

# FEASIBILITY STUDY OF HUMAN BIORHYTHM TO IMPROVE SPORTS TRAINING INJURY



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ESTUDO DE VIABILIDADE DO BIORRITMO HUMANO PARA A RECUPERAÇÃO DE LESÕES POR TREINO ESPORTIVO

ESTUDIO DE VIABILIDAD DEL BIORRITMO HUMANO PARA LA RECUPERACIÓN DE LESIONES POR ENTRENAMIENTO DEPORTIVO

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## ABSTRACT

**Introduction:** Sports injury often occurs in sports teaching and training, which directly affects the performance of the human body function and the improvement of sports performance. **Objective:** To study the feasibility of improving the biorhythm in sports training injury. **Methods:** 120 young athletes who are engaged in track and field training in traditional track and field sports schools in Liaoning Province are taken as the research objects. The effective data of the time and types of sports injuries, and the birth date, month and date of the injured athletes during training from 2005 to 2006 were collected. **Results:** Results show that in the relationship between human body three rhythm and the athlete's sports injury, the probability of sports injury in triple height is smaller; regarding the biological rhythm in one or more than one period or critical period, the damage probability is 95%, showing that most athletes sports injuries occur at a low and critical period stage. **Conclusions:** The arrangement of sports training must be adapted to the original biological rhythm of the human body, and the corresponding monthly cycle training plan should be made according to changes that occur in athletes' physical cycles to avoid injury during training. **Level of evidence II; Therapeutic studies - investigation of treatment results.**

**Keywords:** Athletic injuries; Athletic performance; Exercise.

## RESUMO

**Introdução:** Lesões no esporte geralmente ocorrem durante o ensino e treinamento esportivo, o que diretamente afeta o desempenho da função do corpo humano e o desenvolvimento do desempenho no esporte. **Objetivo:** Estudar a viabilidade de melhorar o biorritmo em lesões por treino esportivo. **Métodos:** 120 jovens atletas que praticam atletismo em escolas de atletismo tradicionais na província de Liaoning são os objetos desta pesquisa. Os dados efetivos da hora e dos tipos de lesões por esporte, além da data de nascimento, mês e data dos atletas lesionados durante o treino entre 2005 e 2006 foram coletados. **Resultados:** Os resultados mostram que, na relação entre o ritmo três do corpo humano e a lesão do atleta no esporte, a probabilidade da lesão no salto triplo é menor; quanto ao ritmo biológico em um ou mais de um período ou período crítico, a probabilidade de dano é de 95%, o que demonstra que a maioria das lesões de atletas no esporte ocorre numa etapa de período baixo e crítico. **Conclusões:** O manejo do treinamento esportivo deve se adaptar ao ritmo biológico original do corpo humano e o plano de treinamento de ciclo mensal correspondente deve ser feito de acordo com mudanças que ocorrem nos ciclos físicos dos atletas para evitar lesões durante o treino. **Nível de evidência II; Estudos terapêuticos – investigação de resultados de tratamento.**

**Descritores:** Traumatismos em atletas; Desempenho atlético; Exercício físico.

## RESUMEN

**Introducción:** Lesiones en el deporte generalmente ocurren durante la enseñanza y entrenamiento deportivo, algo que directamente afecta el rendimiento de la función del cuerpo humano y el desarrollo del rendimiento en el deporte. **Objetivo:** Estudiar la viabilidad de mejorar el biorritmo en lesiones por entrenamiento deportivo. **Métodos:** Os objetos de esta investigación son 120 jóvenes atletas que practican atletismo en escuelas de atletismo tradicionales en la provincia de Liaoning. Se recogieron los datos efectivos de la hora y los tipos de lesiones por deporte, además de la fecha de nacimiento, mes y fecha de los atletas lesionados durante el entrenamiento entre 2005 y 2006. **Resultados:** Los resultados muestran que, en la relación entre el ritmo tres del cuerpo humano y la lesión del atleta en el deporte, la probabilidad de lesión en el salto triple es menor. **Conclusión:** El manejo del entrenamiento deportivo debe adaptarse al ritmo biológico original del cuerpo humano y el plan de entrenamiento de ciclo mensual correspondiente debe hacerse de acuerdo a los cambios que ocurren en los ciclos físicos de los atletas para evitar lesiones durante el entrenamiento. **Nivel de evidencia II; Estudios terapéuticos – investigación de resultados de tratamiento.**

**Descriptor:** Traumatismos en atletas; Rendimiento atlético; Ejercicio físico.



## INTRODUCTION

The occurrence of sports injury is very complicated. At present, the research on the function and tissue changes after sports injury is more common. To explore the sports injury from the change of human biological rhythm and understand the relationship between sports injury and different functional states of human body. The life rhythm of human body is the basic characteristic of human body itself, and it is an inseparable quality of the organism.<sup>1</sup> According to the statistical analysis of relevant experts in the world, it is believed that the biological rhythm of human body has periodicity, and each cycle can be divided into high tide period, low tide period and critical period. When the human body is in high tide period, it is physically energetic, clear-headed and responsive. When hard times, people fatigue, emotional instability, poor judgment, are in a critical period, the human body internal physiology change, impulsive, coordination of the body organs function drops, easy to make mistakes in the long process of social history, human beings have discovered the body's own and the world around us there are many activity characteristic of cyclical rhythms.<sup>2,3</sup> By means of investigation and statistics, the relationship between athletes' injury and biological rhythm is analyzed. The results show that there is a certain relationship between the biological three rhythms of human body and the time and types of athletes' sports injury, it is very important to use biorhythm to arrange periodicity principle to guide sports training and avoid injury.<sup>4</sup>

## METHOD

### Experimental subjects

This study takes 120 young athletes (sprinting, middle and long-distance running, short span, jumping and throwing) who are engaged in track and field training in traditional track and field sports schools in Liaoning Province as the research objects, this paper mainly studies the sports injury of these athletes in the course of sports training and the cycle of their biorhythm when sports injury occurs.<sup>5,6</sup> Data are shown in Table 1:

### Research Methods

Medical personnel of the provincial track and field sports teams were entrusted to collect the effective data of the time and types of sports injuries and the birth date, month and date of the injured athletes during the training from 2005 to 2006. SPSS12.0 statistical software package was used for statistical processing and  $\chi_2$  test.<sup>7</sup> The monthly rhythm of athletes can be calculated by the following formula: The total number of days = (measured year - birth year) × 365 + leap year (solstice birthday days on January 1) + (solstice measured day days on January 1). Divide the number of days obtained by 23, 28 and 33d respectively. Check the three-rhythm graph of sinusoidal monthly cycle to know the situation of athletes' physical strength, mood and intelligence. The results showed that 5% of the athletes' biorhythm cycle was in triple high tide, and 95% of the athletes were in more than one low tide and critical period when sports injuries occurred. The damage frequency of low tide, high tide and critical period were compared and the difference was significant ( $P < 0.01$ ). In the study of the relationship between the occurrence of sports injury and the biological rhythm of athletes, it was found that there was no significant difference

**Table 1.** Age distribution of track and field athletes.

Age	13-14	15-16	17-18	19-20	20-21	average age	
number of people	man	12	17	21	18	8	17.5 ± 1.21
	Woman	6	9	16	13	4	15.9 ± 2.45
	1-3	4-5	6-7	8-9			average age
number of people	man	17	28	19	11		96.75 ± 1.23
	Woman	6	14	16	9		5.96 ± 1.75

in the frequency of sports injury in the high and low periods of physical cycle, emotional cycle and intellectual cycle respectively ( $P > 0.05$ ) (Table 2).

The results showed that 82.42%, 28.57% and 12.09% of the 90 cases occurred in low tide period, critical period and high tide period. According to the comprehensive rhythm of the three rhythms of human body, among the 16 cases of fractures, 81.25% occurred in the low tide period, 18.75% in the critical period, and none occurred in the triple high tide period. Among the 13 cases of kick injuries, 86.42% occurred in low tide period, 15.38% in critical period and 7.69% in high tide period.<sup>8</sup> (Table 3)

**Table 2.** Circadian rhythms of human body in athletes with sports injuries.

Low-tide period	%	critical period	%	high-tide period	%	$\chi_2$	P value
Physical strength cycle	65	51.62	12	10.92	46	38.5	0.31
Emotional cycle	51	45.67	17	13.23	54	45.2	
Intelligence cycle	59	49.12	4	3.23	57	47.6	

**Table 3.** Study on the types of sports injuries and the three rhythms of human biology.

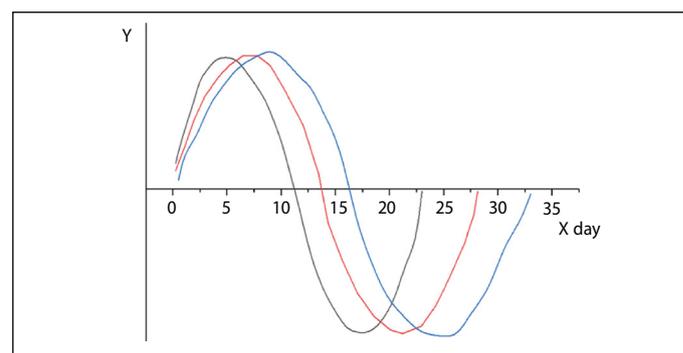
Type of damage	frequency	physical strength			mood			intelligence		
		ow tide	critical	high tide	ow tide	critical	high tide	ow tide	critical	high tide
Newla suffered a fall	91	41	12	39	22	14	56	45	5	41
%	75.63	45.23	13.19	45.26	24.18	15.32	65.44	48.23	4.53	45.23
cataclasis	15	13	3	0	9	0	7	8	0	8
%	13.33	81.25	18.75	0	56.25	0	43.25	49	0	50
Colble	13	2	2	6	12	0	3	8	0	6
%	10.23	35.62	15.36	45.12	46.23	0	23.21	53.86	0	46.12

## DISCUSSION

Studies have shown that artificially altering the daily hours of light and darkness can shift the diurnal phase of some functions of the body. As shown in Figure 1, the positive phase is the high tide period, the person's mood is high, the physical strength is full, the thinking is quick, can bear the larger movement load, even if the fatigue, the elimination is fast. The negative value stage is the low tide period, people's emotional state is unstable, easy to fatigue. Therefore, it is a biological factor that cannot be ignored in sports training to make scientific and reasonable use of the characteristics of human monthly rhythm to guide our sports training.<sup>9</sup>

The physical trough, the emotional peak. Shaded section in Figure 2. Athletes physical cycle at the stage of low lows at this stage, and the emotional cycle just at the peak stage of height, is to "adjust" down a "more" phase transition, athletes in high spirits, high spirit, but as a result of physical cycle is low, physical peak techniques can be done at the moment is not easy to complete.

Double peak or double trough stage of physical and emotional. The shaded part of Figure 3. Athletes' physical and emotional cycle is in



**Figure 1.** The cycle curve of three rhythms of human biology.

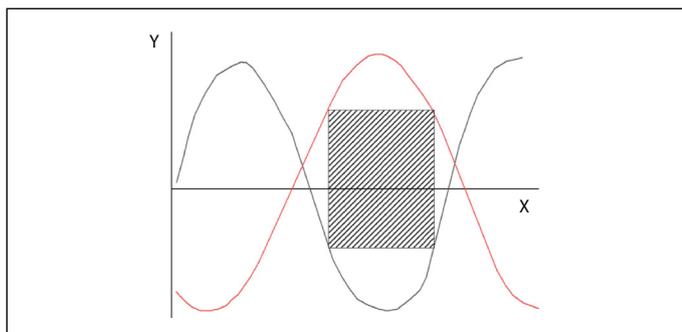


Figure 2. Physical and emotional cycle curve two.

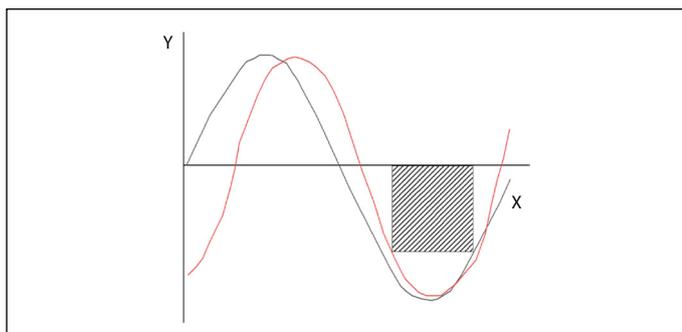


Figure 3. Double trough curve force of physical strength and emotion.

the peak stage of the high tide period at the same time, their physical and emotional stage are in a good state. It is the best time for heavy load training. It is full of physical strength, spirit, strong athletic ability and not easy to fatigue. If the coach can make full use of this stage, the training effect can be greatly improved. As can be seen from Figure 3, in the shadow part, the athletes' physical and emotional cycles are all in the trough stage of the low tide period.<sup>10</sup>

Athletes' intelligence level, to a great extent, determines their ability to accept the coaches' guidance and self-control ability in training, and also determines whether they can assess the situation, skillfully use the skills and tactical abilities acquired in training, grasp the aircraft, and win the victory. Therefore, intelligence factor is very important in sports training. The coaches should fully grasp the intelligence of the athletes and guide the sports training. The study of complex techniques and the practice of repeated movements should be carried out in the period of high intelligence, which often gets twice the result with half the effort. In the period of high intelligence, the athletes' implementation of the coaches' technical and tactical arrangement is obviously better than that in the period of low intelligence, especially in some collective events, the intelligence factor is particularly important. Coaches must

understand the athletes' current mental cycle, so as to guide training and competition, and combine the change of human biological rhythm with sports training organically.

The occurrence of sports injury is closely related to the biological rhythm of human body. Significant difference was found in the critical period with high damage rate ( $P < 0.01$ ). The injury rate in the low tide period was also lower than that in the critical period ( $P < 0.05$ ), which may be because the tissues, organs, tubes and systems in the low tide period of the body have been in the adaptation period, and the mutual questions are in a new harmony, and the body can adjust the stimulation of external meters. When the body is in the critical period, the sports injury rate is the highest, which is consistent with the reported incidence of other accidents. In the critical period, the body's physiological changes are complex and the various systems are not coordinated with each other. Therefore, under the strong stimulation of movement, the decrease of the body's working ability is prone to accidents and trauma. The analysis results suggested that there was no significant difference between the low period of intelligence rhythm and the critical daily mean injury frequency ( $P < 0.5$ ), but the trend low period of injury frequency was still lower than that of the critical period. This may be related to the small amount of hydrological sample, or the body is prone to damage during the low intelligence rhythm period.<sup>11,12</sup>

## CONCLUSION

The results show that in the relationship between the three rhythms of human body and the occurrence of sports injury, the probability of sports injury is small when the athletes are in the triple high tide period. When the biorhythm is in one or more low tide or critical period, the probability of injury is up to 95%, indicating that most athletes' sports injuries occur in low tide and critical period. It is an important biological factor in sports training to scientifically and rationally utilize the characteristics of human body cycle rhythm and guide sports training from the physiological point of view. Sports training arrangement must adapt to the objective existence of the human body's original biorhythm, according to the change of athletes' physical cycle, the corresponding monthly cycle training plan should be made to avoid the injury during training.

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## REFERENCES

- Grootendorst MR, Cariati M, Pinder SE, Kothari A, Douek M, Kovacs T, et al. Intraoperative Assessment of Tumor Resection Margins in Breast-Conserving Surgery Using 18F-FDG Cerenkov Luminescence Imaging: A First-in-Human Feasibility Study. *J Nucl Med.* 2017 Jun;58(6):891-898.
- Finnegan S, Bruce J, Skelton DA, Withers EJ, Lamb SE; PreFIT Study Group. Development and delivery of an exercise programme for falls prevention: the Prevention of Falls Injury Trial (PreFIT). *Physiotherapy.* 2018 Mar;104(1):72-79.
- Zhang T, Yan L, Ma S, et al. Human biological rhythm in traditional Chinese medicine. *Journal of Traditional Chinese Medical Sciences.* 2016;3(4):206-11.
- Sargn B, Güler G. Evaluation of biological-rhythm using the biological rhythm interview of assessment in neuropsychiatry (BRIAN) in rheumatoid arthritis. *Med Bull Haseki.* 2020;58(1):48-51.
- Mari B. Creatine kinase as transient muscular damage indicator: Analyzes and importance for technology of sports training. *Fizicka Kultura.* 2018;72(1):20-8.
- White SH, Warren LK. Submaximal exercise training, more than dietary selenium supplementation, improves antioxidant status and ameliorates exercise-induced oxidative damage to skeletal muscle in young equine athletes. *J Anim Sci.* 2017;95(2):657-70.
- Santos EG, Gonçalves RV, Souza-Silva TG, Maldonado IR, Santos EC, et al. Could pre-infection exercise training improve the efficacy of specific antiparasitic chemotherapy for Chagas disease?. *Parasitology.* 2019;146(13):1-35.
- Nasci AB, Orcy RB, Cabistany LD, Formalioli A, Del Vecchio FB. Acute responses of high-intensity circuit training in women: Low physical fitness levels show higher muscle damage[J]. *Revista Brasileira de Cineantropometria e Desempenho Humano.* 2018;20(5):391-401.
- Hansen M, Bangsbo J, Jensen J, Krauser-Jensen M. Protein intake during training sessions has no effect on performance and recovery during a strenuous training camp for elite cyclists. *Journal of the International Society of Sports Nutrition.* 2016;13(1):1-11.
- Jung M, Rueber A, Freerk D. Exercise therapy for children with obesity: a systematic literature review. *International Medicine.*
- Zhang T, Yan L, Ma S, He J. Human biological rhythm in traditional Chinese medicine. *Journal of Traditional Chinese Medical Sciences.* 2016;3(4):206-11.
- Puchkova AN, Poluektov MG. Sleep as a biological rhythm: clinical aspects[J]. *Meditsinskiy Sovet.* 2021(2):56-61.