3889</td>
<td>0.0547</td>
<td>0.2359</td>
</tr>
<tr>
<td>[0.4,0.6]</td>
<td>0.3228</td>
<td>0.2928</td>
<td>0.0634</td>
<td>0.3114</td>
<td>0.2904</td>
<td>0.2816</td>
<td>0.0213</td>
<td>0.3037</td>
</tr>
<tr>
<td>[0.6,0.8]</td>
<td>0.0778</td>
<td>0.1539</td>
<td>0.0137</td>
<td>0.1444</td>
<td>0.4232</td>
<td>0.1651</td>
<td>0.0301</td>
<td>0.1977</td>
</tr>
<tr>
<td>[0.8,1]</td>
<td>0.0213</td>
<td>0.0426</td>
<td>0.0213</td>
<td>0.0490</td>
<td>0.1612</td>
<td>0.0213</td>
<td>0.0213</td>
<td>0.0426</td>
</tr>
</tbody>
</table>

The statistical analysis of the training samples shows that in all 151 samples, 47 non-professional athletes, 42 non-professional athletes and 62 other non-professional athletes are included. Dividing by the total number of samples, the prior probabilities of three types of non-professional athletes can be calculated as 31.1%, 27.8% and 41.1% respectively. The above calculation results are brought into formula (2), and the classification output of 151 training samples is calculated one by one. The classification result is compared with the expert diagnosis results, and the classification accuracy rate reaches 72%. The fusion classification model was established, and the existing 30 groups of test samples were tested. It was found that the accuracy rate of the fusion algorithm based on DS evidence theory was 86.7%, which was significantly higher than 83.3% of the CART non-professional athletes training and competition model 80% of the fuzzy naïve Bayesian model[18].

3.3. Non-professional athletes training and competition in the analysis of differences in blood lactate

In order to validate the VLE method based on adaptive optimization, this study randomly selected 20 of the 181 athletes tested and divided them into two groups. The experts in the field of blood lactic acid conducted these two groups of athletes, while reference is to test the blood lactate background sample value, and the athlete's blood lactate score, and determine the corresponding level of blood lactate. According to the value of blood lactic acid index of 20 athletes to be assessed vague first index of the athletes with the X₁ index (moisture content) as an example to briefly introduce the calculation process, we can get the difference of other indicators, as shown in Table 2.

<table>
<thead>
<tr>
<th>Difference</th>
<th>Level I</th>
<th>Level II</th>
<th>Level III</th>
<th>Level IV</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mk1</td>
<td>0.60</td>
<td>0.89</td>
<td>0.92</td>
<td>0.80</td>
<td>Level III</td>
</tr>
<tr>
<td>Mk2</td>
<td>0.60</td>
<td>0.88</td>
<td>0.90</td>
<td>0.76</td>
<td>Level III</td>
</tr>
<tr>
<td>Mk3</td>
<td>0.98</td>
<td>0.82</td>
<td>0.71</td>
<td>0.31</td>
<td>Level I</td>
</tr>
<tr>
<td>Mk4</td>
<td>0.75</td>
<td>0.97</td>
<td>0.76</td>
<td>0.62</td>
<td>Level II</td>
</tr>
<tr>
<td>Mk5</td>
<td>0.55</td>
<td>0.83</td>
<td>0.97</td>
<td>0.83</td>
<td>Level III</td>
</tr>
<tr>
<td>Mk6</td>
<td>0.54</td>
<td>0.83</td>
<td>0.96</td>
<td>0.81</td>
<td>Level III</td>
</tr>
</tbody>
</table>
The level of blood lactate of the athlete corresponding to the maximum overall difference M2 can be analyzed. Similarly, the blood lactate level of the remaining athletes can be determined. At the same time, field experts determined the blood lactate score of each athlete through the doctor's consultation, and the experts scored in the range of [5,10]. The athletes' blood lactate was divided into 4 grades according to the distribution of the scores. For all two athletes, analysis of the result of blood lactic acid evaluation shows that the accuracy of the matter-element model evaluation is 85%. Further analysis of the output of the matter-element model shows that the expert evaluation results of the athletes 3 and 5 are level I and the model evaluation results are level II. This is mainly due to the poor performance of athletes such as pO2, which has a great impact on the results of the comprehensive evaluation of matter-element models. As a result, the results of the combined results are Level II, even though most of the remaining indicators belong to level I. First of all, through 28 iterations, the weight of the fat index is gradually reduced, and finally the model output level of the athlete 3 with the largest e value is changed to level I, which is consistent with the expert opinion. Secondly, by analyzing the indexes of athletes 17 with the second largest e value, they failed to achieve better results and even worsened the evaluation results of other athletes. Therefore, the adjustment of athletes was suspended temporarily. After the dynamic adjustment of blood lactic acid index weight value is shown in Figure 2.

![Figure 2. dynamically adjusted blood lactic acid of indicator weight value](image)

### 4. Conclusion

Glycogen is a very important energy source in the process of body movement. Badminton playing races and training this shorter is, more intense exercise is. Especially for badminton, it plays an important role in supplying, and lactic acid is also produced in large quantities. For competition and training as the ultimate stage of sports training, the capabilities and deficiencies of non-professional badminton player athletes have been fully demonstrated here. Therefore, we can know the blood lactic acid concentration characteristics of non-professional badminton player athletes, during competitions and trainings can understand the physical metabolism status during different competitions and trainings. This will help coaches clarify the direction of future training and the goals to be improved.

### References

29(3), pp.758.


