

Warm-Up Protocols and Stretching Exercises on Muscular Injury Prevention Among High School Athletes

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ABSTRACT: The study investigated the effectiveness of warm-up protocols and stretching exercises in preventing muscular injuries among high school varsity athletes. Utilizing a quantitative descriptive research design, the study aimed to provide data-driven insights into athletes' adherence to exercise techniques and their perceived impact on injury prevention. A total of 79 purposively selected student-athletes from volleyball, basketball, football, and badminton teams of Sun Valley National High School participated. The study employed a researcher-made questionnaire checklist to gather data, with statistical analysis encompassing both descriptive (mean, standard deviation) and inferential (paired samples t-test) methods. Findings revealed that athletes demonstrated high adherence to strength, cardiovascular, flexibility, and skills training routines, with skill-specific training scoring the highest. However, upper-body strength and core flexibility exercises were identified as needing further emphasis. The study also showed that warm-up and stretching exercises were considered highly effective in reducing injuries, enhancing recovery, and supporting long-term athletic development. Coaching emphasis and sport-specific adaptation were found to play a crucial role in maximizing the impact of these protocols. Significant differences were found in injury prevention outcomes based on athletes' adherence to proper techniques, with flexibility and strength exercises showing the most substantial impact. These results underscored the critical importance of proper technique and structured routines in minimizing the risk of injury. The study recommended the implementation of targeted intervention programs and training for coaches and athletes to reinforce the value of proper warm-up and stretching practices in school sports programs.

KEYWORDS: exercise adherence, high school athletes, muscular injury prevention stretching exercises, warm-up protocols

I. INTRODUCTION

Across the globe, young athletes dedicated significant time and effort to training and competitions, aspiring to achieve excellence in their chosen sports. However, with increased physical demand came the heightened risk of muscular injuries, which could disrupt performance, hinder development, and lead to long-term health issues. Preventing such injuries was a critical focus in sports science, with warm-up protocols and stretching exercises emerging as key preventive measures recognized for their role in preparing the body for physical exertion.

Stretching was an integral part of athletes' warm-up routines, particularly in sports requiring flexibility and precise, controlled movements, as it enhanced range of motion and reduced the risk of injury while optimizing performance. Per Ferri-Carwana et al. (2020), stretching was widely incorporated into athletes' warm-up routines, especially in sports that demanded a high degree of flexibility and smooth, controlled movements. By enhancing the range of motion (ROM), stretching helped prepare the muscles and joints for the demands of physical activity, reducing the risk of strains and improving overall performance. This was particularly crucial for sports like volleyball, gymnastics, and dance, where athletes needed to move efficiently and with a full range of motion.

In the context of high school sports, where athletes often lacked access to advanced training resources, the proper implementation of warm-up and stretching routines was essential. These practices were designed to enhance flexibility, improve muscle performance, and reduce injury risks. Despite their proven benefits, the extent of adherence to these routines and their actual impact on injury prevention among high school athletes remained underexplored.

The effectiveness of warm-ups in sports injury prevention remained uncertain due to inconclusive empirical evidence. In fact, McCrary, Ackermann, and Halaki (2015, as cited in Behm et al., 2023) stated that although many athletes and coaches advocated that warming up was crucial for preventing injuries, empirical evidence supporting this belief was lacking. While warm-ups were commonly practiced with the intention of reducing injury risk, scientific studies had not consistently demonstrated a direct link between warm-up routines and a measurable decrease in injury rates. This gap in data suggested that more rigorous research

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was needed to establish the effectiveness of warm-ups in injury prevention, challenging the assumption that they universally protected against injuries across all sports and activities.

To maximize athletic performance, especially for teenagers, effective physical conditioning was essential since it equipped them to handle the physical demands of their sport. Just as Karuc et al. (2020) stated, adolescents' physical conditioning significantly impacted their sports performance, requiring preparation tailored to the specific demands of each sport. For example, basketball and volleyball involved rapid, explosive movements, jumping, and agility, so conditioning for young athletes should include exercises that built strength, endurance, and flexibility targeted for these actions. Additionally, Mizoguchi et al. (2020) shared that integrating educational guidance and pre-competition physical preparation could support young athletes in performing optimally while reducing injury risk. Such guidance might include sport-specific warm-ups, techniques for safe movement, and knowledge on injury prevention, all of which were crucial for sustained performance improvement. Consequently, Marinho and das Virgens Chagas (2022) stated that physical education programs that were structured around these sport-specific needs played a critical role in equipping young athletes with the foundational skills, knowledge, and physical conditioning they needed to succeed and remain injury-free.

Therefore, this descriptive study focused on evaluating the adherence to proper exercise techniques and the effectiveness of warm-up protocols and stretching exercises in reducing muscular injury risks among high school athletes at Sun Valley National High School. By examining strength, cardiovascular, flexibility, and skills training routines, this research aimed to provide evidence-based insights to inform better training practices and propose a structured program to enhance injury prevention and athletic performance.

Over the years, the researcher had witnessed promising athletes sidelined by preventable muscular injuries, disrupting their growth not only as athletes but also as individuals striving for discipline and excellence. These experiences ignited her curiosity and concern: Is she doing enough to equip her athletes with the tools they need to stay injury-free? Could structured warm-ups, targeted stretching exercises, and complementary training methods like strength, cardiovascular, and flexibility routines be the key to minimizing injuries and maximizing their potential?

As a MAPEH teacher and volleyball coach, the researcher's professional journey had been shaped by a deep passion for sports and a commitment to nurturing the holistic development of young athletes. Her teaching and coaching had provided first-hand insights into the challenges that high school athletes faced, particularly in balancing peak performance with injury prevention.

As a coach, she experimented with various training methods, observing how they impacted performance and injury rates. However, she realized that anecdotal evidence alone was insufficient and a more rigorous, evidence-based approach was needed to truly understand what worked best for high school athletes. This realization inspired her to pursue this study, driven by a desire to provide athletes and others with a safer, more effective pathway to success on the court.

This research reflected her dual roles as a teacher and coach, blending academic knowledge with practical experience as it was rooted in her belief that sports education should not only aim for athletic excellence but also prioritize the well-being and sustainability of young athletes' physical health. Through this study, the researcher hoped to contribute to the growing body of knowledge in sports science and offer meaningful insights to coaches, teachers, and athletes alike.

The implementation of the Republic Act No. 10533, or the Enhanced Basic Education Act of 2013, provides a strong foundation for this study. It mandates the K to 12 Basic Education Curriculum, which includes Physical Education and Health (PEH) as a core learning area. This law emphasizes the holistic development of learners, not only intellectually but also physically. It promotes the integration of physical activities that reduce health risks, such as proper warm-up and stretching routines, which are essential for injury prevention among high school athletes (Violon, 2024).

In line with this, Republic Act No. 10676, also known as the Student-Athletes Protection Act, ensures the protection and welfare of student-athletes. The law supports the creation of safe training environments and highlights the need for appropriate coaching practices. This includes implementing injury prevention strategies such as warm-up protocols and stretching exercises that are vital in maintaining the physical well-being of student athletes (Department of Education, 2021).

Lastly, Republic Act No. 5708, or the Schools Physical Education and Sports Development Act of 1969, advocates for the promotion and proper management of physical education and sports programs in schools. It places emphasis on supervised physical development, which includes injury-preventive practices like warm-up and stretching. This law affirms the educational value of sports and physical training and supports the development of effective injury prevention measures within school-based athletic programs (Palad et al., 2023).

Collectively, these legal instruments provide a comprehensive legal and policy framework supporting the relevance, necessity, and implementation of the proposed study on warm-up protocols and stretching exercises for muscular injury prevention among high school athletes.

II. RESEARCH QUESTIONS

1. What is the extent of adherence to proper exercise techniques among high school athletes in terms of strength training exercises, cardiovascular training exercises, flexibility training exercises, and skills training exercises?

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2. What is the level of effectiveness of warm up protocols and stretching exercises on muscular injury prevention among high school athletes?

3. Is there a significant difference in the effectiveness of warm up protocols and stretching exercises on muscular injury prevention when grouped according to exercise techniques adherence?

III. RESEARCH METHOD

The study employed a quantitative descriptive research design which was a quantitative approach that offered a strong basis for inferences and suggestions based on facts. The respondents of the study specifically focused on 79 high school athletes from both Junior and Senior High School for the School Year 2024 - 2025 varsity teams who had a minimum of one season of training experience. This study utilized researcher-made questionnaire checklist as research instruments to gather data on the efficacy of warm-up protocols and stretching exercises in preventing muscular injuries among high school athletes.

IV. RESULTS AND DISCUSSION

Table1.1 Extent of adherence to proper exercise techniques among high school athletes in terms of strength training exercises

Proper exercise techniques	Mean	Std. Deviation	Interpretation
1. Squats	3.68	.667	To a great extent
2. Lunges	3.51	.718	To a great extent
3. Pull-Ups/Chin-Ups	3.48	.744	To a moderate extent
4. Overhead Press	3.42	.740	To a moderate extent
5. Planks	3.56	.759	To a great extent
6. Leg Raises	3.64	.619	To a great extent
Strength Exercises Total	21.29	3.205	High Adherence

Legend: 1.00-1.49 (1) Not at all, 1.50-2.49 (2) To a little extent, 2.50-3.49 (3) To a moderate extent, 3.50-4.00 (4) To a great extent; *Sub-total:* 18–24 (High Adherence), 12–17 (Moderate Adherence), 6–11 (Low Adherence), 0–5 (No Adherence)

The statistical results indicate that high school athletes exhibit a high level of adherence to proper exercise techniques in strength training exercises, with a total mean score of 21.29 (SD = 3.205). Among the specific exercises assessed, squats (M = 3.68, SD = 0.667), lunges (M = 3.51, SD = 0.718), planks (M = 3.56, SD = 0.759), and leg raises (M = 3.64, SD = 0.619) were mostly performed. Meanwhile, pull-ups/chin-ups (M = 3.48, SD = 0.744) and overhead press (M = 3.42, SD = 0.740) were adhered to at a moderate extent.

Table 1.2 Extent of adherence to proper exercise techniques among high school athletes in terms of cardiovascular training exercises

Proper exercise techniques	Mean	Std. Deviation	Interpretation
1. Box Jumps	3.58	.705	To a great extent
2. Jogging	3.76	.558	To a great extent
3. Leg/Arm Swings	3.66	.623	To a great extent
4. High Knees	3.70	.632	To a great extent
5. Sprinting	3.69	.595	To a great extent
6. Shuttle runs	3.63	.631	To a great extent
Cardiovascular Exercises Total	22.02	3.025	High Adherence

Legend: 1.00-1.49 (1) Not at all, 1.50-2.49 (2) To a little extent, 2.50-3.49 (3) To a moderate extent, 3.50-4.00 (4) To a great extent; *Sub-total:* 18–24 (High Adherence), 12–17 (Moderate Adherence), 6–11 (Low Adherence), 0–5 (No Adherence)

The results indicate a high level of adherence to proper exercise techniques in cardiovascular training exercises among high school athletes, with a total mean score of 22.02 (SD = 3.025). All assessed exercises, box jumps (M = 3.58, SD = 0.705), jogging (M = 3.76, SD = 0.558), leg/arm swings (M = 3.66, SD = 0.623), high knees (M = 3.70, SD = 0.632), sprinting (M = 3.69, SD = 0.595), and shuttle runs (M = 3.63, SD = 0.631)—were performed to a great extent.

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Table 1.3 Extent of adherence to proper exercise techniques among high school athletes in terms of flexibility training exercises

Proper exercise techniques	Mean	Std. Deviation	Interpretation
1. Hamstring Stretch	3.57	.706	To a great extent
2. Torso Twists	3.49	.785	To a moderate extent
3. Quadriceps Stretch	3.46	.751	To a moderate extent
4. Walking Lunges with Twist	3.54	.717	To a great extent
5. Butterfly Stretch	3.40	.885	To a moderate extent
6. Shoulder Stretch	3.70	.591	To a great extent
Flexibility exercises Total	21.02	3.528	High Adherence

Legend: 1.00-1.49 (1) Not at all, 1.50-2.49 (2) To a little extent, 2.50-3.49 (3) To a moderate extent, 3.50-4.00 (4) To a great extent; *Sub-total:* 18–24 (High Adherence), 12–17 (Moderate Adherence), 6–11 (Low Adherence), 0–5 (No Adherence)

The findings indicate that high school athletes exhibit a high level of adherence to proper exercise techniques in flexibility training exercises, with a total mean score of 21.02 (SD = 3.528). Among the specific exercises, the shoulder stretch (M = 3.70, SD = 0.591), hamstring stretch (M = 3.57, SD = 0.706), and walking lunges with a twist (M = 3.54, SD = 0.717) were mostly performed. Meanwhile, torso twists (M = 3.49, SD = 0.785), quadriceps stretch (M = 3.46, SD = 0.751), and butterfly stretch (M = 3.40, SD = 0.885) were adhered to at a moderate extent.

Table 1.4 Extent of adherence to proper exercise techniques among high school athletes in terms of skills training exercises

Proper exercise techniques	Mean	Std. Deviation	Interpretation
1. (Basketball) Shooting Drills , (Volleyball) Serving Practice, (Badminton) Clear and Smash Drills, (Football) Dribbling Through Cones	3.81	.478	To a great extent
2. (Basketball) Dribbling Drills, (Volleyball) Setting Drills, (Badminton) Net Play Drills, (Football) Shooting on Goal	3.68	.587	To a great extent
3. (Basketball) Passing Drills, (Volleyball) Spiking and Hitting Drills, (Badminton) Footwork Drills, (Football) Passing and Receiving	3.79	.531	To a great extent
4. (Basketball) Defensive Stance and Movement, (Volleyball) Blocking Drills, (Badminton) Defensive Lifts, (Football) Defensive Tackling	3.75	.559	To a great extent
5. (Basketball) Rebounding Drills, (Volleyball), Digging Drills, (Badminton) Drive Drills, (Football) Crossing and Finishing	3.73	.651	To a great extent
6. (Basketball) Fast Break Simulations, (Volleyball) Transition Drills, (Badminton) Serve Practice, (Football) 1v1 Attacking and Defending	3.76	.591	To a great extent
Skills Exercises Total	22.50	2.444	High Adherence

Legend: 1.00-1.49 (1) Not at all, 1.50-2.49 (2) To a little extent, 2.50-3.49 (3) To a moderate extent, 3.50-4.00 (4) To a great extent; *Sub-total:* 18–24 (High Adherence), 12–17 (Moderate Adherence), 6–11 (Low Adherence), 0–5 (No Adherence)

The results indicate that high school athletes demonstrate a high level of adherence to proper exercise techniques in skills training exercises, with a total mean score of 22.50 (SD = 2.444). All assessed skill-related exercises, including shooting drills in basketball, serving practice in volleyball, clear and smash drills in badminton, and dribbling through cones in football (M = 3.81, SD = 0.478), were mostly performed.

Table 2 Level of effectiveness of warm up protocols and stretching exercises on muscular injury prevention among high school athletes

Item-Statements	Mean	Std. Deviation	Interpretation
1. Injury Reduction – The frequency and severity of muscular injuries among athletes have decreased due to structured warm-up and stretching routines.	3.74	.599	Highly Effective
2. Performance Consistency – Athletes demonstrate stable and improved performance levels as a result of effective warm-up and stretching practices.	3.80	.499	Highly Effective

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3. Recovery Enhancement – Warm-up and stretching exercises contribute to faster muscle recovery and reduced post-activity soreness.	3.77	.529	Highly Effective
4. Coaching Emphasis – Coaches actively integrate and reinforce warm-up and stretching as essential components of injury prevention strategies.	3.77	.540	Highly Effective
5. Overall Physical Health – Athletes exhibit improved muscle flexibility, endurance, and general physical well-being due to consistent warm-up and stretching routines.	3.77	.560	Highly Effective
6. Confidence in Performance – Proper warm-up and stretching routines enhance athletes' self-assurance in their physical capabilities and movement efficiency.	3.79	.503	Highly Effective
7. Reduction in Muscle Fatigue and Cramps – Athletes experience fewer occurrences of muscle cramps, stiffness, and early fatigue during training and competition.	3.76	.555	Highly Effective
8. Long-Term Athletic Development – Regular implementation of warm-up and stretching routines supports sustained athletic growth and injury resilience.	3.76	.591	Highly Effective
9. Sport-Specific Adaptation – Warm-up and stretching routines are tailored to meet the unique physical demands of different sports and activities.	3.74	.555	Highly Effective
10. Injury Prevention Culture – The consistent practice of warm-up and stretching fosters a proactive mindset toward injury prevention among athletes, coaches, and trainers.	3.71	.618	Highly Effective
Effectiveness of Warm-Up Protocols and Stretching Exercises Total	37.61	4.615	Highly Effective

Legend: 1.00-1.49 (1) Not Effective, 1.50-2.49 (2) Slightly Effective, 2.50-3.49 (3) Moderately Effective, 3.50-4.00 (4) Highly Effective; **Sub-total:** 35–40: Highly effective, 30–34: Moderately effective, 20–29: Slightly effective, Below 20: Not effective

Statistical findings reveal that warm-up protocols and stretching exercises are highly effective in preventing muscular injuries among high school athletes, with a total mean score of 37.61 (SD = 4.615). All assessed indicators, including injury reduction (M = 3.74, SD = 0.599), performance consistency (M = 3.80, SD = 0.499), and recovery enhancement (M = 3.77, SD = 0.529), were rated as highly effective.

Furthermore, coaching emphasis (M = 3.77, SD = 0.540) and sport-specific adaptation (M = 3.74, SD = 0.555) indicate that coaches play a crucial role in reinforcing these practices, ensuring that warm-up and stretching routines are tailored to the physical demands of different sports. The high effectiveness scores for long-term athletic development (M = 3.76, SD = 0.591) and injury prevention culture (M = 3.71, SD = 0.618) further emphasize that these protocols not only provide immediate benefits but also foster a sustainable approach to athletic conditioning and injury resilience.

Table 3 Paired Samples Analysis of Exercise Technique Adherence on effectiveness of warm up protocols and stretching exercises on muscular injury prevention

Variables	Mean	Std. Deviation	Std. Error Mean	T	df	Sig. (2-tailed)	Decision	Interpretation
Strength Exercises Total	-16.325	3.915	.310	-52.744	159	.000	Reject H0	Significant
Cardiovascular Exercises Total	-15.594	3.702	.293	-53.287	159	.000	Reject H0	Significant
Flexibility exercises Total	-16.594	4.210	.333	-49.852	159	.000	Reject H0	Significant
Skills Exercises Total	-15.112	3.825	.302	-49.980	159	.000	Reject H0	Significant

Test used= Paired samples t-test, .05 level of significance, paired with effectiveness of warm up protocols and stretching exercises

Results showed a statistically significant difference between strength exercise adherence and the effectiveness of warm-up and stretching routines, $t(159) = -52.74$, $p < .001$. Similarly, adherence to cardiovascular exercises also showed a significant effect, $t(159) = -53.29$, $p < .001$. Flexibility exercise adherence was likewise found to have a statistically significant impact, $t(159) = -49.85$, $p < .001$. Lastly, a significant relationship was observed between skills exercise adherence and the effectiveness of warm-up and stretching interventions, $t(159) = -49.98$, $p < .001$.

The results of the paired samples t-test indicate a statistically significant difference in the level of effectiveness of warm-up protocols and stretching exercises based on the type of exercise performed. The negative mean values across all exercise categories—strength training (M = -16.33, SD = 3.92), cardiovascular training (M = -15.59, SD = 3.70), flexibility training (M = -16.59, SD = 4.21), and skills training (M = -15.11, SD = 3.83)—suggest that each type of exercise contributes differently to the

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overall effectiveness of injury prevention strategies. Since all p-values were below the .05 level of significance, it can be concluded that the degree of adherence to these exercises significantly impacts the effectiveness of warm-up and stretching routines in preventing muscular injuries among high school athletes.

CONCLUSIONS

The study concludes that high school athletes demonstrate strong adherence to proper exercise techniques across all training domains, indicating a high level of awareness and commitment to their training. Enhancing these areas will help ensure balanced muscular development, which is crucial for injury prevention and overall athletic performance. It also confirms that warm-up and stretching exercises are highly effective in reducing muscular injuries, improving performance consistency, and enhancing recovery. The significant role of coaching in reinforcing these protocols, as well as the long-term benefits of integrating them into training programs. This highlights the importance of structured warm-up routines in promoting both immediate and sustained athletic development. Flexibility and strength exercises appear to have a stronger impact on preventing injuries, emphasizing the importance of focusing on these areas to maximize the effectiveness of warm-up protocols. Implementing a comprehensive action plan focused on reinforcing proper warm-up and stretching routines in schools and sports organizations will likely lead to reduced muscular injury risks and improved athlete performance. By ensuring that athletes consistently adhere to effective warm-up techniques, these organizations can foster a culture of injury prevention and long-term athletic growth.

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