Achilles Tendinopathy and Associated Factors among Recreational Ballet Dancers: A Cross Sectional Study

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Abstract

Background: Achilles tendinopathy (AT) describes an overuse condition which common experienced by dancers. The reason is because dance is a physical activity involving short explosive runs, turns, jumps, leaps and weight bear on metatarsal heads which forcefully contract the calf muscles and this causes more pressure on Achilles tendon. However, lack of studies on AT in dancers has been reported.

Objectives: To find out the prevalence and risk factors of Achilles tendinopathy among recreational ballet dancers.

Method: Quantitative approach, non- experimental and descriptive research design was conduct on a sample of 53 female and male recreational ballet dancers. Ages varied from 15- 30 and at least with 2 years of ballet dancing experiences were selected by purposive sampling from the ballet dance company or studios. Screening tools and prevalence sheet priority given to the subjects to fill in to select appropriate population who passed the study's inclusion and exclusion criteria. Then researcher required to palpate the Achilles tendon area to confirm the problem before distribute the questionnaire form to ballet dancers. All the data were using percentage and mode to analyze. Results: Our findings show 28.3% of the recreational ballet dancers had AT and footwear is the highest average risk factors among training duration, limited warm up and cool down, and muscle strength. Besides that, our findings also show BMI, unfamiliar choreography, training surface, medication, flexibility and lower limb abnormalities are not the risk factors that cause them to have AT.

Conclusion: AT is common among recreational ballet dancers and footwear is the highest average of risk factors among the four risk factors. These findings provide clearly

Information for dancers, teachers, sport therapists, health professionals and parents to prevent or treat the injuries more effectively and help to develop strategies aimed at reducing the prevalence of ballet injuries.

Keywords: *Achilles Tendinopathy, Ballet dancers, Calf muscle, Heel pain, Physical therapy, Questionnaire, Training surface.*

Introduction

Achilles tendinopathy (AT) describes an overuse condition[1] that causes pain, swelling and stiffness of the Achilles tendon[2] Achilles tendon is the strongest tendon in the human body connecting the heel with the calf muscles[3] . "It is used in locomotion by controlling the lowering of the forefoot to heel strikes and heel off the ground during walking and jumping"[4]. "AT results when the demand placed on the Achilles tendon is greater than its ability to function"[5] and it is common in runners, track and field and racquet athletes as well as soccer and volleyball players[6]. Besides that, Achilles tendon has been suggested for dancer one of the most sensitive parts of the body [7] because ballet dancers

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force their turnout, leading to increased pronation in the mid foot and hind foot, dancing on pointe, on demi-pointe, or in plié are places force on the Achilles tendon. Therefore, pain and injury involving Achilles tendon are also common among ballet dancers[8]. "AT which is not limited to the athletic populations is the most frequently reported injury related to the ankle and foot in different sports" [9]. The reason is because "recreational sports activities are getting more and more popular and athletes are being pushed to enhance their performance; hence injuries in sports are increasing"[6]. Around 35% of highland dancers had tendonitis injury, 18% of ballet dancers will suffer an Achilles injury at some stage in their dance life and around 30-40% may suffer an Achilles or arch tendon damage in Irish Dance[10].Besides that, a systematic review done by Hincapie CA, Morton EJ and Cassidy JD (2008)[11] showed that the foot and ankle sustained the majority of injuries within the lower extremity and reported incidence rates are between 17% and 67%. Another study claimed that AT is considered an injury common to the dance community, although the prevalence and incidence of AT has not been specifically identified in the dance literature[12]. This condition will cause pain, swelling, weakness and stiffness of the Achilles tendon in the morning[13], impaired ability to perform strenuous activities[14] and will affect almost all the foot movements of the dancer. This condition will also result in financial outlay by the dance company[15], owing to dancers unable to dance or time loss from dance class, rehearsal, or performance[16]. Current treads on assessment are Ultrasonography, MRI, palpation, passive and active range of motion, Thompson's test and single leg calf raise[17]. Treatment for Achilles tendon injury in ballet dancers are conservative with rest, refraining from dancing, and local treatment such as ice and adhesive strapping, anti-inflammatory drugs, local injections, thermotherapy, laser therapy and stretching exercises[18]. Previous research had described several risk factors for Achilles tendon injury in Football, Cricket and Badminton Players and runners[19]. There is no evidence about whether recreational ballet dancers have the same risk factors of AT as studies on AT in recreational dancers are lacking. Achilles tendon injury will affect the dancers' ability to perform at an optimum level and will cause pain to be felt when walking or running. Therefore, it is importance to identify the risk factors in order to help develop strategies aimed at reducing the prevalence of ballet injuries and makes it clear information for dancers, teachers, sport therapists, health professionals and parents to prevent or treat injuries in recreational ballet dancers[20]. To fill the gap in the literature, population will be on recreational ballet dancers of both genders, will use purposive sampling because to minimize bias and this sampling is commonly used, moderate cost, and the sample will meet a specific objective. In addition, the questionnaire to be established by review of researcher will add in those questions which previous research had recommended getting more clear information about the risk factors.

Method

This study will utilize a Quantitative approach, non-experimental, descriptive research design to find out the prevalence and risk factors of AT among recreational ballet dancers. This study was conducted for a period of four months. The first month was allotted for proposal revisions, and acquisition of necessary permissions and approvals. The second month was the implementation of the study. The third month includes data collection, preparation and analysis and the final month covers the writing of the results and final paper presentation. Before starting the procedure, the researcher sends the informed letter to the Dance Company to get the permission to conduct the study. An informed consent form (IFC) will be provided to each subject stating their willingness to participate in the study. During the study, researcher give priority to the screening tools and prevalence sheet to all the dancers who are willing to give consent to select the appropriate population who passed the study's inclusion and exclusion criteria. After selecting the dancers who are suitable to conduct this study, Achilles tendon area was palpated to confirm the problem. The questionnaire will be given to the dancers at that movement. On the questionnaire dancers will indicate the BMI, training hours in a week, unfamiliar choreography, duration of warm up, stretching and cool down exercises, type of floor surfaces, shoes type during practice, medication history, flexibility, foot posture, and calf muscle strength. The instrument utilized in this study is purely questionnaire-based. A self-developed questionnaire was adopted from researchers whom carried out similar studies. To enhance content validity, experts in Kinesiology, Growth and Development and Physical Therapy reviewed the questionnaires and then the questionnaires were adjusted based on their recommendations. The measures used to determine the factors influencing the likelihood of sustaining an injury were one questionnaire. The one questionnaire administered by the researcher were factors of AT. To develop content reliability, a pilot test will be

conducted on 6 female or male dancers aged 15- 30. Upon completing the questionnaire, the dancers were asked to identify any question they found unclear or confusing. The questionnaire was then adjusted thereby making it easier to understand for the participants in the study. After 2 weeks, the questionnaire was conducted again on the same dancers to prevent the recall bias and enhance the reliability. The screening tools and prevalence sheet also provided to obtain the subject's name, age, gender, ethnic, occupation, company/studio name, ballet grade/level, and number of years in ballet dance, any Achilles tendon injuries/pain, and symptoms of AT, time of injury, doctor diagnosis, surgery history on lower extremity, history of joint instability, details of treatment received, and any other musculoskeletal disorder. All descriptive information was analyzed using measures of central tendency such percentage and mode as measure of dispersion. The statistical treatment of data used Statistical Package for Social Sciences (SPSS) v Version 24.

Results

A total of 108 recreational ballet dancers were recruited and 53 subjects met the inclusion criteria. A total of 53 (100%) female subjects with age range: 15-19 years (n=42, 79.2%), 20-24 years (n=9, 17%), 25-30 years (n=2, 3.8%) participated in the study. Figure 3.1.1 shows the prevalence of Achilles tendinopathy was 28.3% (15/53) among recreational ballet dancers. A number of extrinsic and intrinsic risk factors have been identified in Table 3.1.1 for ballet dance related AT, including BMI, training duration, unfamiliar choreography, limited warm up and cool down, training surface, footwear, medication, flexibility, lower limb abnormalities and muscle strength. Not only that, Figure 3.1.2 shows footwear is the highest average of risk factors (57.77%) among training duration, limited warm up and cool down, and muscle strength. The BMI of 53.3% (n=8) recreational ballet dancers were under normal weight status (18.5- 24.9) which clearly shows that most of the ballet dancers are under normal weight status. For the training duration of recreational ballet dancers, 40% (n=6) dancers usually practiced 0-3 hours of ballet dance per week. However, before they were injured 46.7% (n=7) of dancers practice more than 9 hours of ballet dance per week. During the period to cope with exam or competition or performance, 46.7% (n=7) of ballet dancers practiced more than 9 hours per week. This result shows that there was a sudden increase of training duration., For the unfamiliar choreography, 60% of recreational ballet dancers do not feel difficulty in moves in the choreography will cause them to get injured. The result of limited warm up and cool down shows that, before ballet dance there are 7 (46.7%) of recreational ballet dancers use 0-5 minutes to warm up and 7 (46.7%) of dancers use 5-10 minutes to do stretching exercise. However, after the ballet dance 7 (46.7%) of dancers do not perform any cool down or stretching exercises. These results clearly indicated that there is a limited duration of warm up and stretch before ballet dance and lack of cool down exercises after ballet dancing. Next, the result of training surface showed that 13 (86.7%) of recreational ballet dancers are using sprung wood as a floor surface during practice time in studio and there are 13 (86.7%) dancers get injured on ballet studio instead of examination hall, competition area or home practice. For the footwear, 53.3% (n=8) dancers usually wear soft shoes for practice whereas for the shoes that causes pain on Achilles tendon, there are 60% (n=9) dancers having pain when wearing pointe shoe to dance. About the tightness of the shoe ribbon, 60% (n=9) dancers proper fit to tie the shoe ribbon. The result of medication shows that 15 (100%) of recreational ballet dancers do not take any medication like OCP, HRT, Fluor quinolone antibiotics, high blood pressure medication, and DM medication. The result of lower limb abnormalities and flexibility shows that 53.3% of recreational ballet dancers have normal foot posture in standing upright position. 66.7% of dancers having normal hamstring flexibility and 53.3% of dancers having normal calf flexibility. Therefore, most of the recreational ballet dancers are having normal foot posture and flexibility. The muscle strength of 33.3% (n=5) recreational ballet dancers able to do 20-24 single heel rises on right side, which clearly indicate the weakness of the right lower limb muscles, although 33.3% (n=5) recreational ballet dancers are able to do more than 25 single heel rises on both sides.

Discussion

In the present study, 53 recreational ballet dancers with age range from 15-30 have completed the questionnaire. The aim of this study was to investigate the prevalence and risk factors of AT among recreational ballet dancers. In this descriptive study, the prevalence rate of 28.3% was observed which suggests that AT is common among the recreational ballet dancers because this result is higher than the prevalence in ballet dancers done by Hullachan (2008) where a prevalence of 18% was reported. Regarding the BMI of the respondents in

this study, most frequently recreational ballet dancers (53.3%) are under normal weight status and none of the dancers are overweight or obese as this indicate that BMI is not the risk factors of AT among recreational ballet dancers. This result agrees with a prior study by Longo, U.G., et al. 9) which reported that weight and height did not have influence in the development of AT. Another study by Franceschi, F., et al. (2014) also stated that, significant associations found for AT in people who were overweight or obese compared to normal weight. Furthermore, previous research stated that unfamiliar choreography is one of the contributing factors to AT because they have "insufficient time to become accustomed to the movements and fine-tune their technique accordingly". Although difficulty choreography will cause AT, but according to our findings, most of the recreational ballet dancers (60%) do not feel difficulty in the moves. Therefore, unfamiliar choreography is not one of the risk factors of AT among recreational ballet dancers. Based on the result of this study, training surface is not one of the risk factors of AT among recreational ballet dancers because most of the dance floor they commonly used for practice is sprung wood. According to Motta-Valencia, K. (2006), sprung wood as a floor surface during practice are advantageous for dancing because they are built with layers of different materials and a specific resiliency. Hence, the most important properties of ballet dance surfaces are resiliency, surface friction and shock absorption. The reason that causes them more prone to overuse injuries is the floor material which lack of spring. According to the result of current study, most of the dancers are having normal flexibility therefore flexibility is not one of the risk factors of AT. The reason is because normal flexibility in the hamstring and calf muscles will not cause tension in the Achilles tension and impact the functioning of ankle joint. A study done by Rabin et al shown that limited flexibility of the gastrocnemius and soleus increases absorption work by the plantar flexors during walking and running, which may lead to increased strain on the Achilles tendon. Another study by Miller and Royal Surrey County Hospital (2017) stated that having poor flexibility like tight calf muscles and/or hamstring are the causes of AT. In this report, most of the dancers are having normal foot posture instead of flat arch in standing upright position. This result indicates that lower limb abnormities is not one of the risk factors of AT among recreational ballet dancers because normal foot posture does not lead to an increase torsional stress on Achilles, whereas flat arch foot posture prone to Achilles tendonitis. According to Carey, Achilles tendon has been stressed due to the flattened arch pulls on calf muscles and it will cause the tendon to become inflamed and painful if continuous stress applied on the heel and tendon. Another studies by Footbionics also found that there was a correlation between excessive pronation and increased strain on the medial portion of the tendon. "People who taking medicines from a group called fluoroquinolones will have an increased risk of developing AT. It is also more common in people who have high blood pressure, high cholesterol or diabetes". The reason is because fluoroquinolone antibiotics have toxic effect that may cause tendonitis or spontaneous rupture of the Achilles tendon. However, current study find out that 100% (n=15) of recreational ballet dancers do not take any medication like OCP, HRT, Fluoroquinolone antibiotics, high blood pressure medication, and DM medication. Therefore, medication is not one of the risk factors that caused them to have AT. In current study, most of the recreational ballet dancers are having limited duration of warm up and stretch before ballet dance and lack of cool down exercises after ballet dancing. This result clearly indicates that limited warm up and cool down are one of the risk factors of AT among recreational ballet dancers because each of the dancers do not take about 15 minutes for warm up before the class and cool down after the class and also stretching exercises. According to a study done by Malliou, P., et al. (2007), there is an important co-relation between the rate of injuries and the duration of the warm up and cool down because the result shows that, the number of injured instructors appears significantly smaller when they take part in warm up and cool down about 15 minutes. Another study by Woods also stated that, before beginning the activity, a warm up and stretching protocol should be applied within 15 minutes in order to increase blood flow to the tissues, reduce injury and increased flexibility. Furthermore, training duration is also considered one of the risk factors of AT among recreational ballet dancers because in present study result shows that there was a sudden increase of training duration from about 3 hours ballet dance per week to more than 9 hours per week during the season to cope with exam or competition or performance. This result agrees with prior study that dancers are having risk of sustaining an injury when dance more than 8 hours per week due to overwork and fatigue. Martin, S. also claimed that pre-professional dancers are especially easily to get Achilles tendonitis when they increase their training, like starting a summer intensive.

In another study which done on runners by Hein, T., et al. (2014), overtraining is described as a major risk factor for AT, including excessive training distance, changes in training routines, increases in training intensity and faster training pace. Besides that, footwear is also one of the risk factors of AT because current study result shows that most of the dancers are feeling pain on Achilles tendon when wearing pointe shoe for practice. Pain is noticeable when wearing pointe shoe because "Achilles tendon is stressed when on pointe or demi pointe due to the forceful contraction of the gastrocnemius and soleus muscles". However, for the tightness of the shoe ribbon, current study result shows that most of the dancers are proper fit therefore shoe ribbon is not excessively tightened around the ankle which do not cause further compression on Achilles tendon . Muscle strength is also one of the risk factors of AT among recreational ballet dancers because 33.3% dancers are unable to perform more than 25 single heel rises on right sides although another 33.3% of dancers are able to do more than 25 single heel rises on both sides. This result clearly indicates that there was reduced muscle strength over the right lower limb. There are many reviewed articles have reported 25 raises for a general healthy population but as a recreational ballet dancer more raises should be performed for both lower limb. The reason is because the dancer spends a good deal of time with releve (ankle plantar flexed) movement, therefore more raises to perform is important for dancers to improve the calf muscle strength and prevent more stress on Achilles tendon and lead to AT. Mahieu, N.N., et al. (2006) showed increased risk of AT with reduced plantar flexion strength in the calf muscles due to decreases of the ability of the Achilles tendon to absorb high forces during intense stretch-shortening cycles. Our findings clearly demonstrated that training duration, limited warm up and cool down, footwear and muscle strength are the risk factors of AT among recreational ballet dancers whereas BMI, unfamiliar choreography, training surface, medication, flexibility and lower limb abnormalities are not the risk factors that cause them to have AT. Furthermore, results also have shown that footwear is the highest average risk factors (57.55%) among the four risk factors. The weakness of the current study is unable to recruit male recreational ballet dancers and small number of samples collected in the study because most of the male dancers are participating in other dance forms besides ballet dance. On the contrary, major strength of current study is the fact that information was collected by questionnaires form which has validity and reliability. The questionnaires form also been established by review of researcher with reference to recommendation of previous study. Besides that, subjects also able to answer the questionnaires themselves without any incomplete data or claimed that they do not understand the questionnaire. Secondly, our study clearly provided a preliminary data on the prevalence and risk factors of AT among recreational ballet dancers where previous study was mentioned there was a lack of studies on AT among ballet dancers.

Conclusion

In a nut shell, 53 recreational ballet dancers in age range from 15 to 30 are participated in this study with completed the questionnaire which establish by researcher. We found that AT is an overuse condition which commonly reported among recreational ballet dancers with the prevalence rate of 28.3%. A number of extrinsic and intrinsic risk factors have been identified in this study such as BMI, training duration, unfamiliar choreography, limited warm up and cool down, training surface, footwear, medication, flexibility, lower limb abnormalities and muscle strength but our findings clearly demonstrated that training duration, limited warm up and cool down, footwear and muscle strength are the risk factors of AT among recreational ballet dancers. Besides that, among this four risk factors, footwear is the highest average of risk factors (57.55%) for AT. According to this findings, it indicates the risk factors of AT among recreational ballet dancers and shows the highest average of the risk factors among the four risk factors of AT which provide clearly information for dancers, teachers, sport therapists, health professionals and parents to prevent or treat the injuries more effectively and help to develop strategies aimed at reducing the prevalence of ballet injuries.

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References

1. Tendinopathy A. 2016 December 12.
2. Payne J. Achilles Tendinopathy. 2016.
3. Khan MJ, GASMaKMI. Risk Factors of Tendo-Achilles Injury in Football, Cricket and Badminton Players at Dhaka, Banglades. Bangladesh Medical Research Council Bulletin. 2015.
4. Lauren W. Understanding dance injuries. 2012.
5. Mumbleau A. Physical Therapist's Guide to Achilles Tendon Injuries (Tendinopathy). American Physical Therapy Association. 2013.
6. Rosso CaVV. Chapter 4 Biomechanics of the Achilles tendon. Achilles Tendinopathy. 2010.
7. Maffulli N, ea. Chronic Rupture of Tendo Achilles. Foot and ankle clinics. 2007; 12(4): p. 583-596.
8. Albert H. Ultrasound may help predict future tendon injuries in dancers. 2012.
9. Sobhani S, ea. Epidemiology of ankle and foot overuse injuries in sports: a systematic review. Scandinavian journal of medicine & science in sports. 2013.
10. Hullachan.. Intro to the Achilles Tendon. 2008.
11. Hincapie CA MEaCJ. musculoskeletal injuries and pain in dancers: a systematic review. Arch Phys Med Rehabil. 2008; 89(9): p. 1819-1829.
12. Kulig Kea. Dancers With Achilles Tendinopathy Demonstrate Altered Lower Extremity Takeoff Kinematics. Journal of Orthopaedics and sports physical therapy. 2011; 41(8): p. 606-613.
13. Benjamin MA C. Achilles tendinitis. 2014.
14. Jarvinen T. A. ea. Achilles tendon injuries. Current Opinion Rheumatology. 2001; 13(2): p. 150-155.
15. Sheyi, O. and SHAW B. Injuries in a Modern Dance Company Effect of Comprehensive Management on Injury Incidence and Cost. Journal of Dance Medicine & Science. 2011; 15(3): p. 116-122.
16. Liederbach MaCJ, M. Psychological Aspects of Fatigue-Related Injuries in Dancers. Journal of Dance Medicine & Science. 2001; 5(4): p. 116-120.
17. Saglimbeni A, J. Achilles tendon Injuries Clinical Presentation. Physical Medicine and Rehabilitation. 2016.
18. Paddock M. how can Achilles tendinitis be prevented? 2015.
19. Azevedo L. Risk factors for Achilles tendinopathy in runners–An investigation of selected intrinsic, kinematic, kinetic and muscle activity factors that are associated with Achilles tendinopathy. 2008.
20. Balding KJ. an epidemiological investigation of dance injuries in ballet dancers in the greater Durban area. 2004.