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The Effect of Using Body Chest Rig Resistance Band on Students-Athletes Strength in Pontianak

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Abstract Resistance band is an easier alternative to strength training for young athletes in stimulating neural adaptation, enhancing hypertrophy, muscle capacity, strength and power. This study aimed to assess the effectiveness of the body chest rig resistance band training model on student athletes. Methods: This study used a pseudo-experimental research design with a pretest-posttest control group design. The subjects of this study were student athletes from various sports in Pontianak, specifically martial arts, athletics, and volleyball. The sample comprised student athletes aged 15-17 years, enrolled in junior and senior high schools. A total of 58 student athletes participated, divided equally into two groups: the experimental group and the control group, with 29 participants in each group. Analysis: Quantitative data analysis was performed using strength test instruments (psychomotor), including push-pull and back-leg dynamometers. Data analysis was conducted using SPSS version 2025. Results: The results indicated that adding load through resistance exercises using body chest rig resistance bands, with exercise loading stages adjusted by band color and additional weight, significantly impacted muscle strength in student-athletes aged 15-17 years. The statistical analysis revealed that the average strength test scores in the experimental group increased from 73.52 before treatment to 83.83 after receiving the body chest rig resistance band strength training model. Conclusion: Body chest rig resistance band training is effective in enhancing muscle strength among student-athletes. The findings suggest that the benefits of body chest rig resistance bands are comparable to those of traditional isotonic machines and free weights.

Keywords Body Chest Rig Resistance Band, Strength, Students-Athletes

1. Introduction

The development of coaching science is increasingly growing in its attempt to adequately prepare athletes' physical condition [1]. Much of this progress is based on an enhanced understanding by both coaches and athletes of how the body adapts more effectively to various physical and psychological stresses [2]. Moreover, a deeper comprehension of the interrelationship between bodily performance to various interventions from training outcomes and biomechanical factors can improve athlete performance [3]. Therefore, sport-specific physical training programs are able to target the specific biomotor needs of different sports [3]. Many sports require a combination of key biomotor performance aspects. However, referring to the principle of specificity, Harsono emphasizes that even if the training methods and forms are correct and aligned with the movements, the benefits to performance will be minimal if the muscle groups being trained do not correspond to those used in the sport's movement patterns or skills [1] [4]. Therefore, the principle of specificity must also be applied when training muscle groups. Training that focuses on specific exercises will be more beneficial [5], ultimately influencing an athlete's performance on the field.

Athlete performance is primarily determined by a combination of strength, speed, and endurance. Most sporting activities can be categorized as biomotor dominant skills. According to Bompa [4], these three abilities are crucial for athletic success, with strength being a particularly dominant factor in improving performance. Strength serves as the foundation for the development of other biomotor components, such as speed, power, agility, and the abilities derived from them [6]. Furthermore, strength is a biomotor component that significantly influences biomotor abilities, including speed, endurance, and coordination [7]. It has also been linked to various physical attributes, such as agility, speed, acceleration, repeated sprint ability, and aerobic endurance [8] [9]. Thus, strength is a key biomotor ability that directly affects athletic effectiveness across all sports [10]. According to further research [11], improving strength is essential, as it forms the foundation for the development of other biomotor components. Strength, as explained by [12], plays a vital role in enhancing movement learning and achieving better performance. As the driving force behind all physical activities, strength is fundamental in preventing injuries and is especially important for young athletes, as it underpins other physical components [13]. However, a study by Heri Tage indicates that factors such as age, gender, and race have minimal influence on individual responses to strength training [14]. However, strength training requires experience and adherence to a structured physical training program as experienced and trained individuals tend to develop more strength than those without prior physical training [15]. Therefore, strength training programs aimed at adolescent athletes should focus on improving motor control and coordination, which aids in the development of proprioception (awareness of limb position and body orientation). Nevertheless, the primary goal at this stage should remain the development of strength [16]. If the fundamental movement patterns in strength training are sufficiently diverse and the types of exercises used are varied, you can proceed to develop sport-specific skills while continuing to provide enough stimulus for adaptation. This is because the primary purpose of strength training is to induce adaptation [17]. In accordance with that, the National Strength and Conditioning Association (NSCA) states that strength training should begin with neural system adaptations [18]. To achieve additional results, exercise variation is crucial [15]. Such variations should aim to build a comprehensive strength base, incorporating exercises like pull-ups, push-ups, sit-ups, back extensions, squats, lunges, crunches, good mornings, deadlifts, bench presses, chin-ups, and shoulder presses [6].

Based on these perspectives, sports and health professionals require effective strength training tools that can promote positive adaptations to exercise [19][20]. A wide variety of strength training devices are available, each with its own strengths and limitations. The most common and traditional tools for providing external resistance in strength training programs are weights and machines, which have demonstrated benefits for physical function, body composition, and other health-related variables [21][22]. However, weights and machines often require specialized facilities and can be costly, limiting accessibility for many individuals [23]. Additionally, some people may hesitate to use free weights and machines due to their association with high physical demands [24] or the risk of injury. As a result, there are simpler alternatives for strength training, particularly for young athletes aiming to stimulate neural adaptation—one such alternative being the use of resistance bands.

Resistance bands offer an excellent alternative to traditional fitness equipment, which can be expensive, bulky, and often requires specialized skills to operate [25]. The use of resistance bands in sports training has increased in recent years due to their effectiveness, affordability, and ease of use [26]. Additionally, resistance bands allow for exercises that can be performed anywhere and at any time, with a wide variety of movements adaptable to different sports. The level of difficulty can also be adjusted based on individual abilities, making resistance bands highly versatile. Research shows that resistance band training can enhance muscle hypertrophy, strength, and power [19][27]. Studies indicate that when the intensity is appropriately adjusted, resistance bands can generate similar muscle activation pressure as constant resistance, while offering mechanical advantages over weights and machines [28][19][29]. Furthermore, several studies have demonstrated that resistance band training can improve muscle strength in the legs, arms, and balance [30][31][32]. Elastic bands can also be used for explosive, multi-joint movements, making them suitable for strength training in young athletes and adolescents [33]. Despite evidence supporting the benefits of resistance bands, including improvements in strength among adolescents [34], there is currently no systematic review that examines the effects or parameters of resistance band training.

Based on the analysis of various references, resistance band training has significant potential for further development. Although extensive research on resistance band training has already been conducted, with studies from several countries contributing to the field, most of these focus on applying a single type of exercise model directly to athletes. In light of this, this study examines resistance band training by introducing a modified implementation tool—a chest rig that can be equipped with additional weights. This modification allows for specific physical exercises to be performed simultaneously with sport-specific techniques, providing a more comprehensive approach to athletic training.

Building on this foundation, the researcher aims to investigate the effects of adding weight through resistance training using body chest rigs combined with resistance bands. The training will follow a progression based on the resistance levels indicated by the color of the bands and the additional weight, with each band color representing a different resistance level. This approach is intended to offer a variety of training models and programs tailored to the specific principles and characteristics of various sports, thereby optimizing the outcomes of sport-specific exercises. Moreover, the findings from this study will contribute to the development of targeted training programs, providing a foundation for future research and practical applications in athletic training. The primary objective of this study is to analyze the effectiveness of body chest rig resistance band training on athletes aged 15-17 years.

2. Materials and Methods

The research method used in this study aims to assess the effectiveness of the body chest rig resistance band training model on student athletes. A pseudo-experimental research design was utilized, specifically a pretest-posttest control group design.

Table 1 shows the division of the control group and the experimental group. The subjects of this study were student athletes from various sports in Pontianak, specifically martial arts, athletics, and volleyball. The sample comprised student athletes aged 15-17 years, enrolled in junior and senior high schools. A total of 58 student athletes participated, divided equally into two groups: the experimental group and the control group, with 29 participants in each group. The experimental group underwent the body chest rig resistance band training model across 16 sessions. To evaluate the effectiveness of the training model, quantitative data analysis was performed using strength test instruments (psychomotor), including push-pull and back-leg dynamometers. Data analysis was conducted using SPSS version 2025. The paired t-test was applied to compare pre- and post-intervention values within each group, while one-way ANOVA was used to compare data between the experimental and control groups. The significance level was set at $p<0,05$).

Table 2 outlines the treatment regimen for the study. The experimental group underwent a body chest rig resistance band training program for 12 sessions over 4 weeks, with training occurring 4 times per week. The loading levels were adjusted according to the color of the resistance bands attached to the chest rig. The exercise regimen included specific repetitions, sets, and intervals of 2-3 minutes per set, with intensity progressively increased in line with the training volume. In contrast, the control group received conventional muscle strength training as prescribed by their coaches at their respective schools or clubs. This included traditional exercises such as pull-ups, push-ups, sit-ups, back extensions, squats, lunges, crunches, good mornings, deadlifts, and bench presses. Although the two study groups received different treatments, both groups followed a strength training program material.

The experimental group received a body chest rig resistance band exercise program which was divided into 3 phases. The first phase is the adaptation phase, which includes nerve adaptation using red resistance bands. This is followed by the development phase with blue bands, and then the advanced combination phase that incorporates both red and blue bands. Additional weights can be added if needed, utilizing the chest and back pockets. Each movement technique and stage of the program must be thoroughly understood and properly executed before proceeding to the next stage. This approach ensures that the loading is progressively increased, facilitating the desired strength gains while minimizing the risk of injury.

The research data collection involved psychomotor test instruments, including strength tests using push-pull and back-leg dynamometers. Data were collected before (pretest) and after (posttest) the treatment for both the experimental and control groups. This data was analyzed to evaluate the effectiveness of the body chest rig resistance band training model in the experimental group and compared with the control group. Data were analyzed using SPSS version 25. To assess the impact of the body chest rig resistance band training on muscle strength, a paired t-test was conducted to compare pretest and posttest results within both the experimental and control groups, with the significance level set at $p<0,05$.

Based on statistical number of homogeneity test (Table 3), the significance value based on Mean of exercise model was $p=0,380 > 0,05$. It can be concluded that variance of exercise model data of students-athletes was homogeneous.

Table 1. Research Design in Model Effectiveness Test

Subject	Pre-test	Treatment	Post-test
R	O_1	X	O_2
R	O_2	-	O_2

Table 2. Phases of Body Chest Rig Resistance Band Exercise.

Meeting	1	2	3	4
Phase 1 Red color	2 set, 10 reps, interval 2-3 minutes	3 set, 12 reps, interval 2-3 minutes	4 set, 10 reps, medium-speed, interval 2-3 minutes	5 set, 10 reps, medium-speed, interval 2-3 minutes
Phase 2 Blue color	2 set, 10 reps, interval 2-3 minutes	3 set, 12 reps, interval 2-3 minutes	4 set, 10 reps, interval 2-3 minutes	5 set, 10 reps, high-speed, interval 2-3 minutes
Phase 3 Green color and advanced combination	2 set, 10 reps, interval 2-3 minutes	3 set, 12 reps, interval 2-3 minutes	4 set, 10 reps, interval 2-3 minutes	3 set, 10 reps, high-speed, interval 2-3 minutes

Table 3. Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Training Models	Based on Mean	,784	1	56	,380
	Based on Median	,874	1	56	,354
	Based on Median and with adjusted df	,874	1	55,959	,354
	Based on trimmed mean	,844	1	56	,362

3. Results

The results indicated that adding load through resistance exercises using body chest rig resistance bands, with exercise loading stages adjusted by band color and additional weight, significantly impacted muscle strength in student-athletes aged 15-17 years at the junior and senior high school levels. The statistical analysis revealed that the average strength test scores in the experimental group increased from 73.52 before treatment to 83.83 after receiving the body chest rig resistance band strength training model (see Table 4).

Table 4. Paired Samples of Strength Test of Experimental Group

		Mean (Kg)	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest Exp-Strength Test	73,52	29	10,626	1,973
	Posttest Exp-Strength Test	83,83	29	10,794	2,004

Based on the results of the analysis output using SPSS 25 confirms that the average strength test results, measured using the push-pull and back-leg dynamometers, improved from 73.52 before the intervention to 83.83 after the training. This indicates a significant increase in strength test results due to the training model.

Based on the analysis output from SPSS 25, the average strength test score using the push-pull and back-leg dynamometer before conventional treatment was 76.48. After receiving standard muscle strength training according to the program provided by the coach at each school or club—which included exercises such as pull-ups, push-ups, sit-ups, back extensions, squats, lunges, crunches, good mornings, deadlifts, and bench presses—the average score increased to 80.28. This indicates an improvement in muscle strength (see Table 5). The control group also followed a strength training program. A comparative diagram of the average strength results before and after the treatment with the body chest rig resistance band exercise model and the average strength test results of the control group in the pretest and posttest is illustrated in Figure 1.

In the significance test for the difference of experimental group, the results indicated a t-value of 17.129, with df = 28 and a p-value of 0.00, which is less than 0.05. This demonstrates a significant increase in muscle strength before and after the application of the body chest rig resistance band exercise model. In the significance test for the difference of control group, the results showed a t-value of 5.333, with df = 28 and a p-value of 0.00 < 0.05. This indicates a significant increase in muscle strength before and after the conventional strength training treatment (see Table 6).

Table 5. Paired Samples of Strength Test of Control Group

		Mean (Kg.)	N	Std. Deviation	Std. Error Mean
Pair 2	Pretest Control-Strength Test	76,48	29	9,676	1,797
	Posttest Control-Strength Test	80,28	29	8,643	1,605

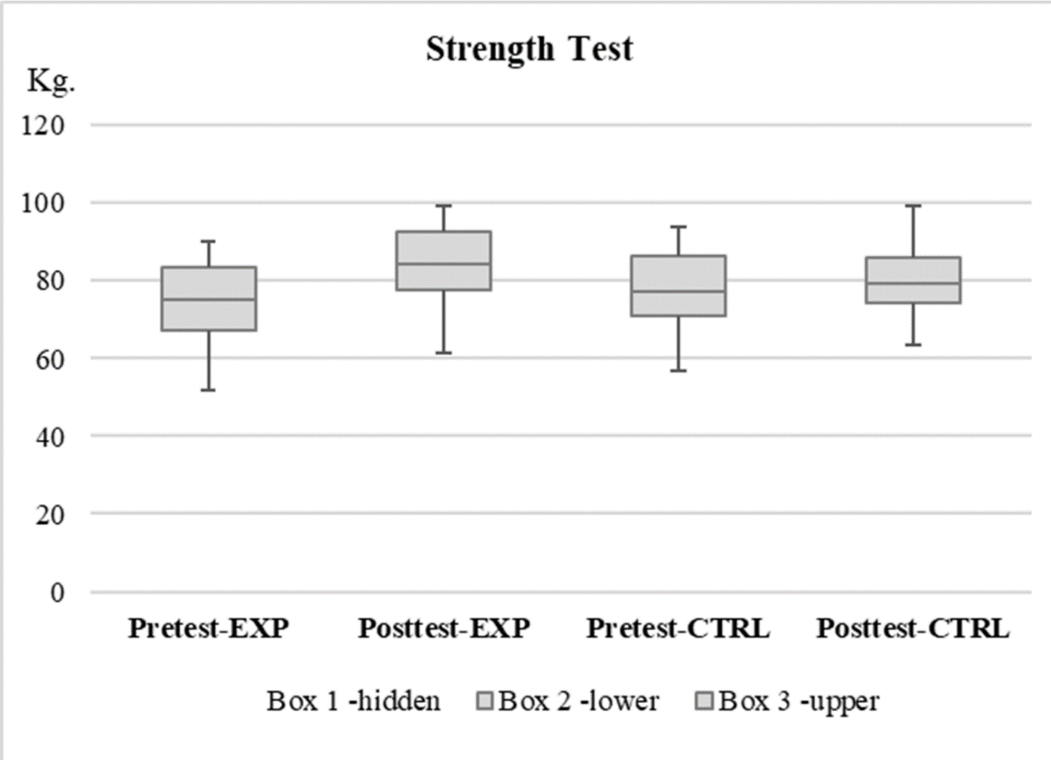

Figure 1. Strength Test of Experimental Group and Control Group

Table 6. Paired Differences Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean (Kg.)	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest Exp-Strength Test	-10,310	3,242	,602	-11,543	-9,077	-17,129	28	,000
Pair 2	Pretest - Posttest Control-Strength Test	-3,793	3,830	,711	-5,250	-2,336	-5,333	28	,000

Table 7. Paired Samples of Strength Test of Experimental-Control Groups Training Models

	N	Mean (Kg.)	Std. Dev.	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Body Chest Rig Resistance Band	29	10,38	3,156	,586	9,18	11,58
Conventional	29	3,97	3,950	,734	2,46	5,47
Total	58	7,17	4,798	,630	5,91	8,43

Table 8. ANOVA Test Differences of Experimental-Control Groups Training Models

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	596,483	1	596,483	46,666	,000
Within Groups	715,793	56	12,782		
Total	1312,276	57			

Based on the paired samples of strength test results (Tables 7) using SPSS 25, the average increase in muscle strength test scores before and after the body chest rig resistance band training model was 10.38, while the average increase in muscle strength test scores in the control group was 3.97. Furthermore, based on the ANOVA test results (Tables 8) the p-value is less than 0,05 (0,000<0,05). It can be concluded that the average increase in muscle strength test results between the treatment and control groups is significantly different.

4. Discussion

The treatment group underwent a 4-week strengthening exercise program using a body chest rig resistance band. In the first week, participants used a yellow resistance band with a stretch equivalent to 50% of the length of their arms and legs. In the second week, the intensity increased by switching to a red resistance band, also stretched to 50%. By the third week, a combination of the two bands was used, maintaining the 50% stretch. This progression led to a significant increase in muscle strength, as evidenced by the statistical test results. The average strength test score in the experimental group improved from 73.52 to 83.83, with a p-value of =0.00<0.05, indicating a statistically significant change. A comparison of the improvement in muscle strength between the experimental and control groups further supported these findings. The experimental group exhibited an average increase of 10.38, while the control group showed a lesser increase of 3.97, with a significance level of p=0,000<0,05. These results clearly demonstrate a significant difference in strength gains between the two groups. These findings align with prior research, such as [35] and [36], which reported similar or even greater increases in strength through free-weight or body-weight exercises. Other studies [28], [37], [29], and [34] have demonstrated that variable resistance bands can induce muscle activation levels comparable to constant resistance when intensity is appropriately adjusted. Resistance band exercises also offer mechanical advantages over free weights and machines. Resistance band exercises are known to enhance motor unit recruitment and activate both the Golgi tendon organ and muscle spindles, leading to increased muscle contraction [38]. Moreover, this type of exercise causes the muscles to contract by resisting the force of the band, and muscle strength can be further enhanced by increasing the number of repetitions or using bands with higher resistance, based on the color coding of the bands [39].

An important finding among studies on resistance band training in adolescents is the increased motivation and participation of young athletes [43], likely due to the fact that this type of training appears more appealing and provides a greater sense of safety compared to traditional weightlifting exercises [44]. Consequently, elastic resistance training has been shown to result in greater physical performance improvements compared to bodyweight exercises [42]. This is possibly because the stimulus from body weight exercises may either be insufficient or too challenging for certain individuals to adapt to [41]. In contrast, the stimulus from resistance band training can be easily adjusted, providing an optimal stimulus for neuromuscular improvement [40]. In contrast, bodyweight exercises may either provide insufficient stimulus or be too challenging for some individuals to adapt to [41]. As a result, elastic resistance training demonstrates greater physical performance improvements compared to bodyweight exercises [42]. Studies [45], [42] have found that free weight training can result in similar or even greater strength gains. Thus, elastic resistance programs enhance functional capacity across various age groups, including young, middle-aged, and older adults [19], [46], and improve body composition [19], [45] at all ages.

High-quality dose-response clinical trials are essential to determine the optimal dosage and effectiveness of elastic resistance training across various age groups, particularly in children. Further research is required to investigate the impact of elastic resistance training on health-related biomarkers and body composition variables. Future studies should provide detailed descriptions of the exercise volume, intensity, frequency, duration, and rest intervals used in the training program [19].

5. Conclusions

Based on this systematic review, training with body chest rig resistance bands proves effective in enhancing muscle strength among adolescent athletes. The findings suggest that the benefits of body chest rig resistance bands are comparable to those of traditional isotonic machines and free weights. Additionally, these resistance bands appear to be effective for improving body composition and may positively impact athlete motivation, though further research is necessary to confirm these effects. Future studies will investigate the effectiveness of body chest rig resistance band training with sport-specific principles and characteristics tailored to particular sports, such as Pencak Silat. The results from these investigations will contribute to the development of future body chest rig resistance band training models.

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