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Effects of Different Intensity Training Interventions on the Physiological and Psychological of Young Throwing Athletes: A Meta-Analysis

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Abstract
[Objective]: This paper focuses on the effects of different intensity training interventions on the physiological and psychological of young throwing athletes. [Methods]: Randomized controlled trials on the effects of different intensity training interventions on physiological indicators in young throwing athletes were searched by computer using the China Biomedical Literature Database, China Knowledge Network full-text journal database, Wanfang Data Knowledge Service Platform, China Vipers full-text database, Cochrane Library, Web of Science, PubMed, by 2 evaluators independently evaluated and cross-checked the quality of the included studies, and the quality of the included studies was evaluated using the quality evaluation method of the Cochrane-Handbook 5.0 manual. Data were collected on the effects of different intensity training interventions on the psychological indicators of young throwing athletes using a questionnaire, and the data were statistically analyzed using SPSS 25.0 software. A meta-analysis of the collected literature data was conducted using RevMan 5.0 software with funnel plots and sensitivity tests. [RESULTS]: The results of the analysis confirmed that a sudden shift based on the absence of high-intensity training is most likely to cause muscle damage. However, excessive training loads can cause increased levels of physical injury and psychological stress in athletes.
Keywords: Different Intensity, Young Throwing Athletes, Physiological Indicators.

Introduction

Most researchers agree that different intensity training interventions have an impact on physiological and psychological indicators in young throwing athletes. Some researchers have argued that low-intensity exercise endurance is a necessary ability for athletes whose anaerobic capacity is the dominant sport, and that the reliance on aerobic metabolism during recovery is precisely the basis for this assertion. However, although low-intensity exercise endurance training can enhance a variety of physiological factors such as the rate of recovery between high-intensity activities, the decreasing effects of anaerobic capacity and athletic performance through low-intensity exercise endurance training outweigh the positive effects of the training intervention (Savikj, 2020). Long-term, high-volume low-intensity training tends to cause fatigue, especially of the nervous system, and fatigue of the nervous system and the organism causes a decrease in the overall quality of training and hinders the development of training to higher levels (Alves, 2016). Other researchers have argued that the development of high-intensity exercise endurance can indeed enhance low-intensity exercise endurance performance, so the same training methods used by athletes in anaerobic endurance programs can be helpful for athletes in aerobic endurance programs (Shave, 2019). On the other hand, if training is always high intensity, but never adding low intensity training or rest days, this can have an impact on long-term performance (Arazi, 2011). And studies have also shown that appropriate moderate intensity exercise can improve cardiorespiratory fitness and enhance the immune system (Allemeier, 1994). In the book Essentials of Strength and Conditioning, a common cause of overtraining is called "excessive progressive overload rate. That is, increasing volume or intensity (or both) too quickly over a period of weeks or months of inadequate recovery can lead to greater structural damage and can lead to overtraining. Any faulty training prescription, if it is repeated over a period of time, can theoretically lead to overtraining. This is commonly encountered when athletes with a high level of aggressiveness are performing a large number of high intensity and high frequency training loads with limited rest during the recovery period between training sessions (Balabinis et al., 2003).

A total of 35 randomized controlled trials were included, and the results of the randomized controlled trials were analyzed and compared with the results of different intensity training interventions on the physiological indicators (such as basal blood indicators, hormone levels, immune levels, etc.) of young throwing athletes, respectively. At the same time, the analysis of psychological indicators were conducted based on the results collected from the questionnaire: the anxiety self-rating scale was used to evaluate the effect of different intensity training interventions on the anxiety level of young throwing athletes, and the analysis results confirmed that different intensity training interventions had different degrees of effect on the anxiety level of young throwing athletes, along with the increase of training intensity; the depression S*elf-Rating Scale* was used to evaluate comparing the effects of different intensity training interventions on the depression level of young throwing athletes, the analysis results confirmed that along with the increase of training intensity, the depression level of young throwing athletes was also increasing. Therefore, the conclusion of this study is that sudden shift based on the absence of high-intensity training is most likely to cause muscle damage. However, excessive training loads can cause increased levels of physical injury and psychological stress in athletes.

Methods

Subjects and Study Protocol

In this paper, by using "training intensity", "young throwing athletes", "physiological", "psychological", we found 2,034 papers. After reading the title, abstract and full text, we eliminated the literature that did not meet the inclusion criteria and finally identified 35 papers. Inclusion criteria: (1) Study type: Randomized controlled trial(RTC). (2) Study population: young throwing athletes aged 16 to 25 years old. (3) Intervention: Intervention group 1 was a high-intensity training intervention with an 8-week cycle. Intervention group 2 was a low-intensity training intervention with a period of 8 weeks. Intervention group 3 was a medium-intensity intervention with a period of 8 weeks. (4) Outcome indicators: The main objective was to evaluate the physiological and psychological indicators of young throwing athletes. Psychological indicators: anxiety self-assessment scale, depression self-assessment scale. Physiological indicators: basic blood indicators, hormone levels, immune levels. Exclusion criteria: the study population was young throwing athletes aged 16 to 25 years old. Non-randomized controlled trials; reviews, conferences or unrelated literature; duplicate publications. The specific qualitative data codes are shown in **Table 1**.

Study Objective

The ultimate goal of athletic training is to improve athletic performance and thus athletic performance, and effective training helps to improve athletic performance (Colberg SR, 2010). This study analysed the effects of training interventions of different intensities on physiological and psychological indicators in young throwing athletes and concluded that changes in physiological indicators (e.g. basic blood indicators, hormone levels, immune levels) and changes in psychological indicators (e.g. anxiety, depression, etc.) changes can promote the quality of sports research and training, promote more scientific sports training, help coaches to develop suitable training plans for young throwers, and also provide training suggestions to improve the physical fitness level and specific technical level of young throwers, which in turn can improve the athletic status of the athletes, thus promoting the physiological and psychological This will help to improve the physiological and psychological stability of the junior throwers during training and provide a strong guarantee for final competition.

Basic Blood Indicators

Regular blood tests can explain the symptoms and problems of recovery disorders due to a lack of optimization and management of the physical health base. Hemoglobin, erythrocyte count, and phosphocreatine kinase are a few of the basic blood indicators commonly used to test youth throwing athletes, and the physicochemical characteristics of the blood are quite important to the athletic performance of youth throwing athletes.

Self-Rating Scale

The Anxiety Self-Rating was developed by W.K. Zung as a measure of the severity of anxiety states and changes in treatment, and can be used to screen for anxiety problems in specific populations and to evaluate the effectiveness of psychotherapy and medication. In this paper, we analyzed the anxiety level of young throwing athletes based on anxiety self-rating scale. The Self-Rating Depression Inventory (SRI) was developed by William W.K. Zung (Duke University, USA) in 1965 to measure the severity of depressive states and their change in treatment. The scale has been widely used in basic psychological research as well as in practice assessment in China, and some researchers have reported good reliability and validity of the scale in Chinese subjects (Botonis, 2016). Therefore, this paper analyzes the depression levels of young throwing athletes based on the Depression Self-Rating Scale.

Hormone Levels

Testosterone is the main hormonal driver of anabolic proliferation, the process of material growth, especially in muscle. Since testosterone hormone has a huge role in increasing muscle size and strength, and this hormone has an important role in youth throwing athletes, testosterone hormone was chosen as an important physiological indicator in this paper.

Immune Levels

Exercise enhances the immune function of the circulatory system, resulting in a significant increase in immunocompetent lymphocytes, greatly improving human resistance, microcirculation and organismal immune function. Therefore, it is necessary to explore the effects of different levels of training on the immune system of young throwing athletes.

Statistical analysis

A meta-analysis of the collected literature data was conducted using RevMan 5.0 software with funnel plots and sensitivity tests. This study involved only measurement data, and weighted mean differences (MD) or standardized mean differences (SMD) were used as effect analysis statistics. All effect sizes were expressed as 95% confidence intervals (CI). The included studies were tested for heterogeneity using the Cochrane Q-test, and multiple studies were considered homogeneous if $P>0.1$ and $I2<50\%$, and Meta-analysis could be performed using a fixed-effects model; if $P<0.1$ and $I2>50\%$, statistical heterogeneity was considered to exist between studies, and the sources of heterogeneity were analyzed, and factors that could lead to heterogeneity were Subgroup analysis, if If statistical heterogeneity existed between the 2 study groups without clinical heterogeneity, a random-effects model was used for analysis. If the heterogeneity between the 2 groups was too large or no source of heterogeneity could be found, descriptive analysis was used and $P<0.05$ was considered a statistically significant difference.

Table 1.
Comparison of horizontal and vertical training degree on the horizontal direction blood level forest diagram

Study or Subgroup	Mea	SD	Tot	Mea	SD	Tota	Weig	IV, Random, 95%
Izquierdo et al (13)	-1.54	5.85	45	2.21	6.83	45	8.3%	[-12.94～-9.55]
Alen et al (17)	-2.58	9.22	38	3.47	9.26	38	5.7%	[-11.28～-8.23]
Howatson et al (19)	-3.77	7.54	46	6.05	6.24	46	8.4%	[-14.08～-9.63]
Ratamess et al (18)	-3.23	6.29	49	4.38	8.20	49	9.2%	[-14.12～-8.72]
Barbosa et al (19)	-2.61	8.50	51	5.44	8.57	51	10.3%	[-13.19～-9.32]
Psilander et al (16)	-3.28	9.65	66	3.21	10.6	66	11.5%	[-11.12～-9.43]
Strokosch et al (20)	-4.32	7.32	62	5.77	9.39	62	11.2%	[-12.12～-10.21]
Mujika et al (18)	-2.57	8.54	73	6.54	8.78	73	12.3%	[-13.92～-10.13]
Shaw et al (18)	-3.18	9.12	28	3.88	7.31	28	4.7%	[-11.12～-9.43]
Villareal et al (17)	-2.93	7.15	35	2.96	7.51	35	5.4%	[-11.25～-10.43]
Shaw et al (14)	-1.92	9.21	95	6.45	10.5	95	18.9%	[-13.67～-9.25]
Silva et al (13)	-3.72	8.54	67	5.28	8.54	67	11.7%	[-13.88～-10.21]
Sousa et al (12)	-3.65	7.65	72	9.32	7.65	72	12.5%	[-12.25～-9.13]
Stone et al (14)	-2.99	9.51	35	4.65	11.2	35	5.4%	[-12.11～-9.55]
Chtara et al (15)	-3.25	8.69	85	5.88	9.52	85	17.9%	[-12.12～-9.92]

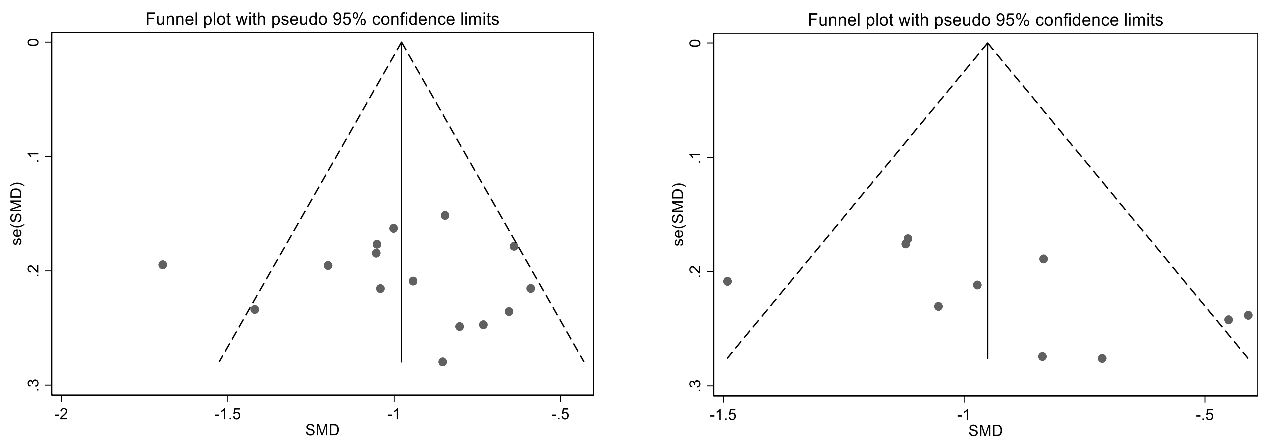
Table 2.
Comparison of horizontal and vertical training degrees on hormone level forest plots in the horizontal direction

Study or Subgroup	Mea	SD	Total	Mea	SD	Total	Weigh	IV, Random, 95%
Arazi et al (11)	-	8.1	35	1.38	7.42	35	7.3%	[-9.21～-8.32]
Chtara et al (12)	-	9.6	28	4.52	8.56	28	6.7%	[-8.28～-7.05]
Robert et al (19)	-	8.2	79	5.85	7.12	79	11.4%	[-9.13～-7.63]
Petre´ et al (18)	-	7.5	50	4.62	7.26	50	9.2%	[-9.22～-8.72]
Cadore et al (17)	-	8.9	43	6.85	7.57	43	8.1%	[-8.19～-7.28]
Marques et al (16)	-	7.5	61	4.21	9.52	61	9.8%	[-7.85～-7.43]
Plisk et al (17)	-	6.9	59	7.65	8.13	59	9.7%	[-12.12～-7.55]
Rivie` re et al (18)	-	9.2	75	5.28	7.85	75	11.3%	[-8.82～-8.13]
Rønnestad BR et al.	-	7.2	29	4.33	9.54	29	6.8%	[-9.19～-8.43]
Villareal et al (15)	-	7.9	36	1.06	7.89	36	7.2%	[-9.12～-7.29]

Results

Fifteen studies comparing the effects of different intensity training interventions on blood levels in young throwing athletes were evaluated in a total of 1,040 cases in **Table 1**. Because of the statistical heterogeneity of the included studies (I2=96%, P<0.01), a random effects model was used for the pooled analysis, and the results of the meta-analysis showed statistically significant differences between the intervention groups (WMD=-11.75, 95% CI-14.94 to -8.55, Z=7.21, P<0.01). 10 studies evaluated comparing different intensity Meta-analysis showed statistically significant differences between intervention groups (WMD=-8.24, 95% CI-9.44 to -7.04, Z=13.47, P<0.01).

Ten studies evaluated the effects of different intensity training interventions on immune levels in young throwing athletes with a total of 735 cases. A total of 805 cases. Meta-analysis results showed statistically significant differences between intervention groups (WMD=-8.12, 95% CI-10.75 to -5.49, Z=6.05, P<0.01). See Tables 1-4. (Mean indicates sample mean, SD is pre-experimental sample standard deviation, Total is sample content, and Weight is weight, indicating the weight of each included study at the size of the combined effect).



Panel A

Panel B

Figure 1. Funnel Plot with Pseudo 95% Confidence Limits

Table 3.
Comparison of horizontal and vertical training degrees on immune levels forest plots in the horizontal direction.

Study or Subgroup	Mean	SD	Tot	Mea	SD	Total	Weig	IV, Random, 95%
Chaouachi et al (15)	-2.33	6.92	50	3.65	8.1	50	8.5%	[-10.75～-5.32]
Daniel et al (17)	-2.72	8.56	40	2.58	7.3	40	5.4%	[-10.28～-5.12]
Lofving et al (18)	-1.85	7.69	65	4.32	6.8	65	9.2%	[-9.57～-4.98]
Strokosch et al (20)	-3.19	7.23	58	5.44	7.5	58	8.7%	[-9.13～-4.68]
Requena et al (17)	-2.88	6.25	29	3.54	6.8	29	4.3%	[-8.16～-4.53]
Sperlich et al (15)	-4.68	8.65	36	3.56	7.1	36	4.5%	[-8.25～-6.52]
Wong et al (14)	-5.82	8.82	78	4.38	8.9	78	10.2%	[-8.69～-5.69]
Chaouachi et al (18)	-2.16	9.05	89	5.42	7.5	89	11.3%	[-9.24～-7.12]
Kraemer et al (17)	-3.24	8.12	76	4.25	8.4	76	9.8%	[-9.36～-6.18]
Villareal et al (16)	-3.97	9.65	65	3.56	9.6	65	9.2%	[-8.77～-6.29]

Figure 1 depicts the funnel plot. A dashed line with the funnel centered represents the fixed effect model, whereas a dotted line represents the random effects model estimate. Both estimations are comparable, as in our example, and therefore are difficult to identify (Panelss A). However, based on the contour-enhanced funnel plot, the funnel plot appears to be asymmetric. The Harbord test is very significant (p<0.001), indicating that small-study effects are present. The trim-and-fill method was used to limit five trials to the meta-analysis (Panel B), resulting in an adjusted random-effects estimate of RR=0.9, indicating that haloperidol had no statistically significant benefit over placebo.

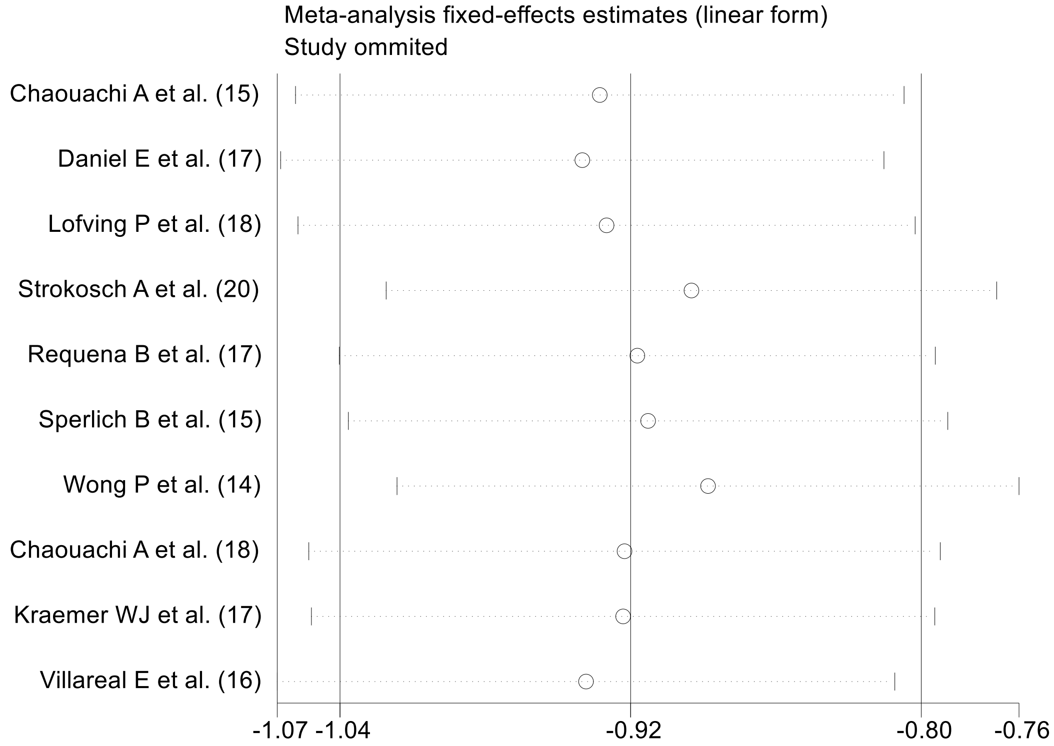


Figure 2. Meta-analysis fixed-effects estimates (linear form)

Table 4.
Meta-analysis results (Aggregate).

Influencing Factors	Number of Literature	WMD	CI	Z	I^2	P
Blood level	15	-11.75, 95%	-14.94~-	7.21	96%	0.009
Hormone levels	10	-8.24, 95%	-9.44~-7.04	13.47	84.8	0.005
Immunity levels	10	-8.12, 95%	-10.75~-	6.05	83.5	0.006

Discussion
In order to test the effects of different intensity training interventions on the psychological indicators of young throwing athletes, this paper analyzes and verifies the correlation between different intensity training interventions on the psychological indicators of young throwing athletes based on the results of questionnaires and Pearson correlation coefficients in statistics. The specific data analysis results are shown in **Table 5**.

The results of the correlation analysis of the psychological indicators of young throwing athletes with different intensity training interventions showed that the level of anxiety and their depression increased with the increase of training intensity. This indicates that there is a significant positive correlation between different intensity training interventions and the psychological indexes of young throwing athletes.

Table 5.
Associations of training interventions of different intensities on psychological indicators in young throwing athletes.

Type of intensity	Anxiety level	Depression level	Physiological indicators
High-intensity training interventions Pearson correlation Significance (bilateral) N	0.632** 0.000 323	0.738** 0.000 323	0.698** 0.000 323
Medium-intensity training interventions Pearson correlation Significance (bilateral) N	0.568** 0.000 323	0.547** 0.000 323	0.557** 0.000 323
Low-intensity training interventions Pearson correlation Significance (bilateral) N	0.495** 0.000 323	0.456** 0.000 323	0.483** 0.000 323

*** indicates a significant correlation at the level of P<0.05 and ** indicates a significant correlation at the level of P<0.01.**

Conclusion

From the above analysis, it is known that the specific volume of erythrocytes and hemoglobin concentration decrease with the increase of training intensity, and there is a positive correlation between the specific volume of erythrocytes, hemoglobin concentration and athletic performance. The increased CPK activity in the blood of young throwing athletes may be indicative of skeletal muscle damage and may also be due to a temporary increase in myocyte membrane permeability resulting in a large leakage of CPK from the myocytes. As training intensity rises, it increases testosterone hormone levels, thus increasing the athlete's motivation. As the intensity of exercise increases, the stimulus to which the organism is subjected increases, and high-intensity sports training or competition can cause suppression of immune function in athletes.

Low-intensity training for young throwers will not form an effective stimulus for the special, and does not meet the needs of the game, because in the game the excitement of the athlete's nervous system should be the highest, the tension of the muscular system and the concentration of endocrine should also be the highest. In addition, after a long period of low-intensity large load training, in the transformation to high-intensity training, the slightest inadvertence will appear injuries, because the muscle has adapted to the chronic contraction, elongation of the training intensity, while the throwing movement requires a high intensity of rapid contraction and elongation, therefore, in the absence of high-intensity training based on the sudden transformation, the most likely to cause muscle damage. However, excessive training load will cause an increase in the degree of physical injury and psychological stress to the athletes. Therefore, only the adapted training load will bring new stimulation to the athletes, so in the training coaches need to arrange the training intensity with the actual situation in a targeted way, and also pay high attention to the physical condition and psychological state of young throwers.

Theoretical and Practical Contribution

This study theoretically analyzed the effects of training interventions of different intensities on the physiological and psychological indices of young throwing athletes, and concluded that the changes of physiological and psychological indices can promote the improvement of sports research and training quality, promote more scientific sports training, help coaches to develop suitable training programs for young throwing athletes, and also provide training suggestions for improving physical fitness level and special technical level. The results of this study show that only adapted training loads can bring new stimuli to athletes, so in training coaches need to arrange training intensity in a targeted manner with the actual situation, while paying high attention to the physical condition and psychological state of young throwing athletes.

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