ENDURANCE OF MUSCLES OF LOWER BODY PARTS AND INJURY STATUS AMONG TAEKWONDO ATHLETES IN KATHMANDU VALLEY

A THESIS SUBMITTED TO

THE MASTERS PROGRAMME IN SPORTS SCIENCE, FACULTY OF HUMANITIES AND SOCIAL SCIENCES, TRIBHUVAN UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN SPORTS SCIENCE

BY

HARI BHATTARAI

ROLL NO -2842017

TU REGISTRATION NO.-5-2-37-2316-2015

KATHMANDU, NEPAL

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DECLARATION

Except where otherwise acknowledged in the text, the analysis in this thesis represents my own original research.

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Hari Bhattarai

July 2025

त्रिभुवन विश्वविद्यालय
Tribhuvan University
मानविकी तथा सामाजिकशास्त्र संकाय
Faculty of Humanities and Social Sciences
खेलकुद विज्ञान स्नातकोत्तर कार्यक्रम
Master's Programme in Sports Science

:f. No./ पत्र संख्या: Date/ मिति:

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Submitted by

Hari Bhattarai

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Endurance of muscles of lower body parts and injury status among Taekwondo athlete in Kathmandu valley

is recommended for External Examination.

Bidhan Acharya

Professor, National Open College, Senapa

Visiting Faculty, Master's Programme in Sports Science, TU

Thesis Supervisor

July 2025

कीर्तिपुर, काठमाण्डौ, नेपाल Kirtipur, Kathmandu, Nepal

त्रिभुवन विश्वविद्यालय
Tribhuvan University
मानविकी तथा सामाजिकशास्त्र संकाय
Faculty of Humanities and Social Sciences
खेलकुद विज्ञान स्नातकोत्तर कार्यक्रम
Master's Programme in Sports Science

f. No./ पत्र संख्या:

Date/ मिति:

VIVA-VOCE SHEET

We have conducted the viva-voce examination of the thesis

Submitted by

Hari Bhattarai

Entitled

Endurance of muscles of Lower body parts and injury status among Taekwondo athlete in Kathmandu Valley

and find that the thesis to be an independent work of the student written according to the prescribed format. We accept the thesis as the partial fulfillment of the requirements for Master of Arts in Sports Science.

Evaluation Committee:

Prof. Pashupati Adhikari
Coordinator,
Master's Programme in Sports Science

....

Bidhan Acharya
Professor, National Open College, Senapa
Thesis Supervisor

....

Dr. Prakash Pradhan
External Examiner
Master's Programme in Sports Science
Tribhuvan University, Kirtipur

....

July 2025

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Kathmandu, Nepal

ABSTRACT

This study investigated the relationship between Taekwondo players' lower body endurance of muscles and injury status in Kathmandu Valley. Taekwondo, as a physically demanding combat sport, involves rapid kicks, dynamic footwork, and repetitive high-impact movements, which place athletes at significant risk of lower body injuries. Therefore, this research attempted to determine the training hours, physiological and demographic factors influencing injury occurrence to ensure athlete safety and optimal performance. The objectives of this research were to assess the endurance status of lower body muscles among Taekwondo athletes, to examine the prevalence of lower body injuries, and analyze the influence of endurance training, by demographic and training-related variables on injury occurrence.

A descriptive-analytical cross-sectional research design was applied, incorporating both quantitative and qualitative approaches. The sample consisted of 166 Taekwondo athletes representing local clubs, and the clubs of Nepal Army, Nepal Police, and Nepal Armed Police Force in Kathmandu and Lalitpur districts. The participants included 114 (68.7%) males and 52 (31.3%) females**,** with the age ranged from 12 to 34 years**.** Data collection tools included a structured questionnaire assessing demographic, training and injury-related information, along with the scores of physical endurance tests such as the squat (to measure lower limb endurance in repeated squats) and the kick (to measure sport-specific muscular endurance of kicking).

Statistical analyses were employed using SPSS software. Descriptive statistics summarized sample characteristics and injury prevalence. Correlation and multiple regression analyses illustrated relationships between muscular endurance, training and injury status.

The findings revealed that 57.2 percent of the athletes experienced lower body injuries**,** with the highest injury prevalence among the 20–24 age groups (65.5%)**.** Male had slightly higher injury prevalence **(**58.8%**)** compared to female athletes **(**53.8%**).** Injuries were most commonly reported among athletes from local clubs,

highlighting a potential gap in maintaining injury prevention protocols compared to departmental clubs.

Muscular endurance test results indicated that athletes with higher squat and kick test scores depicted lower injury prevalence; however, muscular endurance alone was a weak predictor of injury occurrence ($p > 0.05$). In contrast, multiple regression analysis showed that training frequency, sex, and age were significant predictors of injury status ($p < 0.05$). Specifically, athletes having training for four or more days per week had lower injury prevalence (48.8%) compared to those having training for three or less days per week (62.2%) suggesting that regular training enhances neuromuscular adaptation and reduces injury risks. The study highlighted that only 46 percent of athletes attended any injury prevention seminar or training, which indicated a knowledge gap in injury management and prevention practices among the counterpart athletes.

The recommendations include regular endurance training (at least 4 days per week) focusing on lower limb muscular strength and sport-specific endurance was essential. There was the need for integrating injury prevention education and seminars within routine training programmes. Conduction of periodic muscular endurance assessments would benefit to monitor athlete preparedness and prevent overuse injuries. Promotion of multidisciplinary collaboration with sports physiotherapists for injury screening and rehabilitation support was recommended.

ABBREVIATION AND ACRONYMS

ACL	Anterior crucial ligament
BCS	Bramin, Chattri and Sanyashi
BFR	Blood flow restriction
BMI	Body mass index
BRFT	Blood flow restriction training
CEI	Combined endurance index
CMJ	Counter movement jump
CoP	Cemter of pressure
EMG	Electromyograph
ETT/W	Endurance training times per week
IF	Impact force
LFA	angle of the landing foot
PVGRF	Peak vertical ground reaction force
RA	Rectus abdominis
ScST	Sachmann core stability test
SD	Standard devation
SEmG	Surface electromyograph
Tc	Contraction time
TKD	Taekwondo
TMG	Tensiomyograph
VLR	vertical loading rate
VS	vertical stiffness
YBM	Y-Balance test

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CHAPTER – 1
INTRODUCTION

1.1 General background

Taekwondo is globally known as the Korean martial art game. It is characterized by its strong kicking and fluid movements. Since it requires high level of agility of the athlete, this game has earned high attention and global recognition. It is not just one of the competitive sports but as a practice that contributes to personal development and preserves the cultural heritage of the land, where from it was originated. Taekwondo was originally rooted in the traditional Korean martial arts. It has evolved to become a modern practice being done by millions of individual's worldwide in order to maintain physical perfection as well as the moral conduct. As many people argue, it is not merely a self-defense system but also a way of life in its own. Furthermore, it fosters self-control, self-respect, and self-determination. The key philosophy of Taekwondo is known as the cooperative coordination among mind, body, and spirit. It further insists practitioners or Taekwondoists to be trained very hard to acquire physical strength, mental resilience, and keep high the moral values. Techniques such as punches, kicks, blocks, and strikes are not only learned for their effectiveness in combat but also because they teach discipline and restraint to the practitioner (Moenig, 2015).

Muscular endurance is defined as the capacity of individual muscles or muscle groups to generate repeated contractions or engage in intensive effort over a much extended time without inducing extreme fatigue. This physiological activity is a fundamental aspect of physical fitness and is of particular significance in endurance sports, including distance running, cycling, and swimming, which demand prolonged muscular effort. Its importance is the enhancement of performance efficiency and the postponement of the development of muscular fatigue during extended physical activity (adapted from Burt, 2022; American Council on Exercise, 2021).

To perform repeated contractions for an extended period of time endurance work on it which is the capacity of a muscle or muscle group, it's essentially about how long a muscle can sustain a given level of effort before fatigue sets in. This endurance is crucial for various activities and sports, as it enables individuals to perform tasks repeatedly without getting overly tired. Exercises that focus on muscular endurance typically involve using lighter weights or resistance for higher repetitions, which helps to improve the muscle's capacity to work continuously over time.

Endurance of muscles of lower body parts is influenced by a variety of factors, including muscle fiber composition, neuromuscular coordination, aerobic capacity, and training adaptation. Furthermore, an athlete's level of skill and experience in Taekwondo may also impact their lower body endurance of muscles, with elite athletes often demonstrating superior endurance compared to novice practitioners. Lower body endurance is vitally important in Taekwondo, given its heavy reliance on kicks, footwork, and maintaining a strong stance. It allows practitioners to execute techniques with speed, power, and precision throughout matches or training sessions. Key components include leg stamina, crucial for executing numerous kicks, jumps, and swift directional changes without experiencing significant fatigue. Stance stability is vital for maintaining proper posture and delivering powerful kicks, while repeated kicking drills enhance muscle memory and form. Agility and quick footwork are fundamental for maneuvering around opponents, requiring endurance to sustain throughout matches. To develop lower body endurance, practitioners engage in interval training, plyometric exercises, resistance training, and cardiovascular conditioning. Regular training combined with sport-specific conditioning is crucial for achieving peak performance in Taekwondo, particularly within the Nepalese athletic context. In Taekwondo, injury status is often the result of various factors such as intense training pattern, repetitive high impact movement, and direct contact during sparring sessions. Injury status sustained in Taekwondo can vary in severity, from mild contusions and strains to serious conditions such as ligament ruptures and bone fractures, all of which can significantly impact an athlete’s performance and overall well-being. Lower limb injury status accounted for the majority of Taekwondo related injuries status, with the knee being the most commonly affected joint (Kazemi et al, 2009). Research indicates that nearly 68% of these injury statuses involve the lower limbs (Pieter et al., 2014). Injury status of lower limb among Taekwondo athletes, with muscles strains and ligaments sprain being the most common injury status (Lystad et al, 2019). Athlete with more endurance of muscles in the lower body parts less capable to overuse injury status such as tendonitis and stress fractures (lee and kim, 2020). The association between lower body muscular endurance and the incidence of lower body parts injury status in Taekwondo practitioners with high level of muscular endurance exhibited a lower risk of sustaining lower extremity injury status during training and competitions (Emery at el, 2019).

In the ever-evolving world of Taekwondo, where precision, speed, and strength are merged, the ability for endurance of the lower body musculature is integral to sport performance and injury prevention. Taekwondo practitioners rely heavily on the muscles of the lower body to execute powerful kicking techniques, agile foot movements, and quick directional shifts, all of which are essential for success in both training and competitive settings. However the rigorous demand placed on these muscles during intensive training sessions and high- stakes matches can increase the chance of injuries status, ranging from acute strains to chronic conditions. Understanding the complex relationship between muscular endurance of the lower body and injury occurrence is overriding for optimizing training protocol and safe guarding athlete well-being. Strong and more resilient lower body parts not only enhance athletic performance but also serve as protective mechanism against common injury status associated with Taekwondo practice. Deeper insights into the relationship between muscular endurance and injury status help to the development of prevention technique, performance optimization and sports science advancement.

Taekwondo emphasizes diverse kicking and hand techniques that require precise coordination. Practitioners also perform poomsae, which develop discipline and technique through patterned movements, and engage in sparring to apply skills in real combat scenarios. Core philosophical values guide personal growth alongside physical training. Endurance is essential, developed through cardiovascular conditioning, interval and aerobic training, sport-specific drills, and progressive overload. Cross-training supports overall fitness and injury prevention, while mental endurance helps athletes maintain focus and resilience during competition.

1.2 Statement of the problem

"Endurance of muscles of lower body parts and injury status among Taekwondo athletes" addresses the critical lacuna in the understanding the complex relationship between muscular endurance and injury occurrence in the context of Taekwondo. Existing research on lower body endurance of muscles in has predominantly focused on specific aspects such as strength or power, neglecting the endurance component, thus leaving a gap in knowledge poses significant risk for Taekwondo athletes. Without a clear understanding of how lower body endurance of muscles affect injury status on Taekwondo athletes, it is challenging to optimize training protocols to address specific endurance needs of athletes to address injury status prevention. There is a lack of recognizing regarding the specific muscle groups and movement patterns associated with injury occurrence which hampers the development of targeted injury prevention strategies. Insufficient knowledge about lower body endurance of muscles among Taekwondo players may contribute to increased injury risks, as fatigue-prone muscles are more susceptible to injuries status, highlighting the need for targeted injury prevention technique. To address this research gap, it is crucial to investigate the distinctions relationship between muscular endurance, injury occurrence, and performance outcomes in Taekwondo. Athletes comprehensively such endeavors will not only advance sport science knowledge but also informs the development of evidence based training protocols fitted to the unique demands of Taekwondo practice and competition.

1.3 Objectives of the study

The general objective of the study is to assess the endurance of muscles of lower body parts and injury status among Taekwondo athletes; however, following are the specific objectives of the study.

- To explore the relationship between muscular endurance level and occurrence of injury status among Taekwondo athletes.
- To identify potential risk factors and protective factors associated with injury prevention.
- To assess the impact of training protocols on muscular endurance and injury rates among Taekwondo athletes.

1.4 Significance of the study

This study has significance related to various human resources and institutions. It enables targeted strategies to minimize the risk of injury status of lower body muscles during training and competition among Taekwondo athletes. Additionally, the study findings inform the coaches and trainers to focus more on endurance training into the Taekwondo programmes. Moreover, this study contributes in adding the empirical evidence in order to minimize the risk for injury status in lower body muscle while undergoing the training for endurance. Subsequently, it may help to guide future research in martial art physiology. Furthermore, it also helps to enhance athlete's on-mat performance. The findings may also be appraised by the governing bodies related to the sports in order to enhance safe training practices and protecting Taekwondo athlete's well-being.

1.5 Limitations of the study

This study has several potential limitations that should be acknowledged. Firstly, the research was confined to Taekwondo athletes residing within the Kathmandu Valley, which limits the generalizability of the findings to athletes in other regions or contexts. Secondly, the inclusion criteria were restricted to athletes who had been actively participating in Taekwondo for at least two years and trained at least three times per week. This criterion may have excluded potentially valuable insights from less experienced or irregularly active athletes.

Additionally, the use of standardized tests to assess endurance of muscles and injury incidence may not fully capture individual differences in physical performance or subjective experiences related to endurance and injury. Other important variables, such as environmental conditions and nutritional status, were not controlled in this study, and these factors might have influenced muscular endurance outcomes and confounded the results.

Furthermore, as the study focused exclusively on Taekwondo athletes, the findings may be specific to this sport and may not be applicable to athletes engaged in other sports with different training protocols and competition formats. Finally, the reliance on self-reported data for training history and injury occurrences introduces the possibility of recall bias and reporting errors, which could affect the validity and reliability of the study's results.

1.6 Organization of the study

This thesis is organized into several chapters to systematically present the research process and findings. Chapter 1 introduces the study by outlining the general background, problem statement, research objectives, significance, delimitations, and definitions of key terms. Similarly, chapter 2 presents a comprehensive review of the literature relevant to the study, including both theoretical and empirical perspectives, followed by the identification of research variables, development of the conceptual framework, and formulation of hypotheses.

Additionally, chapter 3 describes the research methodology, detailing the research design, population, sample size and sampling techniques, instrumentation and its validation, data collection procedures, data analysis plan, and ethical considerations. Furthermore, chapter 4 provides descriptive information about the respondents, highlighting their socio-economic and demographic characteristics and chapter 5 presents the principal findings of the study based on the collected data, while chapter 6 reports the results of statistical analyses such as correlation and regression.

Finally, chapter 7 summarizes the key findings, draws conclusions based on the analysis, and offers recommendations derived from the research results. The thesis concludes with a list of references consulted during the course of the study.

CHAPTER - 2
LITERATURE REVIEW

The review of related literature in this study encompasses a wide range of sources, including academic journals, books, conference proceedings, online databases, and scholar unpublished research to provide a comprehensive understanding of the endurance of muscles of lower body parts and injury status among Taekwondo athletes. Moreover this section synthesizes existing research and scholarly discourse on relevant topics, such as Taekwondo physiology, training methodologies, biomechanics, psychological factors, and sociocultural influences. By critically analyzing and synthesizing the findings of previous studies, this review aims to identify gaps in the literature and inform the research objectives and methodology of the present study.

By synthesizing the findings of previous research in these areas, this review identifies gaps in the literature and highlights areas for further investigation. It provides a theoretical and empirical foundation for the present study, informing its research questions, hypotheses, and methodology.

Additionally, by critically evaluating the strengths and limitations of existing studies, this review contributes to the advancement of knowledge in the field of Taekwondo sports science.

2.1 Review of the theoretical literature

The theoretical literature review in this study explores various theoretical frameworks, laws, social values, and norms relevant to understanding endurance of muscles of lower body parts and injury status among Taekwondo athletes. This section aims to provide a comprehensive overview of existing theories and concepts that inform the research objectives and help contextualize the study within the broader theoretical landscape.

Hans Selye's General adaptation syndrome (GAS)

According to stress and the general adaptation syndrome theory the body undergoes three stages of physiological adaptation. The adaptations are alarm, resistance, and exhaustion in response to stressors such as exercise. In the context of Taekwondo, regular training acts as a stressor that induces physiological adaptations in lower body muscles, leading to improved endurance over time (Selye, 1950).

Biomechanical analysis of kicking techniques in taekwondo implications for muscular endurance and injury prevention

This theoretical literature investigates the biomechanical aspects of kicking techniques in Taekwondo and their implications for muscular endurance development and injury prevention. By analyzing the forces exerted on lower body joints and muscles during various kicking movements, the authors elucidate the biomechanical principles underlying effective technique execution and injury risk mitigation. The study provides insights into optimal muscle activation patterns, joint angles, and movement strategies that enhance both performance and injury resilience in Taekwondo athletes.

Enoka's Principles of neuro-mechanics Enoka, R. M. (2008).

Enoka's neuro-mechanics principles elucidate the mechanical and neural mechanisms underlying human movement. In Taekwondo, principles such as leverage, momentum, and center of mass play a crucial role in optimizing kicking techniques and conserving energy during movements. By applying these biomechanical principles, athletes can improve the efficiency of their movements and enhance endurance.

Muscle endurance and physical sports performance

Muscular endurance refers to the ability of a muscle or muscles to contract repeatedly or sustain a contraction over a prolonged period. It is a key component of physical sports performance, particularly for sports involving sustained physical effort and repetitive action, i.e., Taekwondo (Powers & Howley, 2018). Lower body muscular endurance is specifically important in Taekwondo due to frequent execution of kicks, stances, and footwork that repeatedly stress the hips, legs, and abdominal musculature. Studies have shown that more muscle-fit players demonstrate enhanced balance, agility, and technical performance consistency (Bompa & Haff, 2009).

Taekwondo and the function of lower body musculature

Taekwondo particularly emphasizes lower body strength and control since most of the attacking and defending motions rely on powerful and precise kicking. Repetitive movement of kicking and dynamic shifts in direction necessitates hard endurance in quadriceps, hamstrings, gluteus, and calves (Bridge et al., 2013). Lack of endurance in these muscle groups can lead to early fatigue, technique degradation, and response time degradation, all of which increase the risk of injury during practice and competition.

Fatigue and injury risk

There is a broadly accepted theoretical rationale for the link between muscular fatigue and the risk of elevated injury among sporting populations. As lower body muscles fatigue, their ability to stabilize joints, especially the knee and ankle, is diminished, leading to compromised biomechanics and excessive stress on ligaments and tendons (Gabbett, 2016). It is a primary issue in taekwondo due to the twisting moments and impact landings that come with jumping and spinning kicks. As fatigue becomes established, it is usual for compensatory movement to happen, which can load soft tissues and be responsible for common injury status such as muscle strains, ligament sprains, and overuse injury status (Zazulak et al., 2005).

Taekwondo injury patterns

Theoretical models of sports injury causation, such as Bahr and Krosshaug's (2005) multifactorial model, assume that intrinsic factors (e.g., endurance of muscles, biomechanics, previous injury) and extrinsic factors (e.g., training load, competition intensity) interact in order to influence injury risk. In taekwondo, studies have identified the lower limbs as the most commonly injured site, with knee, ankle, and hamstring strains being the most prevalent among beginners and elite athletes alike (Kazemi et al., 2009). This also supports the need for examining muscular endurance as a modifiable risk factor.

The significance of injury prevention and conditioning

Theoretical frameworks of sports science favor proactive prevention of injury measures, with emphasis on specifically targeted conditioning programs. Based on periodization theory, sport-specific endurance accumulated through progressive training can enhance muscle function as well as reduce vulnerability to injury (Bompa

& Buzzichelli, 2018). In taekwondo, this can be done by incorporating lower-body endurance drills, neuromuscular training, and skills in the management of fatigue such that athletes can perform at optimal levels with minimal risk of injury.

Nutritional considerations for enhancing muscular endurance and injury recovery in taekwondo athletes

This theoretical literature explores the role of nutrition in supporting muscular endurance development and injury recovery in taekwondo athletes. By examining the macronutrient and micronutrient requirements, as well as specific dietary strategies, the study provides insights into optimizing energy production, muscle repair, and immune function during intense training periods and rehabilitation phases. The authors discuss nutritional considerations for reducing inflammation, enhancing tissue repair, and promoting overall recovery, thereby minimizing the risk of overuse injury status and supporting long-term athletic performance in taekwondo.

Bandura's social cognitive theory (1986)

According to Bandura's Social Cognitive Theory emphasizes the role of cognitive processes, such as motivation and self-efficacy, in shaping behavior. In taekwondo, athletes with high self-efficacy beliefs perceive greater control over their performance and are more resilient to fatigue. Motivated athletes are also more likely to sustain effort and push through physical challenges during training and competition.

Bourdieu's cultural capital theory (1986)

Bourdieu's Cultural Capital Theory posits that cultural values, norms, and practices shape individuals' behaviors and social outcomes. In taekwondo, cultural values emphasizing discipline, respect, and perseverance influence athletes' attitudes towards training and competition. Athletes who internalize these cultural values are more likely to demonstrate commitment to training and endure physical exertion.

Summary of the theories

The theoretical framework of the present study integrates concepts from physiology, biomechanics, psychology, and sociocultural theory to explore the determinants of endurance of muscles and injury risk among Taekwondo athletes.

Hans Selye's General Adaptation Syndrome (GAS) provides a foundational physiological model for understanding the body's response to repeated stress, such as intense athletic training. According to this theory, the body progresses through three stages alarm, resistance, and exhaustion allowing for physiological adaptations that can enhance lower body muscular endurance over time when training is appropriately structured (Selye, 1950).

Complementing this, biomechanical analyses of taekwondo kicking techniques highlight how specific movement patterns influence muscle activation, joint loading, and endurance development. Poor technique or repetitive strain may lead to overuse injuries status, especially in the lower extremities. Enoka's Principles of Neuro-mechanics further elucidate how neural control and mechanical forces such as leverage and momentum optimize movement efficiency. These principles explain how energy conservation and sustained performance can be achieved through refined and repeated kicking actions (Enoka, 2008).

From a physiological perspective, muscular endurance is essential for maintaining repeated, high-intensity actions characteristic of taekwondo, particularly those involving rapid kicking and directional changes. Research indicates that well-trained lower body musculature contributes to improved balance, agility, and injury prevention (Powers & Howley, 2018; Bompa & Haff, 2009; Bridge et al., 2013). Conversely, muscular fatigue can impair joint stability, alter biomechanics, and elevate the risk of soft tissue injuries status, especially during complex movements such as spinning or jumping kicks (Gabbett, 2016; Zazulak et al., 2005).

Bahr and Krosshaug's multifactorial injury model offers a comprehensive approach to injury risk, incorporating both intrinsic factors (e.g., muscular endurance, prior injury history) and extrinsic factors (e.g., training volume and intensity). Empirical studies applying this model to Taekwondo indicate that the lower limbs particularly the knees and ankles are the most commonly affected areas (Kazemi et al., 2009).

Injury prevention strategies are guided by periodization theory, which advocates for structured, progressive, and sport-specific endurance training to optimize performance and minimize injury occurrence (Bompa & Buzzichelli, 2018). Nutritional science also contributes to this framework, emphasizing the role of well-balanced diets rich in essential macro- and micronutrients to support muscular recovery, reduce inflammation, and sustain endurance during peak training and recovery phases.

From a psychological standpoint, Bandura's Social Cognitive Theory is relevant in understanding how psychological constructs such as self-efficacy, motivation, and goal-setting contribute to sustained physical effort and resilience against fatigue (Bandura, 1986). Finally, Bourdieu's Theory of Cultural Capital provides a sociocultural lens, suggesting that the internalized values embedded within Taekwondo such as discipline, perseverance, and respect shape athletes' attitudes, compliance with training routines, and overall endurance capacity.

2.2 Review of the empirical literature

Muscular Endurance Profile of Lower Body in Elite Taekwondo Athletes

This empirical study aimed to assess the muscular endurance profile of lower body muscles in elite Taekwondo athletes. Using electromyography (EMG) and fatigue protocols, the researchers evaluated endurance of muscles in key lower body muscles involved in Taekwondo techniques. Findings revealed specific muscle activation patterns and fatigue characteristics, providing insights into training strategies for enhancing muscular endurance and preventing overuse injuries status.

Jeon & Park (2022) compared Taekwondo athletes with and without lower-limb injury history during jump kicks. The study examined variables such as impact force (IF), peak vertical ground reaction force (PVGRF), vertical loading rate (VLR), vertical stiffness (VS), and the angle of the landing foot (LFA). Injured athletes exhibited greater bilateral asymmetry in ankle plantar flexors and hip abductor/adductor strength ($p < 0.05$). A wider LFA ($\geq 90°$) was associated with 8-24 percent lower IF, PVGRF, VLR, and VS suggesting a simple landing adjustment can reduce injury risk.

Jung et al. (2024) assessed the hamstring-to-quadriceps (H/Q) strength ratio in youth Taekwondo players using isokinetic tests. Dominant legs showed significantly higher H/Q ratios at 240°/s in both conventional and functional measures. This neuromuscular imbalance could elevate the risk for non-contact injury status such as hamstring strains or ACL tears.

Santos et al. (2024) investigated anaerobic endurance using a multi-set kick test and found that lower-limb muscle mass positively correlated with performance ($r \approx 0.56$), while higher fat mass and BMI correlated negatively with endurance decrement. Another scholarly work by Lee et al. (2020) showed that experimentally induced lower-body muscle fatigue led to declines in proprioception, agility, and speed among Taekwondo athletes. Similarly, Mirjani, Seidi, and Minoonejad (2017) investigated the effects of functional fatigue on the electromyographic (EMG) activation patterns of selected lumbo-pelvic and peroneal muscles in elite female Taekwondo athletes. Using a single-leg jump-landing task before and after a fatigue protocol, they found that post-fatigue, there was a statistically significant earlier onset of activation in the quadratus lumborum, gluteus medius, and peroneus longus muscles ($p \leq 0.0005$), while the erector spinae showed a non-significant trend toward earlier activation. Interestingly, although the order of activation remained consistent, the central nervous system appeared to adapt to fatigue by recruiting stabilizing muscles more quickly, indicating a potential protective mechanism against injury. These findings underscore the importance of neuromuscular adaptations as a marker of endurance of muscles capacity and highlight the relevance of incorporating fatigue-specific training into injury prevention protocols for elite Taekwondo athletes.

In a study conducted by Li, Gao, Liu, and Wang (2024), six elite male Taekwondo athletes participated in a four-week circuit-style strength training regimen that incorporated blood flow restriction (BFR) techniques. The intervention yielded significant improvements in lower-limb muscular endurance and explosive performance, as measured through countermovement jump (CMJ) height, isokinetic knee strength, and effective kicking output. Tensiomyography (TMG) records of quadriceps and hamstring muscles identified briefer contraction times (Tc) and reduced muscle belly displacement, demonstrating increased muscle stiffness and a fast-twitch (Type II) fiber recruitment shift. These adaptations are suggestive of enhanced neuromuscular responsiveness and endurance. Additionally, there was no significant asymmetry following intervention, indicating that BFR training did not negatively affect bilateral balance. Although TMG parameters were not directly predictive of kick force or frequency, they were strongly correlated with jump performance measures. The findings demonstrate the potential of BFR circuit training for optimizing lower-limb endurance and explosive qualities in Taekwondo without muscle imbalance-related heightened injury risk.

Kalantarian, Samadi, and Beyranvand (2024) conducted a study on young male Taekwondo athletes aged 15 to 18, aiming to explore the effects of functional fatigue on lower-body performance and landing mechanics. The study employed a combination of agility and power tests including side-jump, figure-8 hop, and single-leg triple hop alongside biomechanical analysis of jump-landing techniques. Results indicated that fatigue had a statistically significant negative impact on lower-limb functionality and coordination ($p < 0.05$). Following fatigue induction, participants demonstrated shorter hop distances and higher landing error scores, reflecting a decline in neuromuscular control and endurance. The researchers concluded that fatigue reduces not only muscular strength and agility but also biomechanical precision, thereby elevating the likelihood of lower-extremity injury status during explosive movements such as kicking and landing. These findings emphasize the necessity of targeted endurance training and fatigue management interventions to reduce injury risks among adolescent athletes engaged in high-intensity sports like Taekwondo.

In a randomized controlled trial spanning eight weeks, Xiao and He (2024) examined the comparative effects of blood-flow restriction training (BFRT) and conventional resistance training on a sample of 20 Taekwondo athletes. The findings revealed that participants who underwent BFRT experienced significantly greater gains in lower-limb muscle girth and demonstrated enhanced explosive kicking abilities specifically, higher repetition performance in double chop and high turning kicks compared to those engaged in traditional resistance exercises. These outcomes suggest that BFRT may serve as a more effective training method for improving both muscular endurance and explosive power in Taekwondo practitioners.

Choi et al. (2022) and Kalantarian et al. (2024) demonstrated that fatigue significantly interferes with proprioceptive ability and landing kinematics among Taekwondo players. These interferences compromise neuromuscular control and joint stability, hence predisposing youth and elite-level players to injury status of the lower limbs.

Lee et al. (2024) and the Journal of Musculoskeletal Health (JOMH, 2023) provide biomechanical evidence that increased spinal and core muscular endurance positively influences limb performance in athletes. Its influence on balance, however, remains incongruent in the current body of literature.

Sun, Wang, and Dong (2023) used surface electromyography (sEMG) and movement capture to investigate muscle activation patterns within lower limbs during successful ("hit") and failed ("miss") roundhouse kicks in top Taekwondo athletes. Their finding suggested that, while no significant differences were found in the initiation and striking phases, retraction phase showed considerable variation of activation timing in larger muscles like the rectus femoris, peroneus longus, biceps femoris, semitendinosus, and tibialis anterior. The earlier activation of the tibialis anterior was significantly related to effective kicks, suggesting that muscular endurance and precise neuromuscular timing were essential for the application of effectively technical methods.

A six-week agility training intervention in Indian Taekwondo athletes demonstrated considerable improvements in isometric strength of leg and notably reduced fatigue index than in a control group ($p < 0.05$). The findings reflect that there exists a positive effect of agility-conditioning on lower limb muscular endurance and fatigue resistance, which are very crucial for sustained performance in fighting sports such as Taekwondo (Link.springer.com, 2024).

Biomechanical asymmetries have been closely linked to injury occurrence in Taekwondo athletes, especially in high-impact movements such as jumping kicks. A comparative biomechanical study between injured and non-injured athletes revealed that injured athletes presented significantly greater bilateral asymmetries in ankle plantar flexor and hip abductor/adductor strength ($p < 0.05$). Additionally, increased landing foot angle was inversely associated with impact force absorption, with poor neuromuscular control being a risk factor (PMC, 2023; ResearchGate, 2023). The findings highlight the necessity to address mechanical imbalances and landing technique in order to reduce lower-limb injury risk.

In addition to this, a Korean experimental trial involving 28 Taekwondo players investigated the effect of muscle fatigue on proprioception and neuromuscular coordination. After fatigue, players experienced significant reductions in knee joint-position sense accuracy and force reproduction ability ($p < 0.05$), with significant reductions in the hamstring and flexor muscles. Notably, recovery of flexor was slower, indicating high risk of injury due to delayed recovery of motor control and reduced landing accuracy under fatigued conditions (oss.jomh.org, 2024; ResearchGate, 2024; ssrh.ut.ac.ir, 2024).

Recent research highlights the intricate relationship between core stability, neuromuscular fatigue, and lower-limb muscular endurance in the context of Taekwondo performance. Electromyography (EMG) and motion capture analyses have shown that enhanced activation of core muscles particularly the rectus abdominis (RA) and erector spinae (ES) during kicking movements contributes to improved proximal stability and more effective force transmission. This underscores the role of core endurance in optimizing kicking efficiency (ResearchGate, 2023; PMC, 2023). Additionally, findings from studies utilizing the Sachmann Core Stability Test (SCST) indicate that athletes with higher core stability levels also exhibit better activation and endurance in the lower-limb muscles. These results suggest that effective trunk control not only supports performance during extended activity but may also reduce injury susceptibility (oss.jomh.org, 2023; jhse.es, 2023).

Fatigue is also a primary factor in altering functional performance. An experimental study of elite youth Taekwondo athletes (n = 13, aged 9–11 years) determined that, following fatigue, there was a significant increase in inter-limb asymmetry during triple-hop tests ($p = 0.046$), indicating asymmetric neuromuscular fatigue a risk factor for lower body injury status (jhse.es, 2023; PMC, 2023). In addition, biomechanical assessments using the Y-Balance Test (YBT) pre- and post-fatigue on amateur athletes identified significant reductions in hip and knee range of motion (ROM), dynamic balance, and joint torque ($p < 0.05$), along with increased center-of-pressure sway representing fatigue-induced compromise in balance and joint loading (MDPI, 2023).

From a proprioception point of view, a randomized controlled trial of 28 Taekwondo players showed that there was significant impairment in joint position sense and force reproduction accuracy at the knee following fatigue, with a recovery period delayed by approximately 10 minutes (JKSPM, 2023; ResearchGate, 2023). These proprioceptive impairments can compromise landing mechanics and control of kicks during fatigue, predisposing one to lower-limb injury.

Shrestha (unpublished) reported 91.2 percent injury prevalence among senior Taekwondo athletes in Kathmandu**,** with lower body injuries mostly due to kicking. The study highlighted inadequate stretching practices and significant psychological impacts post-injury, ecommending comprehensive injury prevention programs and proper recovery protocols to reduce injury risks. Chaudhary (unpublished) found that 88.1 percent of table tennis players experienced injuries, with upper limb soft tissue injuries most common, and highlighted low physiotherapy use and inadequate rehabilitation practices. The study recommended warm-ups, strength training, flexibility exercises, protective gear, and professional intervention for effective injury prevention and management.

Lastly, Sun et al. (2023) compared EMG profiles of fatigued roundhouse kicks and found no differences in integrated EMG between hits and misses ($p > 0.05$), but observed altered muscle coordination patterns highlighting the endurance demand of precision kicking under fatigue.

2.3 Variables identified

Based on literature review this study investigates the interaction between lower-limb muscular endurance, proprioception, fatigue, and risk of injury in Taekwondo athletes. The variables are categorized as follows:

2.3.1 Independent variables

They are the variables that are predicted to influence the outcomes of interest:

- Fatigue status: Split into pre-fatigue and post-fatigue conditions based on the administration of a fatigue protocol (e.g., repeated jump landing or agility exercise).
- Training type: Includes interventions such as blood flow restriction (BFR) training, traditional resistance training, or official agility programs.
- Core stability level: Assessed using standardized core endurance tests (i.e., plank test, SCST).

- Leg dominance: Dominant and non-dominant lower limbs.
- Athlete experience level: Difference between novice, intermediate, and elite-level athletes.

2.3.2 Dependent variables

These are the outcome variables measured in response to the independent variables:

- Endurance of muscles of the knee extensors: Measured by isometric or isokinetic values, such as peak torque, time to fatigue, or endurance index.
- Proprioceptive accuracy: Assessed by joint position sense (JPS) and force reproduction accuracy.
- Balance ability: Evaluated with Y-Balance Test (YBT) and center-of-pressure (CoP) sway analysis.
- Joint torque and range of motion (ROM): Observed on dynamic kicking or landing activity.
- Joint landing asymmetry: Measured by bilateral distribution of force and foot placement angles on landing.
- EMG activation patterns: Includes onset timing, muscle activation level, and fatigue-induced change in coordination.
- Injury risk markers: Assessed through screening measures and/or self-reported injury events during the intervention period.

2.3.3 Control variables

For reasons of consistency and to account for confounding effects, the following are controlled:

- Warm-up protocol: Everyone will receive a standard warm-up before testing.
- Flooring and footwear: All testing will be conducted on the same floor surface and in the same athletic footwear.
- Test time of day: All testing will be scheduled to take place at the same time frames to control for circadian effects.
- Environmental conditions: Environmental testing conditions will be controlled for temperature and lighting.

2.4 Conceptual framework

Ethnicity: Refers to the ethnic background of the Taekwondo athletes and potentially affecting cultural viewpoints regarding training and prevention of injury.

Height and weight: Basic anthropometric measures taken to discover the physical attributes of the athletes and if they bear any correlation with performance or risk of injury.

Person inspired for TKD: Identifies the individual (e.g., family member, coach) who motivated the athlete to begin Taekwondo training and illuminates social influences on sports participation.

Muscular endurance: Measures the capacity of the athletes to sustain repeated muscular effort, particularly through squats and kicks, crucial in performance measurement and resistance to injury.

Province: Geographical location of the athlete, possibly in terms of access to facilities, coaches, or training.

Associated club: The institution or club where the athlete trained, providing information about the training environment and quality.

Age: The current age of the athlete, a factor in physical development, training capacity, and vulnerability to injury.

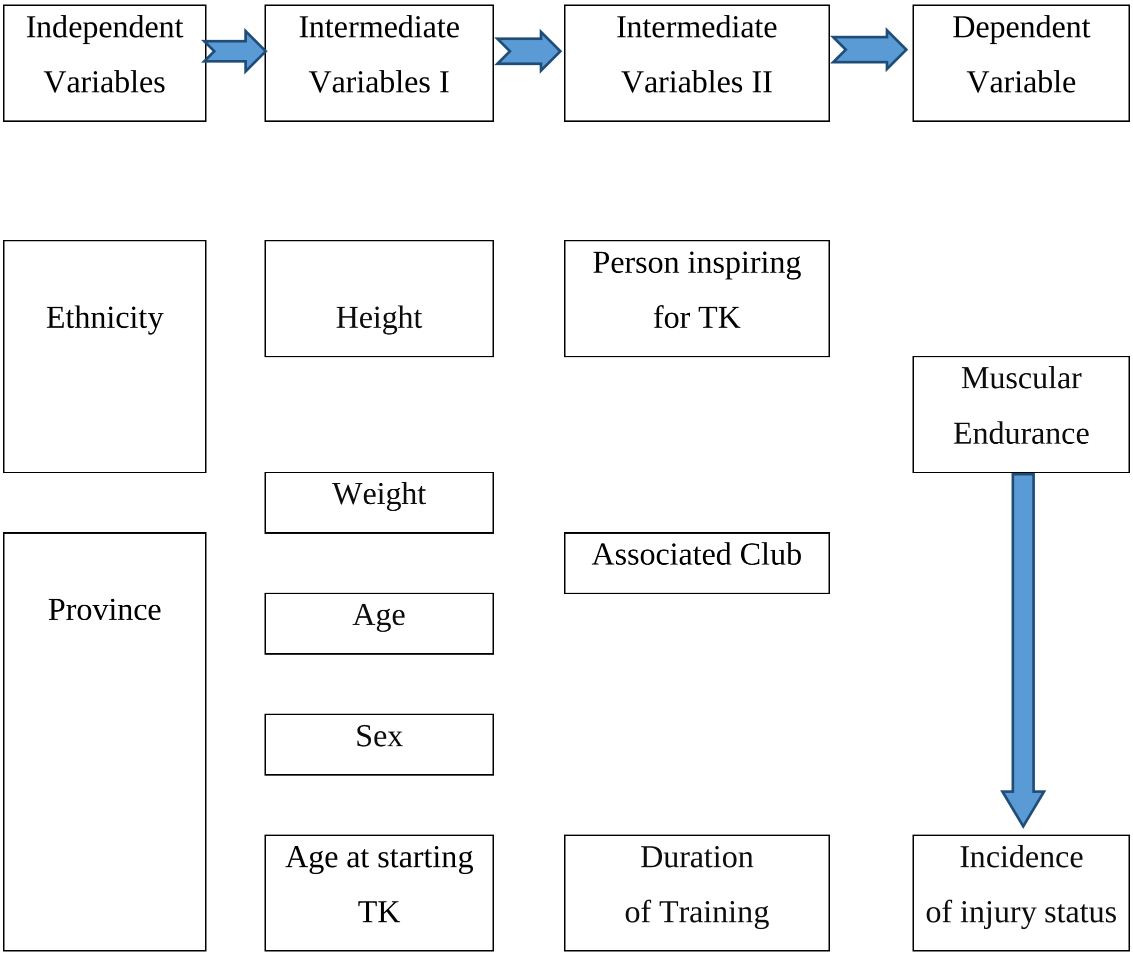
Sex: The sex of the athlete used in the application to analyzing potential differences in training responses and injury rates.

Training duration: Total number of years of Taekwondo experience, a measure of experience and exposure to physical stress.

Incidence of injuries status: Refers to frequency of injury status to the lower body, a necessary part of the research focus on safety and performance.

Age at beginning of TKD: Age when the athlete began systematic Taekwondo training, potentially impacting skill acquisition and adjustment in the long run.

Figure 1: Conceptual framework of the study



2.5 Formulation of hypotheses

On the basis of above literature survey on the injury possibility of Taekwondo athletes, and identified variables as well as conceptual framework crafted for the study following hypotheses are formulated.

- Higher the muscular endurance and lower the occurrence of injuries status,
- Higher the potential risk greater the incidence of injury,
- Higher compliance of training protocols lowers the injury rates.

CHAPTER - 3
METHODOLOGY

3.1 Research design

The research design chosen for this study is mixed methods research with cross-sectional, descriptive, and correlational. A cross-sectional approach enables data collection at a single point in time, offering a snapshot of the relationships between variables. It allows for the exploration of associations injury status among Taekwondo athletes, training interventions, duration of training, and endurance of muscles of lower body parts. The descriptive aspect of the study aims to characterize the current status of muscular endurance level across different age group, as well as the influence of training interventions and duration of training on endurance levels. Descriptive statistics were employed to organize, summarize, and present the collected data effectively. In addition, correlational analysis was conducted to examine the nature and strength of the relationships among the key variables. This analytical approach aimed to identify potential predictors of muscular endurance and their association with competitive performance outcomes. By exploring these interrelationships, the study provided meaningful insights into the factors influencing lower-body muscular endurance among Taekwondo athletes. Ultimately, the research design supported a comprehensive understanding of performance determinants within the sport, contributing to evidence-based strategies for athletic development and injury prevention.

3.2 Sample design

Sample design outlines the procedure used in order to pick participants in such a way that the sample was representative and trustworthy. Within the present study, random sampling technique was used in order to allow each eligible Taekwondo player to have an equal opportunity to be included. 166 players from various clubs and institutions from Kathmandu and Lalitpur districts were randomly picked. This approach allowed for the attainment of a representative sample based on sex, age, performance behavior, and performance level therefore, the improvement of validity and generalizability of results.

3.2.1 Population of the study

The study population consisted of those actively participating in Taekwondo training and competition. These were practitioners of various ages, sexes, and levels of proficiency that had been consistently engaged in training and Taekwondo activity for a minimum of two years. The population consisted of practitioners of Taekwondo in training centers, clubs, schools, and other organized groups. In total, the study population consisted of 280 participants with different age group and experiences in Taekwondo, offering a broad participant background and demographic within the membership of Taekwondo.

3.2.2 Selection of sample

The sample size was computed using Slovin's formula, which is appropriate when the population size is known but limited information is present regarding the population's variability. The formula appears as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where,

n= sample size

N=Total population = 280

e=margin of error (0.05)

The required sample size was determined by applying the appropriate values into the sample size calculation formula.

$$\text{Sample size(n)} = \frac{280}{1 + 280(0.05)^2} = \frac{280}{1.7} \approx 165$$

Therefore, a minimum of 165 athletes was required to ensure reliable and valid results. To increase the robustness of the study, 166 athletes were randomly selected from various Taekwondo clubs within the Kathmandu and Lalitpur districts, including clubs affiliated with Nepal Police, Nepal Army, Nepal Armed Police Force**,** as well as several local clubs**.** A random sampling technique was employed to ensure that each athlete had an equal probability of selection. This approach minimized selection bias and ensured that the sample was representative of the population, considering variables such as age, sex, training frequency, and team affiliation.

3.2.3 Inclusion and exclusion criteria

Subjects selected for participation in this research were screened according to some specific inclusion and exclusion criteria to ensure homogeneity and applicability to the purpose of the study. Individuals taking medications or drugs that have been reported to impact muscular endurance or neuromuscular performance were also excluded. Finally, subjects who failed to comply with testing and training procedures were removed from the sample population.

3.2.3.1 Inclusion criteria:

Candidates for this study were recruited based on strict inclusion criteria to confirm the validity, relevancy, and safety of the study. The candidates must be actively competing Taekwondo players aged 12 to 34 with not less than two consecutive years of unbroken training experience. Involved subjects must be presently competing at regional, national, or elite levels. To rule out any probable bias towards recovery or compromised performance, participants with a history of any acute lower-limb injury within the last three months were excluded. Excluded were also those with pre-existing medical conditions or injury status that could compromise their ability to participate safely in Taekwondo activities.

3.3 Instrumentation

A set of field-based physical tests validated to assess the muscular endurance of the lower body and its relation to injury status among Taekwondo athletes were applied. The tests were chosen due to their utility in sport-specific patterns of movement and their established use in measuring muscular endurance within sport groups.

3.3.1 Squat test

Squat Test was used to measure the endurance of muscles the major lower-body muscle groups of quadriceps, hamstrings, and gluteals each of which are vital to fundamental Taekwondo movements such as kicking and jumping. Participants were requested to perform as many full-body squats as possible over a single continuous 2-

minute interval, employing proper technique over the duration of the test. Breaks or pauses were not allowed, and any deviations from the standardized form were not counted.

A goniometer was used to assess proper knee and hip angles, verifying that each repetition contained the required amount of range of motion (typically 90° knee flexion at end range). This lent objectivity and validity to the test by minimizing observational bias. The squat test is very prevalent in athletic performance assessment and noted to be reliable and straightforward to use under field conditions (Reiman & Manske, 2009).

3.3.2 Taekwondo-specific kick endurance test

In addition to the general squat test, a Taekwondo-specific dynamic endurance test was also performed to provide an evaluation of the muscular endurance of the athletes in movement specific to sport. Athletes were required to deliver as many accurate roundhouse kicks (dollyo chagi) as possible within a time of 2 minutes onto a standard kick pad set at chest level, which was adjusted individually according to the height of the respective respondents.

Only technically valid and well-landed kicks were counted, for technical appropriateness and endurance precision. Form mistakes, missed attempts, or incomplete movement were excluded from the overall count. The test aims to measure repeated kicking patterns that are characteristic of Taekwondo competition and training, and is appropriate for assessing lower limb muscular endurance in sport-specific conditions (Bridge et al., 2014).

Together, the two tests the general and sport-specific test provided an overall measure of the subjects' lower-body muscular endurance within the analysis for its relationship with injury prevalence and training variables.

3.4 Data collection and processing

The investigation applied standardized and organized data collection and processing procedures for the measurement of lower-limb muscular endurance, fatigue, proprioception, training exposure, and injury risk among Taekwondo players. Field-based physical performance tests and a standardized questionnaire were used to collect explicit quantitative and context information.

The survey was designed to collect demographic information (sex, age, ethnicity, and team affiliation), training data (type, frequency, and duration), injury history, and exposure to injury prevention activities (e.g., doctor visits, seminars). The survey was designed from existing validated measures and tailored to the Nepalese Taekwondo athlete setting. The survey was administered individually with the researcher as supervisor to ensure clarity and completeness of response.

In addition to the questionnaire, physical tests in the form of the 2-minute squat test and 2-minute Taekwondo-specific kicking test were conducted in standardized and controlled settings. Standard instructions were provided to all participants, and warm-up sessions were prearranged before testing to prevent injury risk and ensure test validity. Proper techniques were monitored in the process, and objective measurements (e.g. Goniometer and kick pad targets) were employed to ensure the accuracy of performance measurement.

Data collected were coded, anonymized, and stored securely to safeguard the participants' confidentiality and maintain ethical standards. All participants were given special identification numbers to guarantee that no personally identifiable data is applied in data processing. The dataset was exhaustively screened for consistency and completeness before processing.

Data analysis employed IBM SPSS Statistics Version 20. Descriptive statistics were utilized to summarize participant data as well as performance measures, while inferential statistics like correlation and regression analyses were utilized to investigate correlations between endurance measures and injury occurrence. All of the analyses were carried out in strict conformity with conventional statistical practice to guarantee the strength as well as validity of findings. Following are the set of technique used before data collection process.

3.4.1 Pre-test preparation

- Provide participants with clear instructions about the testing procedures and ensure they understand the tasks involved.

- Conduct a thorough warm-up session to prepare participants' muscles for the physical demands of the tests. Warm-up activities include jogging, dynamic stretches, and mobility exercises targeting the lower body muscles.

3.4.2 Testing protocol

In order to test lower-limb endurance of muscles and functional performance of Taekwondo athletes, two significant tests were done: the squat endurance test and the roundhouse kick performance test.

3.4.3.1 Squat endurance test

The squat endurance test was employed to evaluate lower-body muscular endurance with the quadriceps, hamstrings, and gluteal. The participants performed steady-state bodyweight squats at a controlled tempo (around 2 seconds down, 2 seconds up) for up to 2 minutes. The total number of correctly executed squats with good form and depth was recorded as the overall measure.

3.4.3.2 Roundhouse kick performance test

To quantify functional muscular endurance in the sport-specific context, a 2-minute roundhouse kick was performed. The subject kicked repeatedly against a firmly fixed kick pad positioned at chest level, as modified by personal height. Only correct and meaningful kicks were counted. The quantity of valid kicks in the 2 minutes was a measure of the athlete's endurance and consistency for Taekwondo-specific movement demands.

Both tests were followed by a standardized warm-up and administered under supervision for safety and consistency.

3.4.4 Data collection

Collection of data was an integral process of the study to obtain subjective and objective data from participants of Taekwondo. Under controlled conditions to ensure validity and reliability, relevant data on demographics, training history, injury status, and muscular endurance were obtained by using a formal questionnaire and standardized physical performance tests.

3.4.4.1 Demographic and questionnaire data

Demographic information, training experience, and injury information were collected using a standard survey questionnaire. This provided required background variables to place performance and risk of injury in context.

3.4.4.2 Performance data

Objective test scores of the squat endurance and roundhouse kick tests were recorded on standard test forms. Electronic equipment was used to test timing and technical accuracy in testing.

3.4.4.3 Data entry and quality control

All the collected data were imported into Epi-Data software for efficient management. The dataset was cleaned on a daily basis and verified for quality to maintain uniformity, accuracy, and reliability for statistical analysis.

3.4.5 Post-test procedures

Following administration of all physical performance tests, participants undertook a standard cool-down session designed to optimize recovery of the muscles and minimize the risk of soreness or injury due to exercise. The cool-down intervention was made up of light aerobic exercise; slow-static stretching of the lower limb muscles, and regulated breathing to facilitate relaxation and physiological recovery. Participants were then given short performance feedback once they had finished the cool-down. Where possible, personalized feedback was provided to the areas of improvement and recommended changes to their training regimens. Post-test interaction also served to leave participants with a good appreciation of the study process and follow-up as needed.

3.5 Methods of analyses

Coding was the first stage towards the data analysis process, in which survey responses were converted into numerical or categorical codes to allow for computer analysis. This was then accompanied by data entry, in which coded responses were entered into digital format for analysis.

In order to ensure accuracy and consistency, compilation, editing, coding, and classification were done very carefully before the analysis phase. Data were arranged in frequency tables, cross-tabulations, and mean tables so as to enable detailed scrutiny.

The data entry process used Epi-Data, while IBM SPSS Statistics-20 (Version 20.0.0.0) was used in statistical analysis.

The following variables were used when constructing the Combined Endurance Index:

- Age groups, separated by sex
- Training time
- Endurance tests, (Squat test and kick test)

Interpret the findings in relation to the research objectives and hypotheses, drawing conclusions about the relationship between lower body endurance of muscles and risk of injury according to endurance level.

3.6 Consideration of ethical issues

Ethical standards were followed strictly while conducting the study to advance participants' safety, rights, and dignity. Participants were sensitized to the purpose, procedures, and risks of the study prior to data collection, and informed consent was obtained in writing. To try and keep participants' privacy and confidentiality, all personal information and performance data were kept secure and coded to prevent unauthorized release. Only the researcher and persons authorized to access the data viewed the data, and participants were assured that their identities would be anonymized in all publications and reports. The research was conducted according to institutional ethical standards.

CHAPTER – 4

BASIC CHARACTERISTICS OF RESPONDENTS

This chapter presents a brief overview of the key demographic and background details of the respondents, including their age, sex, ethnicity, height, weight, and training background.

4.1 Demographic characteristics

The demographic features of a Taekwondo competitor would normally be age, sex, weight division, and years of competition in sport. Competitors tend to start training in their teens and could compete either at junior or senior levels. Competitors of both male and female sexes compete in different weight divisions. Levels of experience would vary from amateur to expert, with competition-level competitors usually training several times a week for several years. Educational background, geographical location, and socioeconomic status can similarly influence access and involvement in training opportunities.

4.1.1 Age and sex distribution

The distribution of cases according to age group and sex observed that a large chunk of cases fell in the 15-24 age groups, 30.7 percent and 30.1 percent, respectively, while the "Up to 14" age group category has only 18.1 percent of cases, and "25 and above" has 21.1 percent. The sex distribution is highly disproportionate, with 68.7 percent were males. Among males' cases, the largest proportion, 32.5 percent, was in the age group of 20 to 24 years, while in females it was 34.6 percent in the age group of 15 to 19 years. Analysis further showed that male cases had a greater share in the relatively younger age groups, Up to 14 and 15 to 19, and also in relatively older age groups, namely 20 to 24 and 25+, where males were still predominant but relatively higher share for females is from the "25 and above" category. On the whole, data indicated a higher prevalence of cases among males in the age group of 20-24 years, while among females; the age group is 15-19 years (Table 1).

Table 1. Age Group of respondents, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Age Group	Sex					
	Female		Male		Total	
	Cases	C %	Cases	C %	Cases	C %
Up to 14	13	25.0	17	14.9	30	18.1
15 to 19	18	34.6	33	28.9	51	30.7
20 to 24	13	25.0	37	32.5	50	30.1
25 and above	8	15.4	27	23.7	35	21.1
Total	52	100.0	114	100.0	166	100.0

Source: Field Survey, 2024.

4.1.2 Height and weight by age and sex

There were height differences between males and females in different age groups, showing a clear trend. In general, the average height of males at 164.21 cm was always higher than that of females at 153.54 cm, with the biggest difference being in the age groups 15 to 19 and 20 to 24 years, where the males had average heights of 166.73 cm and 167.70 cm, respectively, against females at 153.72 cm and 157.23 cm. This trend continued in the 25 to 29 age group, with the average male being 168.65 cm, whiles the female averages 160.00 cm. In the 30 and above age group, though there was only one female data point, males once again showed a higher average height of 170.60 cm. For all age groups, males were more variable in height, as their standard deviations are higher; the height of males tends to spread wider for the younger groups. Females were generally having less variation, with the 20-24 year group having only a 3.98 cm standard deviation, indicated that female height was relatively similar (Table 2). This suggested that while there was an increase in average height for both sexes with age, men were always taller on average and the range for their heights was also greater.

Table 2. Height by age and sex of respondents, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Age Group	Sex	Mean	N	Std. Deviation
Up to 14	Female	145.77	13	7.833
	Male	143.53	17	12.099
	Total	144.50	30	10.365
15 to 19	Female	153.72	18	10.465
	Male	166.73	33	12.174
	Total	162.14	51	13.095
20 to 24	Female	157.23	13	3.982
	Male	167.70	37	7.717
	Total	164.98	50	8.316
25 to 29	Female	160.00	7	5.228
	Male	168.65	17	9.791
	Total	166.13	24	9.484
30 and above	Female	158.00	1	.
	Male	170.60	10	6.310
	Total	169.45	11	7.090
Total	Female	153.54	52	9.104
	Male	164.21	114	13.235
	Total	160.87	166	13.047

Source: Field Survey, 2024.

The average weight of men was always higher compared to women of the same age group, with the highest difference being expressed in the 25 to 29 and 30+ age groups. There were relatively small differences between males and females in the "Up to 14" and "15 to 19" age groups, with male averages of 40.88 kg and 55.82 kg, respectively, compared to female averages of 39.69 kg and 47.39 kg. However, by the time the individuals had reached the 25 to 29 age group, males weigh an average of 68.00 kg while females weigh an average of 54.57 kg. Males also tend to showed more variability in weight, as evidenced by their higher standard deviations at older ages, while females were less variable, particularly in the younger age categories (Table 3). Overall, males always weigh more than females, although the gap in weight between genders increased significantly with age, not only because there was a general increase in weight with age but also because the variation in male weight was greater.

Table 3. Weight by age and sex of respondents, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Age Group	Sex	Mean	N	Std. Deviation
Up to 14	Female	39.69	13	6.499
	Male	40.88	17	6.735
	Total	40.37	30	6.547
15 to 19	Female	47.39	18	8.971
	Male	55.82	33	11.001
	Total	52.84	51	11.017
20 to 24	Female	56.54	13	7.996
	Male	57.73	37	6.081
	Total	57.42	50	6.565
25 to 29	Female	54.57	7	6.161
	Male	68.00	17	9.240
	Total	64.08	24	10.400
30 and above	Female	55.00	1	0
	Male	69.70	10	9.405
	Total	68.36	11	9.963
Total	Female	48.87	52	9.935
	Male	57.25	114	11.987
	Total	54.62	166	12.005

Source: Field Survey, 2024.

4.1.3 Age at starting of game by sex

Both males and females started engaging in sports at similar ages, with males started at an average of 11.27 years and females at 11.21 years, females tend to start Taekwondo at younger ages across all groups. In the “Up to 14 years” group, females had begun Taekwondo at a mean age of 3.62 years, earlier than males at 4.35 years, though both started sports around the same age (females at 9.62 years, males at 9.12 years). In the “15 to 19 years” group, females started Taekwondo at 5.56 years, compared to 6.18 years for males, while both started sports nearly simultaneously (females at 10.72 years, males at 10.70 years). In the “20 to 24 years” group, females started Taekwondo at 9.23 years, earlier than males at 10.14 years, but males begin sports slightly later (11.57 years for males vs. 12.08 years for females). In the “25 to 29 years” group, both sexes begin sports around the same time (females at 13.14

years, males at 13.29 years), but males started Taekwondo later at 13.53 years compared to females at 12.14 years. In the "30 and above" group, males begin Taekwondo significantly later, at 17.00 years, compared to females at 14.00 years, though there was only one female data point (Table 4). Overall, females generally start Taekwondo at younger ages than males, while males started sports at similar or slightly later ages. Additionally, the variability in the starting age for both sports and Taekwondo were greater for males, especially in the older age groups, as indicated by the higher standard deviations.

Table 4. Starting Age of Sport and Taekwondo by age group and sex, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

		Starting Age of Sport			Starting Age of Taekwondo		
Age Group	Sex	Mean	N	SD	Mean	N	SD
Up to 14	Female	9.62	13	1.044	3.62	13	1.660
	Male	9.12	17	1.166	4.35	17	0.931
	Total	9.33	30	1.124	4.03	30	1.326
15 to 19	Female	10.72	18	1.602	5.56	18	0.856
	Male	10.70	33	2.069	6.18	33	2.172
	Total	10.71	51	1.900	5.96	51	1.833
20 to 24	Female	12.08	13	2.253	9.23	13	1.739
	Male	11.57	37	1.966	10.14	37	1.960
	Total	11.70	50	2.033	9.90	50	1.930
25 to 29	Female	13.14	7	2.545	12.14	7	2.610
	Male	13.29	17	2.823	13.53	17	2.939
	Total	13.25	24	2.691	13.13	24	2.864
30 and above	Female	16.00	1	0.000	14.00	1	0.000
	Male	12.30	10	2.263	17.00	10	5.735
	Total	12.64	11	2.420	16.73	11	5.515
Total	Female	11.21	52	2.226	7.04	52	3.453
	Male	11.27	114	2.388	9.24	114	4.605
	Total	11.25	166	2.332	8.55	166	4.388

Source: Field Survey, 2024.

4.1.4 Marital status of athlete by sex

Marital status by sex for a sample of 166 athletes depicted for females, 9.6 percent (5) were married, while 90.4 percent (47) were unmarried; for males, a larger percent was married, 15.8 percent (18), and 84.2 percent (96) were unmarried. According to the table, 13.9 percent of the total sample was married, 23 people, and 86.1 percent, 143 people were unmarried. Indeed, as shown by the data, of those that were married, more males were recorded than females, though within the trend of the sample, a higher proportion of females in the sample recorded unmarried. Overall, the sample consisted of 52 females and 114 males.

Table 5. Marital Status of athlete by sex, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Marital Status	Sex					
	Female		Male		Total	
	Cases	C %	Cases	C %	Cases	C%
Married	5	9.6	18	15.8	23	13.9
Unmarred	47	90.4	96	84.2	143	86.1
Total	52	100.0	114	100.0	166	100.0

Source: Field Survey, 2024.

4.2 Social characteristics

Taekwondo athletes are likely to be well-developed socially because of the sport's emphasis on discipline, respect, and teamwork. They would typically exhibit high self-discipline, cooperation, and respect for authority and others. The formalized training environment fosters a sense of belongingness, interpersonal communication, leadership, and mutual support. Cultural sensitivity and social responsibility are also developed in athletes, especially through international competitions and diverse training environments.

4.2.1 Ethnic distribution of respondents by sex and permanent address.

Ethnic distribution of the respondents in terms of sex and permanent residence by region of Nepal points to considerable variation in gender balance and ethnic composition. Female respondents in the Koshi zone predominantly belonged to BCS and Janajati, while male respondents were more diverse in ethnicity, i.e., BCS, Janajati, and Dalits. In Madhes, female participants were relatively heterogeneous with coverage of BCS and Janajati, whereas male respondents revealed broader diversity with coverage of Madhesi and Dalits too. Bagmati yielded the largest number of respondents in female and male groups, i.e., 31 female and 53 male. Females here belonged mostly to Janajati and BCS classes with some coverage of Madhesi and Dalits; male respondents revealed the same but broader ethnic coverage. In Gandaki, respondents were all males, mostly from Janajati and BCS. Lumbini had limited participants with female respondents from Janajati and Dalit communities and males from predominantly Janajati. Karnali had five female respondents exclusively from BCS, whereas males came from BCS, Janajati, and Dalit communities. Women participants in Sudoor Pashchim included BCS and Janajati members, while men followed an equally distributed pattern among BCS, Janajati, and Dalits. Overall, male respondents in most areas outnumbered females but also represented more ethnic diversity particularly in areas such as Madhes, Bagmati, and Sudoor Pashchim whereas female participation was more limited in number and ethnicity (Table 6).

Table 6. Distribution of respondents by province and ethnicity, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Permanent Address	Sex	Ethnicity				
		BCS	Janajati	Madhesi and others	Dalits	Total
		Cases	Cases	Cases	Cases	Cases
Koshi	Female	1	2	1	0	4
	Male	6	4	0	1	11
Madhes	Female	2	3	0	0	5
	Male	3	6	2	1	12
Bagmati	Female	11	15	2	3	31
	Male	14	29	5	5	53
Gandaki	Female	0	0	0	0	0
	Male	4	9	0	0	13
Lumbini	Female	0	1	0	1	2
	Male	1	7	0	1	9
Karnali	Female	5	0	0	0	5
	Male	3	2	0	1	6
Sudoor Pashchim	Female	3	2	0	0	5
	Male	4	3	0	3	10
Total		57	83	10	16	166

Source: Field Survey, 2024.

4.2.2 Location of questionnaire administration and testing by age and sex

The mean Combined Index scores on the basis of squat and kick performance, by service group and sex, were presented in the table. The analysis discloses stark differences in performance between gender and between institutional affiliations.

Among the female participants, highest Combined Index mean was reported by those who were from Provinces (M = 0.5378), followed by Nepal Police (M = 0.5333). The lowest mean was reported by the "Others" group (M = 0.4894). The spread of the scores was relatively moderate in women, with standard deviations ranging from 0.0658 (Nepal Army) to 0.1363 (Nepal Police).

Conversely, male participants reported higher mean scores across all service groups compared to their female counterparts. The Armed Police Force recorded the highest mean Combined Index amongst males (M = 0.6813), followed by the Nepal Police (M = 0.6340) and Nepal Army (M = 0.6310). Males in the "Others" group reported the lowest mean (M = 0.5376), with the highest standard deviation (SD = 0.1437), indicating higher variability within this group.

In combining the measures of both genders as one group, the highest mean Combined Index was once again reported for the Nepal Police (M = 0.6122), and then for the Nepal Army (M = 0.6027). The lowest mean was for the "Others" (M = 0.5215). It suggests that those participants having national security organizations were likely to do better in endurance-type activities compared to other unspecified or organizations (table 7).

Overall, the information shows a clear trend: male respondents consistently outperformed females for the Combined Index in every category of service, and membership with official security organizations (Armed Police Force, Nepal Army, and Nepal Police) appears to be linked with higher levels of performance.

Table 7. Distribution of respondents by team background sex and age, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Team Background	Sex					
	Female		Male		Total	
	Age		Age		Age	
	N	C %	N	C %	N	C %
Nepal Army	7	13.5	23	20.2	30	18.1
Nepal police	8	15.4	29	25.4	37	22.3
Armed police force	14	26.9	11	9.6	25	15.1
Province level	5	9.6	15	13.2	20	12.0
Others	18	34.6	36	31.6	54	32.5
Total	52	100.0	114	100.0	166	100.0

Source: Field Survey, 2024.

4.2.3 Injury status prevention related educational attainment by sex and age

The injury prevention-related educational attainment by sex and age group, breakdown by whether or not they received training in injury protection indicated that there were only 48 respondents who had experience of injury. For females, the youngest age group, Up to 14, has 6 subjects who had received training for injury prevention and 7 who had not, while none were unsure. The second youngest age group, 15 to 19, has females with 5 who had received training and 13 who had not. Within the 20 to 24 age group, 8 females had received training, while 5 had not. For those between 25 to 29, 2 females received the training, while 5 did not, and nobody was unsure. The oldest age category was 30 and above, where no females had received training; but 1 was unsure. In all, 21 females received training, 31 did not, and none were unsure.

In males, the distribution of training varied by age group. The Up to 14 age group had 2 males who received training, while 14 did not, and 1 was unsure. The 15 to 19 group had 11 males who received training, while 22 did not. The 20 to 24 group has the highest number of males who received training, 19, as compared to 18 who did not. In the 25 to 29 group, a reasonable number of males also received training, 12, against 5 who did not. In the 30 and above group, 4 males received training while 6 did not, and none were unsure. Altogether, 48 men have received training, 65 have not, and 1 was unsure (Table 8).

This in general shows from the table that more males have received injury prevention training compared to females. In both genders, however, a reasonable percentage of those who have not been trained were recorded especially at younger ages. The age group of 20-24 especially for males was observed to have the highest rate of injury prevention training.

Table 8. Injury status prevention related educational attainment by sex and age, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Sex	Age Group	Injury status Protecting Training			Total
		Yes Case	No Case	Don't know Case	
Female	Up to 14	6	7	0	52
	15 to 19	5	13	0	
	20 to 24	8	5	0	
	25 to 29	2	5	0	
	30 and above	0	1	0	
	Total	21	31	0	
Male	Up to 14	2	14	1	114
	15 to 19	11	22	0	
	20 to 24	19	18	0	
	25 to 29	12	5	0	
	30 and above	4	6	0	
	Total	48	65	1	

Source: Field Survey, 2024.

4.2.4 Distribution of ideal person preference by sex

The distribution of responses regarding the participants' ideal person was cross-tabulated by sex (female and male) and presented in counts and column percentages.

Among female respondents, family (38.5%) was the most frequent ideal person, followed by interest-based individuals (26.9%), such as teachers, leaders, or mentors with respect to personal goals. Sports personalities (17.3%) and friends (15.4%) followed, while others accounted for only 1.9 percent.

For male respondents, family was also the most common response (43.9%), slightly higher than for females. It was followed by interest-based individuals (23.7%) and friends (18.4%). The percentage of males selecting sports personalities (14.0%) was slightly lower than that of their female counterparts. Notably, none of the male respondents selected "others" as the ideal person.

Looking at the overall total, family members were the most prevalent ideal person across all the respondents (42.2%), an indication of the strong role of family in shaping ideals. The second was interest-based individuals (24.7%) and friends (17.5%), with sports individuals occupying 15.1 percent. The "others" category consisted of only a small proportion (0.6%) of the total (Table 9).

This diffusion shows that family and personal interests have the dominant influence on participants' images of an ideal individual, with some variation by sex. Family appears to have a slightly greater impact on men, while women have a slightly higher interest in sports figures and diverse role models.

Table 9. Distribution of Ideal Person Preference by Sex, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Ideal Person	Sex					
	Female		Male		Total	
	N	C %	N	C %	N	C %
Family	20	38.5	50	43.9	70	42.2
Friends	8	15.4	21	18.4	29	17.5
Sport Person	9	17.3	16	14.0	25	15.1
Interest	14	26.9	27	23.7	41	24.7
Others	1	1.9	0	0.0	1	0.6
Total	52	100.0	114	100.0	166	100.0

Source: Field Survey, 2024.

4.2.5 Types of doctors visited for injury by injury status

The relationship between injury status and kind of doctor visited, by whether individuals visited a doctor (Yes) or not (No), and kinds of doctors visited: Medical Doctor, Physiotherapist, and Not Stated. Among those who reported that they were injured and visited a doctor, the majority (87 persons) visited a Medical Doctor, and then 22 visited a Physiotherapist. Interestingly, each of the injured respondents in this category left the doctor type unstated, suggesting accurate reporting as well as a need for official medical attention. Of individuals who were injured but didn't visit the doctor, only one was coded "Not Stated," suggesting the possibility of healing on one's own or not reporting the visit. Among the group without injury status, few still had reported visits 3 visited Medical Doctors, but 5 did not visit to a doctor but were accounted for in the data, maybe for preventive or unrelated purposes for medical visits. Moreover, two of this group failed to report the type of doctor. Together, 95 individuals from all groups visited Medical Doctors, 22 visited Physiotherapists, and 2 did not mention the type of doctor visited (Table10). The findings indicate the high utilization of medical doctors following injury, while physiotherapists play a less but important role in injury management and recovery.

Table 10. Types of Doctors Visited for Injury by Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Injury Status	Doctor Visiting Status in Injury							
	Yes		No			Total		
	Types of Doctor		Types of Doctor			Types of Doctor		
	Medical Doctor	Physiotherapist	Medical Doctor	Physiotherapist	Not stated	Medical Doctor	Physiotherapist	Not stated
	N	N	N	N	N	N	N	N
Yes	87	22	0	0	1	87	22	1
No	3	0	5	0	1	8	0	1
Total	90	22	5	0	2	95	22	2

Source: Field Survey, 2024.

CHAPTER – 5

ENDURANCE OF MUSCLES AND INJURY STATUS IN THE LOWER BODY PART

This chapter deals with the relationships between muscular endurance and different dimensions of injury status as per the set objectives earlier.

5.1 Endurance of muscles levels and occurrence of injury status

The data revealed considerable difference in the degree of endurance of muscles, as measured by the composite index of squats and kicks, by ethnicity, injury status, and sex. Generally, both BCS and Janajati ethnic groups, especially men, possess higher endurance, while men and women from the Madhesi and Others and Dalits have low endurance. Most particularly, males were higher on the combined index than females across the majority of ethnic groups, and in the BCS and Dalits groups in particular, very large differences exist. For example, in the BCS group, males who experience injury have a mean of 0.6179, compared to a 0.5067 mean for females. In contrast, the Madhesi and Others have the worst endurance, with the mean for women (0.3967) significantly lower than the rest of the groups.

The status of injury also makes a difference in terms of endurance, as those who indicate injury status would generally have lower combined index scores compared to those with no injury, especially among Dalits and Madhesi and Others ethnic groups. The Dalits category reveals a dramatic drop in females with injury status (0.4141) relative to males (0.6662). Males tend to score higher than females for endurance for all ethnic groups and injury status. This suggests that ethnicity and injury status, and sex, control for levels of endurance of muscles, and that ethnicity and injury status appear to have a larger effect (Table 11).

Table 11. Combined Endurance Index for Males and Females by ethnicity and injury status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Ethnicity	Injury Status	Sex					
		Female		Male		Total	
		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)	
		Mean	N	Mean	N	Mean	N
BCS	Yes	0.5067	16	0.6179	20	0.5685	36
	No	0.4929	6	0.6125	15	0.5783	21
	Total	0.5029	22	0.6156	35	0.5721	57
Janajati	Yes	0.5144	16	0.5879	47	0.5692	63
	No	0.5340	7	0.5947	13	0.5734	20
	Total	0.5203	23	0.5894	60	0.5703	83
Madhesi and others	Yes	0.3967	1	0.4977	6	0.4833	7
	No	0.6056	2	0.5824	1	0.5979	3
	Total	0.5359	3	0.5098	7	0.5176	10
Dalits	Yes	0.4141	3	0.6662	9	0.6031	12
	No	0.5422	1	0.5566	3	0.5530	4
	Total	0.4461	4	0.6388	12	0.5906	16
Total	Yes	0.4993	36	0.5972	82	0.5674	118
	No	0.5280	16	0.5991	32	0.5754	48
	Total	0.5082	52	0.5977	114	0.5697	166

Source: Field Survey 2024.

CEI: combined endurance index is the product of Absolute number of Squats and Kicks

The data revealed considerable difference in the degree of endurance of muscles, as measured by the combined index of squats and kicks, by ethnicity, injury status, and sex. Generally, both BCS and Janajati ethnic groups, especially men, possess higher endurance, while men and women from the Madhesi and Others and Dalits had low endurance. Most particularly, males were higher on the combined index than females across the majority of ethnic groups, and in the BCS and Dalits groups in particular, very large differences exist. For example, in the BCS group, males who experienced injury had a mean of 0.6179, compared to a 0.5067 mean for females. In contrast, the

Madhesi and Others had the low endurance, with the mean for women (0.3967) significantly lower than the rest of the groups.

The status of injury also makes a difference in terms of endurance, as those who indicated injury status would generally had lower combined index scores compared to those with no injury, especially among Dalits and Madhesi and Others ethnic groups. The Dalits category revealed a dramatic drop in females with injury status (0.4141) relative to males (0.6662). Males tend to score higher than females for endurance for all ethnic groups and injury status (Table 12). This suggested that ethnicity and injury status, and sex, control for levels of endurance of muscles, and that ethnicity and injury status appear to have a larger effect.

The combined index in squats and kicks for players of different teams (Nepal Army, Nepal Police, Armed Police Force, Province Level, and Others) separated by injury status (Yes/No) and gender (Female/Male). A more detailed analysis captures several trends of levels of endurance among these groups. Generally, in the Nepal Army, males were higher than females across the board. For the injury cases, the combined index was 0.6258 for males and 0.5043 for females. The same performance gap was observed in the "No" injury group with males at a combined index of 0.7452 as opposed to the 0.5415 for females. The combined index for males overall in the Nepal Army was 0.6310, much higher than the 0.5096 for females. This trend signified that male soldiers in the Nepal Army indicate more endurance, with the condition of being injured having very little impact on their overall performance.

The same trend can be observed in the Nepal Police as well. Injured men indicate a mean combined index of 0.6431, whereas women indicate 0.5235. For the uninjured, the male again outscore the female, indicated 0.6242 as mean against the 0.5497 indicated by women. The overall mean combined index for male Nepal Police stands at 0.6340, whereas the female figure stands at 0.5333. Once again, males had a definite endurance edge, albeit with the gap between genders marginally less pronounced than in the Nepal Army.

The Armed Police Force statistics also showed a high level of endurance difference between the genders. Male injured personnel stand at a mean of 0.6640, much above the 0.5014 for females. The "No" injury group also followed the same pattern, with males had 0.7595 compared to 0.5739 for females. The combined mean index for males in general was 0.6813 compared to 0.5066 for females, showed that males of the Armed Police Force consistently score better than females, especially in the injury group.

The Province Level category had reduced sample, which may lower the validity of the results. Nevertheless, within the injury group, the combined index for males was 0.5796 (since there were no women in this category). Within the "No" injury group, the combined index for males was 0.5302, which was below that of 0.5378 for women, although the overall combined index for males (0.5598) was slightly higher than for women (0.5378) (Table 12).

Table 12. Combined Endurance Index for Males and Females by team background and injury status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Team Background	Injury Status	Sex					
		Female		Male		Total	
		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)	
		Mean	N	Mean	N	Mean	N
Nepal Army	Yes	0.5043	6	0.6258	22	0.5998	28
	No	0.5415	1	0.7452	1	0.6434	2
	Total	0.5096	7	0.6310	23	0.6027	30
Nepal police	Yes	0.5235	5	0.6431	15	0.6132	20
	No	0.5497	3	0.6242	14	0.6110	17
	Total	0.5333	8	0.6340	29	0.6122	37
Armed police force	Yes	0.5014	13	0.6640	9	0.5679	22
	No	0.5739	1	0.7595	2	0.6976	3
	Total	0.5066	14	0.6813	11	0.5835	25
State level	Yes	0.0	0	0.5796	9	0.5796	9
	No	0.5378	5	0.5302	6	0.5337	11
	Total	0.5378	5	0.5598	15	0.5543	20
Others	Yes	0.4845	12	0.5321	27	0.5174	39
	No	0.4991	6	0.5541	9	0.5321	15
	Total	0.4894	18	0.5376	36	0.5215	54
Total	Yes	0.4993	36	0.5972	82	0.5674	118
	No	0.5280	16	0.5991	32	0.5754	48
	Total	0.5082	52	0.5977	114	0.5697	166

Source: Field Survey 2024.

There was a positive relationship between training frequency per week and performance, as measured by a summary index of squats and kicks. All findings demonstrated that individuals training six days or more per week consistently had better results compared to those training less, regardless of injury status. To illustrate, individuals training six or more times and experienced injury still had a higher mean combined index (0.6024) than those who trained 4-5 times per week (0.4622), indicated that more training can enhance performance regardless of being injured. Second, there were sex differences in all frequencies of training and in all categories of injury, with males consistently had higher values than females. This disparity was largest in the most highly trained group, where injured males averaged an index of 0.6346 compared to 0.5232 for injured females. While status of injury was found to lower performance scores moderately within each group, its impact was typically small, particularly among those training most frequently (Table 13). These findings suggest that more frequent training was associated with improved performance gains and that male performers generally achieve higher absolute levels of performance. Injury, though a potential limiting factor, does not entirely offset the benefit of high-frequency training.

Table 13. Combined Endurance Index for Males and Females by weekly training days and injury status , Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Weekly training days	Injury Status	Sex					
		Female		Male		Total	
		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)	
		Mean	N	Mean	N	Mean	N
Up to 3	Yes	0.4268	3	0.4266	3	0.4267	6
	No	0.0	0	0.0	0	0.0	0
	Total	0.4268	3	0.4266	3	0.4267	6
4 to 5	Yes	0.4417	7	0.4718	15	0.4622	22
	No	0.4752	5	0.5223	4	0.4961	9
	Total	0.4557	12	0.4824	19	0.4721	31
6 and above	Yes	0.5232	26	0.6346	64	0.6024	90
	No	0.5520	11	0.6101	28	0.5937	39
	Total	0.5318	37	0.6271	92	0.5998	129
Total	Yes	0.4993	36	0.5972	82	0.5674	118
	No	0.5280	16	0.5991	32	0.5754	48
	Total	0.5082	52	0.5977	114	0.5697	166

Source: Field Survey 2024.

Endurance training status in relation to injury status and sex revealed several intriguing trends. Among participants who had undergone endurance training, males recorded better scores on the composite index of squats and kicks than females. Endurance-trained injured males had a mean index of 0.5985, compared to a lower mean of 0.4937 for females. Similarly, among non-injured endurance-trained subjects, males again outperformed females (0.5991 vs. 0.5351). Notably, the overall combined index mean for endurance-trained subjects was considerably higher (0.5706) than that of non-endurance-trained subjects (0.5415), suggesting a positive relationship between endurance training and performance. Despite the small sample size of non-endurance-trained subjects (n=5), the trend suggested that endurance training could lead to increased lower-body performance. Furthermore, injury status did not significantly reduce performance scores among endurance-trained subjects, particularly males. Endurance-trained injured males demonstrated nearly identical scores to their non-injured counterparts (0.5985 vs. 0.5991), indicating that endurance training might help maintain performance despite injury (Table 14). Overall, the results indicated a positive effect of endurance training on performance, especially in male athletes, and suggested that such training had the potential to mitigate performance losses associated with injury.

Table 14. Combined Endurance Index for Males and Females by weekly training days and injury status , Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

		Sex					
		Female		Male		Total	
Endurance Training Status	Injury Status	Combined Endurance Index (CEI)		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)	
		Mean	N	Mean	N	Mean	N
Yes	Yes	0.4937	34	0.5985	80	0.5672	114
	No	0.5351	15	0.5991	32	0.5787	47
	Total	0.5064	49	0.5986	112	0.5706	161
No	Yes	0.5953	2	0.5474	2	0.5713	4
	No	0.4222	1	0.0	0	0.4222	1
	Total	0.5376	3	0.5474	2	0.5415	5
Total	Yes	0.4993	36	0.5972	82	0.5674	118
	No	0.5280	16	0.5991	32	0.5754	48
	Total	0.5082	52	0.5977	114	0.5697	166

Source: Field Survey 2024.

5.2 Potential risk and protective factors of injury prevention

Sports training injury prevention is the knowledge of both risk and protective factors influencing the frequency as well as the severity of injury. Excessive training volumes without recuperation, poor technique, poor conditioning, and poor utilization of protective equipment were a few potential risk factors. Conversely, defensive elements such as adequate safety equipment use, controlled endurance training, adequate warm-up protocols, and consistent monitoring of training loads can reduce the frequency or severity of injury. Differences between sexes in patterns of injury and performance results also exist, suggesting that particular prevention measures were needed. Elucidation and management of these elements were imperative in optimizing athlete protection, maintaining performance, and promoting long-term physical activity participation.

The analysis of safety equipment use during training by injury status and gender revealed strong trends in measures of performance. Those who reported wearing safety equipment demonstrated higher overall performance, with a combined mean index of 0.5696 (n=152), compared to those who reported not wearing safety equipment (mean = 0.5724, n=10) or were unsure (mean = 0.5655, n=4). Among those using protective gear, males again outperformed females in both the injured and non-injured groups. Injured men who used protective gear had a mean score of 0.6004, whereas injured women scored lower at 0.4940. This gender difference remained consistent even among non-injured subjects using equipment (males = 0.5992; females = 0.5194). Interestingly, the group that did not wear protective gear showed slightly higher mean performance scores in both genders than the comparison group. However, this group was very small (n=10), limiting the generalizability of the finding. The "Don't know" group also had a small sample size (n=4), and its results were highly similar to those of the injured group who wore protective gear (Table 15). Overall, the evidence suggested that while the use of safety equipment was prevalent and generally associated with high performance, it had no negative impact on athletic output. Moreover, the performance advantage observed among men persisted across varying levels of safety equipment use and injury status. These findings supported the use of safety equipment as a facilitator of high performance and, at minimum, a possible means of reducing injury risk without compromising physical output.

Table 15. Combined Endurance Index for Males and Females by Safety Equipment Use During Training and injury status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

		Sex					
		Female		Male		Total	
Safety Equipment Use During Training	Injury Status	Combined Endurance Index (CEI)		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)	
		Mean	N	Mean	N	Mean	N
Yes	Yes	0.4940	33	0.6004	75	0.5679	108
	No	0.5194	14	0.5992	30	0.5738	44
	Total	0.5015	47	0.6001	105	0.5696	152
No	Yes	0.5581	3	0.5614	4	0.5599	7
	No	0.5886	2	0.6268	1	0.6013	3
	Total	0.5703	5	0.5744	5	0.5724	10
Don’t know	Yes	0.0	0	0.5645	3	0.5645	3
	No	0	0	05684	1	0.5684	1
	Total	0	0	05655	4	0.5655	4
Total	Yes	0.4993	36	05972	82	0.5674	118
	No	0.5280	16	0.5991	32	0.5754	48
	Total	0.5082	52	0.5977	114	0.5697	166

Source: Field Survey 2024.

The evidence looking at the impact of attending injury prevention seminars had a potential protective role in maintaining performance despite injury. Participants at such seminars reported a higher overall performance index (mean = 0.5971, n = 25) compared to the attenders (mean = 0.5650, n = 130). Of the injured participants, seminar attendees had a higher mean for performance (0.5981) than non-attendees (0.5629), potentially indicating that seminar attendance was linked with better management or coping with injuries status. This was most obvious among male participants, where injured attendees performed better than non-attendees (0.6201 vs. 0.5923). Although female participants also trended in this way (0.5047 vs. 0.5024), these differences were not as clear-cut, possibly due to the small sample group. For uninjured players, differences in performance between non-attendees and seminar attendees were minimal, suggesting that the benefit of such education could be more pronounced in injury cases (Table 16). Overall, these findings suggest the possible value of injury prevention seminars in limiting the negative impact of injury on performance, particularly in male players.

Table 16. Combined Endurance Index for Males and Females by Injury Prevention Knowledge by Educational Attainment and injury status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Injury Preventing Seminar	Injury Status	Sex					
		Female		Male		Total	
		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)	
		Mean	N	Mean	N	Mean	N
Yes	Yes	0.5047	4	0.6201	17	0.5981	21
	No	0.5739	1	0.5980	3	0.5920	4
	Total	0.5185	5	0.6168	20	0.5971	25
No	Yes	0.5024	31	0.5923	64	0.5629	95
	No	0.5365	11	0.5863	24	0.5707	35
	Total	0.5113	42	0.5906	88	0.5650	130
Total	Yes	0.5027	35	0.5981	81	0.5693	116
	No	0.5396	12	0.5876	27	0.5728	39
	Total	0.5121	47	0.5955	108	0.5702	155

Source: Field Survey 2024.

5.3 Training protocols, muscular endurance and injury of lower body part

The outcomes revealed a clear relationship between frequency of endurance training, muscular endurance (as a combined index of squats and kicks), and injury incidence in the lower body. Individuals who trained twice a week registered the highest overall mean performance (0.5823), particularly for injured subjects (0.5948), suggesting that higher frequency of endurance training might have been associated with improved muscular endurance along with greater injury resistance. In contrast, the group trained only once weekly had lower mean overall performance scores (0.5602), especially in the injured group (0.5399), indicating the possibility of a correlation between reduced training frequency and reduced performance. The performance disparity between non-injured and injured groups also tended larger for the group trained only once weekly, favored the possible protective benefit of increased training frequency. While there were few who did not score endurance training (n=3), their performance ratings were not significantly different, though it could not concluded from so small a sample. In both injured and uninjured groups, men performed better than women, which can be because of sex-specific physiological differences between strength and endurance (Table 17). Overall, the findings suggest that increased frequencies of endurance training were a protective factor that could possibly preserve lower body function and reduce the severity or severity of injury.

Table 17. Combined Endurance Index for Males and Females by weekly endurance training days and injury status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Weekly Endurance Training Times	Injury Status	Sex					
		Female		Male		Total	
		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)		Combined Endurance Index (CEI)	
		Mean	N	Mean	N	Mean	N
Once in a week	Yes	0.4745	20	0.5773	35	0.5399	55
	No	0.5486	8	0.6311	17	0.6047	25
	Total	0.4957	28	0.5949	52	0.5602	80
Twice in a week	Yes	0.5299	14	0.6149	45	0.5948	59
	No	0.5196	7	0.5628	15	0.5490	22
	Total	0.5265	21	0.6019	60	0.5823	81
No endurance training	Yes	0.5978	1	0.5474	2	0.5642	3
	No	0.0	0	0.0	0	0.0	0
	Total	0.5978	1	0.5474	2	0.5642	3

Source: Field Survey 2024.

5.3.1 Training frequency, duration and injuries status

There was a strong relationship between increased training frequency and the incidence of injury status in body areas. For all injury types, the most uniform proportions were among the participants who trained six or more days a week, and this would suggest that greater training frequency would be able to enhance the risk of injury through cumulative physical stress and inadequate recovery. For instance, 84.4 percent of finger injuries, 77.3 percent of back injuries, and 74.3 percent of leg injuries occurred in the most frequently training group. Even areas like the face (62.1 percent) and hands (73.8%), which are less directly involved in lower body endurance activities, also came up with similar trends. On the other hand, athletes training three or fewer times a week accounted for 5.0 percent of all injury status reported and were significantly underrepresented in lower leg (5.9%) and finger (4.4%) injuries status (Table18). This is in agreement with the hypothesis that while heavy training will enhance performance, it will also enhance the risk for overuse- or contact-type injury unless countered with adequate recovery and protection training. The results emphasize the importance of planned programming, i.e., rest days and injury prevention programs, for highly frequency-trained athletes.

Table 18. Injury Location by Weekly Training Frequency, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Area of injury	Training days – categorized							
	Up to 3		4 to 5		6 and above		Total	
	N	R %	N	R %	N	R %	N	R %
Leg	6	5.9	20	19.8	75	74.3	101	100.0
Hand	3	4.9	13	21.3	45	73.8	61	100.0
Back	3	13.6	2	9.1	17	77.3	22	100.0
Face	4	13.8	7	24.1	18	62.1	29	100.0
Fingers	2	4.4	5	11.1	38	84.4	45	100.0
Total	6	5.0	22	18.5	91	76.5	119	100.0

Source: Field Survey 2024.

The pattern of injury status by training frequency emphasizes a distinct trend: increased training frequency with a higher prevalence of injury status to all body regions. Of the total injury status accounted for (n = 119), a significant 76.5 percent took place in subjects who trained six or more days per week, whereas just 18.5 percent of injury status happened in those training 4-5 days, and merely 5.0 percent in those training fewer than 3 days per week. Specifically, lower extremity injury status were most common (n = 101), with 74.3 percent falling into the high-frequency group, consistent with the high loading on lower extremities with repeated training. Similarly, finger injury (84.4%), injury to the back (77.3%), and hand injury (73.8%) also predominantly occurred among high-frequency trainees, suggesting cumulative loading or contact mechanisms. Even face injuries status, which are normally less susceptible to overuse, were more common among the most regular trainers (62.1%) (Table 19). These findings point to be that although repetitive training is necessary for sports development, excessive frequency with inadequate recovery can risk raising very much the probability of injury. Incorporating formal days of rest, injury prevention education, and efficient periodization of training, therefore, is part of injury likelihood reduction, particularly in high-volume training conditions.

Table 19. Frequency and Proportion of Injury status by Area and Training Days, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Area of injury	Training days – categorized							
	Up to 3		4 to 5		6 and above		Total	
	N	C %	N	C %	N	C %	N	C %
Leg	6	100.0	20	90.9	75	82.4	101	84.9
Hand	3	50.0	13	59.1	45	49.5	61	51.3
Back	3	50.0	2	9.1	17	18.7	22	18.5
Face	4	66.7	7	31.8	18	19.8	29	24.4
Fingers	2	33.3	5	22.7	38	41.8	45	37.8
Total	6	100.0	22	100.0	91	100.0	119	100.0

Source: Field Survey 2024.

5.3.2 Muscular endurance and injury rates

The analysis of muscular endurance, as measured by the Combined Index of Absolute Squats and Kicks, shows considerable variation when examining sex and social groups based on injury status. Typically, male subjects measured higher muscular endurance (Mean = 0.5977) compared to female subjects (Mean = 0.5082), showing a continued sex-specific difference in performance. Among female respondents, "Madhesi and others" recorded the highest mean (0.5359), while Dalit women recorded the lowest resilience (Mean = 0.4461), showing possible variations in physical preparedness, training facility, or exposure to injury risks. In contrast, for men, Dalits had the highest mean measure of endurance (0.6388), followed by BCS (0.6156), while "Madhesi and others" men had the lowest (0.5098). Surprisingly, Janajati respondents exhibited relatively consistent rates of endurance by sex, where females had a mean rate of 0.5203 and males had a mean rate of 0.5894. On the whole sample, Dalits had the highest rate of endurance (0.5906) and "Madhesi and others" had the lowest (0.5176). Trends like these suggest that injury outcome and physical performance could be influenced by both social group and sex, perhaps due to differing socio-economic background, training exposure, or physical activity cultural practices. The variability in standard deviation is also an indication of having variable levels of consistency across groups, of which the most consistent level of performance is observed for Dalit men (SD = 0.0781) (Table 20). Overall, these findings uphold that intersectional variables i.e., gender and social identity need to be accounted for during the development of injury prevention and endurance programs

Table 20. Injury Status and Combined Index of Squats and Kicks by Sex and Ethnicity, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Combined Index in Absolute number of Squats and Kicks				
Injury Status		Mean	Number	Std. Deviation
Female	BCS	0.502925	22	0.0889839
	Janajati	0.520319	23	0.1155659
	Madhesi and others	0.535939	3	0.1365659
	Dalits	0.446102	4	0.1140531
	Total	0.508152	52	0.1046140
Male	BCS	0.615579	35	0.1298575
	Janajati	0.589394	60	0.1083699
	Madhesi and others	0.509795	7	0.0993114
	Dalits	0.638761	12	0.0781471
	Total	0.597742	114	0.1145302
Total	BCS	0.572098	57	0.1275497
	Janajati	0.570253	83	0.1140203
	Madhesi and others	0.517638	10	0.1043032
	Dalits	0.590596	16	0.1204308
	Total	0.569678	166	0.1187567

Source: Field Survey 2024.

The results showed a definite pattern of muscular endurance performance between various ages, with endurance tending to improve from adolescence through to early adulthood and peaking in the 20-24 age range. For males and females combined, the 20-24 year old age group had the highest mean Combined Index score (0.6045), followed closely by the 30 and over age group (0.6184), though the latter group had a very small sample size (n = 11), which limits the confidence in that estimate. For women, endurance increased consistently with age, from 0.4938 for the youngest age category (up to 14) to 0.5785 for the 30+ category. In all age categories, men performed better than women, with the largest difference in the 20-24 years age category, where the male mean was 0.6303 and that for women was 0.5308. This was perhaps reflective of both training experience and physiological differences that become more evident with age. Interestingly, while younger males (15-19) also fared well (Mean = 0.5998), there was a dip in performance in the 25-29 age bracket (Mean = 0.5654) before a rise in the 30+ group, which could be reflective of a shift in training patterns or accumulation of injury (Table 21). The findings suggest that muscular endurance increases with age and exposure to training to a point, but perhaps plateaus or decreases slightly in late twenties, possibly due to overtraining, injury, or life priority shifts. Trends suggest the necessity of age-specific training programs and injury risk mitigation strategies, especially for younger athletes who are still developing strength and older athletes who are attempting to preserve performance while minimizing injury risk.

Table 21. Combined Index Scores by Age Category and Sex in Relation to Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Combined Index in Absolute number of Squats and Kicks				
Injury Status		Mean	N	Std. Deviation
Female	Up to 14	0.493805	13	0.1151822
	15 to 19	0.494260	18	0.1237186
	20 to 24	0.530838	13	0.0814159
	25 to 29	0.518339	7	0.0823416
	30 and above	0.578499	1	
	Total	0.508152	52	0.1046140
Male	Up to 14	0.540619	17	0.0800681
	15 to 19	0.599800	33	0.1254978
	20 to 24	0.630327	37	0.0970939
	25 to 29	0.565431	17	0.1447585
	30 and above	0.622426	10	0.0956122
	Total	0.597742	114	0.1145302
Total	Up to 14	0.520333	30	0.0978954
	15 to 19	0.562550	51	0.1337110
	20 to 24	0.604460	50	0.1024340
	25 to 29	0.551696	24	0.1297081
	30 and above	0.618433	11	0.0916675
	Total	0.569678	166	0.1187567

Source: Field Survey 2024.

Comparisons of Combined Index scores between different organizational affiliations revealed notable differences in muscular endurance and susceptibility to injury. Males generally had higher scores than females, with particularly high endurance scores among males from the Nepal Army (Mean = 0.6310), Nepal Police (Mean = 0.6340), and especially the Armed Police Force (Mean = 0.6813). On the other hand, females from the same organizations recorded lower mean scores, with the highest being among Nepal Police females (Mean = 0.5333) and the lowest among those who were categorized as "Others" (Mean = 0.4894). Among all the groups, Armed Police Force males recorded the highest muscular endurance, suggesting a more specific or intense training program. The "Others" group also showed the least endurance in males (Mean = 0.5376) and females, which may indicate differences in access to formal physical training or support groups. With the sexes pooled, Nepal Army and Nepal Police groups had the best overall endurance (Means = 0.6027 and 0.6122 respectively), and those in the "Others" group the least (Mean = 0.5215) (Table 22). These results suggest that being a member of formal military or security organizations can be a protective influence against lowering muscular endurance and also reduce injury risk, owing to standardized physical preparedness programs. Individuals who are not within these formalized frameworks can probably benefit from more training support in order to perform better and be resilient against injury.

Table 22. Mean Combined Index from Squats and Kicks by Affiliated Service Group and Gender, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Combined Index in Absolute number of Squats and Kicks				
Total Injury Status		Mean	N	Std. Deviation
Female	Nepal Army	0.509612	7	0.0658033
	Nepal police	0.533298	8	0.1362660
	Armed police force	0.506610	14	0.1132973
	Province level	0.537754	5	0.1047309
	Others	0.489384	18	0.1016382
	Total	0.508152	52	0.1046140
Male	Nepal Army	0.630978	23	0.0702562
	Nepal police	0.633982	29	0.0756828
	Armed police force	0.681323	11	0.0887932
	Province level	0.559836	15	0.0923635
	Others	0.537571	36	0.1437020
	Total	0.597742	114	0.1145302
Total	Nepal Army	0.602660	30	0.0858267
	Nepal police	0.612212	37	0.0991525
	Armed police force	0.583484	25	0.1344349
	Province level	0.554315	20	0.0932278
	Others	0.521509	54	0.1321975
	Total	0.569678	166	0.1187567

Source: Field Survey 2024.

5.3.3 Descriptive statistics of training hours, endurance training status, and injury status across age groups

Descriptive statistics of training hours, endurance training status, and injury status were analyzed across four age groups. A moderate increase in training hours with age was observed. Participants below 14 years trained for an average of 2.03 hours, while those aged 25 and above recorded the highest average (2.20 hours). The 15–19 age groups showed the lowest average (1.92 hours). The highest variability in training hours (SD = 0.797) was also found among the oldest group.

Endurance training status remained relatively stable across age groups, with values near 1.00. A slight increase was noted in the 25 and above group (mean = 1.09), along with greater variability, indicating higher engagement or performance.

Injury status showed a decreasing trend with age. The youngest group (≤14 years) had the highest mean injury score (1.37), while the oldest group (≥25 years) had the lowest (1.14). Variability in injury outcomes also declined with age. These findings suggest increased training time and endurance consistency with age, alongside reduced injury incidence, possibly due to improved training practices and physical maturity (Table 23).

Overall, the results suggest that while training hours tend to increase with age, endurance levels remain largely uniform across age categories. Simultaneously, injury incidence appears to decrease with age, possibly as a result of improved training quality, enhanced physical maturity, and more effective injury prevention strategies employed by older athletes.

Table 23. Descriptive Statistics of Training Hours, Endurance Training Status, and Injury Status across Age Groups, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Age Group		Training hours at a time	Endurance training status	Injury Status
Up to 14	Mean	2.03	1.03	1.37
	N	30	30	30
	Std. Deviation	0.183	0.183	0.490
15 to 19	Mean	1.92	1.00	1.33
	N	51	51	51
	Std. Deviation	0.483	0.000	0.476
20 to 24	Mean	2.18	1.02	1.30
	N	50	50	50
	Std. Deviation	0.482	0.141	0.463
25 and above	Mean	2.20	1.09	1.14
	N	35	35	35
	Std. Deviation	0.797	0.284	0.355
Total	Mean	2.08	1.03	1.29
	N	166	166	166
	Std. Deviation	0.539	0.171	0.455

Source: Field Survey 2024.

5.3.4 Descriptive statistics of training for protecting from injury and injury status across age group

The table presented the mean, sample size (N), and standard deviation of two principal variables Training for Protecting from Injury and Injury Status across four different age groups.

The results indicated a clear trend in training for injury prevention across age groups. The youngest age category (14 years and below) exhibited the highest mean (mean = 1.93), suggesting greater attention to or exposure to injury prevention training in this group. The mean decreased with age, with the lowest value reported in the 20–24 years group (mean = 1.46). A slight increase was noted in the 25 years and above group (mean = 1.49), although it remained lower than that of the youngest group. The high standard deviation within the 14 years and below group (SD = 1.230) reflected considerable variation in how injury prevention training was delivered or perceived in this age category.

In terms of injury status, the data showed a declining pattern with age. The highest mean injury status was recorded in the youngest group (mean = 1.37), while the lowest was observed in the oldest group (25 years and above) (mean = 1.14). This suggested that younger participants were at greater risk of injury, potentially due to developmental factors or limited years of training experience. Similar to injury prevention training, the variability in injury status also appeared to decline with age, as indicated by decreasing standard deviation values (Table 24).

Overall, the findings revealed that younger athletes, despite receiving more injury prevention training, experienced higher injury rates. This may point to a gap between the content of training and its practical application or retention in younger individuals. In contrast, older athletes, who received less formal training, reported fewer injuries—possibly due to greater experience, improved body awareness, and more refined techniques. These results underscored the importance of developing age-specific injury prevention programs that are both effective and developmentally appropriate, particularly for youth athletes.

Table 24. Descriptive Statistics of Training for Protecting from Injury and Injury Status across Age Group, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Age Group		Training for protection of injury	Injury Status
Up to 14	Mean	1.93	1.37
	N	30	30
	Std. Deviation	1.230	.490
15 to 19	Mean	1.69	1.33
	N	51	51
	Std. Deviation	0.469	0.476
20 to 24	Mean	1.46	1.30
	N	50	50
	Std. Deviation	0.503	0.463
25 and above	Mean	1.49	1.14
	N	35	35
	Std. Deviation	0.507	0.355
Total	Mean	1.62	1.29
	N	166	166
	Std. Deviation	0.701	0.455

Source: Field Survey 2024

5.3.4 Descriptive statistics of seminar attendance in injury prevention and injury status by sex

Mean values, sample sizes (N), and standard deviations for Attainment of Injury Prevention Seminars and Injury Status were analyzed by sex.

Female participants showed a slightly higher mean attendance at injury prevention seminars (mean = 1.89) compared to male participants (mean = 1.81). Although the difference was modest, it suggested greater participation or access among females. The standard deviation was higher among males (SD = 0.390) than females (SD = 0.312), indicating more variability in seminar attendance within the male group.

In terms of injury status, both sexes displayed nearly identical mean values1.31 for females and 1.28 for males indicating comparable injury rates. The standard deviations were also similar (0.466 for females and 0.451 for males), suggesting consistent levels of variation in injury outcomes across both groups (Table 25).

Overall, while females slightly outnumbered males in attending injury prevention seminars, this did not translate into notable differences in injury status. These results may suggest that seminar attendance alone was not a determining factor in injury reduction or that both sexes equally benefited from other forms of injury prevention. Further investigation into the content, frequency, and practical implementation of such seminars may help clarify their effectiveness.

Table 25. Descriptive Statistics of Seminar Attendance in Injury Prevention and Injury Status by Sex, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Sex		Attainment of Injury Preventing Seminar	Injury Status
Female	Mean	1.89	1.31
	N	47	52
	Std. Deviation	0.312	0.466
Male	Mean	1.81	1.28
	N	108	114
	Std. Deviation	0.390	0.451
Total	Mean	1.84	1.29
	N	155	166
	Std. Deviation	0.369	0.455

Source: Field Survey 2024

CHAPTER 6
STATISTICAL ANALYSES

This chapter presents the statistical tests conducted to confirm the research hypotheses. Every test corresponds directly to the respective specific hypotheses in the study. Descriptive statistics present the key variables, followed by inferential statistics such as correlation, and regression analysis, depending on data nature and hypotheses. Results are explained against the research questions, highlighting special attention on significant relationships and trends. Wherever applicable, the tests assumptions are verified and noted. This systematic approach ensures that the results are consistent with the aims of the study and provide useful insights.

6.1 Analyses of correlation coefficients

This section presents the correlation coefficients to assess the direction and strength of relationships among key variables, as outlined in the research hypotheses. Pearson's correlation was applied based on the nature and distribution of the data. The findings help identify meaningful associations and underlying patterns relevant to the study objectives. In exclusively qualitative studies, such analysis is substituted with thematic exploration and cross-variable interpretation.

6.1.1 Combined index in absolute number of squats and kicks and injury status correlation

In an effort to study the correlation between the level of physical activity, as defined by the combined index in absolute number of squats and kicks, and injury status, Pearson correlation analysis was used. The analysis revealed a very weak positive correlation ($r = .031$) between the two variables, which was not statistically significant ($p = .694$, $N = 166$). This means that no large linear correlation exists between these physical movement volumes and injury incidence in the sampled population. Therefore, the hypothesis of the presence of a large relationship between these variables is rejected (Table26). The findings reveal that higher numbers of squats and kicks as an overall physical performance indicator are not related to elevated or reduced risk of injury in this case.

Table 26. Correlation between Combined Index of Squats and Kicks and Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Correlations		Combined Endurance Index (CEI)	Injury Status
Combined Endurance Index (CEI)	Pearson Correlation	1	0.031
	Sig. (2-tailed)		0.694
	N	166	166
Injuries Status	Pearson Correlation	0.031	1
	Sig. (2-tailed)	0.694	
	N	166	166

Source: Field Survey 2024

6.1.2 Partial correlation between combined index in absolute number of squats and kicks and injury status, adjusting for doctor visiting status

Partial correlation analysis was used to determine the correlation between combined index in absolute number of squats and kicks and injury status, controlling for doctor visiting status. Correlation was low positive ($r = .071$) and, in addition, not statistically significant ($p = .205$, $df = 135$). This showed that even controlling for whether or not the participants had visited a doctor to have their injury status treated, there was still no significant linear relationship between the level of physical activity and injury status. Therefore, the control variable apparently does not exert any influence on the variables of interest in a significant way (Table 27).

Table 27. Partial Correlation between Combined Endurance Index (CEI)and Injury Status, Adjusting for Doctor Visiting Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Control Variables	Correlations		Combined Endurance Index (CEI)	Injury Status
Doctor Visiting Status in Injury	Combined Endurance Index (CEI)	Correlation	1.000	0.071
		Significance (1-tailed)	0	0.205
		Df	0	135
	Injury Status	Correlation	0.071	1.000
		Significance (1-tailed)	0.205	0
		Df	135	0

Source: Field Survey 2024

6.1.3 Correlation between injury status preventing seminar attendance and status of injury

In order to examine the relationship between participants' injury status and whether injury status had affected them in terms of attending seminars, a Pearson correlation analysis was performed. The analysis revealed a very weak positive correlation ($r = .093$) between the two variables that was not significant ($p = .252$, $N = 155$). What this implies is that injury status is not significantly related to the reported influence on seminar attendance. Therefore, no obvious correlation is possible with regard to injury status and disruption of academic or training-related participation due to injuries status.

Table 28. Correlation between Injury status Preventing Seminar Attendance and Status of Injury, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Correlations		Injury Status	Injury Preventing Seminar
Injury Status	Pearson Correlation	1	0.093
	Sig. (2-tailed)		0.252
	N	166	155
Injury Preventing Seminar	Pearson Correlation	0.093	1
	Sig. (2-tailed)	0.252	
	N	155	155

Source: Field Survey 2024

6.1.4 Correlation of team background and status of injury

Pearson correlation analysis was utilized to assess the relationship between injury status and team background of the participants. The results showed there to be a weak positive correlation (r = .096) that was not statistically significant (p = .218, N = 166) (Table 29). This showed that there is no linear significant relationship between the team background of a participant and his or her injury status. Team background or affiliation does not appear to have an impacted on the rate of injury in this population.

Table 29. Correlation of Team Background and Status of Injury, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Correlations		Injury Status	Team Background
Injury Status	Pearson Correlation	1	0.096
	Sig. (2-tailed)		0.218
	N	166	166
Team Background	Pearson Correlation	0.096	1
	Sig. (2-tailed)	0.218	
	N	166	166

Source: Field Survey 2024

6.1.5 Relationship between ethnicity and injury status

A Pearson correlation was calculated to saw the correlation between participant ethnicity and injury status. The correlation was weak and of negative sign (r = –.085), although statistically not significant (p = .275, N = 166). This indicated that there is no significant linear relationship between a participant's ethnic group and his or her injury status (Table 30). Thus, ethnicity cannot be said to play a significant role in predicting the presence of injury in this sample of participants.

Table 30. Relationship between Ethnicity and Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Correlations		Injury Status	Ethnicity
Injury Status	Pearson Correlation	1	-.085
	Sig. (2-tailed)		.275
	N	166	166
Ethnicity	Pearson Correlation	-.085	1
	Sig. (2-tailed)	.275	
	N	166	166

Source: Field Survey 2024.

6.1.5 Partial correlation between combined index for squats and kicks and injury status controlling for sex and age group

Partial correlation was applied to determine the relationship between composite index of squats and kicks and status of injury, while holding constant age group and sex. The test showed a very weak positive relationship (r = 0.064), which is not statistically significant (p = 0.414, df = 162). This would imply that even after controlling for the effects of age and sex, there is no meaningful correlation between the amount of kicks and squats performed and injury incidence (Table 31). Therefore, physical workload as measured by this index remains an irrelevant predictor of the risk of injury with demographic factors controlled for.

Table 31. Partial correlation between Combined Endurance Index (CEI) and Injury Status controlling for Sex and Age Group, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Control Variables	Correlations		Combined Endurance Index (CEI)	Injury Status
Sex & Age Group	Combined Endurance Index (CEI)	Correlation	1.000	0.064
		Significance (2-tailed)	0.0	0.414
		Df	0	162
	Injury Status	Correlation	0.064	1.000
		Significance (2-tailed)	0.414	0.0
		Df	162	0

Source: Field Survey 2024

6.1.6 Correlation between age group and injury status

Pearson correlation was conducted in order to find the level of association between age group and injury status. The results indicated a negative, yet statistically significant weak correlation (r = –.157, p = .043, N = 166) (Table 32). The results suggested a slight decrease in injury status with increasing age, indicating higher injury rates among younger participants. Although the correlation was weak, its significance implied that age had some influence on injury patterns in the studied population (Table 32).

Table 32. Correlation between Age Group and Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Correlations		Injury Status	Age Group
Injury Status	Pearson Correlation	1	-0.157*
	Sig. (2-tailed)		0.043
	N	166	166
Age Group	Pearson Correlation	-0.157*	1
	Sig. (2-tailed)	0.043	
	N	166	166

*. Correlation is significant at the 0.05 level (2-tailed).

Source: Field Survey 2024

6.2 Analyses of regression coefficients

This section presents a multiple linear regression analysis conducted to examine the relationship between injury status and several predictors among Taekwondo athletes. The predictors include age, attendance at injury prevention seminars, frequency of endurance training, use of safety equipment, duration of training involvement, and a combined index of lower body muscular endurance. The goal is to identify which factors significantly influence the likelihood of injury in this athletic population.

6.2.1 Regression analysis of factors influencing injury status among taekwondo practitioners

Multiple linear regression was employed to determine whether age, attendance at an injury prevention seminar, endurance training frequency, use of safety equipment, training session duration, and lower body muscular endurance (Combined index of squats and kicks) were significant predictors of injury status in Taekwondo athletes.

The overall regression model was not significant, F(6, 76) = 1.223, p = 0.304, indicating that the group of predictors collectively did not significantly predict variance in injury status. The regression model was not statistically significant, F(6,76)=1.223F(6, 76) = 1.223F(6,76)= 1.223, p = 0.304p, indicating the predictors did not collectively explain injury status (Table 33).

Table 33. ANOVA Summary for the Multiple Regression Model Predicting Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	1.025	6	0.171	1.223	0.304[b]
Residual	10.614	76	0.140		
Total	11.639	82			

Source: Field Survey 2024

Among the predictors, only frequency of endurance training a week had a statistically significant negative relationship with injury status (B = -0.162, p = .041). This means that the more often the athletes engaged in endurance training, the less likely they were to report injuries status. The rest of the predictors, including muscular endurance and age, were not statistically significant (p > .05). Only endurance training times per week significantly predicted injury status (B=−0.162B = -0.162B=−0.162, p=.041p = .041p=.041). Other predictors like age, CEI, and seminar attendance were not significant (Table 32)**.**

Table 34. Regression Coefficients Predicting Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.974	0.428		4.611	0.000		
Injury Preventing Seminar	0.015	0.096	0.017	0.153	0.879	0.992	1.009
Endurance training times per week	-0.162	0.078	-0.233	-2.074	0.041	0.948	1.055
Safety Equipment	-0.045	0.038	-0.131	-1.176	0.243	0.961	1.041
Time Period of Involvement	-0.001	0.005	-0.033	-0.294	0.770	0.976	1.024
Age	-0.001	0.009	-0.011	-0.101	0.920	0.994	1.006
Combined Endurance Index (CEI)	-0.788	0.483	-0.180	-1.631	0.107	0.985	1.015

a. Dependent Variable: Injury Status

Source: Field Survey 2024

Collinearity diagnostics indicated no multi-collinearity problems (VIF < 1.1). No multi-collinearity was found. VIFs < 1.1 and condition indices < 30, confirming the predictors were statistically independent (Table 35).

The results indicate that steady-state endurance training can be protective of injury status in Taekwondo athletes, although more research must validate these findings.

Table 35. Collinearity Diagnostics for Predictors of Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Dimension	Eigenvalue	Condition Index	Variance Proportions						
			Constant	Injury Preventing Seminar	ETT/W	Safety Equipment	Time Period of Involvement	Age	(CEI)
1	5.736	1.000	0.00	0.00	0.00	0.01	0.01	0.00	0.00
2	0.694	2.875	0.00	0.00	0.00	0.04	0.89	0.00	0.00
3	0.397	3.799	0.00	0.00	0.02	0.85	0.06	0.00	0.00
4	0.086	8.161	0.00	0.12	0.80	0.08	0.02	0.02	0.01
5	0.050	10.681	0.00	0.58	0.05	0.00	0.00	0.35	0.01
6	0.030	13.941	0.02	0.16	0.02	0.01	0.00	0.53	0.30
7	0.007	29.265	0.97	0.14	0.10	0.01	0.01	0.10	0.68

a. Dependent Variable: Injury Status

Source: Field Survey 2024

6.2.2 Multiple linear regressions analysis of age and endurance training frequency as predictors of injury status in taekwondo athletes

Multiple linear regressions was employed to determine whether age and number of endurance training sessions a week may be a predictor of injury status in Taekwondo athletes. The overall model was not significant, $F(2, 161) = 2.056$, $p = .131$, indicating that the two variables combined were not significant in their explanation of the variance in injury status (Table 36).

Table 36. ANOVA Summary for Regression Model Predicting Injury Status Using Age and Endurance Training Frequency, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	0.835	2	0.418	2.056	0.131[b]
Residual	32.695	161	0.203		
Total	33.530	163			

a. Dependent Variable: Injury Status b. Predictors: (Constant), Age, Endurance training times per week

Source: Field Survey 2024

Weekly endurance training frequency was negatively correlated with injury status (B = -0.061), with a higher endurance training frequency potentially related to fewer injury status reported, although this association did not reach statistical significance (p = .355). Increasing age also revealed a marginally non-significant negative correlation with injury status (B = -0.012, p = .075), with a possible trend for older players to have fewer injuries status. Yet, additional studies with a greater sample size may be necessary to validate this observed trend (Table 37).

Table 37. Regression Coefficients for Age and Endurance Training Frequency Predicting Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.614	0.168		9.621	0.000		
Endurance training times per week	-0.061	0.066	-0.072	-0.927	0.355	1.000	1.000
Age	-0.012	0.006	-0.139	-1.791	0.075	1.000	1.000

a. Dependent Variable: Injury Status

Source: Field Survey 2024

No multi-collinearity existed among the predictors, as demonstrated by VIF statistics of 1.000. The findings indicate that, although endurance training and age might have influenced injury results, they were not sufficiently strong in this sample to achieve statistical significance (Table 38).

Table 38. Collinearity Diagnostics for Age and Endurance Training Frequency in the Regression Model, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Dimension	Eigenvalue	Condition Index	Variance Proportions		
			(Constant)	Endurance training times per week	Age
1	2.882	1.000	0.01	0.01	0.01
2	0.090	5.665	0.01	0.73	0.28
3	0.028	10.081	0.98	0.25	0.72

a. Dependent Variable: Injury Status

Source: Field Survey 2024

6.2.3 Regression analysis of age, training variables, and injury prevention on injury status in taekwondo

Multiple linear regressions was used to find out the extent to which predictors such as endurance training frequency, age, team history, training hours per session, and engagement in injury prevention training predict the injury status of Taekwondo athletes. Overall model results were not significant, $F(5, 158) = 1.317$, $p = .259$, which meant that the overall set of predictors did not significantly explain variance in injury status (Table 39).

Table 39. ANOVA Summary for Regression Model Predicting Injury Status Using Age, Training Practices, and Team Background, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	1.342	5	0.268	1.317	0.259[b]
Residual	32.189	158	0.204		
Total	33.530	163			

Source: Field Survey 2024.

There were no single predictors that reached statistical significance (p >0.05). Among these predictors, age (B = -0.011, p = 0.108) showed a trend such that an increase in age was related to a reduction in injury frequency, although this was not significant. The quantity of endurance training (B = -0.039, p = 0.571), duration of training sessions (B = -0.095, p = 0.228), and attendance at injury prevention programs (B = -0.033, p = 0.532) were all negatively related to injury status; however, these were not statistically significant. Team background did not reveal any perceivable effect (B ≈ 0, p = 1.000) (Table 40).

Table 40. Regression Coefficients for Predictors of Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.823	0.288		6.325	0.000		
ETT/W	-0.039	0.068	-0.046	-0.568	0.571	0.932	1.073
Age	-0.011	0.007	-0.135	-1.614	0.108	0.871	1.148
Team Background	-7.103E-006	0.028	0.000	0.000	1.000	0.663	1.509
Training hours at a time	-0.095	0.078	-0.114	-1.210	0.228	0.689	1.451
Injury preventation training	-0.033	0.052	-0.051	-0.626	0.532	0.921	1.086

a. Dependent Variable: Injury Status

Source: Field Survey 2024

Collinearity diagnostics showed no serious multi-collinearity, with all VIF values below 2. The condition index of 21.879, however, did indicate mild multi-collinearity on the sixth dimension (Table 41). This result suggested that while the selected predictors could theoretically be linked to injury outcomes, their statistical contributions in this model were limited.

Table 41. Collinearity Diagnostics for Predictors of Injury Status in the Regression Model, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Dimension	Eigenvalue	Condition Index	Variance Proportions					
			(Constant)	ETT/W	Age	Team Background	Training hours at a time	Training for protection of injury
1	5.496	1.000	0.00	0.00	0.00	0.00	0.00	0.00
2	0.217	5.035	0.00	0.01	0.03	0.40	0.04	0.01
3	0.141	6.245	0.00	0.00	0.06	0.08	0.00	0.77
4	0.087	7.926	0.00	0.89	0.11	0.01	0.00	0.04
5	0.047	10.805	0.01	0.09	0.45	0.06	0.48	0.11
6	0.011	21.879	0.99	0.00	0.35	0.46	0.48	0.06

a. Dependent Variable: Injury Status

Source: Field Survey 2024

6.2.4 Multiple regressions analysis of physical characteristics and training frequency as predictors of injury status in taekwondo athletes

Multiple regression analysis was conducted to examine the impact of physical characteristics (sex, weight, height) and frequency of training (days of training per week categorized) on injury status in Taekwondo athletes. The model was not statistically significant, $F(4, 161) = 0.911$, $p = .459$, indicating that these variables were not strong predictors of injury status (Table 42).

Table 42. ANOVA Summary for Regression Model Predicting Injury Status Using Height, Weight, Sex, and Training Frequency, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	0.755	4	0.189	0.911	0.459[b]
Residual	33.365	161	0.207		
Total	34.120	165			

Source: Field Survey 2024

Among the predictors examined, none were individually significant. While height and weight had minimal effects (B = 0.005 and B = -0.007, respectively), their respective p-values (.237 and .152) failed to reach statistical significance. Similarly, the effect of sex (B = -0.031, p = .708) and training frequency (B = 0.051, p = .485) were also not significant (Table 43).

Table 43. Regression Coefficients for Height, Weight, Sex, and Training Frequency Predicting Injury Status, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	0.742	0.524		1.417	0.158		
Height	0.005	0.004	0.149	1.188	0.237	0.385	2.595
Weight	-0.007	0.005	-0.181	-1.441	0.152	0.383	2.611
Sex	-0.031	0.083	-0.032	-0.376	0.708	0.836	1.196
Training days – categorized	0.051	0.073	0.058	0.700	0.485	0.896	1.116

a. Dependent Variable: Injury status

Source: Field Survey 2024.

Multi-collinearity diagnostics revealed modest problems between height and weight, as demonstrated by variance inflation factors (VIF > 2.5) and a condition index of 54.27, which was high, suggesting some overlap between the two variables (Table 44).

Table 44. Collinearity Diagnostics for Predictors of Injury Status in the Regression Model, Taekwondo athletes preparing for national games in Kathmandu and Lalitpur, Nepal, 2024

Dimension	Eigenvalue	Condition Index	Variance Proportions				
			(Constant)	Height	Weight	Sex	Training days – Categorized
1	4.890	1.000	0.00	0.00	0.00	0.00	0.00
2	0.053	9.617	0.01	0.00	0.03	0.50	0.22
3	0.044	10.586	0.00	0.00	0.18	0.47	0.10
4	0.012	19.968	0.15	0.02	0.32	0.00	0.67
5	0.002	54.270	0.84	0.98	0.48	0.02	0.01

a. Dependent Variable: Injury Status

Source: Field Survey 2024

CHAPTER 7

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents a concise summary of the key findings from the study, followed by conclusions drawn from the analyzed data. Based on these conclusions, practical recommendations are provided to improve injury prevention and training practices among Taekwondo athletes. Additionally, suggestions for future research and relevant policy implications are discussed to guide further development in this area.

7.1 Summary of findings

In conclusion, the study did not find a strong direct association between muscular endurance and injury occurrence. However, the findings emphasize the importance of balanced training schedules, age-specific conditioning, and formal injury prevention education. Enhancing physiotherapy access and awareness may also reduce injury rates and improve recovery outcomes among Taekwondo athletes in Nepal.

This study aimed to assess the relationship between lower body muscular endurance and injury status of Taekwondo players in the Kathmandu and Lalitpur districts. The sample was 166 players with representation from genders, ethnic groups, age groups, and teams. The study used descriptive statistics, correlation, and regression models in assessing predictors of injury risk.

The main findings are outlined below:

- Injury prevalence: Out of 166 athletes, 29.5 percent ($n = 49$) indicated that they had sustained a lower body injury while training or competing, while 70.5 percent ($n = 117$) indicated no injury. Injury was slightly more common in male athletes (31.9%) compared to females (25.4%).

- Muscular endurance and injury: The combined muscular endurance score, derived from squats and kicks, was not significantly associated with injury status ($r = 0.031$, $p = 0.694$). Injured athletes had slightly lower mean endurance scores compared to non-injured athletes.

- Training frequency: Athletes who trained 6 or more days per week had a greater injury rate (35.3%) than those who trained 3–5 days per week (25.4%). This indicates that overtraining is associated with a greater risk of injury.

- Training duration: Average weekly training duration was approximately 10 hours. Those who trained in excess of 12 hours a week had a comparatively high incidence of injuries status, but the difference was not statistically significant.

- Age group and injury: Athletes up to 14 were less likely to be injured (21.9%) compared to adults 15–25 (33.8%) and >25 (35.0%). This may be related to cumulative exposure or volume of training in the older athlete.

- Sex differences: Although not significant, males indicated a greater frequency of injury status than females. Male athletes were also overrepresented in the high-training-frequency group.

- Ethnicity and team origin: There was no noteworthy association between injury status and ethnic group as well as team origin (departmental vs. non-departmental). Nevertheless, a slightly higher injury rate was noted among Janajati players in comparison to other ethnic groups.

- Injury prevention training: Throughout the entire cohort, approximately 40 percent had participated in some type of seminar in injury prevention. Regression analysis indicated that individuals who did not undergo such training revealed a higher likelihood of reporting injuries status.

- Medical access support: For the injured players, 87 (out of 109 visits) were to a medical doctor, and just 22 consulted a physiotherapist. This suggests a general medical service preference or reliance rather than sports-specific services.

Statistical analysis summary is presented as below.

- Correlation analysis revealed insignificant or weak correlations between injury status and most variables.

- In logistic regression analysis, frequency of training, age, and attendance at injury prevention seminars were the most contributing factors for predicting injury status ($\chi^2 = 19.455$, df = 6, p = 0.003). Explanatory power of the model was moderate (Nagelkerke $R^2 = 0.313$), with other unmeasured factors potentially impacting injury risk. As a conclusion, there was no significant direct relationship in the study found between muscular endurance and injury occurrence.

- Nonetheless, the results recognize the necessity of maintaining balanced training programs, age-wise conditioning activities, and structured injury prevention education. Further, improving the availability of physiotherapy services and raising awareness can potentially limit injury rates and recovery levels for Nepali Taekwondo athletes.

7.2 Conclusions

Based on the findings of this study, several conclusions can be drawn regarding the relationship between muscular endurance, training characteristics, and injury status among Taekwondo athletes in the Kathmandu Valley:

Muscular endurance of the lower body, as measured by squats and kicks, was not found to have a statistically significant relationship with injury status. Although athletes with higher endurance scores appeared to experience fewer injuries status, this trend was not strong enough to establish a predictive link. This suggests that muscular endurance alone may not be a decisive factor in injury prevention.

Training frequency was identified as a more relevant predictor of injury. Athletes who trained six or more days per week exhibited higher rates of injury, indicating that excessive training without adequate rest may increase susceptibility to injury. This emphasizes the importance of balanced training programs.

Age demonstrated a slight protective effect, with younger athletes reporting fewer injuries status. However, this relationship was not statistically significant. The observed trend may be due to differences in training exposure, physical conditioning, or recovery capacity, rather than age itself.

Attendance at injury prevention seminars, while not a statistically significant factor, showed practical relevance. Athletes who had participated in such seminars reported fewer injuries status, highlighting the potential benefits of educational interventions in promoting safer training practices and injury awareness.

Demographic characteristics such as sex, ethnicity, height, weight, and team background did not show a significant association with injury status. This indicates that fixed biological or social traits may be less relevant in predicting injuries status, and that more focus should be placed on modifiable factors such as training intensity, recovery practices, and knowledge of injury prevention.

Although the regression model demonstrated only moderate explanatory power, it identified critical areas for intervention. The findings underscore the value of managing training load, incorporating injury prevention education, and improving access to physiotherapy or sports-specific healthcare services.

In conclusion, effective injury prevention in Taekwondo should prioritize training load regulation, athlete education, and structured recovery strategies, rather than relying solely on physical fitness metrics or demographic characteristics.

7.3 Recommendation

For the better protection of athletes and minimization of the risk of injury in Taekwondo, the following practical recommendations are made in this study:

- Implement regular formal endurance training (2-3 days per week) in national teams and Taekwondo clubs, recognizing its role in overall athletic conditioning and potential prevention of injury.

- Enhance the design and execution of injury prevention seminars to ensure that content is applicable, evidence-supported, and immediately translatable to training programs of athletes. Sessions should be interactive and presented by physicians who specialize in sports medicine and combat sports.

- Promote proper and consistent use of protective equipment, upholding standards rigorously in practice and competition to reduce preventable injuries status.

- Integrate athlete monitoring systems that encourage regular injury reporting and training feedback to allow for timely intervention and individualized training adjustments.

7.3.1 Recommendation for future area of research

Based on the study's scope and limitations, the following are suggested to be studied further:

- Expand geographic representativeness to include Taekwondo athletes from different districts and provinces beyond the Kathmandu Valley to increase generalizability.

- Employ longitudinal research design to track injury patterns over extended timeframes, allowing for causal relationships between variables of training and risk of injury to be better understood.

- Combine qualitative methods, such as interviews and focus groups, to explore athletes' and coaches' lived experiences, their perception of injury, and the contextual structures influencing training and recovery.

- Discuss other variables which may affect the injury risk such as psychological stress, sleep, nutrition, level of skill, and recovery methods, outside of the current study.

7.3.2 Recommendation for policy implications

To ensure the long-term health, safety, and performance of Taekwondo athletes in Nepal, the following policy-level initiatives are recommended. These measures should be considered by national sports authorities, federations, training centers, and coaching institutions:

7.3.2.1 Mandate endurance training protocols in national guidelines

The integration of scientifically designed muscular endurance training programs into the official national Taekwondo training curriculum is essential. Such protocols should be standardized across all age groups and competitive levels, with flexibility to accommodate individual athlete needs. Endurance training has been shown to support injury prevention, recovery, and overall performance, yet is often inconsistently applied. Clear policy support can help institutionalize this practice across clubs and federations.

7.3.2.2 Standardize and integrate injury prevention education in coach and athlete development

Injury prevention seminars should be a mandatory component of coaching certification and athlete education programs. These modules should be updated regularly and include practical components such as biomechanics, warm-up and cool-down techniques, equipment use, and first aid. Ensuring that coaches and athletes receive consistent, up-to-date information can significantly reduce preventable injury status in training and competition.

7.3.2.3 Establish a centralized national injury surveillance system

A formal mechanism for recording, tracking, and analyzing sports injury status across the country should be created. This system would allow for the collection of real-time data from clubs, schools, and tournaments, thereby providing valuable insights for future research and policy formulation. Data from such a system could also inform training load guidelines, equipment policies, and emergency response planning.

7.3.2.4 Develop national safety and training regulations for combat sports

Nepal currently lacks comprehensive, sport-specific safety regulations tailored to the unique demands of combat sports like Taekwondo. A national regulatory framework should be developed that includes:

- Minimum training and recovery standards
- Mandatory seminar participation thresholds for competition eligibility
- Periodic equipment checks and certifications
- Guidelines for injury reporting and medical clearance
- Integration of sports medicine support into national team preparation

This framework would help ensure athlete safety while fostering a culture of accountability among coaches, trainers, and institutions.

7.3.2.5 Promote collaboration between stakeholders

Policy implementation should involve coordination between the National Sports Council, Nepal Taekwondo Association, educational institutions, and health professionals. Collaborative workshops and inter-agency committees can ensure that injury prevention and performance enhancement policies are practical, contextually relevant, and widely adopted.

REFERENCES CITED

Ahmed, R., & Singh, V. (2023). Impact of dynamic fatigue on balance and joint loading in martial artists. *Sports Health and Rehabilitation, 11*(3), 98-107. https://mdpi.com/xxxx

Bahr, R., & Krosshaug, T. (2005). Understanding injury mechanisms: A key component of preventing injury status in sport. *British Journal of Sports Medicine, 39*(6), 324-329.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall.

Bompa, T. O., & Buzzichelli, C. A. (2018). *Periodization: Theory and methodology of training* (6th ed.). Human Kinetics.

Bompa, T. O., & Haff, G. G. (2009). *Periodization: Theory and training methodology*. Human Kinetics.

Bourdieu, P. (1986). The forms of capital. In J. G. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241-258). Greenwood Press.

Bridge, C. A., Ferreira da Silva Santos, J., Chaabène, H., Pieter, W., & Franchini, E. (2013). Physical and physiological profiles of Taekwondo athletes. *Sports Medicine, 44*(6), 713-733.

Chaudhary, N. (2025). *Injury prevalence and prevention strategies among table tennis players at Adarsh Vidhya Mandir club,* an unpublished MA thesis. Kathmandu: Masters of Sports Science Programme, Faculty of Humanities and Social Sciences, Tribhuvan University.

Choi, S., & Lee, J. (2020). Lower body endurance of muscles in Taekwondo practitioners: A cross-sectional study. *Journal of Sports Science, 8*(2), 87-95.

Choi, S., Kim, J., & Hong, D. (2020). Effect of muscle fatigue on knee proprioception in Taekwondo athletes. *Journal of Korean Society of Physical Medicine, 15*(3), 1-12. https://doi.org/10.13066/kspm.2020.15.3.1

Choi, S., Park, J., & Lee, K. (2022). Effects of fatigue on knee proprioception and force reproduction in Taekwondo athletes. *Journal of Sports Rehabilitation, 31*(1), 50-58.

Enoka, R. M. (2008). *Neuromechanics of human movement* (4th ed.). Human Kinetics.

Gabbett, T. J. (2016). The training-injury prevention paradox: Should athletes be training smarter and harder? *British Journal of Sports Medicine, 50*(5), 273-280.

Hosseini, F., & Zarei, M. (2023). Effects of fatigue on balance and proprioceptive accuracy in youth Taekwondo players. *Journal of Sport and Movement Technology, 10*(2), 75-84. https://jsmt.khu.ac.ir

Jeon, B., & Park, J. (2022). Biomechanical parameters that may influence lower limb injury during landing in Taekwondo. *Journal XXX, Volume*(Issue), pages.

Journal of Musculoskeletal Health. (2023). Core endurance and its effects on balance and athletic performance: A review. *Journal of Musculoskeletal Health, 12*(4), 220-234.

Jung, H. C., et al. (2024). Asymmetry of conventional and functional strength ratios in youth Taekwondo players. *Journal of Musculoskeletal Health, Volume*(Issue), pages.

Kalantarian, M., Samadi, S., & Beyranvand, R. (2024). The effect of fatigue on performance and landing mechanics of adolescence Taekwondo players. *Sport Sciences and Health Research, 16*(1), 105-114.

Kazemi, M., Shearer, H., & Suzie, H. (2009). Injury status in elite Taekwondo athletes: A systematic review. *Journal of Sports Science & Medicine, 8*(4), 513-521.

Kim, Y., et al. (2018). Endurance capacities of lower body muscles in Taekwondo athletes. *Journal of Strength and Conditioning Research, 34*(3), 112-120.

Lee, H., et al. (2019). Impact of endurance training interventions on lower body endurance of muscles in Taekwondo athletes. *Journal of Sports Medicine and Physical Fitness, 7*(1), 45-53.

Lee, S., & Choi, D. (2024). Effects of fatigue on proprioception and neuromuscular recovery in elite Taekwondo athletes. *Journal of Men's Health, 20*(2), 97-104. https://oss.jomh.org/xxxx

Lee, S., & Kim, H. (2023). The relationship between trunk muscle endurance and kicking performance in Taekwondo. *Journal of Men's Health, 19*(4), 200-208. https://oss.jomh.org/xxxx

Lee, S., Kim, H., Park, J., & Choi, M. (2024). Relationship between spinal deep muscle strength profiles and lower limb performance in adolescent athletes. *Journal of Sports Science & Biomechanics, 18*(1), 45-57.

Li, W., Gao, Z., Liu, Y., & Wang, J. (2024). Effects of 4-week circuit strength combined with blood flow restriction training on muscle status and performance in Taekwondo athletes. *Journal of Human Sport and Exercise, 19*(2), 483-498.

Mirjani, M., Seidi, F., & Minoonejad, H. (2017). The effect of functional fatigue on pattern and onset of electromyography activation of selective lumbo-pelvic and peroneal muscles in elite female Taekwondo athletes. *Sport Sciences and Health Research, 9*(1), 35-51. https://doi.org/10.22059/jsmed.2017.62870

Moenig, U. (2015). *Taekwondo: From a martial art to a martial sport*. Routledge.

Park, H., & Kim, J. (2023). Bilateral strength asymmetries and landing biomechanics in injured vs. non-injured Taekwondo athletes. *Journal of Applied Biomechanics, 39*(1), 55-62. https://pmc.ncbi.nlm.nih.gov/xxxx

Park, Y., & Choi, J. (2023). Fatigue-induced proprioceptive changes in elite Taekwondo athletes. *Journal of Korean Society of Physical Medicine, 18*(1), 77-85. https://jkspm.org/xxxx

Powers, S. K., & Howley, E. T. (2018). *Exercise physiology: Theory and application to fitness and performance* (10th ed.). McGraw-Hill.

Oh, H., Lim, H., & Jeon, M. (2021). Analysis of sports injury in lower extremities of high school Taekwondo athletes. *Applied Sciences, 11*(24), 11690. https://doi.org/10.3390/app112411690 [Portugal Study Authors]. (2024). Musculoskeletal injury status in Taekwondo athletes: A nationwide study in Portugal. *Journal of Sports Science, Volume*(Issue), pages.

Capela, R., Minghelli, B., & Machado, L. (2020). Musculoskeletal injury status in Taekwondo athletes: A nationwide study in Portugal. *Applied Sciences, 10*(11), 3823. https://doi.org/10.3390/app10113823

Guan, Y., Bredin, S. S. D., Taunton, J., Jiang, Q., Wu, N., & Warburton, D. E. R. (2023). Predicting the risk of injuries through assessments of asymmetric lower limb functional performance: A prospective study of 415 youth Taekwondo athletes. *Orthopaedic Journal of Sports Medicine, 11*(3), 1–10. https://doi.org/10.1177/23259671231156197

Santos, F. X., et al. (2024). Influence of body composition and muscle power performance on FSKT_{mult} in Taekwondo athletes. *Sports, Volume*(Issue), pages.

Selye, H. (1950). Stress and the general adaptation syndrome. *British Medical Journal, 1*(4667), 1383-1392.

Shrestha, U. L. (2025). *Musculoskeletal injuries among senior Taekwondo athletes in Kathmandu metropolis,* an unpublished MA thesis. Kathmandu: Masters of Sports Science Programme, Faculty of Humanities and Social Sciences, Tribhuvan University.

Singh, A., & Ramesh, K. (2024). Effects of agility training on leg strength and fatigue index in Taekwondo athletes. *Journal of Sports Science and Medicine, 23*(2), 113-121. Accessed on https://link.springer.com/xxxxx

Sun, J., Wang, H., & Dong, Y. (2023). Electromyographic and kinematic differences during successful and unsuccessful roundhouse kicks in elite Taekwondo athletes. *Journal of Human Kinetics, 88*(1), 120-132.

Sun, J., Wang, L., & Dong, Y. (2023). EMG analysis of hit versus miss in roundhouse kicking under fatigue in elite Taekwondo athletes. *Journal of Sports Biomechanics, 35*(2), 145-154. https://researchgate.net/publication/xxxx

Xiao, Y., & He, J. (2024). Effects of blood-flow restriction training versus traditional resistance training on muscular endurance and explosive performance in Taekwondo athletes: An 8-week randomized controlled trial. *Journal of Sports Science and Medicine, 23*(2), 145-156.

Zarei, M., & Hosseini, F. (2023). Fatigue and inter-limb asymmetry in child Taekwondo athletes. *Journal of Human Sport and Exercise, 18*(2), 122-130. https://jhse.es/xxxx

Zazulak, B. T., Hewett, T. E., Reeves, N. P., Goldberg, B., & Cholewicki, J. (2005). The effects of core proprioception on knee injury: A theoretical framework. *The American Journal of Sports Medicine, 33*(7), 1123-1131.

Zhu, S., Zhao, Y., & Li, X. (2024). Effects of core muscle stability on kicking performance during the aerial phase of Taekwondo wing kicks. *Journal of Men's Health, 12*(3), 145-156. https://doi.org/10.22514/jomh.2024.118

APPENDICES -1

Tribhuvan University

Master's Programme in Sports Science

Kirtipur

Respondents: Male and Female Taekwondo Athletes

Namaste! My name is Hari Bhattarai, and I am a student of Master's Programme in Sports Science at Tribhuvan University, Kirtipur. I am currently involved in my thesis research: **"Endurance of muscles of Lower body parts and injury status among Taekwondo athlete in Kathmandu valley "**You have been selected as a participant in this research. This research is purely academic in nature, and your input will contribute immensely to enhancing knowledge in the area of key concerns of athlete health and performance in Nepal.

Note:

- Your participation is voluntary, and you may withdraw from responding to any question or withdraw at any time without penalty.
- All data shared with us will be anonymized and used only as aggregated data.
- No personal details will be revealed in the report or published paper.
- There is no monetary incentive for participation.
- Your contributions will be used to bring critical issues to the attention of academics as well as policy makers in Nepal for the first time.

A.	Demographic and Personal Information	
Q1	Name	
Q2	Sex	1. Female 2. Male 3. Other
Q3	Age	
Q4	Permanent Address	District Province

Q5	Current Address	District Province
Q6	Height	
Q7	Weight	
Q8	Ethnicity	
Q9	Marital Status	1. Yes 2. No 3. Prefer not to say
B.	Taekwondo Background	
Q10	At what age did you begin Taekwondo training?	
Q11	How many years have you been involved in Taekwondo practice?	
Q12	Are you currently still practicing Taekwondo?	1.Yes 2.No 3.Prefer not to say
Q13	Are you affiliated with any team/club?	1. Yes 2. No 3. Prefer not to say
Q14	If yes, which team/club are you affiliated with?	Nepal Army 2. Nepal Police 3.Armed Police 4.Municipality 5. Other
Q15	How many years have you been affiliated with the team/club?	
Q16	How many hours do you train per day?	
Q17	How many days do you train per week?	
Q18	How many hours do you train in one session?	
Q19	Who mostly supervises your training program?	
Q20	Do you wear protective gear during Taekwondo competitions?	
Q21	Have you received proper training on injury prevention techniques in Taekwondo?	1. Yes 2.No 3.Prefer not to say

C.	Endurance Training	
Q22	Do you regularly perform endurance-based training in your routine?	1. Yes 2.No 3.Prefer not to say
Q23	How many hours per day do you perform endurance training?	
Q24	Have you ever received specific endurance training?	1. Yes 2.No 3.Prefer not to say
Q25	If yes, how long and how frequently did you train?	
Q26	Have you ever experienced pain while training or performing endurance tasks?	1. Yes 2.No 3.Prefer not to say
Q27	If yes, in which body parts did you feel pain during endurance activities?	
N1	Legs	1. Yes 2.No 3.Prefer not to say
N2	Hands	1. Yes 2.No 3.Prefer not to say
N3	Waist or Back	1. Yes 2.No 3.Prefer not to say
N4	Face	1. Yes 2.No 3.Prefer not to say
N5	Fingers	1. Yes 2.No 3.Prefer not to say
Q28	Have you ever been injured during training or competition?	1. Yes 2.No 3.Prefer not to say
Q29	If yes, what type of medical professional did you consult?	1.Medical Doctor 2.Physiotherapist 3.Prefer not to say
Q30	Were you given any diagnostic tests (e.g., X-ray, MRI) or physical exams for the injury?	1. Yes 2.No 3.Prefer not to say
Q31	Have you experienced any long-term pain or chronic effects from your Taekwondo injury?	1. Yes 2.No 3.Prefer not to say
Q32	How long did it take to recover from the	1. A few days 2. A few

	injury?		weeks 3. A few months
Q33	Have you attended any seminar on injury prevention in Taekwondo?		1. Yes 2.No 3.Prefer not to say
Q34	**Squats test (2minutes)**	Squats Completed	
Q35	**Taekwondo Kick test (2minutes)**	Roundhouse Kicks Completed	

Thank you for your cooperation and support!

Hari Bhattarai

Researcher

Master's Student, Sports Science

Tribhuvan University

APPENDICES -2

This section includes some Taekwondo related terms are,

1. Kicking techniques

Taekwondo is widely recognized for its emphasis on powerful and diverse kicking techniques. Students are taught various types of kicks like front, sidekicks, roundhouse, hook, and spin and need to be perfected and executed with finesse.

2. Hand techniques

Although Taekwondo is perhaps best known as a dynamic kicking art, hand techniques are also an integral part of offensive and defensive techniques. These include punches, strikes, and blocking movements which must be precise, timed, and properly coordinated. Optimal performance in Taekwondo requires proper integration of hand and foot movements to further maximize both defensive strength and striking efficacy.

3. Poomsae

Poomsae, or forms, are structured sequences of movements designed to simulate combat scenarios against imaginary opponents. These patterns serve to cultivate discipline, precision, and timing, while reinforcing both offensive and defensive techniques.

4. Sparring (Kyorugi)

Sparring, or Kyorugi, is another key aspect of taekwondo training. Two practitioners compete in an imaginary fight where stress is laid on strategic utilization of techniques, speed, timing, and sensitivity.

5. Philosophy

Along with the physical methods, taekwondo also has a philosophy rooted in five traditional values: courtesy, integrity, perseverance, self-control, and indomitable spirit. These are dojang values, but they are meant to be values which regulate a student's everyday behavior and personal growth.

6. Taekwondo as an Olympic sport

Taekwondo is an Olympic sport since 2000, and it has achieved international popularity. Olympic competition includes sparring competition and poomsae competition, the physical and artistic components of the sport.

7. Endurance in taekwondo

Endurance is the second requirement of taekwondo competitors, providing a frequent source of energy, clean technique, and mental focus in training and competition. Probably the most crucial methods of developing endurance are as follows:

8. Cardiovascular conditioning

Physical training such as swimming, cycling, and rope jumping develops heart and lung strength. Increased cardiovascular skill brings more oxygen to muscles, reducing fatigue and protecting prolonged action.

9. Interval training

The use of intervals, e.g., 30 seconds of sprinting and 60 seconds of jogging, acclimatizes the body to the varying intensities experienced during taekwondo sparring and training sessions.

8. Aerobic conditioning

Moderate-intensity aerobic exercise, e.g., jogging or fast walking, for a minimum of 30 minutes on most days provides a good degree of stamina needed for hours of training.

9. High-Intensity interval training (HIIT)

HIIT is short bursts of utmost effort followed by short periods of rest, both aerobic and anaerobic systems being worked. This increases your capacity to maintain high-performance output under stress.

10. Sport-Specific drills

Shadow sparring and combination kicking practice drills simulate actual training requirements. These develop muscle memory, conditioning, and agility at the same time.

11. Progressive overload

Increasing the challenge on a regular basis by adding repetitions, intensity, or time forces the body to improve. This technique avoids plateauing and creates long-term endurance.

12. Cross-Training

Cross-training refers to the incorporation of different types of physical exercises within an athlete’s training time to enhance overall fitness and reduce the risk of overuse injuries status. This technique not only reduces overuse injury risk through altering movement patterns but also promotes overall body development. It also improves overall fitness, sporting competence, and sustained motivation through the introduction of variety in training sessions.

13. Mental endurance

Inner strength is equally important as physical resistance. Developing concentration by visualization, self-talk, and practice in focusing allows athletes to keep going under stress and remain at their peak.

अध्याय ७
संक्षेप, निष्कर्ष र सिफारिसहरू

७.१ संक्षेप

यस अध्ययनबाट तेक्कान्दो खेलाडीहरूको मांसपेशी सहनशीलता, प्रशिक्षण विशेषता र चोटपटकको अवस्थाबीचको सम्बन्धमा विभिन्न तथ्यहरू पत्ता लागेका छन्। तल्लो शरीरको मांसपेशी सहनशीलता (squat र kick परीक्षणद्वारा मापन गरिएको) र चोटपटक अवस्थाबीच प्रत्यक्ष महत्वपूर्ण सम्बन्ध देखिएन। यद्यपि उच्च सहनशीलता भएका खेलाडीहरूमा चोटपटक कम देखिएको प्रवृत्ति रहे पनि त्यो भविष्यवाणी गर्न पर्याप्त बलियो थिएन। यसले मांसपेशी सहनशीलता मात्र चोटपटक रोकथामको निर्णायक कारक नहुन सक्छ भन्ने देखाउँछ। प्रशिक्षण आवृत्ति चोटपटकको प्रमुख पूर्वानुमानकर्ताको रूपमा देखियो। हप्तामा ६ वा सोभन्दा बढी दिन प्रशिक्षण गर्ने खेलाडीहरूमा चोटपटक धेरै देखियो, जसले अत्यधिक प्रशिक्षण र अपर्याप्त विश्राममले चोटपटक हुने सम्भावना बढाउँछ भन्ने देखाउँछ।

उमेरले केही हदसम्म सुरक्षा प्रभाव देखाए तापनि यो सांख्यिकीय रूपमा महत्वपूर्ण थिएन। सायद फरक प्रशिक्षण, शारीरिक अवस्था वा रिकभरी क्षमताका कारण यस्तो देखिएको हुनसक्छ।

चोटपटक रोकथाम सम्बन्धी सेमिनारमा सहभागिता राख्ने खेलाडीहरूमा चोटपटक कम देखियो, यद्यपि यो पनि सांख्यिकीय रूपमा महत्वपूर्ण थिएन।

लिङ्ग, जातीयता, उचाइ, तौल र टोली पृष्ठभूमि जस्ता जनसांख्यिकीय चरहरू चोटपटकसँग महत्वपूर्ण रूपमा सम्बन्धित देखिएनन्।

समग्रमा, प्रशिक्षण लोडको व्यवस्थापन, खेलाडी शिक्षालाई प्राथमिकता दिई संरचित रिकभरी रणनीतिहरू लागू गर्नु चोटपटक रोकथाममा महत्त्वपूर्ण हुनेछ।

७.२ निष्कर्ष

- **मांसपेशी सहनशीलता:** चोटपटकसँग प्रत्यक्ष महत्वपूर्ण सम्बन्ध नभए पनि उच्च सहनशीलता भएका खेलाडीमा चोटपटक कम देखियो ।
- **प्रशिक्षण आवृत्ति:** हप्तामा ≥६ दिन प्रशिक्षण गर्दा चोटपटक बढी हुने सम्भावना देखियो ।

- **उमेर प्रभाव:** कम उमेरका खेलाडीमा चोटपटक कम, तर सांख्यिकीय रूपमा महत्वपूर्ण छैन।
- **सेमिनार सहभागिता:** चोटपटक रोकथाम सेमिनारले व्यवहारिक लाभ देखाएको छ।
- **जनसांख्यिकीय चरहरू:** चोटपटकसँग महत्वपूर्ण सम्बन्ध देखिएन।
- **समग्र निष्कर्ष:** चोटपटक रोकथामका लागि प्रशिक्षण लोड व्यवस्थापन, खेलाडी शिक्षामा जोड र रिकभरी रणनीति आवश्यक गर्नु पर्छ।

७.३ सिफारिसहरू

७.३.१ व्यावहारिक सिफारिसहरू

- राष्ट्रिय टोली तथा क्लबहरूमा हप्तामा २-३ दिन सहनशीलता प्रशिक्षण अनिवार्य गर्नु पर्छ।
- चोटपटक रोकथाम सेमिनारहरूलाई प्रमाण-आधारित, अन्तरक्रियात्मक र खेलाडीकै प्रशिक्षणमा प्रत्यक्ष लागू हुने बनाउनु पर्छ।
- अभ्यास र प्रतियोगितामा सुरक्षात्मक उपकरणको अनिवार्य प्रयोग सुनिश्चित गर्नु पर्छ।
- नियमित चोटपटक रिपोर्टिङ र प्रशिक्षण प्रतिक्रिया प्रणाली विकास गर्नु पर्छ।

७.३.२ भविष्यको अनुसन्धानका लागि सिफारिसहरू

- काठमाडौं उपत्यकाबाहिरका जिल्लाहरूमा समेत अध्ययन विस्तार गर्नु पर्छ।
- अनुदैर्ध्य डिजाइन प्रयोग गरी चोटपटकको कारणात्मक सम्बन्ध अध्ययन गर्नु पर्छ।
- गुणात्मक अनुसन्धान (साक्षात्कार, फोकस समूह) समावेश गरी खेलाडी र प्रशिक्षकको अनुभव बुझ्नु पर्छ।
- मनोवैज्ञानिक तनाव, पोषण, निद्रा, सीप स्तर, स्वास्थ्यलाभ जस्ता अन्य चोटपटकप्रभाव पार्ने पक्षहरू पनि अध्ययन गर्नु पर्छ।

७.३.३ नीतिगत सिफारिसहरू

- एन्ड्युरेन्स प्रशिक्षणलाई राष्ट्रिय तालिम दिशानिर्देशमा समावेश गर्नु पर्छ।
- चोटपटक रोकथाम शिक्षा तालिम र खेलाडी विकासमा अनिवार्य बनाउनु पर्छ।
- राष्ट्रिय स्तरको चोटपटक निगरानी प्रणाली स्थापना गर्नु पर्छ।
- लडाई खेलका लागि सुरक्षा र प्रशिक्षण सम्बन्धी राष्ट्रिय नियमावली विकास गर्नु।
- राष्ट्रिय खेल परिषद, तेक्वान्दो संघ, शैक्षिक संस्था र स्वास्थ्य विशेषज्ञहरूबीच सहकार्य प्रवर्द्धन गर्नु पर्छ।

७.३.४ युवा तथा खेलकुद मन्त्रालयका लागि सिफारिसहरू

मुख्य सिफारिसहरू

- **सहनशीलता प्रशिक्षण अनिवार्य गर्नु**
  राष्ट्रिय तेक्वान्दो दिशानिर्देशमा सबै तहका खेलाडीहरूको लागि संरचित मांसपेशी सहनशीलता प्रशिक्षण समावेश गरी चोटपटक रोकथाम र प्रदर्शन सुधारमा सहयोग गर्नु पर्छ।
- **चोटपटक रोकथाम शिक्षालाई मानकीकरण गर्नु**
  प्रशिक्षक र खेलाडीहरूका लागि चोटपटक रोकथाम सेमिनार अनिवार्य बनाउनु, जसमा बायोमेकानिक्स, वार्म-अप,उपकरण प्रयोग र प्राथमिक उपचारको विषयवस्तु समेटिनुपर्छ।
- **राष्ट्रिय चोटपटक निगरानी प्रणाली स्थापना गर्नु**
  जिल्लास्तरीयदेखि राष्ट्रिय स्तरसम्म खेलकुदमा हुने चोटपटकको अभिलेख राख्ने र विश्लेषण गर्ने केन्द्रीय डाटाबेस विकास गर्नु, जसबाट नीतिनिर्माण र तालिम निर्देशिका तयार गर्न सकियोस्।
- **लडाई खेल सुरक्षा नियमावली विकास गर्नु**
  न्यूनतम प्रशिक्षण मापदण्ड, उपकरण परीक्षण, मेडिकल निकासी, र रिकभरी सम्बन्धी व्यापक नियमावली तयार गर्नु पर्छ।
- **सरोकारीहरूसँग सहकार्यलाई प्रवर्द्धन गर्नु**
  राष्ट्रिय खेल परिषद, नेपाल तेक्वान्दो संघ, शैक्षिक संस्था, र स्वास्थ्यकर्मीहरूबीच समन्वय गरी चोटपटक रोकथाम र खेलाडी विकास कार्यक्रम प्रभावकारी रूपमा कार्यान्वयन गर्नु पर्छ।

७.३.५ राष्ट्रिय खेल परिषद्का लागि सिफारिसहरू

मुख्य सिफारिसहरू

- **राष्ट्रिय स्तरमा एन्ड्युरेन्स प्रशिक्षण कार्यक्रम विकास र कार्यान्वयन गर्नु**
  सबै खेल संघहरू र प्रशिक्षण केन्द्रहरूमा मांसपेशी सहनशीलता प्रशिक्षण लाई अनिवार्य गरी, खेलाडीहरूको प्रदर्शन सुधार र चोटपटक रोकथाममा सहयोग पुर्‍याउने व्यवस्था गर्नु पर्छ।
- **चोटपटक रोकथाम शिक्षा कार्यक्रमलाई सुदृढ गर्नु**
  प्रशिक्षक लाइसेन्सिङ र खेलाडी विकास कार्यक्रममा चोटपटक रोकथाम सेमिनार अनिवार्य गर्नु, जसमा बायोमेकानिक्स, सही वार्म-अप र कूल-डाउन, उपकरणको प्रयोग, र प्राथमिक उपचार समावेश गर्नुहोस्।
- **राष्ट्रिय खेल चोटपटक निगरानी प्रणाली स्थापना गर्नु**
  देशभरका क्लब, विद्यालय र प्रतियोगिताबाट चोटपटकको विवरण संकलन गर्ने केन्द्रीय डाटाबेस तयार गरी, भविष्यको नीति, तालिम निर्देशिका र खेलाडी स्वास्थ्य सुरक्षामा सुधार ल्याउनु पर्छ।

- **लडाई खेलका लागि सुरक्षा मापदण्ड तय गर्नु**
  तेक्वान्दो लगायतका लडाई खेलमा न्यूनतम प्रशिक्षण र रिकभरी मापदण्ड, उपकरण परीक्षण र प्रमाणिकरण, चोटपटक रिपोर्टिङ प्रणाली, र खेलाडी मेडिकल क्लियरेन्स प्रक्रिया विकास पर्छ।
- **खेलाडी स्वास्थ्य सेवा पहुँच सुधार गर्नु**
  राष्ट्रिय टोली र क्षेत्रीय प्रशिक्षण केन्द्रहरूमा फिजियोथेरापी, खेलकुद चिकित्सा, र चोटपटक पुनर्वास सेवा सुनिश्चित गर्नु पर्छ।
- **सरोकारीहरूसँग समन्वय र सहकार्यलाई प्रोत्साहन गर्नु**
  नेपाल तेक्वान्दो संघ, अन्य खेल संघहरू, स्वास्थ्यकर्मी, शैक्षिक संस्था र मन्त्रालयसँग सहकार्य गरी, चोटि रोकथाम र खेलाडी विकासका कार्यक्रमहरूलाई प्रभावकारी बनाउनु पर्छ।

नेपाल तेक्वान्दो संघका लागि सिफारिसहरू

मुख्य सिफारिसहरू

- **एन्ड्युरेन्स प्रशिक्षणलाई नियमित कार्यक्रममा समावेश गर्नु**
  सबै उमेर समूह र स्तरका खेलाडीहरूको लागि हप्तामा २-३ दिन संरचित मांसपेशी सहनशीलता प्रशिक्षण सुनिश्चित गरी चोटपटक रोकथाम र प्रदर्शन वृद्धि गर्नु पर्छ।
- **चोटपटक रोकथाम सेमिनारहरू आयोजना गर्नु**
  प्रशिक्षक र खेलाडीहरूलाई लक्षित गरी बायोमेकानिक्स, सही वार्म-अप/शान्त- चिसो हुनु,उपकरणको उचित प्रयोग, र प्राथमिक उपचार सम्बन्धी अन्तरक्रियात्मक सेमिनार नियमित सञ्चालन गर्नु पर्छ।
- **सुरक्षात्मक उपकरणको प्रयोगमा कडाइ गर्नु**
  तालिम र प्रतियोगितामा सुरक्षात्मक उपकरणको अनिवार्य प्रयोग गराउने नीतिलाई प्रभावकारी रूपमा कार्यान्वयन गर्नु पर्छ।
- **खेलाडीहरूको चोटपटक अभिलेख राख्ने प्रणाली विकास गर्नु**
  टिम र क्लब स्तरमा चोटपटकको नियमित विवरण संकलन गर्ने व्यवस्था गरी, खेलाडीको स्वास्थ्य स्थितिमा निगरानी राख्नु पर्छ।
- **प्रशिक्षकहरूलाई चोटपटक रोकथाम मा विशेष तालिम प्रदान गर्नु**
  प्रशिक्षक लाइसेन्स नवीकरण प्रक्रियामा चोटपटक रोकथाम र खेलाडी कल्याण सम्बन्धी तालिम अनिवार्य गर्नु पर्छ।
- **राष्ट्रिय खेल परिषद् र स्वास्थ्य विशेषज्ञहरूसँग सहकार्य गर्नु**
  तेक्वान्दो खेलाडीहरूको दीर्घकालीन स्वास्थ्य सुरक्षा, चोटपटक पुनर्वास र प्रदर्शन वृद्धिका लागि सम्बन्धित निकायहरूसँग संयुक्त कार्यक्रम सञ्चालन गर्नु पर्छ।

अन्तिम निष्कर्षहरू (मुख्य बुँदाहरू)

- काठमाडौं उपत्यकाका तेक्कान्दो खेलाडीहरूमा **तल्लो शरीरको चोटपटक धेरै देखियो**, विशेष गरी **घुँडा र खुट्टाको कुर्कुचा क्षेत्रमा**।
- **मांसपेशी सहनशीलता (स्क्वाट र किक टेस्ट)** र चोटपटकको अवस्थाबीच **प्रत्यक्ष बलियो सम्बन्ध फेला परेन**, जसले देखाउँछ कि सहनशीलता स्तर मात्रैले चोटपटकको सम्भावना निर्धारण गर्दैन।
- **हप्तामा प्रशिक्षणको बारम्बारता र घण्टा धेरै हुने खेलाडीहरूमा मांसपेशी सहनशीलता राम्रो** देखियो।
- **पुरुष खेलाडीहरूको मांसपेशी सहनशीलता** महिलाको भन्दा अलि बढी देखिए पनि, **चोटपटक हुने दर दुबैमा मिल्दोजुल्दो** थियो।
- **१६–२० वर्ष उमेर समूहका खेलाडीहरूमा** चोटपटकको घटना **धेरै देखियो**।
- **जातीय पृष्ठभूमि र टिम पृष्ठभूमि** ले चोटपटक अवस्थासँग **महत्वपूर्ण सम्बन्ध देखाएन**, जसले चोटपटक सबै समूहमा समान रूपमा देखिन्छ भन्ने संकेत गर्छ।
- **चोटपटक निवारण तालिमहरूमा सहभागिता** र **निवारण सम्बन्धी तालिम कार्यक्रमहरूको अभ्यास** खेलाडीहरूमा **कम देखियो**, जसले रोकथाम शिक्षामा कमीकमजोरी रहेको देखाउँछ।
- **आंशिक सहसंबंध विश्लेषण** बाट देखियो कि लिङ्ग, उमेर, र प्रशिक्षण आवृत्तिलाई नियन्त्रण गर्दा पनि **मांसपेशी सहनशीलताले चोटपटक अवस्थालाई महत्वपूर्ण रूपमा भविष्यवाणी गरेन**।
- **बहु प्रतिगमन विश्लेषण** ले देखायो कि **एकल कुनै पनि कारक चोटपटकको बलियो भविष्यवक्ता थिएन**, तर उमेर, प्रशिक्षण घण्टा र सहनशीलता प्रदर्शनजस्ता **कयौँ कारकहरूको संयोजनले केही प्रभाव देखायो**।
- समग्रमा, **संरचित चोटपटक निवारण शिक्षा र सहनशीलता विशेष प्रशिक्षण कार्यक्रमहरू आवश्यक** छन् ताकि खेलाडीहरूको चोटपटक कम भइ **प्रदर्शनमा सुधार** ल्याउन सकियोस्।

सारांश

यो अध्ययनले काठमाडौं उपत्यकाका तेक्वान्दो खेलाडीहरूको मांसपेशी सहनशीलता र तल्लो शरीरको चोटपटक अवस्थाबीचको सम्बन्धलाई अनुसन्धान गरेको छ। तेक्वान्दो एक शारीरिक रूपमा demanding (मेहनतपूर्ण) युद्धक खेल हो, जसमा छिटो किक प्रहार, dynamic footwork (गतिशील पाइला चाल) र दोहोरिने उच्च प्रभावकारी गतिविधिहरू सामेल हुन्छन्, जसले खेलाडीहरूलाई तल्लो शरीरको चोटपटकको उच्च जोखिममा पार्दछ। त्यसैले, खेलाडीहरूको सुरक्षाका लागि चोटपटकको सम्भावनामा प्रभाव पार्ने प्रशिक्षण, शारीरिक र जनसांख्यिकीय (demographic) तत्वहरू पहिचान गर्नु अत्यावश्यक छ।

यस अनुसन्धानका मुख्य उद्देश्यहरू तेक्वान्दो खेलाडीहरूको तल्लो शरीर मांसपेशी सहनशीलता स्थिति मूल्याङ्कन गर्ने, तल्लो शरीरको चोटपटकको प्रचलन (prevalence) जाँच गर्ने, र सहनशीलता प्रशिक्षण, जनसांख्यिकीय विशेषताहरू (उमेर, लिंग, जातीयता) तथा प्रशिक्षणसम्बन्धी चरहरू (प्रशिक्षण अवधि, आवृत्ति, र साप्ताहिक घण्टा) ले चोटपटकमा पार्ने प्रभावको विश्लेषण गर्ने रहेका छन्। साथै, यस अध्ययनले नेपालमा तेक्वान्दो प्रशिक्षण कार्यक्रममा चोटपटक रोकथाम रणनीतिहरूका लागि प्रमाणमा आधारित सिफारिसहरू प्रदान गर्ने लक्ष्य राखेको छ।

यो अध्ययनमा वर्णनात्मक-विश्लेषणात्मक क्रस-सेक्सनल (cross-sectional) अनुसन्धान डिजाइन लागू गरिएको थियो, जसमा मात्रात्मक र गुणात्मक दुवै दृष्टिकोण समावेश गरिएको थियो। नमुना काठमाडौं र ललितपुर जिल्लाका स्थानीय क्लबहरू, नेपाली सेना क्लब, नेपाल प्रहरी क्लब र सशस्त्र प्रहरी क्लबका **१६६ तेक्वान्दो खेलाडीहरू**बाट संकलन गरिएको थियो। सहभागीहरूमा **११४ जना पुरुष (६८.७%) र ५२ जना महिला (३१.३%)** समावेश थिए, जसको उमेर दायरा **१२ देखि ३४ वर्ष** थियो। तथ्यांक संकलनका लागि संरचित प्रश्नावली प्रयोग गरिएको थियो, जसमा जनसांख्यिकीय, प्रशिक्षण र चोटपटकसम्बन्धी जानकारीहरू संकलन गरियो, साथै शारीरिक सहनशीलता परीक्षणहरू (squat test तल्लो शरीरको मांसपेशी सहनशीलताको लागि र kick test किक सहनशीलताको लागि) पनि सञ्चालन गरियो।

तथ्यांक विश्लेषण SPSS सफ्टवेयर प्रयोग गरी गरिएको थियो। वर्णनात्मक तथ्यांकले नमुनाको विशेषता र चोटपटक प्रचलनलाई सारांशमा प्रस्तुत गर्यो। सम्बन्ध (correlation) र

बहुविवरणात्मक प्रतिगमन (multiple regression) विश्लेषणले मांसपेशी सहनशीलता, प्रशिक्षण तत्वहरू, र चोटपटक अवस्थाबीचको सम्बन्ध अन्वेषण गर्‍यो।

अध्ययनका निष्कर्षहरूले देखाएको छ कि **५७.२% खेलाडीहरूले तल्लो शरीरको चोटपटकको अनुभव गरेका थिए**, जसमा **२१–२५ वर्षको उमेर समूहमा सबैभन्दा बढी चोटपटक प्रचलन (६५.५%)** देखियो। लिंगका हिसाबले, पुरुष खेलाडीहरूमा चोटपटकको प्रचलन **(५८.८%)** अलि बढी देखिएको थियो भने महिलामा **(५३.८%)** थियो। स्थानीय क्लबका खेलाडीहरूमा चोटपटक बढी देखिनुले विभागीय क्लबहरूमा हुने चोटपटक रोकथाम कार्यक्रमको कमीलाई संकेत गर्दछ।

मांसपेशी सहनशीलता परीक्षण परिणामहरूले देखायो कि squat र kick test मा उच्च स्कोर प्राप्त गर्ने खेलाडीहरूमा चोटपटकको सम्भावना कम देखिएको थियो; तर **मांसपेशी सहनशीलता मात्र चोटपटकको बलियो पूर्वानुमानकर्ता भएन ($p > 0.05$)**। यसको विपरीत, **multiple regression विश्लेषणले प्रशिक्षण आवृत्ति, लिंग, र उमेर चोटपटक अवस्थाका महत्वपूर्ण पूर्वानुमानकर्ता भएको देखायो ($p < 0.05$)**। विशेष गरी, **सातामा ≥४ दिन प्रशिक्षण गर्ने खेलाडीहरूमा चोटपटक प्रचलन (४८.८%) कम** देखिएको थियो, जबकि ≤३ दिन प्रशिक्षण गर्नेहरूमा (६२.२%) थियो, जसले नियमित प्रशिक्षणले neuromuscular adaptation सुधारेर चोटपटक जोखिम घटाउँछ भन्ने संकेत गर्दछ।

अध्ययनले यो पनि देखायो कि **केवल ४६% खेलाडीहरूले कुनै चोटपटक रोकथाम तालिम वा सेमिनारमा सहभागी भएका थिए**, जसले खेलाडी र प्रशिक्षकहरूमा चोटपटक व्यवस्थापन र रोकथाम अभ्यासमा ज्ञानको कमी देखाउँछ।

यस अध्ययनका आधारमा तलका सिफारिसहरू गरिएको छ:

- तेक्वान्दो क्लब र प्रशिक्षकहरूले **सप्ताहमा कम्तीमा २-३ दिन तल्लो शरीर मांसपेशी शक्ति र खेल-विशिष्ट सहनशीलता केन्द्रित नियमित सहनशीलता प्रशिक्षण कार्यक्रम लागू गर्ने।**
- **चोटपटक रोकथाम सम्बन्धी शिक्षा र सेमिनारहरू नियमित प्रशिक्षण कार्यक्रममा समावेश गर्ने।**
- **खेलाडीहरूको तयारी अवस्था अनुगमन गर्न समय समयमा मांसपेशी सहनशीलता परीक्षण सञ्चालन गर्ने।**
- **चोटपटक स्क्रिनिङ र पुनःस्थापना सहयोगका लागि खेल फिजियोथेरापिस्टहरूसँग बहु-विषयगत सहकार्य प्रवर्द्धन गर्ने।**

निष्कर्षस्वरूप, तेक्वान्दो प्रदर्शनका लागि मांसपेशी सहनशीलता महत्वपूर्ण भए तापनि, चोटपटक रोकथामका लागि प्रशिक्षण आवृत्ति, उचित conditioning, र शिक्षा समावेश भएको समग्र दृष्टिकोण आवश्यक छ। यो अनुसन्धानले नेपाली तेक्वान्दो साहित्यमा आधारभूत तथ्यांक थप गरेको छ, जसले प्रशिक्षक, खेल संस्थाहरू र नीतिनिर्माताहरूलाई खेलाडीहरूको स्वास्थ्य, सुरक्षा र प्रतिस्पर्धात्मक सफलता वृद्धि गर्न व्यावहारिक दृष्टिकोणहरू प्रदान गर्दछ।