

Effect of High Heels on Strength of Knee Extensors and Q Angle in Adult Females: A Systematic Review

Ritu Sharma¹, Dr. Pradeep Borkar²

¹Intern, Dr. APJ Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences (DU), Loni, Ahmednagar, Maharashtra, 413736.

²Associate Professor, Dept. of Sports Physiotherapy, Dr. APJ Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences (DU), Loni, Ahmednagar, Maharashtra, 413736.

Abstract:

Objective: To explore what the research suggests on the effect of high heels on the strength of knee extensors and Q angle in adult females.

Data Sources: Study Design: A systematic review was conducted considering the data sources from PubMed, Google Scholar, Medline, Science Direct, and Research Gate databases using the keywords High Heels, Knee extensors Muscles, and Q angle which were identified, sorted, and screened according to the inclusion criteria and exclusion criteria post which the studies were assessed or quality. Data is extracted from a selected internet site such as the data sources from PubMed, Google Scholar, Medline, Science Direct, and Research Gate databases. Articles then were screened with PEDro scale hence, included in qualitative synthesis.

Result: A total of 60 published articles were selected out of which 43 articles were used to extract the data 11 randomized control trials were screened according to the PEDro scale and the rest were excluded.

Conclusion: In comparison to women wearing flat heels, the study indicated that women wearing wedges and pointed heels had significantly less strength in their knee extensors. Heel height on average is 3 inches. With the help of the data gathered for this study, it was confirmed that, when the heel height was increased, there was a significant difference in the Q angle value between the zero and three-inch heel heights when the subject was standing. While those who wear pointed and wedge heels have a markedly higher Q angle than those who wear flat heels, their Q angle is normal.

Keywords: High heels, knee extensors, Q angle.

Introduction

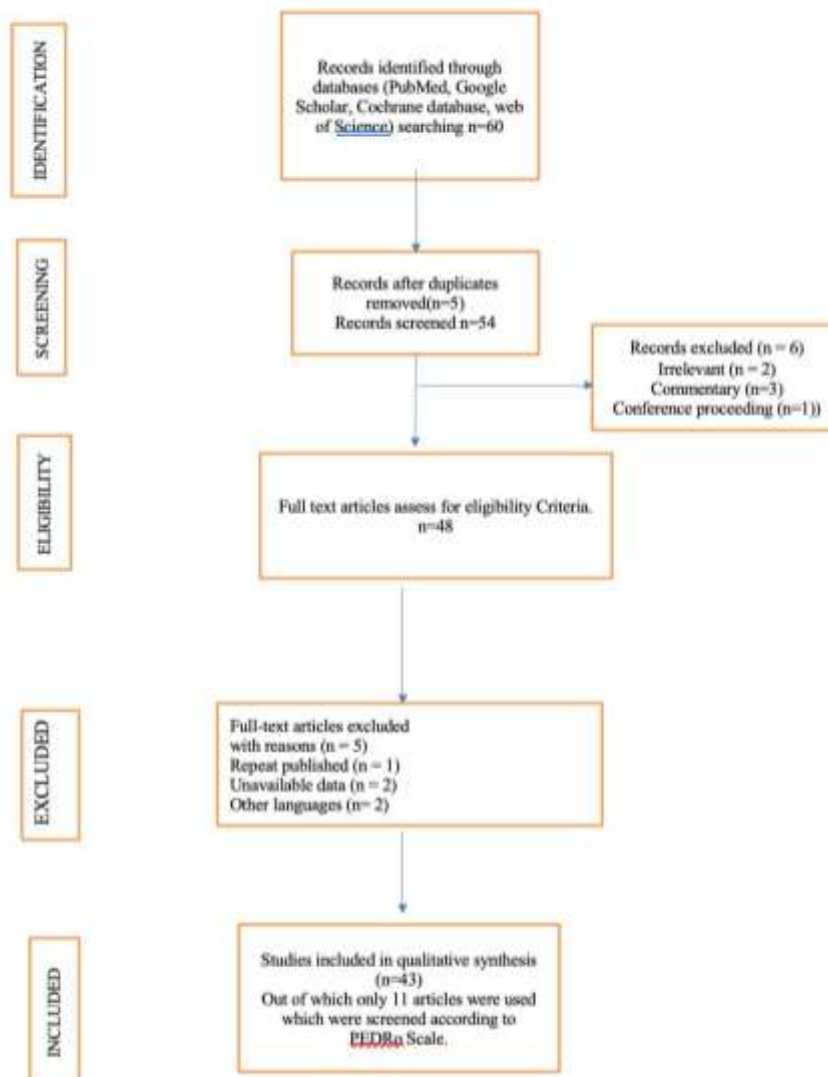
Young women are increasingly opting for high heels to appear taller, thinner, and more fashionable. However, walking is a challenging task due to human bipedalism, and wearing heels can cause unfavorable side effects such as sprained ankles, lower back pain, knee pain, foot pain, foot deformity, leg pain, shortened Achilles tendons, increased oxygen consumption, decreased stride length, and other

changes in gait pattern, walking speed, and mobility. High-heeled shoes (HH) are a significant cause of foot issues and ongoing pain in the lower limbs, causing persistent muscular shortening and affecting the dynamic behavior of the muscle-tendon unit. They also cause increased muscular tension and activation, affecting balance, locomotion, and general well-being. The pattern of load on the lower limbs is influenced by the type of footwear used, and high heels can influence the activation of the vastus medialis oblique, leading to pain during tasks. Chronic usage of HH may cause structural and functional changes in the calf, contributing to chronic joint illnesses like knee osteoarthritis (OA).

Method

Eligibility Criteria The study included randomized controlled trial studies which described the data indicating the “EFFECT OF HIGH HEELS ON STRENGTH OF KNEE EXTENSORS AND Q ANGLE IN ADULT FEMALES”. Articles that were published in English, full text, Experimental study, Published articles, etc. With a score of more than 7 out of 10 according to the PEDro scale were included. Articles with only abstracts, duplicate articles, case reports, and review articles were excluded.

“Effect of High Heels on Strength of Knee Extensors and Q Angle in Adult Females - A Systematic Review”



Sr No.	Author/ year of publication.	Title	Type of Study	Outcome measures	Conclusions
1	Pruthini Patil et.al. (11Oct 2020)	THE EFFECT OF HEEL TYPE ON Q ANGLE	RCT	universal goniometer and <u>EMG</u> .	Variable heel type affects the Q angle. The Flat heel users have a normal Q angle. Wedge heels and pointed heels are associated with a significant increase in Q angle.
2	Laila da Silva Paixão Batista, et.al. (January 2013)	Influence of high-heeled shoes on the quadric electromyographic activity in women with and without patellofemoral pain syndrome during the sit-to-stand task	RCT	EMG	The decreased VMO: VL ratio suggests that the high heels may be an aggravating factor for the muscular imbalance of the stabilizers of the patellofemoral joint in women with PFPS.
3	Sema Polat, et.al. (March 2016)	The effects of wearing high-heeled shoes on the muscles and joints of the lower limb	RCT	Nicholas Manual Muscle Tester and electronic goniometer	Excessive use of high-heeled shoes can cause changes in muscle force/torque/strength and joint range of motion.
4	Ganesh R Naik, et.al. (28 August 2017)	Does Heel Height Cause Imbalance during Sit-to-Stand Task: Surface EMG Perspective	RCT	Electromyography	The study findings suggest that there would be an increased likelihood of fatigue or impending knee issues with regular usage of HHS in women.
6	N. Lythgoe et.al (September 24 th)	Increased Shoe Heel Height Generates Greater Peak Knee Extension Moments Than Fast Walking Speeds	RCT	spatiotemporal measures	High-heel footwear increases knee extension moment and hence knee joint load. This found heel height affects the peak knee extension moment more significantly than walking <u>speed</u> .

7	Ajlan Saç et.al. (August 13, 2018)	Correlation between the Q angle and the isokinetic knee strength and muscle activity	RCT	Goniometer, Electromyographic (EMG) measurements	A higher Q angle is associated with decreased isokinetic knee strength, power output, and torque angles. It is thought that possible high Q angle-related knee joint disorders and sports injuries can be avoided by including proper quadriceps strength exercises in exercise prescriptions to be prepared.
8	Rahul Sharma, et.al. (January 29, 2023)	A Systematic Review on Quadriceps Angle about Knee Abnormalities	Systematic Review	Goniometric method, Electromyogram	Currently, much literature is found which helps us conclude that excessive increase and decrease in Q angle affects knee extensor mechanism and causes various pathologies with the increase in age
9	Simonsen, Erik B., et al. (February 2012)	Walking on high heels changes muscle activity and the dynamics of human walking significantly	RCT	EMG	The results indicate a large increase in bone-on-bone forces in the knee joint directly caused by the increased knee joint extensor moment during high-heeled walking.
10	Cowley, E.E., Chevalier, T.L. and Chockalingam, N.,(2009)	The Effect of Heel Height on Gait and Posture A Review of the Literature	RTC	Barefoot assessment of foot, ankle, hip, knee kinematics, kinetics, posture, and balance.	This review has illustrated the effects of knee flexion-extension during the swing phase was significantly different

					and decreased with high heels. knee would be more injury-prone in high heels. also observed a 25% increase in hip and knee varus moments in high-heeled gait.
11	Chhoeum, Vantha, et al. (December 2020)	The Effect of Shoe Heel Types and Gait Speeds on Knee Joint Angle in Healthy Young Women Preliminary Study.	RCT	Goniometer	There was a significant difference in both the knee flexion and extension angles when the gait in stiletto heels and flat shoes was compared in fast gait conditions. This showed that walking fast in high heels leads to abnormal knee ROM and thus can cause damage to the knee joints.

Outcome Measures

The Physiotherapy Evidence Database (PEDro) scale is a 10-component scale to assess the methodological quality of clinical trials. It is also used to rate systematic reviews. The PEDro scale was developed from the Delphi list. As per the author’s suggestion, the scores are: <4 is ‘fair’, 6 - 8 is ‘good’ and 9 -10 is ‘excellent’. The inter-rater reliability of this PEDro scale is ICC = 0.53 to 0.91 for the clinical trial of physiotherapy-related intervention.

1	Eligibility criteria specified	Yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	Yes
2	Random allocation	yes	yes	No	yes	No	yes	Yes	yes	No	yes	yes
	Concealed allocation	Yes	No	Yes	yes	No	No	Yes	yes	No	Yes	No
4	Groups similar at baseline	yes	yes	yes	yes	yes	yes	yes	Yes	Yes	Yes	Yes

5	Subject blinding	yes	yes	yes	yes	yes	yes	yes	Yes	Yes	No	Yes
6	Therapist blinding	No	No	No	No	No	No	No	Yes	No	Yes	Yes
7	Assessor blinding	yes	yes	yes	yes	yes	yes	yes	Yes	Yes	Yes	Yes
8	Less than 15% dropouts	No	yes	yes	No	yes	yes	yes	No	Yes	No	Yes
9	Intentions to treat analysis	yes	yes	yes	yes	yes	no	yes	Yes	Yes	Yes	Yes
10	Between group statistical comparisons	yes	yes	yes	yes	yes	yes	yes	Yes	yes	Yes	Yes

5. Discussion:

This systematic review is primarily aimed to provide an overview of the Impact “Effect of High Heels on Strength of Knee Extensors and Q Angle in Adult Females”.

The findings of this review have been drawn from the above summarized 17 articles, which had information on the Effect of High Heels on the Strength of Knee Extensors and Q Angle in Adult Females.

The methodological quality of the studies varies between seven to ten on the PEDro scale. The main goal of this study is to review the effect of high heels on the strength of knee extensors and Q angle in adult females.

In recent times, young women are increasingly choosing high heels over low heels to appear taller, thinner, and more fashionable, from a motor control standpoint, walking is the most typical mode of human movement. Yet, due to human bipedalism, walking is an incredibly difficult task.

The current study has explained the effect of various types of heel height on the strength of knee extensors and q angle in adult females. Which reported based on data that, stress on the knee extensors, potentially contributes to muscle fatigue, discomfort, and long-term effects on joint health. The present study also concluded that prolonged use of high heels causes a forward shift in the body’s center of mass, which affects the recruitment of muscles, including the knee extensors, and contributes to increased activation of the quadriceps muscles and potential alterations in the Q angle, impacting knee joint mechanics. Additionally, prolonged high heel use also leads to association with musculoskeletal issues such as shortened calf muscles and change in joint alignment ⁽¹⁾.

Chhoeum V, et.al conducted a study on December 2020, which stated that fast gait speed causes knee flexion angle to significantly increase at toe-off in all five types of shoes. However, there was a significant difference in both the knee flexion and extension angles when the gait in stiletto heels and flat shoes were compared in fast gait conditions. This showed that walking fast in high heels leads to abnormal knee ROM and thus can cause damage to the knee joints ⁽²³⁾.

Many studies were conducted on the effects of high heels on knee extensor muscles, one such study was conducted in, 1994, by CJ Ebbeling and J Hamill. Their study concluded that Women using high heels are more likely to experience weariness and knee problems due to unbalanced VM and VL muscles,

because High-heeled shoes alter lower extremity alignment, particularly at the ankle and knee, with heel heights exceeding 5.08 cm significantly influencing mechanics and walking energy cost, making walking unnatural and altering angular patterns ⁽¹²⁾.

The study conducted by Heena Rathod et.al, 2021 on, “Effect of Footwear on Strength of Vastus Medialis Obliques- to Check by Using Pressure Biofeedback”, concluded that comparing 50 participants wearing shoes and high heels, found that women wearing heels had significantly less vastus medialis obliquus strength compared to those wearing shoes ⁽⁸⁾.

A study was conducted on how Variable heel type affects the Q angle. The Flatheel users have a normal Q angle. Wedge heels and pointed heels are associated with a significant increase in Q angle. increased heel height in a normal adult population. It was found that the mean values for knee flexion extension during the swing phase were significantly different and decreased with high heels. the knee would be more injury-prone in high heels. also observed a 25% increase in hip and knee varus moments in high-heeled gait. It was found that the mean values for knee flexion extension during the swing phase were significantly different and decreased with high heels. the knee would be more injury-prone in high heels. also observed a 25% increase in hip and knee varus moments in high-heeled gait. Esen-yel et al³⁸ demonstrated that the hip abductors showed an 11% increase in work during the stance phase, countering the hip varus moment created by a high-heeled gait ⁽²⁴⁾. The results also showed that the knee extensor peak moment is elevated when walking in high heels. Two other effects of high heels on the knee that have been mentioned include a greater range of motion during the stance phase and less flexion during the swing phase. Increased knee flexion during stance has been linked to higher quadriceps muscle electromyography (EMG) ⁽¹⁸⁾.

CONCLUSION:

In comparison to women wearing flat heels, the study indicated that women wearing wedges and pointed heels had significantly less strength in their knee extensors. Heel height on average is 3 inches. With the help of the data gathered for this study, it was confirmed that, when the heel height was increased, there was a significant difference in the Q angle value between the zero and three-inch heel heights when the subject was standing. While those who wear pointed and wedge heels have a markedly higher Q angle than those who wear flat heels, their Q angle is normal.

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