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Balance Performance of Professional Footballers with Long Term Lower Limb Musculoskeletal Injury in Borno State, Nigeria

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Abstract
Balance has been reported to have an effect on athletic performance; therefore impairment in the sense of balance may result in reduced athletic performance. Lower limb musculoskeletal injury (LLMI) is the most common injury found among footballers, and most commonly-cited risk factor for poor balance performance. However, there is a disagreement over balance impairment persisting in Professional footballers with long term LLMI after the initial rehabilitation upon resuming normal sporting activities. This study therefore aimed at determining the BPF of Professional footballers with long term lower limb musculoskeletal injury, the effect of time lapse since occurrence of injury on BPF, compare BPF of injured professional footballers and uninjured footballers and to compare BPF and site/segment of LLMI among Professional footballers in Maiduguri, Borno State Nigeria.
Sample of convenience was used to recruit 41 professional footballers. The participants comprised of 28(68.3%) injured players (IP) and 14(31.7%) uninjured players (UP) whose ages ranged from 17 to 30 years. Sociodemographic information of age, limb dominance, onset of injury and sites/segments of injury were obtained. Participant's weight and height were measured using standardized procedure. Balance Performance (BPF) was assessed using the Stork balance stand test.
The results indicated that lower balance performance was observed in the injured limb compared to the uninjured limb in IP ($P<0.001$). BPF was lower in the dominant limb of IP compared with the dominant limb of UP ($P<0.001$). Time lapse since injury and sites/segments of the LLMI did not have any effect on BPF ($P>0.05$). It was concluded that balance problems persist in professional footballers with long term LLMI irrespective of time lapse since injury and sites/segments of the LLMI. Coaches and rehabilitation personnel should pay particular attention on balance retraining of players with LLMI using balance exercise programs that will mainly improve/centered on their balance performance.
Keywords: Balance performance, Footballers, LLMI

1. Introduction

Balance is the ability to maintain body mass center in the domain of base of support (Hrysomallis, 2011). Balance is also a dynamic process by which the body is maintained in equilibrium (Kisna and Colby, 2007). Balance is maintained by the vestibular, visual and somatosensory system along with centre of gravity and centre of mass. Balance is an ability to maintain the line of gravity of a body within the base of support with minimal postural sway. Sway is the horizontal movement of the centre of gravity even when a person is standing still. A certain amount of sway is essential and inevitable due to small perturbations within the body or from external sources. Maintaining balance requires coordination of input from multiple sensory systems including the vestibular, somatosensory and visual systems. The senses must detect changes of body position with respect to the base of support, regardless of whether the body moves or the base moves or changes size. A decrement in balance can result from musculoskeletal injury, head trauma, disease or ageing (Malliou *et. al.,* 2004; Mark *et. al.,* 2004; Golomer *et al.*, 1994; Lee *et. al.*, 2009) and can be severely affected in individuals with neurological conditions such as stroke, spinal cord injury, or Parkinson's disease (Lubetzki and Kartin, 2010).

Balance ability has a significant effect on athletic performance (Hrysomallis, 2011). Athletes have presented with superior balance ability compared to non athletes; suggesting that sports participation improves balance (Bressel et al., 2007; Aydin et al., 1996; Thorpe and Ebersole, 2008; Lephart et al., 1996; Davlin, 2004; Matsuda et al., 2008). Athletic training stimulates neurosensory pathways which improve balance and proprioception (Aydin et al., 1996; Lephart et al., 1996). Poor balance ability has been associated with an increased risk of ankle injury in a number of soccer sports (Hrysomallis, 2013). Thus, BPF requires the interaction of the nervous and musculoskeletal system (Giagazoglou *et al.,* 2009). It can also be negatively affected in individuals with injury in the muscles around the hips (gluteals and lumbar extensors), knees and ankles with consequent greater effect on postural stability (Gribble and Hertel, 2003; Davidson *et al.,* 2004).

Football is a contact sport and running game that involves periods of continuous physical activity, interspersed with periods of high-intensity activity, including unexpected, explosive and agile movements and heavy physical contact. The game features contribute to the high risk of injury (Johansson, *et al.,* 1991; Goldie,

et al., 1989). Professional athletes such as footballers perform a lot of lower limb weight bearing functional activities that require some high degree of muscle strength, coordination and balance (Chu, 1998). This sport tasks involve repeated impulsive contacts between the lower limbs and the support surface and when these contacts are poorly controlled, the cumulative effects of vertical impact loading during the game have been implicated as major factors contributing to lower limb injury in footballers (Chu, 1998). Lower limb musculoskeletal injury (LLMI) is the most common injury found in soccer (Junge *et al.,* 2006), and most commonly-cited risk factor for poor BPF (Daniel *et al.,* 1994). Emery et al (2005) also concluded in their study that previous lower limb injuries need to be taken into consideration as a key factor that can influence balance.

Balance impairment has been reported following the acute phase of LLMI (Lentell, 1990). Previous studies have reported impaired balance after injury (Bullock-saxon, 1995; Wang et al., 2006; McGuine et al., 2000; Emery et al (2005; Friden, *et al.*, 1990) and anterior cruciate ligament injury. Holder-Powell and Rutherford (2000) also reported impaired balance in some physically active individuals and amateur athletes after a long-term LLMI. However, it is unclear whether the balance impairments as a result of LLMI persist in the long term (Oates, et al., 1999). In a study conducted among Professional footballers in Nigeria, on BPF by Ogwumike and Tijani (2011), lower BPF was observed in injured limb compared to the uninjured limb. The authors then concluded that balance problems persisted in the cohort of Professional footballers with LLMI irrespective of the time lapse since injury. Indicating that balance impairments indeed can persist after LLMI. The study by Ogwumike and Tijani (2011) was conducted among professional footballers in southern part of Nigeria.

There is however, a dearth in information on balance performance of Professional footballers with long term lower limb musculoskeletal injury in the northern part of Nigeria. Thus this study is therefore aimed at determining the BPF of Professional footballers with long term lower limb musculoskeletal injury, the effect of time lapse since occurrence of injury on BPF, to compare BPF of injured professional footballers and uninjured footballers and to compare BPF and site/segment of LLMI among Professional footballers in Maiduguri, Nigeria.

2. Method

2.1 Participants and materials

Sample of convenience was used to recruit 41 professional footballers of the El-kanemi warriors football club, Maiduguri, Borno State, Nigeria. Professional footballers with at least six month time lapse since occurrence of LLMI, Absence of pain at the site of the injury, Absence of any neurological symptoms consequent to the LLMI and Lack of any LLMI among the uninjured players were included in this study.

Socio-demographic information about the participant's characteristics (these include age, height, weight, and body mass index) and information on dominant limb, injured limb, onset of injury, and site of injury were obtained. BPF of the participants were assessed using the stork balance stand test (Torpend, 2009). This test was used to measure the ability of the participant to balance on the ball of the foot with hands placed on the hips while positioning the non-supporting foot against the inside knee of the supporting leg. Using a stopwatch, the amount of time in seconds that the participant was able to stand on the ball of the foot of one leg was indicative of his BPF. BLF was scored as *excellent* if the participant was able to perform the test for 50 seconds and above. *Good* if the participant was able to perform the test for 40-49 seconds. *Average* if participant was able to perform for 25-39 seconds. *Fair* if the participant was able to perform the test for 10- 24 seconds and *poor* if the participant was only able to perform the test for less than 10 seconds. A Cross-sectional design was used for this study.

2.2 Procedure

The ethical approval for the study was sought and obtained from the Research and Ethical Committee of University of Maiduguri Teaching Hospital (UMTH) before commencement of the study. Informed Consent form was signed by all the participants before the commencement of the study.

2.2.1 Objective Examination

In a supine lying position, each participant was asked to carry out some active movements of both lower limb joints including Hip and knee flexion and extension, ankle dorsiflexion and plantar flexion as well as foot inversion and eversion. These movements were compared with that of the other limb in order to rule out pain and joint range limitation and to ensure that each participant met the inclusion criteria for the study (Ogwumike and Tijani, 2011). Goniometry was used to asses for joint limitation among the participants. Participants with any sort of pain or joint range limitation were excluded from the study.

The participants' weight and height were assessed using standardized procedures. BMI (body mass index) was estimated using the formula; $BMI=Wt/Ht^2$ (kg/m^2).

Participants warm-up for 5 minutes and stands comfortably on both feet with hands on the hips. The dorsum of the foot was placed against the inside knee of the supporting leg. A stopwatch was timed at the same time as the participants raise the heel of the supporting leg to stand on the ball of the foot. Participants were

asked to hold this position for as long as possible. Timing was stopped if:
(i) The supporting foot swivels or moves (hops) in any direction
(ii) The non- supporting foot loses contact with the knee
(iii) The heel of the supporting foot touches the floor.
Overall score was the best of three attempts for each participant. The same procedure was carried out on both lower limbs.

3. Statistical Analysis

Descriptive statistics of mean and standard deviation was used to analyze the Socio-demographic characteristics of the participants. Student paired t-test was used to compare differences in BPF in the injured and uninjured limb of the injured participants (IP). Independent t-test was used to compare differences in BPF between the dominant injured limb of the IP and the dominant limb of the un-injured participants (UP); was to compare the non-dominant injured limb of the IP and the non-dominant limb of the UP. Analysis of variance (ANOVA) was used to compare time lapse since injury and BPF in IP and Sites/segments of LLMI and BPF in IP. Level of significance was defined as at $p< 0.05$.

4. Results

Forty-one professional soccer players participated in this study, with a mean age and BMI of 22.10±3.38 years and 23.94±1.71kg/m^2 respectively. The participants comprised of 28 (68.3%) injured players and 13 (31.7%) uninjured players. Details of the physical attributes of the participants were presented in Table 1.
Table 2 compares the BFP in injured and uninjured limbs of the injured players. The mean BPF score was found to be 22.29±8.22 sec in the injured limb and 25.14±8.05 sec in uninjured limb of the injured players. The difference in BPF between injured and uninjured limbs of the injured Professional footballers shows a statistically significant ($p< 0.001$).
Table 3 shows the difference between the dominant injured limb of the injured players and the dominate limb of the uninjured players. The mean BPF score was found to be 24.67±7.63sec in the Dominant injured Limb of injured players and 49.62±5.78sec in the Dominant Limb of uninjured players respectively. The result also shows that BPF between Dominant injured Limb of injured players and Dominant Limb of uninjured players was statistically significant ($p< 0.001$).

Table 1: Physical attributes of the participants

Variables	IP		UP	
	n	%	n	%
Age group (yrs)				
17-23	18	66.7	9	33.3
24-30	10	71.4	4	28.6
	Mean ± S.D		**Mean ± S.D**	
Weight(kg)	72.68 ± 5.31		79.69 ±7.61	
Height(m)	1.74 ±0.06		1.77 ±0.07	
BMI(kg/m^2)	23.94 ±1.71		25.50 ±2.52	

Key: IP = injured participants
UP = uninjured participants
BMI = body mass index
S.D = Standard Deviation

Table 2: Comparison of BPF between injured and uninjured limbs of injured players

Variables	BPF(s); Mean ± S.D	t-value	P- value
Groups			
IL	22.29 ± 8.22	-13.697	<0.001
UL	25.14 ±8.05		

Key: IL = Injured limb
UL = Uninjured limb
BPF = Balance performance
S.D = Standard Deviation
s = seconds

Table 3: Comparison of BPF between Dominant injured Limb of injured players and Dominant Limb of uninjured players

Variables	BPF(s); Mean ± S.D	t-value	p- value
Groups			
DIL	24.67 ±7.63	-11.097	<0.001
DL	49.62 ±5.78		

Key: DIL = Dominant injured Limb of injured players
DL = Dominant Limb of uninjured players
BPF = Balance performance
S.D = Standard Deviation
s = seconds

The mean BPF score was found to be 15.14±5.55sec and 38.08±10.19sec in Non-Dominant injured Limb of injured players and Non-Dominant Limb of uninjured players respectively. The difference in BPF between Non-Dominant injured Limbs of injured players and Non-Dominant Limbs of uninjured players was statistically significant ($p< 0.001$) as shown in Table 4.

Table 5 shows the relationship between BPF and time lapse since injury among injured participants. The mean BPF score was lower (20.31 ±7.078sec) in participants whose duration of injury was between 6 –12 months. BPF score was higher (30.67 ±4.041sec) in those whose duration of injury was between 36- 60 months. Comparison of BPF and time lapse since injury in the injured players was not statistically significant as $p>0.05$.

The difference between BPF and sites/segments of injury among injured participants was summarized in Table 6. The least BPF (20.15±7.186sec) was found in those with ankle injury and highest BPF (30.00±4.637sec) was found in those with injury in the leg. No statistical difference was found between BPF and Sites/Segments of the LLMI ($p>0.05$).

Table 4: Comparison of BPF between Non-dominants injured Limb of injured players and Non-dominant Limb of uninjured players

Variables	BPF(s); Mean ± S.D	t-value	p- value
Groups			
NDIL	15.14 ±5.55	-4.609	<0.001
NDL	38.08 ±10.19		

Key: NDIL = Non-dominants injured Limb of injured players
NDL = Non-dominant Limb of uninjured players
BPF = Balance performance
S.D = Standard Deviation
s = seconds

Table 5: BPF and Time lapse since injury.

Variables	BPF(s); Mean ± S.D	F-value	P- value
Groups			
6 – 12 months	20.31 ±7.078	3.598	0.142
13 – 36 months	22.78 ±8.899		
37 – 60 months	30.67 ±4.041		

S.D = Standard Deviation
BPF= balance performance
s = seconds

Table 6: BPF and Sites/Segments of LLMI.

Variables	BPF(s); Mean ± S.D	F-value	p- value
Groups			
Groin/hip	20.75±10.626	2.032	0.136
Knee	21.50 ±9.072		
Ankle	20.15 ±7.186		
Leg	30.00 ±4.637		

S.D = Standard Deviation
BPF= balance performance
s = seconds

5.1 Discussion

Male professional footballers with mean age and BMI of 22.10±3.38 years and 23.94±1.71kg/m^2 participated in this study. More participants between 17 to 30 years (65.9%) participated. This was consistent with the study of Ogwumike and Tijani (2011), in which majority of the participants in their study were between 17 to 25 years (74.8%). This may not be out of place because this age group belonged to an age-group of peak performance in individuals with strong muscles and optimal physiological capability of the heart and the lungs which effectively equip the body for exercise (Montenegro, 2010). Effect of age on BFP of the injured participants was not studied in the present study due to narrow age group. Future studies should observe the effect of age on BPF of injured athletes as studies have already showed increased injury incidence at a younger age (McKay *et al.,* 2001; Peterson, *et al.,* 2000) and some have reported increase incidence of injury at an older age (Stevenson, *et al.,* 2000; Backous *et al.,* 1988; Ostenberg and Roos, 2000; Lindenfeld *et al.,* 1994; Orchard, 2001; Knapik *et al.*, 2001**).** Future studies should also look at the effect of BMI on balance performance among professional footballers.

Findings from the present study indicate a lower significant BPF in the injured limbs when compared with the uninjured limbs of injured players (22.29±8.22sec vs. 25.14±8.05sec). This finding buttress the findings of Beynnon *et al.,* (1999) which report that injury not to only compromises important static and dynamic stabilizers of the lower extremity, but may also be associated with deafferentiation of a joint as observed in the compromise of portion of neuroreceptors that innervate the joint and may result in worsened proprioception. This finding is also synonymous with that of Ogwumike and Tijani, (2011), who reported that BPF in the injured limbs is lower than the uninjured limbs of injured players (19.92±13.28sec vs. 26.34±14.23sec). Paul and Nagarajan (2014) moreover reported significant lower BPF in injured limbs (57.26 ± 0.30) when compared with the uninjured limbs (58.67 ± 0.37) among professional footballers in India. However, this finding is inconsistent with a study conducted by Hrysomallis *et al.,* (2007) among Australian footballers with previous lower limb injury who reported no significant difference between balance score of the injured and uninjured limb of injured player. Other studies also reported no association between balance and injury among athletes (Hopper, 1995; Beynnon *et al.,* 2001).

Inconsistence results different from the present study were reported by Thorpe and Ebersole (2008) and Teixeira *et al.,* (2008), who found no difference in the balance performance between the dominant and non-dominant legs in studies with 12 and 11 soccer players, respectively.

Balance Performance in the dominant injured limbs of the injured participants was reported to be lower than that of the dominant limbs of the uninjured participants (24.67±7.63sec vs. 49.62±5.78sec) in the present

study. This finding is consistent with observations of previous studies that reported balance impairments following LLMI (Holder-Powell and Rutherford, 1999; Evans *et al.,* 2004; Ogwumike and Tijani, 2011). The study by Ogwumike and Tijani (2011), reported a significant difference in the BPF of the dominant injured limbs of injured participants and the dominant limbs of the uninjured participants, which is in line with the current study. Similarly the current study reported lower BPF in non-dominant injured limbs of the injured participants than that of non-dominant limbs of the uninjured participants (15.14±5.55sec vs. 38.08±10.19sec). This finding is consistent with the finding of Ogwumike and Tijani (2011), who reported that BPF in non-dominant injured limbs of injured participants was lower when compared with that of non-dominant limbs of the uninjured participants (25.56±12.95sec vs. 44.23±13.94sec). It is difficult to explain this findings but perhaps reduced balance performance in an injured limb may also affect the balance of the uninjured limb of the same footballer thereby affecting overall balance performance of the injured player when compared to their uninjured counterparts. This finding is in agreement with a study by Evans et al., (2004) where the injured and uninjured limbs of individuals after unilateral lower limb sprains, balance deficits were identified to be present in both limbs.

The least duration of injury observed in this study prior to the involvement of the participants was 6 months, while the longest duration was 60 months. This might be because Long-term musculoskeletal injury is defined as physical damage that inhibits or prevents full participation in a sport or activity beyond 6 months (Frank and Jerry, 2001). However, consideration of these time ranges in relation to balance performance revealed no significant effect. These also buttressed the findings of Ogwumike and Tijani (2011), according to them, time lapse since injury did not have any effect on BPF ($P>0.05$).

The Sites/Segments of injury considered in this study were the Groin/hip, knee, leg and ankle. Although, the comparison between BPF and sites/segments of injury was not statistically significant ($P=0.136$). The outcome show that the participants with ankle injury have the lowest BPF scores (20.15sec), Ogwumike and Tijani (2011) also reported similar low BPF score in the ankle (15.00sec) as in the present study. Whereas the current study found those with injury in the leg to have the highest BPF score (30.00sec) which is different from the study by Ogwumike and Tijani (2011) which reported the groin/hip as having the highest BPF score (26.50sec), Ogwumike and Tijani (2011) in their study did not obseved the effect of Balance performance on leg injury . Several studies proved that less balance in the lower limbs is prone for injury of hip, knee and ankle joints. In respect to this issue footballers are required to train well with balance exercise programs to prevent lower limb injuries (Paul and Nagarajan, 2014), and as for the injured players, they should be adequately rehabilitated in areas of balance to prevent reinjuring themselves. This study affirms previous findings that the effect of LLMI can be long lasting with serious consequences on balance performance if not adequately rehabilitated, therefore rehabilitation of the injured players should continuo even after returning to pre-injury state among the professional athletes.

One major limitation of the study is the self-recollection of time lapse since injury and site of injury by the participants. Another limitation is the sample of convenience used in participants' recruitment for this study.

5.2 Conclusion

The outcome of this study portrays that following musculoskeletal injury to the lower limb, BPF in the injured limb is lower than that of uninjured limb. The study also concludes that balance impairment persists in Professional footballers with long term LLMI long after resuming normal sporting activities. The study also found no difference between the decrements in BPF and the sites/segments of LLMI and time lapse since injury.

5.3 Recommendation

Coaches and rehabilitation personnel should pay particular attention/need on balance retraining in players with long term LLMI. It is suggested that balance in players who have sustained long term LLMI should be routinely assessed and more emphasis on balance exercise programs that will mainly improve/centered on balance performance. Furthermore studies in this field should be conducted with a larger sample size and among different athletes. Future studies should perhaps look at prospective design for proper follow up on injuries and their long term effect on balance performance.

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