**Archives of Physical Health and Sports Medicine**

**ISSN: 2639-1805**

**Volume 3, Issue 1, 2020, PP: 07-11**

# Relationship between Chronic Pain and Physical Function Among High School Long-Distance Runners

**Kazumasa NAKAGAWA***

Takasaki University, Faculty of Health and Welfare, Department of Physiotherapy, Japan.

***Corresponding Author:** Kazumasa NAKAGAWA, Takasaki University, Faculty of Health and Welfare, Department of Physiotherapy, Japan.*

## Abstract

*This study aimed to analyze the relationship between regular physical assessment results and chronic pain among high school long-distance runners. Participants included 71 high school long-distance runners that were divided into pain (44 individuals) and non-pain (27 individuals) groups. All subjects underwent regular chronic pain and physical assessments, which included basic information, muscle flexibility, joint mobility, and muscular force, every 6 months. Differences in each measurement between both groups were statistically analyzed. The pain group had a significantly shorter athletic history than in the non-pain group. With regard to physical function, the pain group had significantly lower values for the straight leg raising test, lower leg inclination angle, and hip internal rotation range of motion (ROM) and significantly higher values for hip extension ROM and sole arch efficiency compared to the non-pain group. Inexperienced long-distance runners might be unable to run efficiently and might be burdened by unnecessary running motion, which can lead to pain. The results of this study suggest some possible relationships between certain physical characteristics (e.g., decreased hip inner rotation ROM or hamstrings tightness and increased hip extension ROM or sole arch efficiency) and disability or pain. However, in order to prevent disability, further investigations into the details of the disability/pain and related physical function are necessary. Given the importance of regular physical assessment in obtaining useful information for athletes, we expect continued investigations and measurements in the future.*

**Keywords:** *track and field; adolescent; prevention; physical check; running motion.*

## Introduction

The running motion is one of many basic movements utilized when playing sports. Given that running can be used not only for training athletes but also as aneasily engageable exercise for ordinary individuals, it has become very popular. Although running promotes positive psychological and physical effects, repetitive motions and other factors are often entangled and frequently cause musculoskeletal disorders. These disorders are more pronounced among track and field athletes who are forced to run at higher levels. Indeed, reports have shown that chronic disorders were strongly associated with the running motion [1,2]. Long-distance runners, in particular, often suffer from chronic pain in the lower limbs and other areas [3,4].

Focusing on age differences, young athletes have been found to develop several problems due to their immature body. Apart from musculoskeletal disorders, eating disorders, oligomenorrhea or amenorrhea, low bone mineral density, and low bone mass may be risk factors for injury, particularly among females[5]. When engaging in sports during adolescence, regular physical assessments are imperative for preventing injuries [6].

The author is a sports physiotherapist who has regularly conducted physical assessments for high school track and field athletes in Japan. The present study aimed to confirm the relationship between regular physical assessments results and chronic pain among highschool long-distance runners. The results presented here are believed to become a guide for identifying items related to injury prevention.

## Materials and Methods

A total of 71 high school long-distance runnerswere recruited (41 men and 30 women; mean age ± standard

deviation(SD), 16.7 ± 0.8 years; height, 163.5 ± 7.5 cm; weight, 53.0 ± 5.5 kg). All participants were informed regarding the purpose and procedure of the study, after which they provided written informed consent prior to participation. This study had been approved by the Takasaki Health and Welfare University Ethics Review Committee (No. 2723).

All sparticipants underwent regular assessments for chronic pain caused by repetitive running movement or training intensity. Subjects were regularly (approximately 2–3 days a week during team training at a practice site or match venue) assessed for pain history directly or by checking their daily practice diary. Physical assessments, which were conducted every 6 months, consisted of basic information, muscle flexibility and joint mobility, and muscular force. Basic information included, age, athletic history, height, weight, body mass index, and body fat percentage. Muscle flexibility and joint mobility were determined using the straight leg raising test (SLR), knee flexion angle in the prone position, lower leg inclination angle (LIA), hip joint (extension and rotation) and ankle joint (planter flexion) range of motion (ROM) tests, and sole arch efficiency, which was calculated by dividing the height of the arch in the standing position (the height from the floor surface to the scaphoid) by the foot length. Muscular force was assessed by measuring hip abductor and extensor forces using a hand-held dynamometer, trunk muscle strength using the sit-up test (i.e., the number of times subjects could perform a sit-up from the floor in 30 s), and total lower extremity strength using the stand-up test (i.e., the maximum number of times subjects could stand from a 20cm-tall chair with one leg in 30s). All measurements for muscle flexibility and joint mobility were measured once. Moreover, all measurements using a hand-held dynamometer were measured twice, with the lager value being used for analysis, while the sit-up and stand-up tests were measured once. For those requiring left- and right-side measurements, the average values of the left and right sides were used for analysis.

All participants were measured a total of five or six times while in high school. Moreover, results of the second measurement were compared with those of the third measurement, while the relationship between physical function and chronic pain occurring during that time was determined. participants were divided into the pain and non-pain groups, which comprised participants with and without chronic pain between the 6-month physical assessments, respectively. Chronic pain was herein referred to as that which caused the individual to miss practice or running for at least 1 day.

Given that all measurement results were confirmed to be normally distributed, a paired t-test was performed to statistically evaluate differences in each measurement between both groups. All statistical analyses were conducted using SPSS 24.0J for Windows, with the significance level set at 5%.

## Results and Discussion

A total of 44 participants were included in the pain group, among whom 18 felt pain in their lumbar spine, six in their hip joint and upper thigh, 12 in their knee joint, 17 in their lower thigh, and 15 in their ankle (including duplicates). Moreover, 44 (62%) athletes suffered an injury during this study. Reports have shown that the incidence of lower extremity running injuries range from 19.4% to 79.3% [7], depending on the definition and severity of the injury. In the present study, minor cases, such as those who missed a single day of practice, were included in the pain group, which in turn increased the number of individuals in the group. Studies have shown 75% prevalence of any running-related musculoskeletal pain among elite distance runners, with the lower leg being the most frequently reported location (19.1%). The presence of pain was independent of age, experience, and training volume [8]. It is my hope that investigations and measurements will continue in the future in order to allow the categorization of injury according to not only type but also severity, as well as verifying the same.

The pain group had a significantly shorter athletic history than in the non-pain group. With regard to physical function, pain group had significantly lower values of SLR, LIA, and hip internal rotation ROM and significantly higher hip extension ROM and sole arch efficiency compared to the non-pain group. No other parameters showed significant results. All results are presented in Table 1. The decrease in hip internal rotation ROM and posterior thigh muscle tightness, especially the hamstrings, may have caused the disorder. Moreover,a shorter athletic history was suggested to increase the likelihood of disorder. Although the relationship between athletic history and occurrence of disability remains unclear, the present study showed that participants with less experience

developed pain. Inexperienced long-distance runners might not be able to run efficiently and might be burdened by unnecessary running motion, which can lead to pain. While the approach to the running motion is important, investigating the degree of pain and recovery period, as well as early detection and response, is also imperative.

**Table 1.** *Results of measurement*

| | Pain group (n=44) | Non-pain group (n=27) | P value | 95% CI |
|---|---|---|---|---|
| Age (years) | 16.6 ± 0.7 | 16.9 ± 1.1 | 0.214 | -0.68 to 0.15 |
| Athletic history (years) | 3.8 ± 1.8 | 5.1 ± 1.9 | 0.003** | -2.24 to -0.46 |
| Height (cm) | 163.4 ± 8.4 | 163.6 ± 6.1 | 0.933 | -3.86 to 3.55 |
| Weight (kg) | 52.4 ± 6.0 | 54.1 ± 4.7 | 0.190 | -4.48 to 0.91 |
| Body mass index (kg*$^2$/m) | 19.6 ± 1.5 | 20.3 ± 1.4 | 0.075 | -1.40 to 0.07 |
| Body fat (%) | 15.8 ± 5.2 | 16.3 ± 5.0 | 0.691 | -2.98 to 1.99 |
| Straight leg raising test (deg) | 63.4 ± 7.4 | 69.2 ± 9.0 | 0.004** | -9.74 to -1.90 |
| Knee flexion angle (deg) | 140.1 ± 6.3 | 138.5 ± 6.5 | 0.310 | -1.52 to 4.71 |
| Lower leg inclination angle (deg) | 39 0 ± 7.7 | 42.7 ± 7.2 | 0.047* | -7.29 to -0.05 |
| Hip extension angle (deg) | 29.6 ± 4.2 | 27.5 ± 3.2 | 0.031* | 0.19 to 3.95 |
| Hip internal rotation angle (deg) | 40.0 ± 8.1 | 46.3 ± 12.9 | 0.015* | -11.20 to -1.27 |
| Hip external rotation angle (deg) | 47.6 ± 7.5 | 45.1 ± 11.9 | 0.279 | -2.07 to 7.09 |
| Ankle planter flexion angle (deg) | 50.7 ± 8.8 | 47.8 ± 12.3 | 0.259 | -2.15 to 7.86 |
| Sole arch efficiency (%) | 17.5 ± 2.7 | 16.1 ± 1.6 | 0.022* | 0.20 to 2.53 |
| Gluteus medius muscle force (kgf/kg) | 35.3 ± 11.0 | 37.6 ± 12.6 | 0.415 | -0.80 to 0.33 |
| Gluteus maximus muscle force (kgf/kg) | 34.2 ± 8.3 | 31.6 ± 5.2 | 0.147 | -0.09 to 0.62 |
| Sit-up test (number) | 28.8 ± 5.2 | 29.3 ± 3.7 | 0.654 | -2.80 to 1.77 |
| Stand-up test (number) | 9.3 ± 4.1 | 7.9 ± 3.6 | 0.149 | -0.51 to 3.32 |
| * = p < 0.05, ** = p < 0.01, CI = confidence interval | | | | |

participants in the pain group had a considerably large hip extension ROM but small hip inner rotation ROM, with hamstring tightness also being observed. While hip extension movement has been considered important for the forward tilt of the pelvis in the running motion, evaluating the motion of the pelvic girdle altogether is necessary [9,10]. Although no speculation existed regarding the pelvic forward tilt angle, excessive pelvic forward tilt might have caused lumbar pain. After comparing lower limb muscle tightness, Wang et al. reported no difference in rectus femoris and iliopsoas muscle tightness but did observe a significant difference in hamstring muscle tightness between runners and nonrunners [11]. In the present study, hamstring tightness had also been observed, with the pain group showing considerably greater tightness. Moreover, studies have confirmed that stretching the hamstrings is important for long-distance runners [12]. The relationship between hip internal rotation restriction and disability has been studies considerably, especially for knee injuries [13-15]. Accordingly, restrictions in internal rotation might have possibly caused lower back, knee, and lower leg pain among the participants.

Studies on the foot have highlighted not only the arch but also various running injuries resulting from restrictionsin ankle dorsiflexion and other areas [16,17]. In the present study, the pain group had a greater arch than the non-pain group, which may be due in part to the lack of track and field experience. Although various theories have been presented regarding the relationship between the shape and state of the arch and certain injuries and disorders, the direct relationship between running injuries and shape of the arch has been difficult to explain. While similar results have been obtained in the present study, the shape of the arch may be suggested to have caused injury in conjunction with other physical functions and movements and should be examined continuously [18]. Benette et al. supported the

hypothesis that a pronatory foot type is related to medial tibial stress syndrome (MTSS) [19]. Although the results presented herein showed the opposite, the present study compared pain within the entire lower limb. Thus, future studies should compare and verify each disability, including the relationship between MTSS and other disabilities. Zifchock et al. also reported that hip internal rotation ROM, as well as the deviation from the normal arch height index, had been bilaterally elevated among injured runners [14]. Although left–right differences had not been analyzed herein, similar results had been obtained wherein hip internal rotation ROM and arch were related to pain or disability. A detailed investigation regarding the injury mechanism will nonetheless be needed.

Although the present study found no characteristic point in the hip muscle group, Fredericson et al. reported a relationship between hip abductor weakness and iliotibial band syndrome [20]. Future studies will therefore need to verify such results according to disease and continuously monitor muscle strength around the hip joint. To prevent running injuries, ROM and muscle strength around the hip joint are important [21]. Thus, continuous investigations on the relationship between injury and hip ROM and strength are needed to establish effective preventive training.

Comparing and examining the pain site or its contents had been difficult due to the number of participants. Therefore, the most important point is to eliminate speculation regarding the causal relationship between physical function and disability. However, by verifying the causal relationship between physical function and pain as a whole, screening tests that could cause significant some problems have been observed. This should be considered imperative in the future implementation of the project.

## Conclusion

The results of the present study show that among long-distance runners, a possible relationship between certain physical characteristics and disability or pain had been observed. However, to establish measures preventing disability, detailed investigations regarding the disability and pain, as well as the physical function related there to, are necessary. Moreover, regular physical assessments, which I hope will be continued in the future, should be conducted in order to obtain useful information regarding the athletes.

## Acknowledgement

There is no conflict of interest related to this study. I would like to thank the team coaches and supervisor, the measurement contributors, and most importantly the athletes who cooperated with the measurements for their patience and understanding throughout the study.

## References

[1] Zemper ED. Track and Field Injuries. Med Sport Sci 2005;48:138-151.Available from: doi:10.1159/000084287.

[2] Lysholm J, Wiklander J. Injuries in runners. Am J Sports Med 1987;15(2):168-171. Available from: doi:10.1177/036354658701500213.

[3] Tschopp M, Brunner F. Diseases and overuse injuries of the lower extremities in long distance runners (in German). Z Rheumatol2017;76(5): 443-450. Available from: doi: 10.1007/s00393-017-0276-6.

[4] Dimeo FC, Peters J, Guderian H. Abdominal pain in long distance runners: case report and analysis of the literature. Br J Sports Med 2004;38(5):E24. Available from: doi: 10.1136/bjsm.2003.007237.

[5] Rauh MJ, Nichols JF, Barrack MT, et al. Relationships among injury and disordered eating, menstrual dysfunction, and low bone mineral density in high school athletes: a prospective study. J Athl Train 2010;45(3):243-252. Available from: doi:10.4085/1062-6050-45.3.243.

[6] DiFiori JP. Evaluation of overuse injuries in children and adlescents. Curr Sports Med Rep 2010;9(6):372-378. Available from: doi: 10.1249/JSR.0b013e3181fdba58.

[7] van Gent RN, Siem D, van Middelkoop M, et al. Incidence and determinants of lower extremity running injuries in long distance runners: a systematic review. Br J Sports Med 2007;41(8):469-480. Available from: doi: 10.1136/bjsm.2006.033548.

[8] Teixeira RN, Lunardi A, da Silva RA, et al. Prevalence of musculoskeletal pain in marathon runners who compete at the elite level. Int J Sports Phy Ther 2016;11(1):126-131.

[9] Schache AG, Blanch PD, Murphy AT. Relation of anterior pelvic tilt during running to clinical and kinematic measures of hip extension. Br J Sports Med 2000;34(4):279-283. Available from: doi:10.1136/bjsm.34.4.279.

[10] Schache AG, Bennell KL, Blanch PD, et al. The coordinated movement of the lumbo–pelvic–hip complex during running: a literature review. Gait Posture 1999;10(1):30-47. Available from: doi:10.1016/S0966-6362(99)00025-9.

[11] Wang SS, Whitney SL, Burdett RG, et al. Lower extremity muscular flexibility in long distance runners. J Orthop Sports Phys Ther 1993;17(2):102-107. Available from: doi:10.2519/jospt.1993.17.2.102.

[12] Weerapong P, Hume PA, Kolt GS. Stretching: mechanisms and benefits for sport performance and injury prevention. JPhys Ther Rev 2004;9(4):189-206. Available from: doi:10.1179/108331904225007078.

[13] BediR A, Warren RF, Wojtys EM, et al. Restriction in hip internal rotation is associated with an increased risk of ACL injury. Knee Surg Sports Traumatol Arthrosc 2016;24(6):2024-2031. Available from: doi: 10.1007/s00167-014-3299-4.

[14] Zifchock RA, Davis I, Higginson J, et al. Side-to-side differences in overuse running injury susceptibility: a retrospective study. Hum Mov Sci 2008;27(6):888-902. Available from: doi:10.1016/j.humov.2008.03.007.

[15] Powers CM. The influence of abnormal hip mechanics on knee injury: a biomechanical perspective. J Orthop Sports Phys Ther 2010;40(2):42-51. Available from: doi:10.2519/jospt.2010.3337.

[16] Bennell KL, Malcolm SA, Thomas SA, et al. The incidence and distribution of stress fractures incompetitive track and field athletes. a twelve-monthprospective study. Am J Sports Med 1996;24(2):211-217.Available from: doi:10.1177/036354659602400217.

[17] Manoli A 2nd, Graham B. The subtle cavus foot, "the underpronator". Foot Ankle Int 2005;26(3):256-263. Available from: doi:10.1177/107110070502600313.

[18] Hespanhol Junior LC, de Carvalho AC, Costa LO, et al. Lower limb alignment characteristics are not associated with running injuries in runners: prospective cohort study. Eur J Sport Sci 2016;16(8):1137-1144. Available from: doi:10.1080/17461391.2016.1195878.

[19] Benett JE, Reinking MF, Pluemer B. Factors contributing to the development of medial tibial stress syndrome in high school runners. J Orthop Sports Phys Ther 2001;31(9):504-510. Available from: doi:10.2519/jospt.2001.31.9.504.

[20] Fredericson, M, Cookingham CL, Chaudhari AM, et al. Hip abductor weakness in distance runners with iliotibial band syndrome. Clin J Sport Med 2000;10(3):169-175. Available from: doi: 10.1097/00042752-200007000-00004.

[21] Taylor-Haas JA, Hugentobler JA, DiCesare CA, et al. Reduced hip strength is associated with increased hip motion during running in young adult and adolescent male long-distance runners. Int J Sports Phys Ther2014;9(4):456-467.

**Citation:** **Kazumasa NAKAGAWA.** *Relationship between Chronic Pain and Physical Function Among High School Long-Distance Runners. Archives of Physical Health and Sports Medicine. 2020; 3(1): 07-11.*