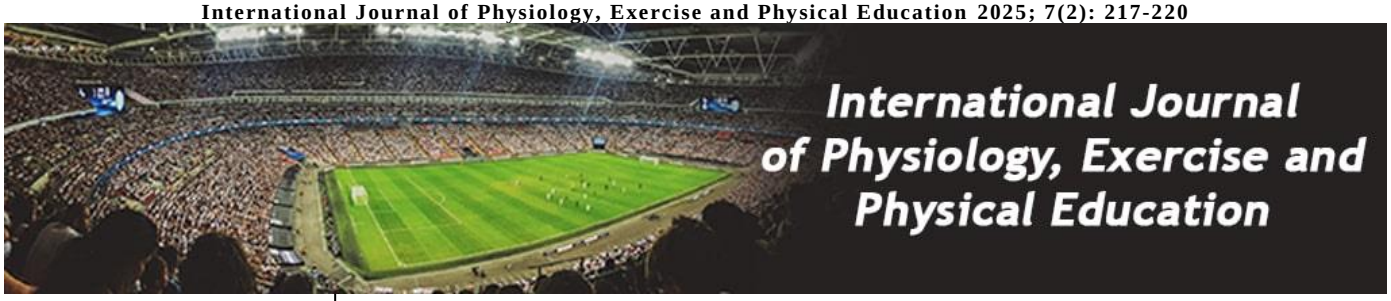

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Resistance training versus CrossFit: A comparative study of strength performance metrics

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Abstract
The purpose of this study was to conduct a comparative analysis of muscular strength between resistance-trained individuals and CrossFit participants. A total of 60 male subjects, comprising 30 resistance-trained individuals and 30 CrossFit practitioners, aged between 20 and 30 years, were selected for the study. The resistance-trained group was drawn from Total Fitness Gym, Heirangoithong, Manipur, while the CrossFit participants were selected from 7 Clan Strength and Conditioning, Nagampal, Manipur. The study focused on three key strength parameters: arm strength, abdominal strength, and explosive strength. Arm strength was measured through push-ups, abdominal strength was evaluated using the sit-up test, and explosive strength was assessed using the vertical wall jump test. Data were analyzed using an independent t-test with the help of SPSS software, and the level of significance was set at 0.05. After the analysis, it was revealed that there was no significant difference in the three variables i.e., arm strength, abdominal strength, and explosive strength between the two groups. Therefore, these findings suggest that both CrossFit and resistance training can be effective methods to enhance general strength and conditioning.

Keywords: Explosive strength, Arm strength, Abdominal strength, Resistance-Trained Individuals and CrossFit participants

Introduction
Strength training has become an integral component of modern fitness regimes, with a growing emphasis on both traditional resistance training and high-intensity functional training methods such as CrossFit. Resistance training (RT) is a well-documented exercise modality to improve several physiological and psychological health parameters (Fiuza-Luces *et al*., 2013) [4]. Resistance training typically focuses on progressive overload using isolated or compound movements with weights to enhance muscle strength and hypertrophy (Ratamess *et al*., 2009) [10]. In contrast, CrossFit combines elements of Olympic lifting, gymnastics, and cardiovascular training to promote general physical preparedness and functional strength (Glassman, 2007) [5]. CrossFit is one form of Resistance Exercise that is recognized as a high-intensity program that combines elements of mobility, technique, and strength (Smith *et al*., 2013) [12] and has seen increasing popularity in recent years. A large part of CrossFit workouts also consists of the “workout of the day” or "WOD," where workouts are performed for the best time or performed in the “as many rounds as possible” style and are completed in a group environment, with some workouts performed as a shared workload. This training form is enjoyed recreationally by participants of varying levels of fitness, training experience, age, and lifestyles (Thompson, 2017) [13] and also exists as its own sport.

Despite the popularity of both training modalities, there is limited empirical evidence directly comparing their effectiveness across specific strength performance metrics. Previous research suggests that traditional resistance training significantly improves maximal strength and muscular hypertrophy (Schoenfeld *et al*., 2016) [11], while CrossFit training is associated with enhanced muscular endurance and functional power output due to its high-intensity, varied format (Feito *et al*., 2018) [3].

Strength can be evaluated across various parameters, including explosive strength, arm strength, and abdominal strength—each contributing uniquely to athletic performance and daily functionality. Explosive strength, often assessed via vertical jump tests, reflects the ability to exert maximal force in minimal time (Markovic & Mikulic, 2010) [7]. Arm strength, typically measured through push-up performance, is a practical indicator of upper-body muscular endurance and strength (Boone & Metaxas, 2007) [1]. Abdominal strength, evaluated through sit-up tests, plays a crucial role in core stability and posture (Iwai *et al*., 2004) [6].

Given the distinct training philosophies and programming approaches of resistance training and CrossFit, it is essential to investigate how these modalities differentially impact various aspects of muscular strength. Therefore, the present study aims to conduct a comparative analysis of strength performance metrics—specifically explosive strength, arm strength, and abdominal strength—between resistance-trained individuals and CrossFit participants aged 20 to 30 years. This research will help bridge the gap in the literature and provide practical implications for fitness professionals and athletes when choosing a training modality to improve specific strength components.

Objectives of the study

1. To assess the differences in arm strength between resistance-trained individuals and CrossFit participants.
2. To evaluate abdominal strength between resistance-trained individuals and CrossFit participants.
3. To compare the explosive strength between resistance-trained individuals and CrossFit participants.

Materials and Methods

The study was conducted on 60 male subjects, comprising 30 resistance-trained individuals and 30 CrossFit practitioners, aged between 20 and 30 years. The resistance-trained group was drawn from Total Fitness Gym, Heirangoithong, Manipur, while the CrossFit participants were selected from 7 Clan Strength and Conditioning, Nagampal, Manipur. The study focused on three key strength parameters: arm strength, abdominal strength, and explosive strength. Arm strength was measured through push-ups, abdominal strength was evaluated using the sit-up test, and explosive strength was assessed using the vertical wall jump test. Data were analyzed using an independent t-test with the aid of SPSS software, and the level of significance was set at 0.05.

Findings

The comparison of Arm Strength (Push-up test) between Resistance-Trained Individuals and CrossFit participants is depicted in Table 1.

Table 1: Comparison of Scores on Arm Strength (Push-up test) Between Resistance-Trained Individuals and CrossFit Participants

Variable	Group	N	Mean	SD	SEM	MD	SED	t-value
Arm strength	Resistance Trained Individuals	30	45.97	18.81	3.43	5.77	4.24	1.36
	CrossFit Participants	30	40.20	13.60	2.48			

*Significance at.05 level
't'.05 (58) = 1.67

From the findings of the above table 1, the mean and standard deviation values with regard to Resistance Trained Individuals on the variable Arm Strength (Push-up test) were 45.97 and 18.81, whereas CrossFit participants were 40.20 and 13.60, respectively. After analysis of the data, the calculated 't' value was 1.36 at a 0.05 level of significance, which was less than the tabulated value of 1.67. So, it indicates that no significant difference was found between Resistance-Trained Individuals and CrossFit participants on Arm Strength.

The graphical representation of the mean comparison between Resistance Trained Individuals and CrossFit participants on Arm Strength (Push-up test) is depicted in Fig. 1.

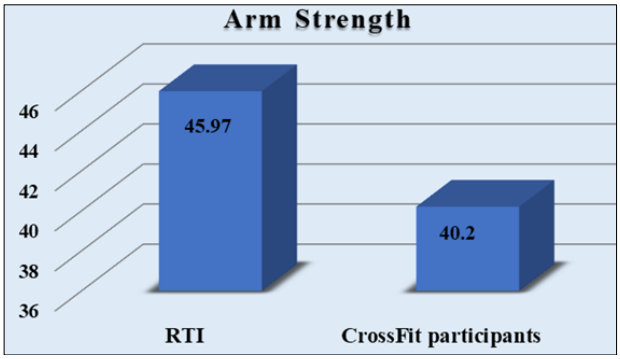

Fig 1: Mean Scores of Resistance Trained Individuals (RTI) and CrossFit Participants on the Push-Up Test for Arm Strength

The comparison of Abdominal Strength (Sit-up test) between Resistance-Trained Individuals and CrossFit participants is depicted in Table 2.

Table 2: Comparison of scores on abdominal strength (sit-up test) between resistance-trained individuals and CrossFit participants

Variable	Group	N	Mean	SD	SEM	MD	SED	t-value
Abdominal Strength	Resistance Trained Individuals	30	36.43	8.92	1.63	2.67	2.22	1.20
	CrossFit Participants	30	33.77	8.24	1.50			

*Significance at.05 level
't'.05 (58) = 1.67

From the findings of Table 2 above, the mean and standard deviation values with regard to Resistance-Trained Individuals on the variable Abdominal Strength (Sit-up test) were 36.43 and 8.92, whereas CrossFit participants were 33.77 and 8.24, respectively. After analysis of the data, the calculated 't' value was 1.2 at a 0.05 level of significance, which was less than the tabulated value of 1.67. So, it indicates that no significant difference was found between Resistance-Trained Individuals and CrossFit participants on Abdominal Strength.

The graphical representation of the mean comparison between Resistance-Trained Individuals and CrossFit participants on Abdominal Strength (Sit-up test) is depicted in Fig.2.

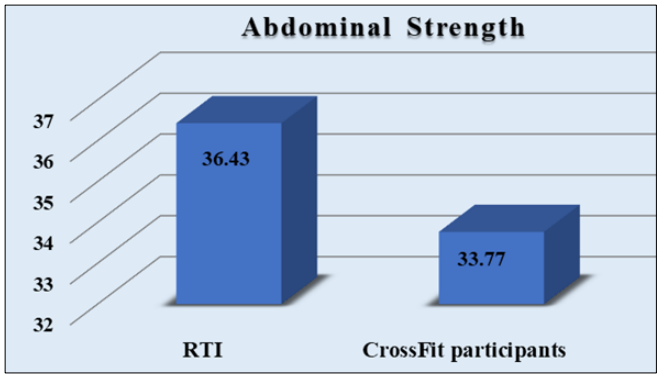

Fig 2: Mean Scores of Resistance Trained Individuals (RTI) and CrossFit Participants on the Sit-Up Test for Abdominal Strength

The comparison of Explosive Strength (Vertical Wall Jump) between Resistance Trained Individuals and CrossFit participants is depicted in Table 3.

Table 3: Comparison of scores on explosive strength (vertical wall jump) between resistance-trained individuals and CrossFit participants

Variable	Group	N	Mean	SD	SEM	MD	SED	t-value
Explosive Strength	Resistance-trained individuals	30	41.96	14.01	2.56	4.8	3.34	1.44
	CrossFit Participants	30	37.16	11.78	2.15			

*Significance at.05 level

't'$_{.05}$ (58) = 1.67

From the findings of above Table 3, the mean and standard deviation values with regard to Resistance Trained Individuals on the variable explosive strength were 41.96 and 14.01 whereas CrossFit participants were 37.16 and 11.78, respectively. After analysis of the data, the calculated 't'-value was 1.44 at a 0.05 level of significance, which was less than the tabulated value of 1.67. So, it indicates that no significant difference was found between Resistance Trained Individuals and CrossFit participants on explosive strength.

The graphical representation of the mean comparison between Resistance Trained Individuals and CrossFit participants on Explosive Strength (Vertical wall jump) is depicted in Fig.3.

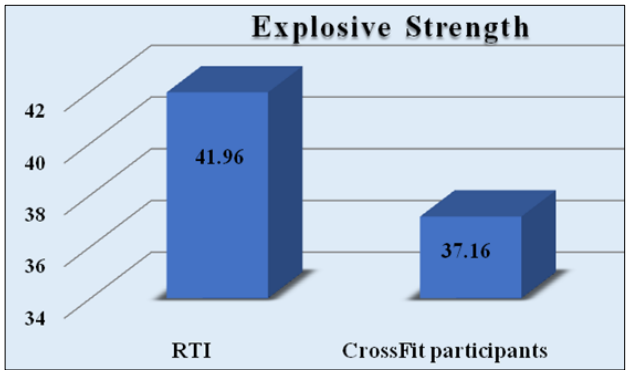

Fig 3: Mean Scores of Resistance-Trained Individuals (RTI) and CrossFit Participants on Explosive Strength (Vertical Wall Jump)

Discussion

The present study aimed to compare the levels of arm strength, abdominal strength, and explosive strength between CrossFit participants and resistance-trained individuals. Across all three strength measures, the differences in mean values were not statistically significant at the 0.05 level, indicating that both training modalities offer comparable outcomes in these domains. These results align with several prior studies that have found similar adaptations between CrossFit and resistance training when it comes to general strength development. Smith *et al.* (2013) [12] investigated physical fitness changes in moderately trained individuals and reported no significant difference in muscular endurance improvements between CrossFit and traditional resistance training programs. This suggests that both modalities may induce comparable neuromuscular adaptations over time, especially when training intensity and volumes are adequately matched. A possible explanation for

the lack of significant difference is that CrossFit incorporates resistance elements like weightlifting, kettlebell work, and bodyweight strength movements, which overlap significantly with conventional resistance training. According to Claudino *et al*. (2018) [2], CrossFit participants often perform exercises that tax both strength and aerobic systems, resulting in well-rounded physical development. In the context of the Indian population, Nataraj *et al*. (2023) [9] conducted a study comparing CrossFit and resistance training among sedentary obese collegiate boys and found no significant difference in upper body strength gains between the two groups after four weeks of intervention. Monarita & Singh (2024) [8] also concluded in their study that no significant difference was found in explosive strength (standing broad jump) between resistance-trained individuals and CrossFit participants. This supports the findings of the current study and demonstrates that in both global and Indian settings, CrossFit and resistance training can yield similar strength outcomes. Resistance training has been popular in all parts of the world including the state of Manipur for a long time. There are various training centers available for resistance training or commonly known as weight training in various parts of the state both in Rural as well as Urban areas. However, CrossFit training is still a new concept in the state of Manipur and a very few has knowledge regarding their benefits. As only few training centers are available till now even in the Urban area, the result of the study will help the players, coaches, fitness experts and the society to gain further knowledge and increase the popularity of the CrossFit programs (Monarita & Singh, 2024) [8].

Conclusion

1. No significant differences were found between Resistance-Trained Individuals and CrossFit participants on the variables of Arm Strength, abdominal strength, and explosive strength.
2. Overall, these findings suggest that both CrossFit and resistance training can be effective methods to enhance general strength and conditioning, and the choice between them may be influenced more by personal preference, training goals, or accessibility rather than a clear superiority in physical outcomes.

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