Methods & Protocols

Impact of Achilles Tendon taping on parameters of gait in asymptomatic-overweight and obese individuals

Impacto do taping no Tendão de Aquiles nos parâmetros da marcha em indivíduos assintomáticos obesos e acima do peso

Amrita Shrestha[1]
Manu Goyal[2]

[1]Corresponding author. Maharishi Markandeshwar (Deemed to be University) (Mullana). Haryana, Índia. amritashrestha200@gmail.com
[2]Maharishi Markandeshwar (Deemed to be University) (Mullana). Haryana, Índia.

ABSTRACT | INTRODUCTION: Does Achilles Tendon taping affect gait parameters in overweight and obese adults? Step length, stride length, and cadence are all shorter in these individuals, with increased fall ratios. **OBJECTIVE:** To know the effect of Achilles Tendon taping on gait parameters in overweight and obese individuals. **METHODS:** A clinical trial will be conducted in a physical therapy outpatient clinic. A total of forty participants with a Body Mass Index (BMI) greater than 25 will be recruited by convenience sampling method. Each group will have 20 participants, aged between 18 and 35 years old, overweight with BMI>25 to 29.9, and obese with BMI>30. Both groups will walk for 10 meters and one minute using a gait analyzer and both groups will have taping on the Achilles Tendons. The predictor variable will be the taping of the Achilles Tendon, and the outcome variables will be step length, stride length, and cadence, which will be measured before and immediately after taping. SPSS 20.0 software will be used for statistical analysis with a significance level of $p<0.05$. **PERSPECTIVES:** Completion of the clinical trial will provide information on the impact of Achilles Tendon taping on gait in overweight or obese individuals. In addition, it could potentially demonstrate that taping can reduce the risk of falls and thus positively impact the quality of life.

KEYWORDS: Achilles Tendon. Adult. Body Mass Index. Obesity. Overweight.

Trial registered on Clinical Trials Registry - India: CTRI/2022/09/045201.

RESUMO | INTRODUÇÃO: O taping do Tendão de Aquiles afeta os parâmetros da marcha em adultos com sobrepeso e obesos? O comprimento dos passos, o comprimento das passadas e a cadência são todos mais curtos nestes indivíduos, com maiores índices queda. **OBJETIVO:** Saber o efeito do taping do Tendão de Aquiles nos parâmetros de marcha em indivíduos obesos e com sobrepeso. **MÉTODOS:** Um ensaio clínico será realizado em um ambulatório de fisioterapia. Um total de quarenta participantes com Índice de Massa Corporal (IMC) maior que 25 serão recrutados pelo método de amostragem por conveniência. Cada grupo terá 20 participantes, com idade entre 18 e 35 anos, sobrepeso com IMC>25 a 29,9 e obesidade com IMC>30. Ambos os grupos caminharão por 10 metros e um minuto usando um analisador de marcha, e ambos os grupos terão taping nos Tendões de Aquiles. A variável preditora será o taping do Tendão de Aquiles e as variáveis de resultado serão o comprimento do passo, o comprimento da passada e a cadência, que serão medidos antes e imediatamente após a bandagem. O software SPSS 20.0 será utilizado para análise estatística, com nível de significância de $p<0.05$. **PERSPECTIVAS:** A conclusão do ensaio clínico fornecerá informações sobre o impacto da bandagem do Tendão de Aquiles na marcha em indivíduos com sobrepeso ou obesos. Além disso, poderia potencialmente demonstrar que a bandagem pode reduzir o risco de quedas e, assim, impactar positivamente na qualidade de vida.

PALAVRAS-CHAVE: Tendão de Aquiles. Adulto. Índice de Massa Corporal. Obesidade. Sobrepeso.

Ensaio registrado no Clinical Trials Registry - India: CTRI/2022/09/045201.

Submitted 10/04/2022, Accepted 02/08/2023, Published 05/18/2023
J. Physiother. Res., Salvador, 2023;13:e4867
http://dx.doi.org/10.17267/2238-2704rpf.2023.e4867
ISSN: 2238-2704
Assigned editors: George Dias, Cristiane Dias

How to cite this article: Shrestha A, Goyal M. Impact of Achilles Tendon taping on parameters of gait in asymptomatic-overweight and obese individuals. J Physiother Res. 2023;13:e4867. http://dx.doi.org/10.17267/2238-2704rpf.2023.e4867

Introduction

Gait is a translational movement of the entire body caused by coordinated, rotatory motions of body parts. It is a hallmark of functional independence.[1] Gait kinetics and kinematics are essential for a better understanding of gait, muscle action, and joint range of motion. Also is a useful clinical indicator of health status. Unfortunately, most assessment tools require controlled laboratory environments, which can be expensive and time-consuming. As smartphones with embedded sensors are becoming ubiquitous, this technology can provide a cost-effective, easily deployable method for assessing gait. During walking, the ankle plantar[2] flexors are responsible for supporting and pushing the body. Here gastrocnemius stores and releases mechanical energy during locomotion by inserting into the Achilles tendon, the thickest and toughest tendon in the human body. Given the importance of the gastrocnemius and the Achilles tendon in gait, understanding how rigid taping would impact their function is critical. The rigid tape has unyielding[3] fabric backing and is used for supporting inert structures, such as ligaments and joint capsules, limiting joint mobility, acting prophylactically, securing the ends of the stretch tape, reinforcing stretch tape, and enhancing proprioception.

Achilles tendon rupture is common in overweight and obese individuals.[4] Some previous studies had investigated Achilles tendon stiffness, in which damage is higher in overweight persons.[5] Altered Achilles tendon impacts daily activities in these populations.[6] Though this population is dominant in today's era, no study has been conducted to find out the impact of Achilles tendon taping on gait parameters in these individuals. The main limitations of the available literature are that none of the articles incorporated a direct measurement of gait parameters after Achilles tendon taping using smartphone applications like Gait Analyzer.[7] For measuring gait, the use of smartphones is a viable way. It reduces costs while also enhancing mobility, accessibility, and convenience. Further, ankle tape is used for the treatment of acute injuries, structural and functional instability, and injury prevention and is an important element of a physiotherapist's toolbox.

Therefore, the objective of this study is to evaluate whether there is an impact of Achilles tendon taping on gait parameters in overweight and obese individuals. We believe that taping the Achilles tendon will increase foot stability, which will reduce falls in these populations. Additionally, considering that the use of smartphone in clinical trials are practical, economical, reliable, and valid, the scientific community needs more study using smartphone to determine gait parameters.

Methods

Study design and location

The proposed study is a two-group pretest-posttest nonrandomized experimental study with a convenience sampling method. Two groups are based on Body Mass Index (BMI): Group A includes overweight with a BMI of >25 to 29.9, and Group B includes obese with a BMI of >30. Figure 1 demonstrates an overview of the protocol. The consent form will be taken from the voluntary patients before the treatment. The patient will be assured that there will be no harmful effects of the treatment on their health conditions, and the privacy of the patients will be maintained. This work will be carried out in accordance with the Declaration of Helsinki.[8] This study will be carried out in the outpatient physiotherapy department in a tertiary care hospital.

Recruitment of participants

Twenty overweight and twenty obese individuals will be recruited for the study according to the selection criteria using convenience sampling. Demographic[9] data such as name, age, gender, occupation, address, and contact number will be taken in a pre-designed performance of the patients. The weight and height of each patient will be measured to calculate BMI.[10]

• Inclusion criteria: Both the males and females[11] in good health of the age group 18-35 years[12] with BMI > 25[13], overweight with BMI > 25 to 29.9, obese with BMI > 30, and cognitive level sufficient to understand procedures and follow instructions.

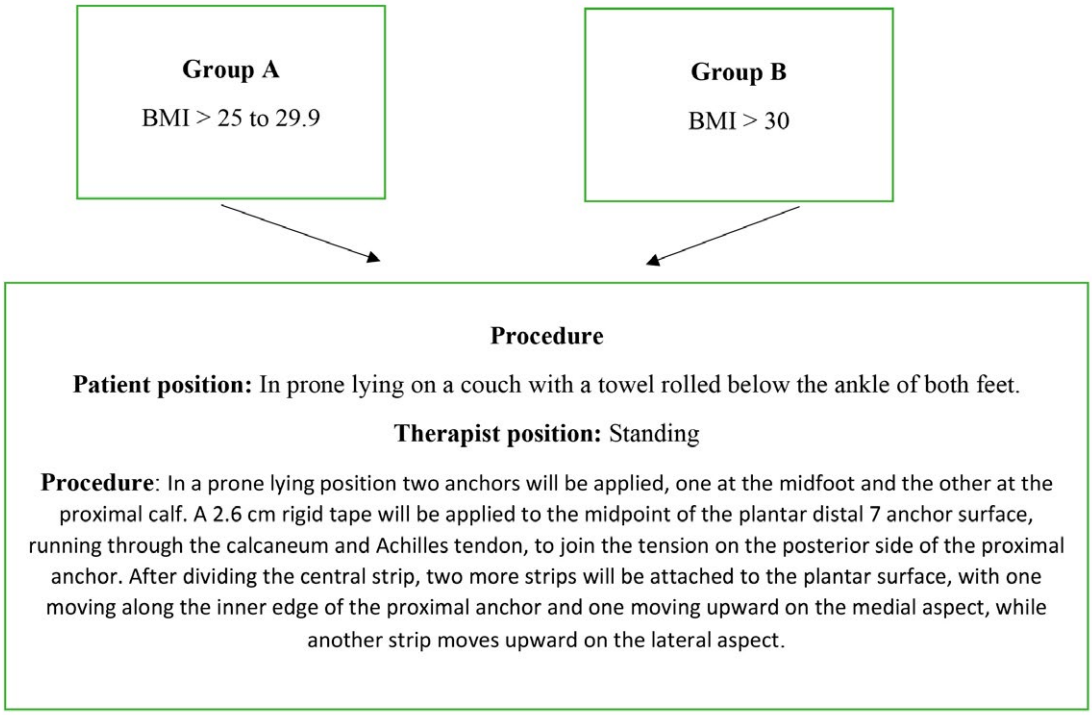
• Exclusion criteria: Individuals with neuropathic pain in the lower extremities, foot deformity, inability to apply ankle tape due to the presence of a wound, ulcer, and skin damage, allergies to the therapeutic tape, leg length discrepancy (apparent and true), and subjects with a previous history of trauma /fracture past six months.[14]

Procedure

The area will be prepared primarily. It will be washed and dried, and then the skin will be shaved in a downward direction. Oils will be eliminated for good adherence. Individuals will be checked for any tape allergy. Regions of friction and pressure will be covered with lubricated cushioning.

Position of subjects: Prone lying, as explained in Figure 1 and demonstrated in Figure 2.

Figure 1. Classification of groups and procedure of taping Achilles tendon



Source: Macdonald R. (2010).[3]

Figure 2. Taping of Achilles tendon

Source: Macdonald R. (2010).[3]

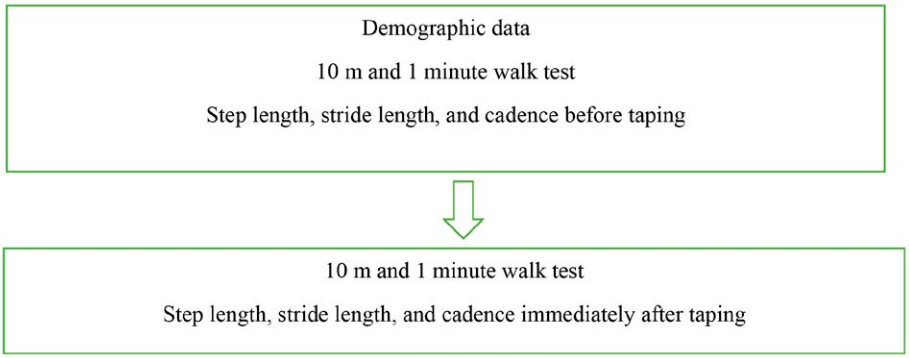
Before and after Achilles tendon taping, subjects will walk in a hallway for one minute and 10 m using a gait analyzer application. This application is calibrated and will provide gait parameters like step length, stride length, and cadence.[7]

Outcomes Variables

• Predictor variables: predictor variables will be a rigid taping of the Achilles tendon of both legs.
• Outcome variables: our outcome variables include step length, stride length, and cadence.

The variables are measured before and after taping, as shown in Figure 3.

Figure 3. Assessment before and immediately after taping Achilles tendon



Source: Silsupadol P et al. (2017).[7]

Step length

Step length is measured on the line of progression[15] between the heel centers of two consecutive footprints by the same foot (left to left, right to right). The linear distance of approximately 15 inches along the line of progression of one foot is traveled during one gait cycle.

Stride length

The distance between two subsequent placements[4] of the same foot is known as the stride length, which is normally 27 to 32 inches. There are two step lengths, left and right, and each one represents how far the specified foot advances in front of the other. The right step length will be zero if the left foot is brought up beside the right one as opposed to in front of it when taking a step forward with the left. If one foot never catches up to the other, the step length on that side may even be negative. Stride length is the linear distance in the plane of progression between the successive point of foot-to-floor contact of the same foot.

Cadence

There are two steps in each gait cycle, and cadence is a measurement of half-cycles. The cadence is the number of steps made in a given amount of time. It is measured as the number of steps/sec or per minute, which is approximately 70 steps/sec.

Data Monitoring

An independent researcher will perform all the statistical analyses and datasets, names of the patients will be kept confidential. The researcher will monitor and record pre-post parameters of gait in each group.

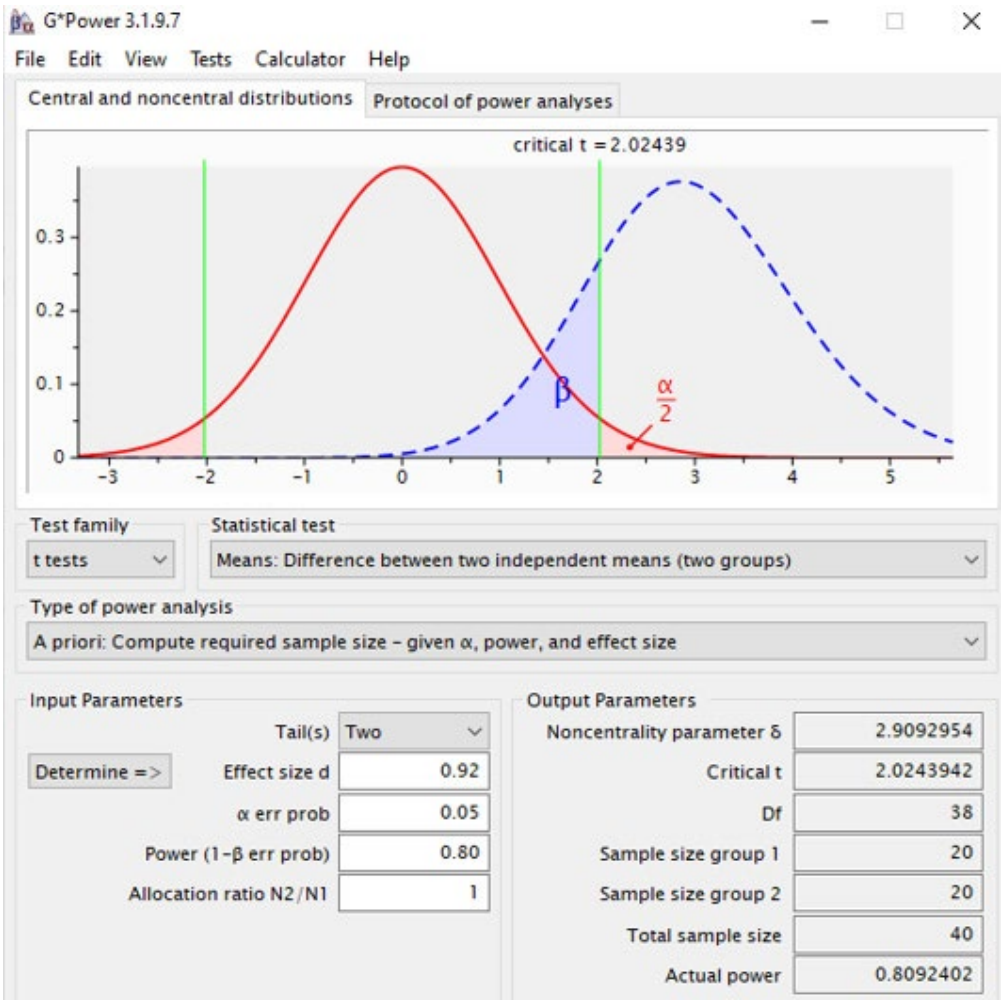
Follow-up

Gait parameters will be taken immediately before and after taping of the Achilles tendon.

Sample size calculation

The sample size was calculated using G*Power[16] 3.1.9.7, the standard application for sample size calculation, in which the power of the study is estimated at 80%. The study included for the estimation of sample size has a 0.92 effect size obtained from the pilot study, so by applying these values in G*Power software, the calculated sample size was 20 in each group. Effect size is calculated with the formula, Effect size=Mean post-Mean pre/SD pooled.[17] Then, the two groups of overweight and obese individuals will have a total sample size of twenty participants in each group, as shown in Figure 4.

Figure 4. Sample size calculation



Source: Faul F et al. (2007).[16]

Data analysis/Statistical planning

All data will be analyzed in IBM SPSS 20 (Chicago, IL). The independent researcher will complete observable investigations and datasets. The normality test, Shapiro Wilk, will be used to check the normal distribution of the sample. Based on the normality, descriptive statistics data will be expressed as mean, standard deviation (SD), or median and interquartile range. A paired t-test or Wilcoxon signed-rank test will be used for within-group comparison, and for between-group, comparisons independent t-test or Mann-Whitney U test will be used. For all analyses, the level of significance will be set as $p \leq 0.05$ with a confidence interval of 95%. The graphical representation of the results obtained will be done in the form of error plots or box and whisker plots.

Ethical Considerations and Confidentiality

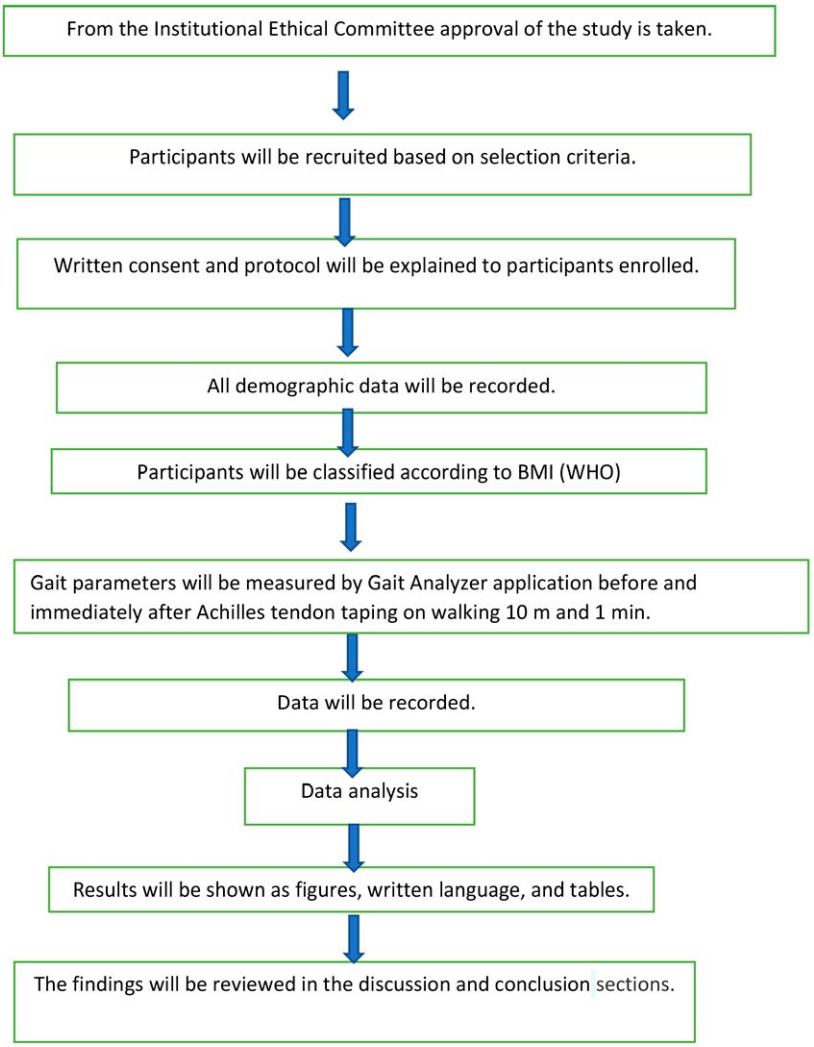
The study has got ethical clearance from Institutional Ethical Committee (IEC) number 2236. This trial has been prospectively registered at Clinical Trial Registry - India (CTRI) number CTRI/2022/09/045201. The trial will be conducted in the physiotherapy outpatient department of a teaching institute. Prior to requesting a formal informed consent form, the participants' verbal understanding of the study objective, procedures, risks, and advantages will be evaluated.

Hard copies of the data will be kept in a secure storage location, and anonymous data will be uploaded to the Mendeley database. Additionally, we want to make the anonymous database publicly accessible through the research registry, publish the study's findings in a reputable international journal, and notify each participant of its findings at the end of the study.

Study Protocol Guideline

SPIRIT (Standard Protocol Items: Recommendations for Interventional Trials) guidelines will be followed to report the result of the study.[18] The study flowchart (Figure 5) demonstrates an overview of the protocol.

Figure 5. Flowchart of the study protocol



Source: Calvert M. et al. (2018).[18]

Perspective

There are more than 1.9 billion overweight people in the globe, with 650 million of them being obese.[19] Overweight and obesity cause around 2.8 million deaths globally. Obesity can change gait patterns, which may increase the risk of developing osteoarthritis and falling. The third most common condition among runners is Achilles tendonitis. Achilles tendon injuries account for around 11% of all running injuries each year.[13]

According to Eggar et al.20, dancers have a 9 percent injury rate, gymnasts have a 5% injury rate, tennis players have a 2% injury rate, and football players have a 1% injury rate. According to this research, about one million athletes are affected by Achilles disorders each year. The rigid tape[21] has a non-yielding fabric backing and is used to hold inert structures like ligaments and joint capsules, limit joint movement, act prophylactically, secure stretch tape ends, reinforce stretch tape, and improve proprioception.

Taping is an essential part of a physiotherapist's toolkit at various phases of injury healing and returns to sport.[22] Treatment of acute injuries, structural and functional instability, and injury prevention are the most common reasons for utilizing ankle tape.

Gait parameters are impacted by Achilles tendon taping because rigid tape stabilizes the ankle by limiting excessive joint movement. Also, an increase in stability leads to a decrease in fall ratio. Every country has seen an increase in the prevalence of adult obesity. Between the ages of 15 and 49, the proportion of obese males increased from 19 to 23%.[12] The percentage increased from 21% to 24% among women in India. Particularly when moving faster than their typical walking speed, obese people appear to adopt a gait pattern that minimizes muscle force output. Obese people may have higher relative gluteal medius force requirements, which could modify kinematics, increasing the risk of injury to the musculoskeletal system and fall rates.[23]

The current study's purpose is to reveal the effect of Achilles tendon tape on gait parameters in overweight and obese adults by using a smartphone. In addition, the result of this study could reveal the potential advantages of taping the Achilles tendon for overweight and obese people to lower their risk of falling.

Limitations

Firstly, this study has not included temporal parameters such as gait speed, step time, and stride time, which are necessary for successful gait analysis. Secondly, future research could investigate the long-term effects of taping on gait parameters in overweight and obese individuals.

Authors' contribution

Shrestha A participated in designing the study's methodology, drafting the manuscript, designing the study, writing and editing the manuscript. Goyal M participated in the conceptualization, designing of the study methodology, and reviewing of the manuscript.

Competing interests

No financial, legal, or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.)

Indexers

The Journal of Physiotherapy Research is indexed by DOAJ, EBSCO, LILACS and Scopus.

References

1. Lindemann U. Spatiotemporal gait analysis of older persons in clinical practice and research: Which parameters are relevant? Z Gerontol Geriatr. 2020;53(2):171-8. https://doi.org/10.1007/s00391-019-01520-8

2. Khokhlova M, Migniot C, Morozov A, Sushkova O, Dipanda A. Normal and pathological gait classification LSTM model. Artif Intell Med. 2019;94:54-66. https://doi.org/10.1016/j.artmed.2018.12.007

3. Macdonald R. Pocketbook of Taping Techniques. Churchill Livingstone; 2010. 235 p. https://doi.org/10.1016/B978-0-7020-3027-7.X0001-5

4. Yoon YK, Park JH, Han SH, Lee JW, Park KH. Obesity is an Independent Risk Factor for Achilles Tendon Rupture: A Nationwide Longitudinal Cohort Study in South Korea. Foot Ankle Orthop. 2022;7(1). https://doi.org/10.1177/24730114215S00509

5. Doral MN, Alam M, Bozkurt M, Turhan E, Atay OA, Donmez G, et al. Functional anatomy of Achilles tendon. Knee Surg Sports Traumatol Arthrosc. 2010;18(5):638-43. https://doi.org/10.1007/S00167-010-1083-7

6. Laurent D, Walsh L, Muaremi A, Beckmann N, Weber E, Chaperon F, et al. Relationship between tendon structure, stiffness, gait patterns and patient reported outcomes during the early stages of recovery after an Achilles tendon rupture. Sci Rep. 2020;10(1):20757. https://doi.org/10.1038/s41598-020-77691-x

7. Silsupadol P, Teja K, Lugade V. Reliability and validity of a smartphone-based assessment of gait parameters across walking speed and smartphone locations: Body, bag, belt, hand, and pocket. Gait Posture. 2017; 58:516-22. https://doi.org/10.1016/J.Gaitpost.2017.09.030

8. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4. https://doi.org/10.1001/jama.2013.281053

9. Afzal M, Rizvi F, Azad AH, Rajput AM, Khan A, Tariq N. Effect of demographic characteristics on patient's satisfaction with health care facility. J Postgrad Med Inst [Internet]. 2014;28(2):154-60. Available from: https://jpmi.org.pk/index.php/jpmi/article/view/1528

10. Peterson CM, Thomas DM, Blackburn GL, Heymsfield SB. Universal equation for estimating ideal body weight and body weight at any BMI. Am J Clin Nutr. 2016;103(5):1197-203. https://doi.org/10.3945/ajcn.115.121178

11. Liao R, Moriwaki K, Makihara Y, Muramatsu D, Takemura N, Yagi Y. Health Indicator Estimation by Video-Based Gait Analysis. IEICE Trans Inf & Syst. 2021;E104(10):1678-90. https://doi.org/10.1587/transinf.2020ZDP7502

12. Maktouf W, Durand S, Boyas S, Pouliquen C, Beaune B. Interactions among obesity and age-related effects on the gait pattern and muscle activity across the ankle joint. Exp Gerontol. 2020;140:111054. https://doi.org/10.1016/j.exger.2020.111054

13. Rosso V, Agostini V, Takeda R, Tadano S, Gastaldi L. Influence of BMI on Gait Characteristics of Young Adults: 3D Evaluation Using Inertial Sensors. Sensors. 2019;19(19):4221. https://doi.org/10.3390%2Fs19194221

14. Chhabra M, Prabhakar S, Chouhan DK, Dhillon MS. Technical Note: Three-dimensional Gait Analysis. J Postgrad Med Edu Res. 2021;55(4):188-91. https://doi.org/10.5005/jp-journals-10028-1445

15. Kirkwood RN, Moreira BS, Vallone MLDC, Mingoti SA, Dias RC, Sampaio RF. Step length appears to be a strong discriminant gait parameter for elderly females highly concerned about falls: a cross-sectional observational study. Physiotherapy. 2011;97(2):126-31. https://doi.org/10.1016/j.physio.2010.08.007

16. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. 2007;39(2):175-91. https://doi.org/10.3758/bf03193146

17. Portney LG, Watkins MP. Foundations of Clinical Research: Application to Practice. 3rd. ed. Philadelphia: F. A. Davis Company; 2015. p. 170-71.

18. Calvert M, Kyte D, Mercieca-Bebber R, Slade A, Chan AW, King MT, et al. Guidelines for Inclusion of Patient-Reported Outcomes in Clinical Trial Protocols: The SPIRIT-PRO Extension. JAMA. 2018;319(5):483-94. https://doi.org/10.1001/jama.2017.21903

19. Hruby A, Hu FB. The Epidemiology of Obesity: A Big Picture. Pharmacoeconomics. 2015;33(7):673-89. https://doi.org/10.1007/s40273-014-0243-x

20. Egger AC, Berkowitz MJ. Achilles tendon injuries. Curr Rev Musculoskelet Med. 2017;10(1):72-80. https://doi.org/10.1007/s12178-017-9386-7

21. Chen SM, Lo SK, Cook J. The effect of rigid taping with tension on mechanical displacement of the skin and change in pain perception. J Sci Med Sport. 2018;21(4):342-6. https://doi.org/10.1016/j.jsams.2017.07.008

22. Stoffel KK, Nicholls RL, Winata AR, Dempsey AR, Boyle JJW, Lloyd DG. Effect of ankle taping on knee and ankle joint biomechanics in sporting tasks. Med Sci Sports Exerc. 2010;42(11):2089-97. https://doi.org/10.1249/mss.0b013e3181de2e4f

23. Lerner ZF, Board WJ, Browning RC. Effects of obesity on lower extremity muscle function during walking at two speeds. Gait Posture. 2014;39(3):978-84. https://doi.org/10.1016/j.gaitpost.2013.12.020