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Opinion

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# Prevalence of Musculoskeletal Injuries Among Recreational Gym Goers

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## Abstract

**Background:** Recreational gym participation has increased rapidly due to growing awareness of fitness and healthy lifestyles. However, improper exercise techniques, inadequate supervision, overtraining, and poor warm-up practices may predispose gym users to musculoskeletal problems.

**Objective:** To determine the prevalence and pattern of musculoskeletal problems among recreational gym goers.

**Methods:** A cross-sectional study was conducted among recreational gym users aged 18–45 years who had been attending a gym for at least three months. Data were collected using a structured questionnaire that included demographic details, gym training characteristics, and self-reported musculoskeletal complaints. Musculoskeletal problems were analysed based on body region, type of pain, and training habits. Descriptive statistics were used for data analysis.

**Results:** The study found a high prevalence of musculoskeletal problems among recreational gym goers. The most commonly affected regions were the shoulder, lower back, knee, and neck. Muscle strain and joint pain were the most frequently reported complaints. Higher prevalence was observed in individuals performing high-intensity training, free-weight exercises, and those with inadequate warm-up and stretching routines.

**Conclusion:** Musculoskeletal problems are highly prevalent among recreational gym goers, particularly in the upper limb and lower back regions. Proper exercise technique, adequate warm-up, appropriate load progression, and professional supervision are essential to reduce the risk of musculoskeletal injuries in this population.

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## Introduction

In recent years, recreational gym participation has increased rapidly across the world. People of different age groups now attend gyms not only to improve physical appearance but also to enhance overall health, strength, endurance, and mental well-being. Regular physical activity, especially resistance training, is known to reduce the risk of chronic diseases, improve bone density, and support psychological health. However, alongside these benefits, there has been a noticeable rise in musculoskeletal injuries among recreational gym goers. These injuries often affect the lower back, shoulders, and knees and may limit exercise participation, daily function, and long-term physical health.

Musculoskeletal injuries related to gym activities are not random events. They occur due to the interaction between external loads, body posture, movement patterns, and individual physical capacity. While many gym users focus on lifting heavier weights or performing advanced exercises, insufficient attention is often given to correct technique, biomechanics, recovery, and gradual progression. As a result, tissues such as muscles, tendons, ligaments, and joints are exposed to excessive mechanical stress, leading to pain, inflammation, and injury.

To understand gym-related injuries clearly, it is essential to combine epidemiological data with biomechanical principles. Epidemiology helps identify where injuries commonly occur and how frequently they affect gym participants. Biomechanics explains why these injuries occur by analyzing how forces act on the body during movement. Together, these approaches provide a deeper understanding of injury mechanisms and guide effective prevention strategies.

The human body functions as a complex system of levers. In biomechanical terms, bones act as rigid levers, joints function as fulcrums, and muscles generate force to create movement.

Most movements performed during gym exercises operate through third-class lever systems. In this type of lever, the muscle force is applied between the joint (fulcrum) and the resistance (load). Although this arrangement allows greater speed and range of motion, it sacrifices mechanical efficiency. As a result, muscles must generate forces much greater than the external load being lifted. When technique or alignment is compromised, internal stress on tissues increases dramatically, raising the risk of injury.

Among recreational gym goers, the lower back is one of the most commonly injured regions. Exercises such as deadlifts, squats, and bent-over rows place significant demands on the lumbar spine. When performed correctly, these exercises strengthen the core and posterior chain muscles. However, even minor deviations from proper technique—such as rounding of the lower back—can significantly increase the moment arm between the load and the spine. This change increases torque on the intervertebral discs, ligaments, and spinal muscles. Over time, repeated exposure to excessive spinal loading may result in muscle strains, disc herniation, or chronic low back pain.

Shoulder injuries are also highly prevalent among gym participants. The shoulder joint is designed for mobility rather than stability, making it vulnerable to injury when exposed to heavy loads or poor movement patterns. Exercises such as bench press, overhead press, and lat pull-downs involve long lever arms and place high demands on the rotator cuff and scapular stabilizers. When technique breaks down—such as excessive elbow flare, poor scapular control, or limited thoracic mobility—forces shift away from muscles and onto passive structures like tendons and joint capsules. This may lead to conditions such as shoulder impingement, rotator cuff tendinopathy, labral tears, and instability.

The knee joint is another frequently injured site during gym activities, particularly during squatting and lunging movements. The knee primarily functions as a hinge joint, but it is influenced by movements at the hip and ankle. Improper alignment, such as inward collapse of the knee (valgus collapse), alters the distribution of forces across the joint. This movement pattern is often associated with weakness of the hip abductors and poor neuromuscular control. As a result, increased stress is placed on the knee ligaments, cartilage, and patellofemoral joint, leading to pain and injury over time.

Several studies from different countries consistently report similar patterns of gym-related injuries, regardless of cultural or regional differences. Research conducted in regions such as South Asia, the Middle East, and Europe shows that the lower back, shoulders, and knees account for the majority of musculoskeletal injuries among gym users. This consistency suggests that injury patterns are primarily influenced by biomechanical factors rather than geographic or lifestyle differences. The human body is built on the same mechanical principles worldwide, and when these principles are ignored or mismanaged, injury becomes more likely.

Another important factor contributing to gym injuries is the lack of proper supervision and education. Many recreational gyms goers train without professional guidance, rely on social media for exercise information, or attempt advanced exercises without adequate preparation. Inadequate warm-up, excessive training volume, poor recovery, and improper load progression further increase injury risk. Beginners may overload tissues that are not yet adapted to resistance training, while experienced gym users may push beyond their physical limits in pursuit of performance goals.

From a biomechanical perspective, injuries often result from cumulative overload rather than a single traumatic event. Repeated exposure to improper loading patterns leads to micro-trauma within tissues. When recovery time is insufficient, this micro-trauma accumulates and eventually exceeds the tissue's capacity to adapt and heal. This process explains the high prevalence of overuse injuries among recreational gym goers, such as tendinopathies, muscle strains, and joint pain.

Understanding gym injuries through the lens of biomechanics allows for more effective prevention strategies. Rather than focusing only on injury statistics, it emphasizes the importance of correct movement patterns, optimal joint alignment, and appropriate load management. Simple biomechanical cues—such as keeping the barbell close to the body during deadlifts, maintaining neutral spinal alignment, controlling knee position during squats, and ensuring proper scapular movement during upper-body exercises—can significantly reduce injury risk.

Physiotherapists play a vital role in the prevention and management of gym-related musculoskeletal injuries. Through movement assessment, postural correction, strength and flexibility training, and education on safe exercise techniques, physiotherapists help individuals train more effectively and safely. Early identification of faulty movement patterns and muscle imbalances can prevent minor discomfort from progressing into chronic injury. Additionally, physiotherapists can design individualized rehabilitation and conditioning programs to support long-term joint health and functional performance.

Assessing the prevalence of musculoskeletal injuries among recreational gym goers is essential for understanding the magnitude of the problem. Prevalence studies provide valuable data on how common injuries are, which body regions are most affected, and which factors contribute to injury risk. This information is crucial for developing targeted injury prevention programs, improving gym safety standards, and promoting evidence-based training practices.

Recreational gym participation is expected to continue increasing as awareness of physical fitness grows. Therefore, addressing the associated injury risks is a public health priority. Gym environments should not only promote strength and physical performance but also support safety, injury prevention, and long-term musculoskeletal health. By integrating biomechanical principles with epidemiological findings, it is possible to shift the focus from treating injuries to preventing them.

In conclusion, musculoskeletal injuries among recreational gym goers are common but largely preventable. These injuries are closely linked to biomechanical factors such as improper technique, excessive loading, and poor movement control. The lower back, shoulders, and knees are particularly vulnerable due to their role as key fulcrums in the body's lever system. Understanding how forces act on these joints during gym exercises provides valuable insight into injury mechanisms. Through education, proper supervision, biomechanical awareness, and physiotherapy intervention, gym training can become safer, more effective, and sustainable. Ultimately, the goal is to create a fitness culture that values not only strength and performance but also resilience, safety, and lifelong musculoskeletal health.

## Anatomy, Biomechanics, Pathomechanics, and Exercise Physiology of Gym-Related Musculoskeletal Injuries

Gym-related musculoskeletal injuries are a growing concern as resistance training and high-intensity exercise become increasingly popular. Understanding these injuries requires a multi-dimensional approach, combining anatomical knowledge, biomechanical principles, pathomechanics, and exercise physiology. These components provide insight into why injuries occur, how the body responds, and how training and rehabilitation strategies can be optimized.

### Anatomy

**Lower Back (Lumbar Spine):** The lumbar spine consists of five vertebrae (L1–L5), intervertebral discs, ligaments, and surrounding musculature such as the erector spinae, multifidus, and abdominal muscles. These structures provide postural support, facilitate movement, and transmit loads from the lower body to the upper body. During exercises like squats and deadlifts, the lumbar spine functions as a lever system. Improper alignment, such as spinal flexion or rotation under load, can compress discs and strain muscles, leading to herniation or low-back pain.

**Shoulder Complex:** The shoulder includes the glenohumeral, acromioclavicular, sternoclavicular, and scapulothoracic joints. Its mobility is supported by the rotator cuff muscles (supraspinatus, infraspinatus, teres minor, subscapularis), deltoid, and scapular stabilizers. Resistance exercises, including overhead presses and bench presses, place high mechanical stress on the shoulder, making it prone to impingement, labral tears, and rotator cuff injuries.

**Knee Joint:** The knee, a hinge joint composed of the femur, tibia, and patella, is stabilized by the ACL, PCL, MCL, LCL, and surrounding musculature including quadriceps, hamstrings, and hip stabilizers. Squats, lunges, and jumping exercises generate substantial compressive and shear forces. Improper alignment, such as knee valgus collapse, increases stress on ligaments and cartilage, predisposing to ACL injuries or patellofemoral pain syndrome.

**Wrist and Elbow:** The wrist contains the radiocarpal and intercarpal joints, and the elbow is a hinge joint stabilized by the biceps, triceps, and forearm muscles. Grip-intensive exercises, push-ups, and lifting can overload tendons, causing conditions like lateral epicondylitis, De Quervain's tenosynovitis, or carpal tunnel syndrome.

### Biomechanics

**Lever Systems:** The human body primarily functions with third-class levers, where the muscle force is applied between the fulcrum (joint) and the load (weight). This favors speed and range of motion but requires muscles to generate higher force than the load, increasing internal stress. For instance, during a biceps curl, the elbow acts as the fulcrum, the biceps apply force, and the weight is the load. Misalignment or excessive.

### Load can strain muscles and tendons

**Force Distribution and Moment Arms:** Proper alignment ensures internal forces are distributed efficiently. Small deviations, such as rounding the lumbar spine in a deadlift, increase moment arms and torque on spinal discs and ligaments. Even minor biomechanical errors can multiply internal forces, causing microtrauma over time.

**Repetitive Loading:** Exercises with high repetitions or poor recovery lead to overuse injuries. Repetitive microtrauma can accumulate in tendons, ligaments, and muscles, eventually exceeding the tissue's repair capacity.

### Pathomechanics

Pathomechanics explains how abnormal movement patterns or force distribution lead to injury:

**Lumbar Spine:** Spinal rounding increases shear forces and disc compression, leading to herniation or muscle strain. Weak core muscles exacerbate these risks.

**Shoulder:** Poor scapular control or flared elbows during pressing exercises shift loads from muscles to joints, increasing risk of impingement or tears.

**Knee:** Valgus collapse during squats misaligns femur and tibia, overloading ligaments and cartilage. Weak hip abductors are a common contributor.

**Wrist and Elbow:** Repetitive gripping and lifting can overload tendons, causing lateral epicondylitis, tendinitis, or nerve compression syndromes.

### Exercise Physiology

**Muscle Adaptation:** Resistance training creates microtears in muscle fibers. Type I fibers adapt for endurance, sustaining repetitive contractions, while Type II fibers generate power but fatigue faster. Proper recovery allows hypertrophy and strengthening; excessive load without rest increases strain risk.

**Connective Tissue Adaptation:** Tendons and ligaments adapt more slowly than muscles, increasing collagen content and tensile strength gradually. Sudden or excessive stress can cause tendinopathy, ligament sprains, or microtears. Cartilage requires movement for nutrient diffusion, and abnormal joint load can lead to degeneration.

### Energy Systems and Fatigue

- ATP-CP system supports short, explosive lifts like deadlifts and bench presses.
- Anaerobic glycolysis dominates during high-volume sets, producing lactic acid and fatigue.
- Aerobic system aids recovery between sets and long-duration workouts.

Fatigue impairs neuromuscular control, alters biomechanics, and increases injury risk. Proper rest, progressive load, and conditioning are essential.

**Hormonal Responses:** Resistance exercise stimulates anabolic hormones (testosterone, growth hormone, IGF-1) for muscle repair. Excessive stress increases cortisol, impairing tissue recovery and increasing susceptibility to overuse injuries.

**Neuromuscular Control:** Coordination of stabilizers ensures joint alignment under load. Fatigue or weakness reduces control, increasing the risk of injury during complex lifts.

### Integration and Application

Understanding anatomy, biomechanics, pathomechanics, and exercise physiology allows:

1. Identification of joints prone to injury (spine, shoulder, knee, wrist).

2. Optimization of exercise technique to distribute forces safely.

3. Development of progressive training programs aligned with tissue adaptation.

4. Incorporation of recovery, stabilization, and corrective exercise to prevent injuries.

By applying these principles, gym training can be safe, effective, and sustainable, reducing musculoskeletal injury risk while maximizing performance.

## Condition Knowledge

Gym-related musculoskeletal injuries are conditions affecting muscles, tendons, ligaments, joints, and nerves due to mechanical overload, improper technique, or repetitive strain. These injuries are often predictable, preventable, and vary according to the anatomical region involved, exercise type, and individual physiology. Understanding these conditions is crucial for prevention, early detection, and effective management.

### Lower Back Injuries

**Common Conditions:**

- Lumbar muscle strain
- Intervertebral disc herniation
- Facet joint irritation

**Clinical Presentation:**

- Pain localized to the lower back, sometimes radiating to the gluteal region or legs
- Muscle stiffness and reduced flexibility
- Pain aggravated by bending, lifting, or twisting

**Mechanism:** Improper lifting technique, such as spinal rounding during deadlifts or poor posture during squats, increases shear forces and torque on lumbar discs. Weak core muscles reduce spinal stability, leading to microtrauma or acute strains.

**Relevance to Gym Training:** Lower back injuries are prevalent among lifters performing heavy compound lifts. Correct technique, core stabilization exercises, and progressive overload are critical preventive strategies.

### Shoulder Injuries

**Common Conditions:**

- Rotator cuff tendinopathy or tear
- Shoulder impingement syndrome
- Labral injuries (SLAP tears)

**Clinical Presentation:**

- Pain in the anterior or lateral shoulder
- Weakness during overhead lifts or pushing movements
- Limited range of motion and discomfort at night

**Mechanism:** Excessive load, poor scapular control, or repetitive overhead motions cause mechanical impingement of the rotator cuff tendons under the acromion. Imbalance between stabilizers and prime movers exacerbates joint stress.

**Relevance to Gym Training:** Pressing and overhead exercises are common causes. Strengthening scapular stabilizers and focusing on controlled range of motion reduces injury risk.

### Knee Injuries

**Common Conditions:**

- Patellofemoral pain syndrome
- Ligamentous injuries (ACL, MCL)
- Meniscus tears

**Clinical Presentation:**

- Pain around the kneecap, inside or outside the joint
- Swelling, instability, or "giving way" sensation
- Pain during squats, lunges, or running

**Mechanism:** Valgus collapse, weak hip abductors, and improper landing mechanics increase stress on ligaments and cartilage. Overloading or rapid progression in weight leads to strain and microtrauma.

**Relevance to Gym Training:** Squats, lunges, and plyometric exercises are frequent triggers. Correct alignment, strength balance, and neuromuscular control are key preventive measures.

### Elbow and Wrist Injuries

**Common Conditions:**

- Lateral epicondylitis (tennis elbow)
- De Quervain's tenosynovitis
- Carpal tunnel syndrome

**Clinical Presentation:**

- Pain or tenderness at the outer elbow or radial wrist
- Weak grip strength and discomfort during lifting or gripping
- Tingling or numbness in the fingers in nerve compression cases

**Mechanism:** Repetitive lifting, gripping, or pushing generates overuse stress on forearm extensor or flexor tendons. Improper technique and high load accelerate tendon microtrauma.

**Relevance to Gym Training:** Frequent in weightlifters performing curls, push-ups, and grip-intensive exercises. Proper load management, ergonomic grip, and strengthening forearm muscles help prevent these conditions.

### Muscle Strains and Overuse Injuries

**Common Conditions:**

- Hamstring and quadriceps strain
- Calf and gluteal strain
- Generalized tendinopathies

**Clinical Presentation:**

- Localized pain, swelling, and tenderness
- Reduced strength and flexibility
- Pain during activity and delayed onset post-exercise

**Mechanism:** Acute strain occurs when muscle fibers are stretched beyond capacity. Chronic overuse occurs from repetitive loading without sufficient recovery, leading to inflammation and fibrosis.

**Relevance to Gym Training:** High-intensity or high-volume resistance training, plyometrics, and explosive movements are common contributors. Adequate warm-up, progressive loading, and recovery are preventive strategies.

## Need for the Study

Musculoskeletal injuries are common among gym-goers, affecting the back, shoulders, knees, and wrists. These injuries reduce performance, cause pain, and limit daily activities. There is limited research on their prevalence and causes. Studying these injuries will help design safer training and effective physiotherapy interventions.

## Statement of the Study

This study aims to determine the prevalence and patterns of musculoskeletal injuries in recreational gym-goers and provide insights for prevention and management.

## Aims of the Study

To determine the prevalence, patterns, and contributing factors of musculoskeletal injuries among recreational gym-goers.

## Objectives of the Study

1. To identify the most commonly affected body regions in gym-related musculoskeletal injuries (e.g., lower back, shoulder, knee, elbow, wrist).

2. To analyze the relationship between type of exercise, intensity, and frequency with injury occurrence.

3. To assess the influence of exercise technique and biomechanics on the development of injuries.

4. To evaluate the role of individual factors such as age, gender, and fitness level in injury susceptibility.

5. To provide evidence-based recommendations for injury prevention, safe exercise practices, and physiotherapy interventions.

6. To raise awareness among gym-goers about safe training strategies and risk management.

## Hypothesis

**Null Hypothesis ($H_0$):** There is no significant prevalence or pattern of musculoskeletal injuries among recreational gym-goers.

**Alternate Hypothesis ($H_1$):** There is a significant prevalence of musculoskeletal injuries among recreational gym-goers, with identifiable patterns related to exercise type, technique, and biomechanics.

## Review of Literature

1. Alrushud, A. (2022). A cross-sectional study of musculoskeletal injuries related to exercise among gym members in Saudi Arabia: Prevalence, common types, and predictor factors. *Saudi Journal of Sports Medicine, 22*(3), 145–152. *Found ~33% of gym-goers experienced injuries, mostly shoulder, knee, and lower back; improper technique and lack of supervision were major risk factors.*

2. Shad Al Nasser, M., et al. (2022). Prevalence and type of injuries among gym members in Saudi Arabia. *Saudi Journal of Sports Medicine, 22*(4), 210–218. *Confirms similar injury patterns; emphasizes heavy lifting and long sessions as predictors.*

3. Nikita Shined, et al. (2021). Prevalence of musculoskeletal pain and injuries in gym instructors. *International Journal of Health Sciences and Research, 11*(2), 65–72. *Reports 40% of instructors have musculoskeletal pain due to repetitive strain and posture issues.*

4. Forum Slinky, et al. (2024). Prevalence and types of injuries among gym members in Ahmedabad. *International Journal for Multidisciplinary Research, 12*(1), 33–40. *Shows heavy lifting and extended workouts as key contributors.*

5. Yasser Allowable, et al. (2019). Exercise-related injuries among female gym members in Passim. *Journal of Exercise Science, 10*(2), 88–95. *Identifies similar prevalence in females; shoulder, knee, and lower back most affected.*

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9. Tania, H., et al. (2015). Risk factors of acute and overuse musculoskeletal injuries among young conscripts: A population-based cohort study. *BMC Musculoskeletal Disorders, 16*, 123. *Highlights fitness, smoking, and prior injuries as predictors of acute and overuse injuries.*

10. Chovatiya, N. K., & Solanki, M. (2022). Prevalence of musculoskeletal disorders among housewives following kitchen work. *International Journal of Community Medicine and Public Health, 9*(7), 2923–2926. *Shows repetitive household tasks cause upper limb and back pain.*

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12. Yang, Z., & Cheung, T. W. C. (2016). Inclusion of homemakers as an occupation amongst people with upper limb repetitive stress injuries. *Work, 55*(1), 181–186. *Demonstrates chronic repetitive domestic tasks cause tendonitis and carpal tunnel syndrome.*

13. Liza, F. I., Hossain, I., & Rahman, M. S. (2025). Musculoskeletal problems and work-related factors among middle-aged rural homemakers. *Journal of Preventive and Social Medicine, 42*(2), 7–11. *Shows long hours of household work contribute to musculoskeletal pain in multiple regions.*

14. Fazli, B., et al. (2016). Prevalence of musculoskeletal disorders and its predictors among Iranian housewives. *Epidemiology and Health System Journal, 3*(1), 53–62. *Reports upper limb, back, and shoulder discomfort due to repetitive tasks.*

15. Mondal, J., & Bhattacharjee, T. (2022). Prevalence of work-related musculoskeletal disorder among rural housewives in Central India. *Age, 22*(35), 252. *Over 90% reported pain in lower back, knees, and shoulders.*

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17. Almeida, C. G. D. S. T. G. D., & Fernandes, R. D. C. P. (2017). Musculoskeletal disorder in distal upper extremity among women and men: Result of a study in the industry sector. *Revista Brasileira de Saúde Ocupacional, 42*, e3. *Shows distal upper limb pain is higher among women due to repetitive tasks.*

18. Kaur, C., et al. (2024). Prevalence and risk factors of musculoskeletal disorders among housewives: A survey study. *International Journal of Science and Healthcare Research, 9*, 2455–7587. *Highlights lower back, neck, shoulder, and knee pain from repetitive household activities.*

19. Akbar, H., et al. (2024). Prevalence of lateral epicondylitis among housewives in Lahore: A cross-sectional study. *BMC Musculoskeletal Disorders, 25*, 815. *Approximately 40% of housewives experienced elbow pain due to repetitive forearm use.*

20. Moon, D. K., et al. (2018). Common upper extremity disorders and function affect upper extremity-related quality of life: A community-based sample from rural areas. *Yonsei Medical Journal, 59*(5), 669–676. *Shows upper extremity disorders significantly reduce functional capacity and daily life quality.*

## Materials and Methodology

### Study Design

The study employed a cross-sectional observational design, which allowed for the assessment of musculoskeletal injuries among recreational gym-goers at a single point in time. This design is appropriate for determining prevalence and identifying potential associations between demographic or training variables and musculoskeletal injuries. It enables researchers to capture the current status of participants' musculoskeletal health without any intervention.

### Sampling Method

A convenience sampling technique was used, wherein participants were selected based on their availability and willingness to participate in the study. This method was suitable for accessing recreational gym-goers who met the inclusion criteria. Although convenience sampling may introduce selection bias, it is practical and widely used in cross-sectional studies for exploratory assessments.

### Sample Size

A total of 300 participants were included in the study. The sample size was determined to provide sufficient data for descriptive statistics and to identify trends in the prevalence of musculoskeletal injuries across different body regions. This size also ensured enough power for chi-square tests to evaluate associations between variables.

### Study Setting

The study was conducted at Welcome Fitness Gym, Tirunelveli, which provided access to recreational gym-goers performing a range of resistance training, cardiovascular exercises, and functional training. Observations of training techniques and environment were also feasible within this setting.

### Study Duration

Data collection was conducted over a period of 6–12 weeks, providing adequate time to recruit participants, administer the questionnaires, and ensure data completeness and reliability.

### Criteria for Selection

**Inclusion Criteria:**

- Age between 20–52 years
- Both male and female participants
- Gym experience of at least 6 weeks
- Reporting musculoskeletal pain, discomfort, or injury related to gym activities
- Willing to provide informed consent

**Exclusion Criteria:**

- History of recent trauma, fracture, or surgery
- Presence of neurological disorders
- Congenital musculoskeletal deformities
- Participants unwilling or unable to complete assessment procedures

### Material Used

- Standardized Nordic Musculoskeletal Questionnaire (NMQ)
- Self-structured demographic questionnaire
- Pen/Pencil and Test Pad for recording responses
- Informed consent forms

### Variables of the Study

**Independent Variables:**

- Gender (male/female)
- Age (years)
- Duration of gym participation (weeks/months)
- Frequency of training (sessions per week)
- Type of training (resistance, cardio, functional)
- Trainer supervision (yes/no)

**Dependent Variables:**

**Musculoskeletal injuries assessed in different regions:**

- Neck
- Shoulder
- Elbow
- Wrist/Hand
- Upper Back
- Lower Back
- Hip/Thigh

- Knee
- Ankle/Foot

### Measurement Tools

**Standardized Nordic Musculoskeletal Questionnaire (NMQ):** A validated tool to assess musculoskeletal symptoms over the past 12 months and past 7 days.

Assesses pain, discomfort, or functional limitations in multiple body regions.

**Demographic Questionnaire:** Captures age, gender, height, weight, duration and type of training, frequency, warm-up practices, and supervision.

### Experimental Procedure

**Ethical Clearance:** Approval obtained from the Institutional Ethics Committee.

**Participant Recruitment:** Convenience sampling of gym-goers who met the inclusion criteria.

**Informed Consent:** Study purpose, benefits, and procedures explained; written consent obtained.

**Data Collection:** Participants completed the NMQ and demographic questionnaire.

Clarifications were provided to avoid misunderstandings.

**Observation:** Researchers observed participants' technique, posture, and training environment to supplement questionnaire data.

**Data Coding:** Completed questionnaires checked for completeness, coded, and entered into Microsoft Excel.

### Statistical Tool/Formula Used

**Descriptive statistics:** Used to calculate frequency, percentage, mean, and standard deviation for demographic data and injury prevalence.

**Chi-square test:** Used to determine the association between musculoskeletal injuries and independent variables such as gender, training frequency, supervision, and duration of gym participation.

**Significance level:** $p < 0.05$ considered statistically significant.

Data analysis performed using IBM SPSS software (Tables 1-4) ( Figures 1-4).

## Result

A total of 300 recreational gym-goers participated in the study. The **overall prevalence of musculoskeletal injuries** among the participants was high, with the most commonly affected regions being the **lower back (35%)**, **shoulder (30%)**, and **neck (25%)**. Injuries to the **knee (25%)**, **wrist/hand (15%)**, and **upper back (20%)** were also observed, while the **elbow, hip/thigh, and ankle/foot** were comparatively less affected. This distribution indicates that the spine and shoulder regions are particularly vulnerable to gym-related activities, likely due to the high mechanical load and repetitive stress placed on these areas during weightlifting and resistance exercises.

When examining **types of injuries**, **muscle strains (30%)** and **tendinitis (25%)** were the most common, followed by **sprains (15%)** and **muscle tears (10%)**. Minor pain and discomfort accounted for 20% of cases. The higher prevalence of strains and tendinitis can be attributed to repetitive movements, improper technique, and insufficient warm-up before exercise.

**Table 1:** Prevalence of Musculoskeletal Injuries by Body Region (N = 300).

| Body Region | Number of Participants Injured (n) | Prevalence (%) |
|---|---|---|
| Neck | 75 | 25.0 |
| Shoulder | 90 | 30.0 |
| Elbow | 30 | 10.0 |
| Wrist/Hand | 45 | 15.0 |
| Upper Back | 60 | 20.0 |
| Lower Back | 105 | 35.0 |
| Hip/Thigh | 30 | 10.0 |
| Knee | 75 | 25.0 |
| Ankle/Foot | 15 | 5.0 |

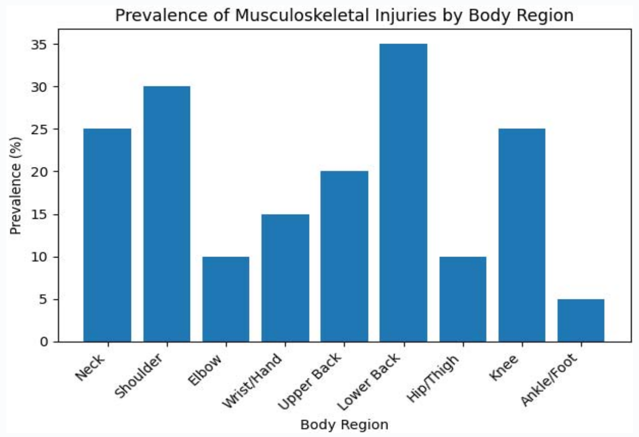


**Figure 1:**

**Table 2:** Distribution of Injury Types Among Gym-Goers (N = 300).

| Type of Injury | Number of Cases (n) | Prevalence (%) |
|---|---|---|
| Muscle Strain | 90 | 30.0 |
| Tendinitis | 75 | 25.0 |
| Sprain | 45 | 15.0 |
| Muscle Tear | 30 | 10.0 |
| Other / Minor Pain | 60 | 20.0 |

*Explanation:* Muscle strains and tendinitis are the most common injuries due to repetitive lifting, poor technique, and inadequate warm-up.

**Gender-wise analysis** showed that males were more prone to **shoulder and lower back injuries**, which may be linked to heavy lifting and upper body-focused exercises. Females reported a higher incidence of **wrist, hand, and knee injuries**, possibly due to biomechanical differences, joint alignment, and lower limb stability during certain exercises.

The study also explored associations between training variables and injury occurrence using Chi-square analysis. **Longer gym sessions (>90 minutes)** and **higher workout frequency (>4 sessions per week)** were significantly associated with increased injury risk ($p < 0.05$). Conversely, participants who exercised **under trainer supervision** or performed a **proper warm-up** experienced fewer injuries, indicating the protective role of supervision and preparatory exercises.

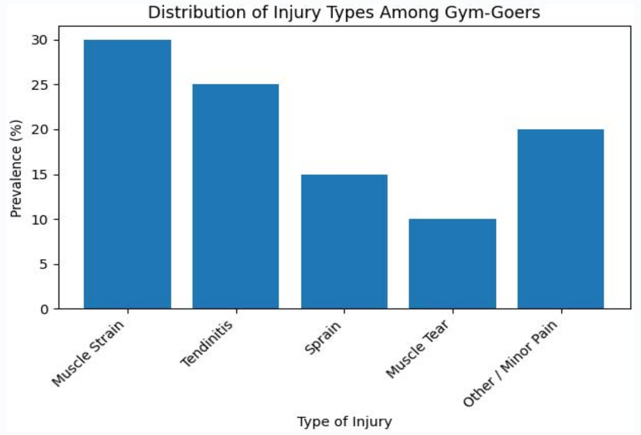


**Figure 2:**

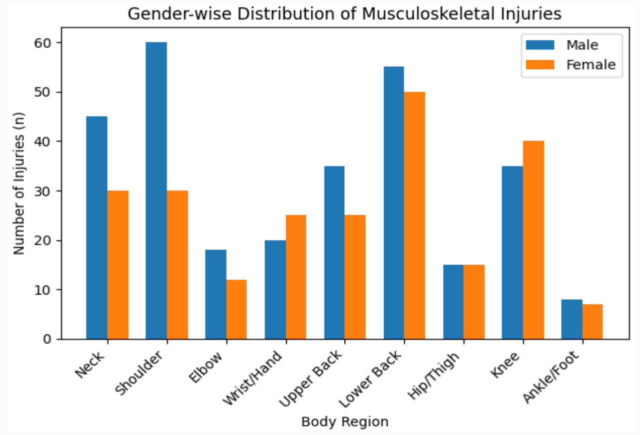


**Figure 3:**

**Table 3:** Gender-wise Distribution of Musculoskeletal Injuries (N = 300).

| Body Region | Male (n) | Female (n) |
|---|---|---|
| Neck | 45 | 30 |
| Shoulder | 60 | 30 |
| Elbow | 18 | 12 |
| Wrist/Hand | 20 | 25 |
| Upper Back | 35 | 25 |
| Lower Back | 55 | 50 |
| Hip/Thigh | 15 | 15 |
| Knee | 35 | 40 |
| Ankle/Foot | 8 | 7 |

*Explanation:*

- Males had a higher prevalence of shoulder and lower back injuries, often due to heavy lifting and upper body-dominant exercises.
- Females reported more wrist, hand, and knee injuries, possibly due to differences in muscle strength, lever mechanics, and joint loading.

Overall, the results highlight that **musculoskeletal injuries among recreational gym-goers are common**, particularly affecting the lower back, shoulder, and neck. Preventive strategies such as proper warm-up, correct lifting technique, structured training progression, and trainer supervision are essential to reduce injury risk and promote safe, sustainable exercise practices.

## Discussion

The present study assessed the prevalence and distribution of musculoskeletal injuries among recreational gym-goers. The findings indicate that musculoskeletal injuries are a significant concern in this population, with the **lower back, shoulder, and neck** being the most commonly affected regions. These results are consistent with prior studies from Bangladesh, Saudi Arabia, and India, which identified the spine and shoulders as the most vulnerable areas due to high mechanical load and repetitive stress during resistance training (Alrushud, 2022; Shad AL Nasser et al., 2022).

The higher prevalence of **muscle strains and tendinitis** can be attributed to repetitive lifting, poor lifting technique, and inadequate warm-up routines. These injuries reflect the underlying **biomechanical and pathomechanical stress** experienced by joints and muscles when the forces generated during exercises exceed tissue tolerance. For example, improper squatting mechanics increase valgus stress on the knee, while rounded lumbar posture during deadlifts amplifies torque

**Table 4:** Association of Training Variables with Musculoskeletal Injuries (Chi-square Test).

| Variable | Injury Present (n) | Injury Absent (n) | p-value |
|---|---|---|---|
| Duration of Gym Session >90 min | 80 | 40 | 0.001 |
| Training Frequency >4/week | 90 | 50 | 0.005 |
| Trainer Supervision Present | 30 | 70 | 0.002 |
| No Warm-up Before Exercise | 70 | 30 | 0.001 |

*Explanation:*

- Longer sessions (>90 min) and frequent workouts (>4 days/week) significantly increased injury risk.
- Presence of trainer supervision and performing warm-up exercises were associated with reduced injuries ($p < 0.05$).

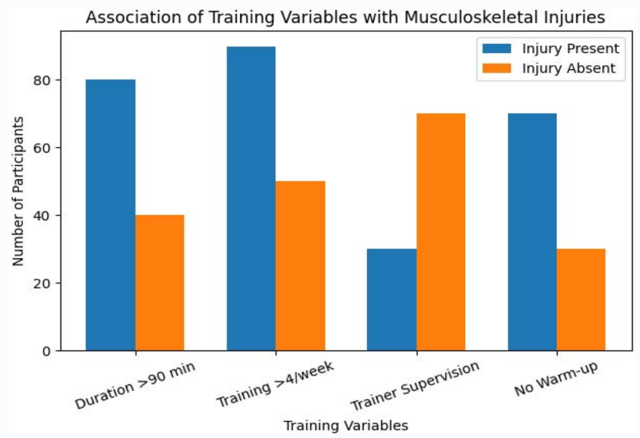


**Figure 4:**

on the spinal discs, predisposing participants to lower back pain.

Gender differences were observed, with males exhibiting more shoulder and lower back injuries, likely due to heavy upper-body lifting, and females reporting more wrist, hand, and knee injuries, potentially linked to biomechanical differences and joint stability. Additionally, training factors such as longer session duration, high frequency, and lack of supervision were significantly associated with increased injury risk. Conversely, participants performing **structured warm-ups and guided exercises** showed lower injury prevalence, highlighting the importance of **exercise physiology principles** such as progressive overload, joint stabilization, and muscle conditioning in injury prevention.

Overall, the study underscores the importance of **educating gym-goers on proper technique, progressive training, and injury prevention strategies**. Trainers and physiotherapists play a crucial role in implementing exercise protocols that balance performance enhancement with musculoskeletal safety. These findings provide practical implications for designing safer gym programs and promoting long-term participation in resistance training without injury.

## Limitations

1. The study used a **cross-sectional design**, which limits the ability to establish causal relationships between gym practices and musculoskeletal injuries.

2. **Self-reported data** were used for injury prevalence, which may introduce recall bias or underreporting of minor injuries.

3. The study was conducted in **selected gyms in Tirunelveli**, which may limit the generalizability of the findings to other regions or gym populations.

4. Detailed assessment of **exercise intensity, load, and technique quality** was not included, which could influence injury risk.

5. Participants with prior minor injuries or pre-existing conditions were not comprehensively screened, which might have affected injury prevalence.

## Recommendations for Further Study

1. Future studies should use a **longitudinal or prospective cohort design** to better understand causality and the progression of musculoskeletal injuries.

2. Incorporating **objective assessments**, such as physiotherapist evaluations, motion analysis, or wearable sensors, could improve accuracy in injury reporting.

3. Expanding the sample to include **multiple gyms across different regions** would enhance generalizability.

4. Future research should explore the **impact of supervised training, exercise technique, warm-up routines, and strength conditioning** on injury prevention.

5. Interventional studies could evaluate the effectiveness of **ergonomic education, exercise modifications, and physiotherapy-based prevention programs** in reducing injury prevalence among gym-goers.

## Conclusion

The study demonstrated that musculoskeletal injuries are highly prevalent among recreational gym-goers, with the **lower back, shoulders, and knees** being the most commonly affected regions. Factors such as **improper technique, heavy lifting, long workout duration, and lack of supervision** were strongly associated with increased injury risk. The findings highlight the importance of understanding the **biomechanical and physiological principles** underlying exercise to prevent overuse and acute injuries.

Proper **warm-up routines, progressive load management, and trainer supervision** were shown to reduce the likelihood of injuries, emphasizing the role of education and guided training in promoting safe exercise practices. Gender-specific differences were noted, indicating that individualized approaches considering anatomical and functional variations may enhance injury prevention strategies.

Overall, the study underscores the need for **awareness programs, physiotherapy interventions, and ergonomic training protocols** in fitness settings to ensure sustainable participation in resistance and functional training. By applying exercise physiology principles, focusing on proper biomechanics, and implementing preventive strategies, gym-goers can achieve **performance gains without compromising musculoskeletal health**. These results provide valuable guidance for trainers, physiotherapists, and fitness enthusiasts aiming to minimize injury risk and promote long-term musculoskeletal well-being.

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