

THE EFFECT OF FITNESS TRAINING ON STRIDE LENGTH AND HIP JOINT ANGLE IN OBESE INDIVIDUALS: A KINEMATIC ANALYSIS

Dr. Sapam Sanatombi Devi

Assistant Professor, Department of Physical Education, National Sports University, Manipur

Dr. Satish Kumar

Assistant Professor, Department of Physical Education & Director of Sports, The ICFAI University, Tripura

Mr. Sairem Marco

Ph.D. Scholar, Department of Physical Education, Manipur International University, Manipur

Ms. Ningthoujam Jeny

Football Coach, Department of Sports Coaching, National Sports University, Manipur

Ms. R.K.Satyapriya Devi

Archery Coach, Department of Sports Coaching, National Sports University, Manipur

Ms. Oinam Wangoleima Chanu

Taekwondo Coach, Department of Physical Education, National Sports University, Manipur

Ms. Hajarimayum Haripyari

Fencing Coach, Department of Physical Education, National Sports University, Manipur

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Abstract

Introduction: Obesity is a prevalent health concern globally, affecting biomechanics and movement efficiency. Individuals with obesity often exhibit altered gait patterns, leading to a shorter stride length and restricted joint mobility. Addressing these biomechanical deficiencies through structured fitness interventions is crucial in enhancing mobility and reducing musculoskeletal stress. This study explores the impact of a six-week physical fitness training program on stride length and hip joint angle in obese individuals.

Design and Methodology: A total of 200 male and female obese participants, aged 35-45 years, were selected through random sampling from Chhattisgarh, India. The participants underwent a six-week structured training program that included endurance, strength, speed, plyometric, and circuit training exercises. Walking trials were recorded using high-speed video analysis, and kinematic variables such as stride length and hip joint angle were analyzed pre- and post-training using KINOVEA software.

Statistical Analysis: Data were analyzed using ANOVA at a 0.05 level of significance. The analysis revealed a statistically significant improvement ($p < 0.01$) in both stride length and hip joint angle post-training. The mean stride length increased from 75.3 cm to 85.6 cm, while the hip joint angle improved from 32.5° to 38.2°, demonstrating enhanced mobility and movement efficiency in participants.

Conclusion: The results indicate that a well-structured fitness training regimen significantly enhances gait mechanics in obese individuals. The observed improvements in stride length and hip joint angle suggest better locomotion efficiency and reduced movement restrictions, potentially lowering the risk of joint-related disorders. This study underscores the necessity of incorporating biomechanical assessments and structured exercise programs into obesity management strategies. Future research should focus on long-term sustainability and additional training modalities to further optimize gait mechanics in obese individuals.

Keywords: Kinematics, Obesity, Stride Length, Hip Joint Angle, Fitness Training

Introduction

Obesity is a growing global health concern linked to reduced physical activity and altered biomechanics. The prevalence of obesity has risen dramatically in recent decades, contributing to various metabolic disorders and reduced physical efficiency. Walking, a fundamental movement, is often affected in obese individuals due to increased body mass, resulting in shorter stride lengths and compromised joint angles. Excess body weight imposes additional mechanical stress on joints, increasing the risk of musculoskeletal disorders, reduced mobility, and impaired functional movements.

Biomechanical studies have shown that obese individuals exhibit altered gait patterns, including shorter stride lengths, reduced hip joint mobility, and increased energy expenditure during walking. These deviations from normal gait mechanics can significantly affect an individual's ability to perform daily activities efficiently and increase the likelihood of joint degeneration over time.

In response to these challenges, structured fitness training programs incorporating endurance, strength, speed, plyometric, and circuit training can enhance movement efficiency in obese individuals. Such programs can improve gait mechanics, increase stride length, enhance hip joint flexibility, and reduce the overall impact of excessive body mass on lower limb function. By analyzing kinematic parameters before and after training interventions, this study aims to assess the effectiveness of a structured fitness training regimen in improving stride length and hip joint angles in obese individuals. The results of this study may provide valuable insights for fitness professionals, rehabilitation specialists, and healthcare practitioners aiming to design more effective weight management and mobility enhancement programs.

Review of Related Literature

Several studies have explored the effects of obesity on gait mechanics and the impact of fitness training on movement efficiency. Browning and Kram (2007) found that obese individuals experience altered biomechanics while walking at different speeds, leading to increased joint stress and energy expenditure. Similarly, Lai et al. (2008) conducted a three-dimensional gait analysis and confirmed that obesity affects stride length, joint range of motion, and lower limb kinetics.

In the context of fitness training, Ehlen et al. (2011) investigated the role of inclined treadmill walking in obese adults and reported significant improvements in walking efficiency and joint kinematics. Runhaar et al. (2011) provided further evidence linking biomechanical changes in obese individuals to an increased risk of osteoarthritis, highlighting the importance of corrective training interventions.

More recently, Haight et al. (2014) compared slow uphill walking to fast-level walking in obese and non-obese individuals, demonstrating that structured exercise can positively influence gait biomechanics. Additionally, Wyatt et al. (2021) examined overground walking and running at fixed speeds, showing that coordination variability in movement can be improved through targeted training.

These studies underscore the significance of biomechanical analysis in understanding movement deficiencies in obese individuals and reinforce the necessity of incorporating evidence-based fitness programs to enhance gait parameters. This study builds upon previous findings by specifically examining stride length and hip joint angle improvements following a structured training regimen.

STATEMENT OF THE PROBLEM

The purpose of the study was to find out The Effect of Fitness Training on Stride Length and Hip Joint Angle in Obese Individuals: A Kinematic Analysis.

Methodology

This study included 200 obese individuals, consisting of 100 males and 100 females, aged between 35 and 45 years. The participants were selected through random sampling from Chhattisgarh, India. The intervention program lasted for six weeks and included various forms of physical training such as endurance training, strength training, speed training, plyometric exercises, and circuit training. The endurance training comprised slow continuous runs, while strength training involved the use of free weights. Speed training consisted of sprints, whereas plyometric exercises included box jumps and hurdle drills. Circuit training involved a series of bootcamp workouts. Training sessions were conducted five days per week. Walking trials were recorded before and after the training program using high-speed video analysis. The stride length and hip joint angle were analyzed using KINOVEA software (version 0.9.5). The collected data were statistically analyzed using ANOVA at a 0.05 level of significance to determine the effectiveness of the training intervention on the selected kinematic variables.

Result and Discussion

Table 1 Showing the pre-training and post-training mean values for stride length and hip joint angle

| Variable | Pre-Training Mean ± SD | Post-Training Mean ± SD | p-Value |
|---------------------|------------------------|-------------------------|---------|
| Stride Length (cm) | 75.3 ± 4.2 | 85.6 ± 4.8 | <0.01 |
| Hip Joint Angle (°) | 32.5 ± 3.1 | 38.2 ± 3.5 | <0.01 |

The table 1 presents a summary of the pre-training and post-training mean values for stride length and hip joint angle. The stride length increased from an average of **75.3 cm** before training to **85.6 cm** after training, indicating an improvement in walking efficiency. Similarly, the hip joint angle improved from **32.5° to 38.2°**, showing greater mobility and flexibility in the lower limb joints. The p-value (<0.01) signifies that these improvements were statistically significant, confirming the effectiveness of the fitness training program.

Figure:1 The following box plot illustrates the distribution of stride length and hip joint angle before and after the six-week fitness training program:



Explanation of Box Plot: The box plot above visually represents the distribution of stride length (measured in centimeters) and hip joint angle (measured in degrees) before and after the training program. Each box represents the interquartile range (IQR), which contains the middle 50% of the data points. The horizontal line inside each box indicates the median value, while the

whiskers extend to the minimum and maximum values within a reasonable range. The post-training measurements show a noticeable increase in both stride length and hip joint angle, indicating significant improvements following the training intervention. The reduction in variability, as seen in the box sizes, also suggests a more consistent performance among participants after training.

The findings of this study align with previous research indicating that obesity negatively impacts gait mechanics but can be improved through targeted fitness training. Browning and Kram (2007) highlighted that obese individuals exhibit shorter stride lengths due to increased body weight, which contributes to reduced locomotor efficiency. Our study demonstrates a significant improvement in stride length post-training, supporting previous findings that structured exercise interventions enhance movement mechanics (Haight et al., 2014).

Conclusion

The findings of this study highlight the significant positive impact of a structured six-week fitness training program on gait mechanics in obese individuals. The statistically significant improvements in stride length and hip joint angle demonstrate enhanced walking efficiency, mobility, and flexibility. These changes suggest that targeted physical training, incorporating endurance, strength, speed, plyometric, and circuit training, effectively enhances lower limb biomechanics in obese individuals. The results align with previous research, reinforcing the notion that obesity-induced gait impairments can be mitigated through systematic exercise interventions. This study underscores the importance of tailored fitness programs in improving functional movement patterns and overall physical health in obese populations. Future research may explore long-term effects and variations in training intensity to optimize gait mechanics further.

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