

ACTIVITY RELATED DIFFERENCES IN THE THICKNESS OF PLANTAR FASCIA OF SOME OCCUPATIONAL GROUPS IN NIGERIA: AN ULTRASOUND BASED STUDY

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Background: The degree of physical activity induces strain and stress on the plantar fascia of the foot and the effect of these forces may lead to thickening of the plantar fascia.

Methods: The effect of occupation-related physical activity on the thickness of the plantar aponeurosis (PAT) was assessed among four classes of occupation- Labourers/farmers, Dancers, Athletes and an inactive class (control/normal group).

Results: Results show that the inactive (control group) had the least value for PAT (3.21 ± 0.42 mm). The dancers and labourers/farmers had higher values than the control though not significant. The value for athletes was significantly higher than the control ($P=0.007$).

Conclusion: Our findings have conclusively established that occupation-related prolonged physical activity induces thickening of the plantar aponeurosis. Interventions should be initiated to avoid the setting in of degenerating conditions that may lead to plantar fasciitis.

Keywords: Physical activity, Occupation, Plantar Aponeurosis thickness, plantar fasciitis.

INTRODUCTION

Physical activity can be described as the degree of use of the musculoskeletal system. It is always done to improve health and physical fitness. However, in some cases it is highly related to the type of occupation of the individuals.

The level of physical activity of individuals has been reported to influence the functional mechanics of the human musculoskeletal system and may obviously influence the geometry and biomechanics of Gait and the plantar fascia being an important factor in the maintenance of arch system may be influenced by level of physical activity. Uzel et al [1] described the lack of relationship between plantar fascia thickness and degree of physical activity. Later, Rchalis [2] reported that the degree of physical activity may influence the structural disposition of the foot soft tissues of which the plantar fascia cannot be excluded.

The biomechanical orientation of the foot during persistent work can be a factor in the thickness of the plantar fascia. In most developing countries human locomotion forms the basic tool in economic growth. The foot is also a veritable tool among athletes who are constantly involved in running, cycling, jumping and other sports that require a sustained use of the feet. Among dancers, it is fundamental in the artistic communication of the beauty of dancing especially in traditional groups where most cultural exhibition of skills are directly as-

sociated with finesse articulation of feet movements; a persistent manifestation of dexterity associated with twisting and turning that imposes relatively high degrees of stress and strain within the foot components.

These factors like the consistent use of the bipedal system of motion by farmers and their associates in the harvest and transportation of farm produce; by labourers in numerous construction sites in Africa and Asia where mechanization has not been totally employed and who transport heavy work tools and building materials; by professional athletes who are constantly using their feet to earn a living by strenuous acts of running, jumping, cycling; by traditional dancers in Abakaliki metropolis, Ebonyi State, Nigeria who entertain people by exhibiting extra-dexterity in feet movement, may impart on the structural and functional inclinations of the different foot components and since the Plantar Fascia of the foot are highly involved in the arch sustaining and stress soaking aspects of the foot, it is absolutely necessary to ascertain its structural dispositions in individuals involved in excessive use of the foot without avoiding investigations in individuals that do not expose their feet to the strain and stress of overuse.

Since literature on the relative effect of occupation related physical activity on plantar fascia and other soft tissues is scanty, there is need to determine such relation-

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ships especially within our developing environment. Furthermore, the need for this study is triggered by the necessity to develop a possible basis for the bio-mechanical evaluation of the foot components among these occupational groups in our environment and to ascertain the possible effects of these occupations on the structural disposition of the plantar fascia.

SUBJECTS AND METHODS

DESIGN: This is a quasi experimental research which was carried out within Abakaliki metropolis, Ebonyi State, Southeast, Nigeria.

STUDY CENTRE: The study centre was done in an ultrasound scanning centre – Veramax imaging centre, Abakaliki, Ebonyi State, Southeast Nigeria. This ultrasound and Imaging centre receives patients from within Abakaliki metropolis and beyond. Their patients are mostly obstetric patients and individuals with soft tissue pathology including all forms of intra-abdominal pathologies. It is well staffed with a total of twelve (12) resident Medical Imaging Scientists. The centre receives patients from all private hospitals in Abakaliki Metropolis and beyond and those not accommodated in the Federal Medical Centre, Abakaliki and Ebonyi State University Teaching Hospital, Abakaliki, Ebonyi State.

STUDY POPULATION: Abakaliki Metropolis is made up of the capital territory of Ebonyi State, Nigeria. It has a land mass of about 2000 sq. km and bordered in the north by Benue State, in the west by Enugu State, in the east by Cross River State and in the south by the rest of the state. It has a population of over 400,000 people. Agriculture is the main stay of its economy and the people are essentially farmers. It has a rich cultural heritage and also known for the popular Quarry Industries where some of its people are exposed to a myriad of hazards, especially the women folk. These women are continuously involved in lifting of crushed stones and probably imposing stress and strain on the natural weight bearing/cushioning parts of the foot. Also due to the large production of stones, a lot of construction sites abound. These women and some few men are always continuously lifting building materials, at times without appropriate podiatric wears. These individuals, earning a living in this case, are most likely to induce plantar pressure on their feet [3].

As a result of its rich cultural heritage, the State Government established a State Council for Arts and Culture and the metropolis plays home to a lot of cultural/traditional dance groups that are always training to earn a living through it and to entertain vigorously, the entire populace. With these categories of people, the Metropolis has all the classes of individuals required for this extensive study and that was why we considered it an ideal choice.

Thus, the study populations comprise the following groups:

a) A convenient study population of 30 Igbos whose occupation is not very physically involving. For

instance young Bankers, Lecturers, Teachers, Students who are resident in Abakaliki metropolis.

- b) A convenient sample population of 30 Igbos whose occupations are labourious – they undergo a high degree of strenuous work. Examples are those in the Quarry industry, Abakaliki and labourers in building and construction sites and full-time farmers resident in Abakaliki metropolis.
- c) A convenient Sample population of 30 highly active individuals who are athletes or involved in active sports like football, sprints, Long Jump, cycling etc.
- d) A convenient Sample population of 30 Traditional music dancers in Abakaliki Metropolis, Ebonyi State who are also highly active.

INCLUSION CRITERIA:

- a) The subjects must be apparently healthy; must have no history of any systemic disease like diabetes, familial hypercholesterolemia etc and foot deformity or have undergone any form of foot surgery. This is to avoid any possible effect of these ailments.
- b) The group (a) study population must not have any other type of job that increases physical activity and must have worked for a minimum of two (2) calendar years.
- c) The group (b) study population must not have any other job impeding his /her degree of physical activity except his normal rest periods and must have worked for a minimum of four (4) calendar years.
- d) The group (c) study population must be professional athletes/sportsman registered in any state owned sports outfit within Abakaliki and Enugu Metropolis and must have trained for a minimum of four (4) calendar years.
- e) The group (d) study population must be professional traditional music dancers Abakaliki Metropolis registered with the Ebonyi State Council for Arts and Culture and must have danced for four (4) calendar years.

EXCLUSION CRITERIA:

- a) Subjects that had any history of foot deformity or foot surgery.
- b) Subjects who were pregnant. This is to avoid the effect of pregnancy on fat distribution and gait mechanics.
- c) Subjects with a history of any systemic disease like diabetes, familial hypercholesterolemia etc. This is to avoid any possible effect of these ailments.

INSTRUMENT FOR DATA COLLECTION: A 7.5 linear-array transducer (Siemens sonoline 940- 2000 model) with a diameter of 39mm was used for the assessment of the thickness of the plantar fascia.

SCANNING PROTOCOL:

During measurement of Plantar Aponeurosis thickness (PAT), each subject lay in a prone position on the couch with knees flexed with the ultrasound gel applied generously on the plantar aspect of the foot. Scanning was then carried out when the probe was placed longitudinally over the centre of the foot at about 3cm from the calcaneal insertion of the aponeurosis. The PAT was measured from its anterior wall to the posterior wall [4].

STATISTICAL ANALYSIS: All measurements obtained were expressed as means± standard deviation. The data obtained were analyzed using Statistical package for social sciences (S.P.S.S) in Microsoft windows.

ETHICAL APPROVAL: In line with Helsinki declaration of 1975, ethical approval was obtained from the academic board of the College of Health Sciences, Abia State University, Uturu.

RESULTS:

Table I shows the means ± SD of the values of PAT (right and Left sides) for all the groups. Figure I shows that the athletes’ group topped the chart with the highest value of PAT. They were closely followed by the labourers and then the other groups (Dancers and control (normal) population).

Table II shows the comparison between the groups using ANOVA and evinces significant differences between the groups with P<0.05 regarded as being significantly different.

Table III shows multiple comparisons between the groups. Between the control population and others shows that only the athletes’ groups was significantly higher (P=0.007). Also the Athletes’ group showed a significantly higher PAT than the dancers’ group. Other groups did not show any form of significant difference even though their values were higher than the control.

Table I. Showing Descriptive Statistics of PAT for all the groups

	Control (normal inactive)	Labourers, group	Dancers’ group	Athletes’ group
PAT (RT)	3.21±0.42	3.47±1.22	3.24±0.44	3.72±0.46
Range	2.8-4.1	2.0-5.8	2.3-3.6	3.0-4.8
PAT (LT)	3.19±0.41	3.43±1.24	3.18±0.35	3.80±0.45
Range	2.8-4.1	1.9-5.8	2.4-3-6	3.2-4.9

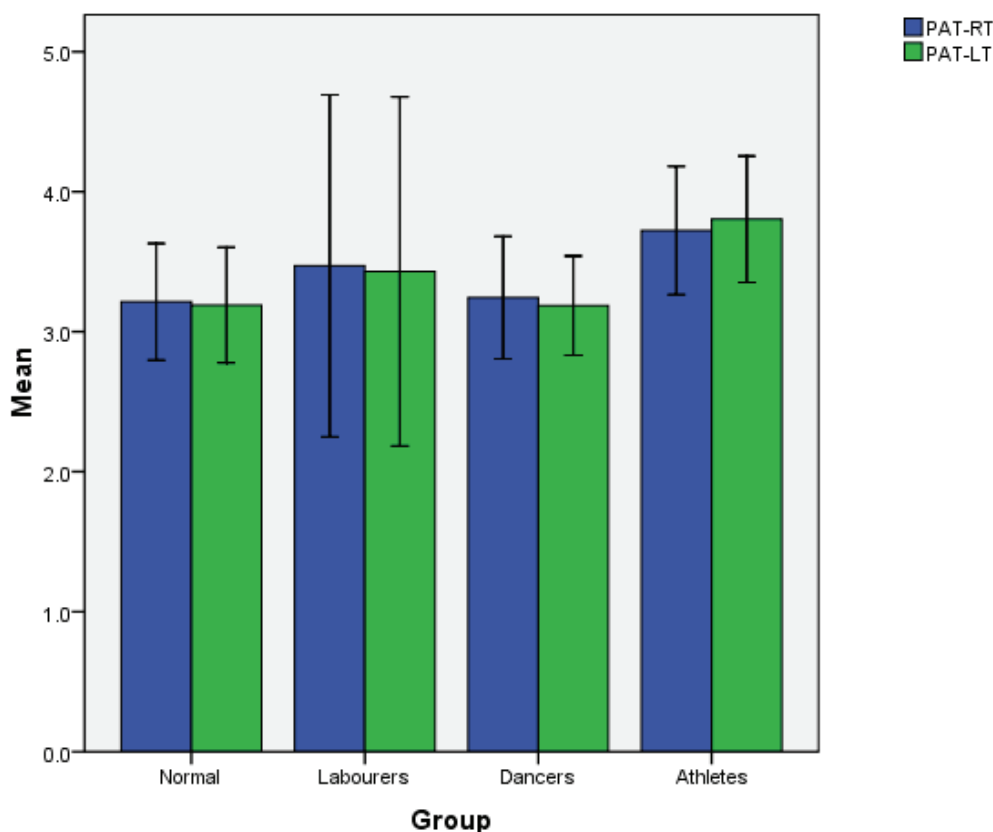


Fig1. Showing the chart of PAT (RT and LT) for all the groups

Table II. Showing Comparison between group using ANOVA

		Sum of Squares	Df	Mean Square	F	Sig
P A T (RT)	Between groups	5.05	3	1.68	3.26	.024*
	Within groups	59.95	116	.517		
	Total	65.00	119			
P A T (LT)	Between groups	7.60	3	2.53	4.93	.003*
	Within groups	59.51	116	.513		
	Total	67.11	119			

*P<0.05 (Level of significance)

Table III. Showing Multiple comparisons between groups using Post Hoc test (P<0.05 as significant)

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
PAT	Normal	Labourers	-.2567	.1856	.169
		Dancers	-.0300	.1856	.872
		Athletes	-.5100*	.1856	.007
	Labourers	Normal	.2567	.1856	.169
		Dancers	.2267	.1856	.224
		Athletes	-.2533	.1856	.175
	Dancers	Normal	.0300	.1856	.872
		Labourers	-.2267	.1856	.224
		Athletes	-.4800*	.1856	.011
	Athletes	Normal	.5100*	.1856	.007
		Labourers	.2533	.1856	.175
		Dancers	.4800*	.1856	.011

DISCUSSION

The plantar fascia is subjected to significant traction as body weight is transferred onto the forefoot during the later half of the contact phase of walking, and the intensity of the fascia's stresses and strains increases with the intensity of activity [5]. These activities may affect the structural disposition of the plantar fascia.

The results from this study have shown that when comparing the control group (normal) with the physically active groups (Labourers, Dancers and Athletes), PAT values were smaller in the control group (Fig1) even though only the values in the group of athletes showed significantly higher difference with the control group (Table III). This is a pointer to the degree of occupationally induced thickening of plantar aponeurosis associated with physical activity contrary to the report of Uzel et al [1] who stated that the plantar fascia thickness was not correlated to physical activity even though they worked on degree of physical activity on an hourly basis and did not consider a near life time effect of occupation induced activity that consistently induce high level of plantar pressure and strain.

The high thickening in the athletes may be accounted for by the possible nature of sustained muscular activity of the entire lower extremity, including the foot, associated with their occupation that consistently alter their

foot arch mechanics. Further investigations should be done in our environments on the biomechanical effects of certain sports on the arch sustaining mechanism of the plantar fascia.

In this study, the entire subjects recorded more than five (5) hours of intense physical activity daily. These individuals involved in persistent subjection of the foot, without appropriate podiatric packaging, to wear and tear of strain may trigger an unprecedented thickening of the plantar fascia that is adaptive in order to maintain its functional role within the foot. This is usually in line with a period of prolonged usage and subsequent adaptation. This may however, alter the elastic significance of the fascia in the maintenance of the foot arch that could lead to future reoccurring cases of plantar pain and/or Fasciitis.

In these individuals who have worked for a sizeable number of years, the collagen deposition sequences may be increased to stimulate an abnormal thickening of the plantar fibrous tissue leading to the higher thickness observed among the active occupational groups. These occurrences may be an outcome of overuse and the dynamic characteristics of the foot arch of the individuals because Kaufman et al[6] stated that dynamic arch characteristics, restricted ankle dorsiflexion and increased hindfoot inversion are risk factors that predispose people to overuse injuries.

Even though the incidence of plantar pain among these occupational groups was not assessed, this study has created an insight into the type of occupational groups that may have increased incidence of podiatric medical problems concerning the plantar fascia and has created the need for the design of intervention programs to avoid the possible occurrence of overuse syndromes associated with the plantar fascia. In a study by Shibuya et al [7], there was increased prevalence of podiatric medical problems in retired war veterans than in non-veterans and because these farmers, labourers, dancers and athletes have a prolonged career of consistent induction of plantar strain and stress, a time may come when these observed thickening of the plantar fascia may become a podiatric problem. Therefore, possible intervention programs for such class of individuals should also be initiated and sustained to avoid an increased level of dependence by the affected occupational class in the future.

CONCLUSION

This study has conclusively established that occupation-related physical activity initiates thickening of the plantar aponeurosis that may affect occupational efficiency and performance and may result to a podiatric problem among labourers/farmers, dancers and

athletes. However, this thickening is more predominant among athletes.

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