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Physical Characteristics of University Rugby Union Players with Low Back Pain Focusing on Lumbopelvic Alignment and Standing Balance

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This aim of this study was to clarify the physical characteristics of university rugby union players with low back pain (LBP). Sixty-two rugby players belonging to a top-level university rugby club participated in this study. Players included 29 backs and 33 forwards. Medical screening results were compared between players with LBP that resulted in time-loss injury during the season (LBP group) and other players (control group). We surveyed each player's history, body composition, and physical measurements (pelvic tilt angle in the standing position, range of motion, muscle flexibility, and body sway in the standing position). Significant differences were observed, with the LBP group being older and displaying changes such as a smaller pelvic tilt angle and larger body sway. Among the backs, the LBP group exhibited greater height and weight, smaller Thomas test values, greater finger-floor distance, and greater body sway (with eyes closed) than the control group. Among the forwards, the LBP group displayed older age, smaller pelvic tilt angle, smaller difference between the right and left heel buttock distance, and greater body sway than the control group. Thus, differences in physical characteristics of the university rugby players with LBP were related to age, pelvic tilt angle and standing body sway. Differences in physical characteristics were also observed between player positions.

Keywords: low back pain, rugby, pelvic tilt, standingl balance

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1. Introduction

Rugby union players frequently experience low back pain (LBP) arising from impact forces caused by collisions, such as those experienced in tackles and scrums. Sato et al. (2011) investigated the correlation between sports and LBP in young people and reported that 51.4% of rugby players reported experiencing LBP. Brooks et al. (2005) reported that lumbar injury during rugby training was the fifth most common rugby injury overall and the second most common injury in those playing as forwards. Lumbar injuries also resulted in the greatest delay in return to training or match (Brooks et al., 2005). Thus, a large proportion of rugby players suffer from LBP, and this negatively influences performance by preventing them from exerting full strength when trying to avoid pain.

Few studies have reported LBP in rugby players, although previous studies have reported injuries other than LBP in rugby players or LBP in athletes in other sports. Ogaki et al. (2014) reported risk factors for shoulder injury but did not report physical characteristics or risk factors associated with LBP. In sports other than rugby, LBP was related to sport type (Hangai et al., 2010), repetition load, and fatigue (Horton et al., 2001). Because rugby is a collision-based sport that involves tackles and scrums, the risk factors of LBP in rugby players are dependent upon rugby-specific characteristic. However, the cause of LBP of rugby players is not yet clear. As a first step in the prevention of LBP, it is necessary to clarify risk factors by comparing the physical properties of players with and without LBP.

Many factors are related to LBP, including lumbopelvic alignment, flexibility, and standing balance. Lumbopelvic alignment degeneration reflects poor posture, a risk factor for bad performance and LBP. A correlation between hip joint movement and LBP has also been reported, and studies have reported large differences in right and left hip joint range of rotation in relation to LBP (Van Dillen et al., 2008). Mellin (1988) reported a negative correlation between the degree of LBP and a player's range of internal hip rotation or hamstring flexibility. Ruhe et al. (2011) reported that body sway in the standing position was greater in patients with LBP than in healthy individuals, and standing balance is known to affect LBP. LBP is also affected by other factors such as hip joint problems, left and right variations, muscle flexibility, attitude control, and problems in the lumbar region.

Rugby players experience compressive stress in the lumbar region. In addition, the shock and load applied to the rugby player differs by position. Forwards are required to use heavy weight and strength to configure the scrum and have high stature to dominate the ball in the line-out. Forwards endure contact such as tackles, scrums and mauls. On the other hand, backs connect with the ball in the pass or kick and are required to run faster and longer distances than forwards. Previous studies have reported that height and weight are high in forwards (Gabbett, 2000, 2002, 2005; Meir et al., 2001), while sprint ability (Gabbett, 2000; Meir et al., 2001), and aerobic capacity are high in backs (Gabbett, 2005). Another study using global positioning system software reported that backs performed a greater number of sprints than forwards during games (Cunniffe et al., 2009). These differences suggest the need for an investigation of LBP-related factors in rugby players by position.

We hypothesized that the risk factors for LBP in rugby players were lumbopelvic alignment, hip joint range of motion and flexibility, and standing balance. If the factors and physical characteristics related to LBP in rugby players can be clarified, it should be possible through medical screening to identify athletes at high risk of developing LBP. The aim of this study was to clarify the physical characteristics of rugby players who are at high risk of experiencing LBP by examining correlations between pre-season medical screening results and LBP experienced by university rugby players.

2. Material and Methods

2.1. Subjects

Rugby players belonging to a top-level university rugby club were enrolled in this study. Players whose rugby activity was limited because of injury before the start of the study or who had LBP at the time of the medical screening were excluded. A total of 62 players participated in this study, including 29 backs and 33 forwards (**Table 1**). The study was approved by the Ethics Committee of the Graduate School of Comprehensive Human Sciences at the University of Tsukuba (approval number: 22-55), and each player provided written informed consent.

2.2. Procedures

We surveyed each subject's age, playing position, history of LBP, and body composition. The players underwent pre-season medical screening (existing players in February 2010 and new players in April after they joined the club). Medical staff, such as the team doctor or the athletic trainers, recorded LBP that occurred during the 2010 season (February to December) and examined the relevance of the medical screening results and LBP.

Table 1 Characteristics of each position

	Total (n = 62)	Forwards (n = 33)	Backs (n = 29)	p (forwards vs. backs)	ES
Age (years)	19.6 ± 1.2	19.7 ± 1.2	19.6 ± 1.2	0.74	*r* = 0.04
Height (cm)	176.5 ± 5.7	178.1 ± 5.8	174.7 ± 5.1	0.04*	*d* = 0.54
Weight (kg)	86.0 ± 12.1	93.5 ± 10.7	77.3 ± 6.5	0.00*	*d* = 1.81

ES, effect size; r, effect size index of Mann-Whitney U test; d, Cohen's d (t-test); *, $p < 0.05$

2.3. Definition and classification of LBP

This study was designed to consider only time-loss injury caused by LBP, defined as an injury that prevented a player from fully participating in a subsequent training session or rugby match (Fuller et al., 2007). Players who were unable to participate in training sessions or rugby matches due to LBP were classified into the LBP group. The others were classified into the control group.

2.4. Medical screening

2.4.1 Questionnaire survey

Medical screening included surveys of the players' past medical history and physical findings. We conducted a questionnaire survey of each player's medical history to assess the extent of time-loss injury before the start of the study.

2.4.2 Pelvic tilt angle

To measure pelvic tilt angle, we photographed each player from the side in a standing posture (**Figure 1**). The pelvic tilt angle, defined as the angle between the horizontal line and the line connecting the anterior superior iliac spine and the posterior superior iliac spine, was calculated using a Posture Analyzer PA 200 (The Big Sports Co., Ltd, Osaka, Japan).

2.4.3 Range of motion of the hips

To determine range of motion of the hips, we measured their internal and external rotation angles using a goniometer. In the supine position with the hip and knee joints bent at 90°, the hip was passively rotated in the internal and external directions and the rotation angle was measured (**Figure 2**).

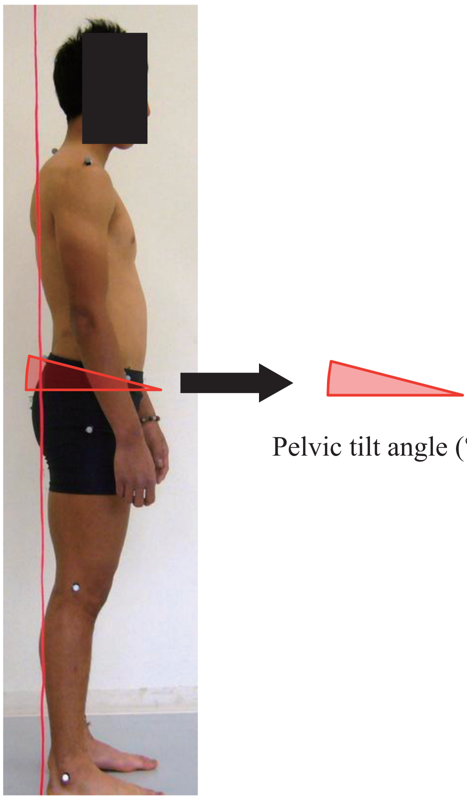
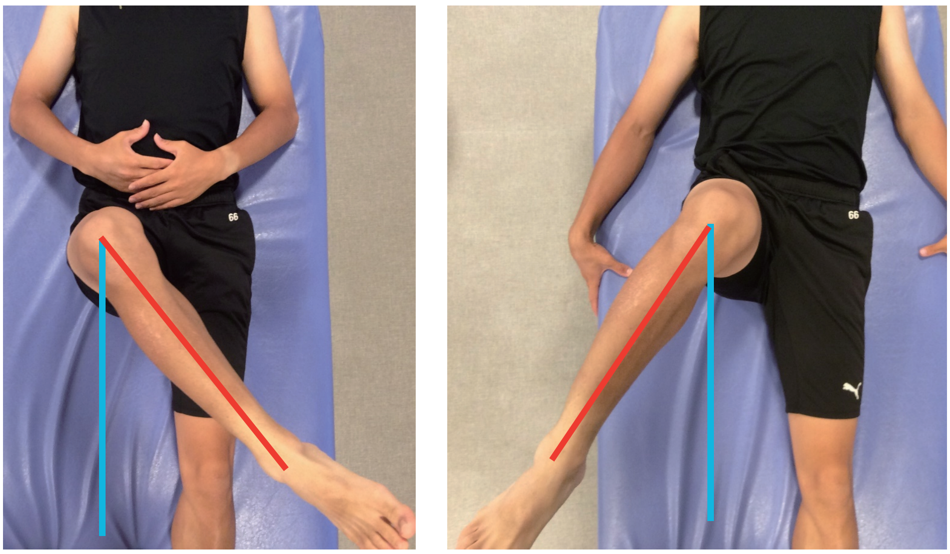


Figure 1 Pelvic tilt angle



a. External rotation

b. Internal rotation

Figure 2 Hip joint rotation angles

Blue line, neutral (basic axis); red line, motion axis

2.4.4. Flexibility (muscle tightness)

The flexibility of the quadriceps femoris muscle was measured as the distance between the heel and buttock with knee flexion in the prone position (heel buttock distance [HBD]). The flexibility of the hamstring muscles was measured as the angle of hip flexion during straight leg raising (SLR) in the supine position. The Thomas test was performed to measure the tightness of the iliopsoas muscle. The angle formed by the thigh axis and the horizontal line when the opposite hip and knee joints were bent to the maximum in the supine position was calculated from an image photographed from the side (**Figure 3**). When the hip joint was in flexion (with the thigh axis above the horizontal line), this was defined as "+"; and when the hip joint was in extension (with the thigh axis below the horizontal line), this was defined as "-" (**Figure 3**). Flexibility of the posterior muscles in the lower extremities and the trunk was measured as the distance between the floor surface and the fingertip when the player bent down toward the floor in a standing position (finger-floor distance [FFD]). When the fingertip reached below the floor surface, the result was considered "-" (**Figure 4**).

2.4.5. Standing balance

Standing balance was measured using a body sway meter (ANIMA Corp., Tokyo, Japan) as the total locus lengths for 30 seconds with the eyes opened and closed while in a standing position.

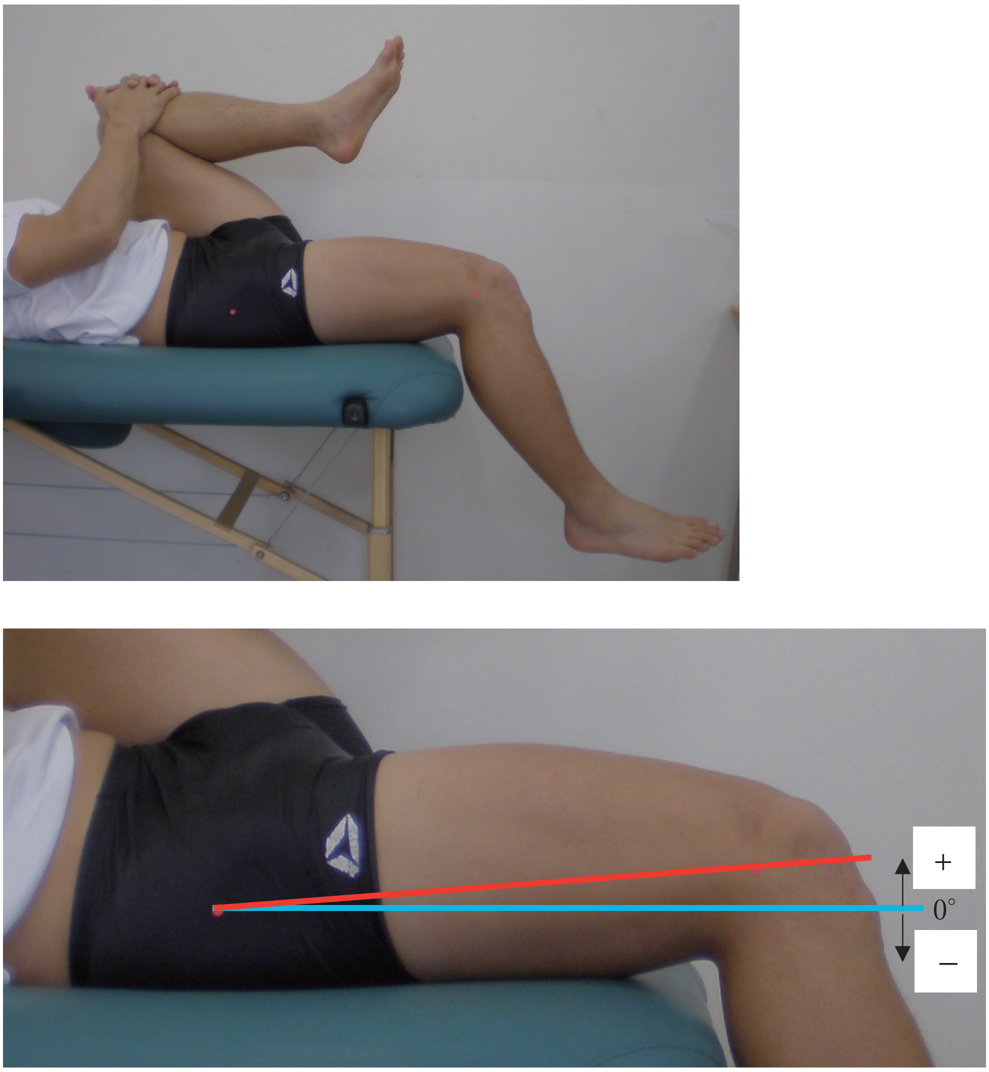


Figure 3 Thomas test

When the hip joint was in flexion, this was defined as "+"; when the hip joint was in extension, it was defined as "-." Blue line, horizontal line (hip neutral position); red line, thigh axis (line connecting the greater trochanter and lateral condyles of the femur).

Figure 4 Finger-floor distance

When the fingertip reached below the floor surface, the result was considered "-." Blue line, level of floor surface; red line, finger tip

2.5. Statistical analysis

Pre-season medical screening measurements were compared between the LBP and control groups to elucidate the physical characteristics specific to the LBP group. Furthermore, to investigate the characteristics of positions, we compared both groups separately for backs and forwards. Flexibility and range of motion were measured on both sides; and right and left differences were calculated as absolute values and averages, and compared between groups. We compared groups based on the normality of the data analysed using the Shapiro-Wilk test. Independent t-tests and Mann–Whitney U tests were used to compare each item between the LBP and control groups. Additionally, chi-square tests were used to compare position and LBP history between groups. Cohen's d, r, and φ coefficients were calculated to show the effect size. IBM SPSS Statistics (version 22) was used, with values of $p < 0.05$ considered significant and those of $p < 0.10$ considered to be a significant trend. For effect size "r or φ," small, medium, and large values were 0.1, 0.3 and 0.5, respectively. For effect size "d," small, medium, and large values were 0.2, 0.5, and 0.8, respectively (Cohen, 1992).

3. Results

3.1 Number of players with LBP

Over the season, there were a total of 218 training sessions, and training frequency was 4.8 times per week excluding matches. A total of 13 players (five backs and eight forwards) experienced LBP and were assigned to the LBP group. Between them, these players experienced 13 lumbar injuries, one in a match and 12 during training sessions.

3.2. Group comparisons of the players' characteristics

Player characteristics are shown in **Table 2**. First, players in the LBP group had a significantly higher mean age in total. There were no significant differences between the LBP and control groups in position, past lumbar injury history, or rugby experience. In terms of position, the mean height and weight of the backs were significantly higher in the LBP group, whereas the mean age of the forwards was significantly higher in the LBP group.

3.3. Characteristics of the players with LBP

The characteristics of each player who developed LBP are shown in **Table 3**. Five players had myofascial LBP, four had intervertebral disc disease or herniation, three had acute LBP, and one player had facet joint arthritis. The mean rehabilitation period was 17.5 ± 14.8 days.

Table 2 Group comparisons of the players' characteristics

	Total				Backs				Forwards			
	Control (n = 49)	LBP (n = 13)	p	ES	Control (n = 24)	LBP (n = 5)	P	ES	Control (n = 25)	LBP (n = 8)	P	ES
Age (years)	19.5 ± 1.1	20.3 ± 1.2	0.02*	*r* = 0.30	19.5 ± 1.2	19.8 ± 1.1	0.63	*r* = 0.10	19.4 ± 1.1	20.6 ± 1.2	0.01*	*r* = 0.43
Years of experience	8.0 ± 3.7	8.2 ± 3.7	0.76	*r* = 0.04	8.7 ± 3.7	9.0 ± 4.7	0.86	*d* = 0.08	7.4 ± 3.7	7.6 ± 3.1	0.67	*r* = 0.08
Height (cm)	176.2 ± 6.0	177.8 ± 4.3	0.36	*d* = 0.28	173.7 ± 4.8	179.9 ± 3.4	0.01*	*r* = 0.47	178.6 ± 6.2	176.4 ± 4.5	0.24	*r* = 0.21
Weight (kg)	84.8 ± 11.9	90.5± 12.3	0.13	*d* = 0.48	76.6 ± 6.9	80.9 ± 2.2	0.02*	*d* = 0.70	92.6 ± 10.2	96.4 ± 12.2	0.39	*d* = 0.35
History of LBP (+)	5	3	0.21	*φ* = 0.16	0	1	0.17	*φ* = 0.60	5	2	0.56	*φ* = 0.05
(-)	44	10			24	4			20	6		
Position: backs	24	5	0.50	*φ* = 0.09								
Forwards	25	8										

ES, effect size; LBP, low back pain; *, $p < 0.05$; r, effect size index of Mann–Whitney U test; d, Cohen's d (t-test); Φ, phi coefficient (chi-square test)

Table 3 Characteristics of players with LBP

Player	Position		Diagnosis or suspected injury	Type	Image inspection	History of LBP	Number of days to return
1	Forwards	HO	Facet arthritis	—	—		13
2	Forwards	HO	Myofascial low back pain	—	—		35
3	Forwards	PR	Lumbar disc disease	flexion	Xp, MRI	○	54
4	Forwards	PR	Myofascial low back pain	flexion	—		9
5	Forwards	PR	Lumbar disc herniation	flexion	—	○	11
6	Forwards	FL	Acute low back pain	flexion	—		4
7	Forwards	FL	Myofascial low back pain	—	—		12
8	Forwards	NO.8	Myofascial low back pain	—	Xp		23
9	Backs	FH	Myofascial low back pain	flexion	—		3
10	Backs	C	Acute low back pain	flexion	—		6
11	Backs	FB	Acute low back pain	—	—		6
12	Backs	FB	Lumbar disc disease	flexion/extension	MRI	○	26
13	Backs	FB	Lumbar disc herniation	flexion	MRI	○	26
							17.5 ± 14.8 [a]

LBP, low back pain; HO, hooker; PR, prop; FL, flanker; FH, fly-half; C, center; FB, fullback;
Xp, X-ray photography; MRI, magnetic resonance imaging; [a] mean ± SD

3.4. Medical screening results

Medical screening results are shown in **Table 4**. Significant intergroup differences were observed in pelvic tilt angle and standing body sway (with eyes open or closed). Among the backs, significant differences between LBP and control groups were observed in the mean of the Thomas test and the body sway (with eyes closed). In addition, a significant trend between the groups was observed in FFD (**Table 5**). The forwards showed significant intergroup differences in HBD left-right difference and standing body sway (with eyes open). In addition, significant trends between the groups were observed in pelvic tilt angle and standing body sway (with eyes closed) (**Table 5**).

4. Discussion

There is need for a clearer definition of LBP in sports. Previous studies have used questionnaire

Table 4 Medical screening results

	Control (n = 49)	LBP (n = 13)	p	ES
Pelvic tilt angle (°)	13.6 ± 5.1	10.1 ± 5.2	0.03*	*d* = 0.68
ROM (°)				
Hip IR				
Mean	35.9 ± 13.4	41.9 ± 12.0	0.15	*d* = 0.46
|R - L|	5.0 ± 5.3	4.2 ± 3.6	0.85	*r* = 0.02
Hip ER				
Mean	55.7 ± 11.0	56.5 ± 6.2	0.80	*d* = 0.08
|R - L|	5.9 ± 6.2	6.7 ± 4.4	0.40	*r* = 0.11
Tightness test				
HBD (cm)				
Mean	5.7 ± 4.5	4.9 ± 2.6	0.50	*r* = 0.08
|R - L|	1.2 ± 1.3	0.8 ± 0.9	0.54	*r* = 0.08
SLR (°)				
Mean	88.2 ± 12.6	83.9 ± 12.1	0.27	*d* = 0.35
|R - L|	5.9 ± 5.1	6.2 ± 9.2	0.40	*r* = 0.11
Thomas test (°)				
Mean	0.5 ± 3.6	1.2 ± 4.0	0.52	*d* = 0.20
|R - L|	2.6 ± 1.8	3.1 ± 2.6	0.84	*r* = 0.03
FFD (cm)	3.7 ± 10.1	2.3 ± 11.9	0.92	*r* = 0.01
Body sway (cm)				
Eyes open	43.1 ± 12.9	57.7 ± 18.6	0.00*	*d* = 1.02
Eyes closed	47.4 ± 15.2	62.9 ± 17.4	0.00*	*r* = 0.39

LBP, low back pain; ES, effect size; IR, internal rotation; ER, external rotation;
R, right; L, left; ||, absolute value; HBD, heel buttock distance;
SLR, straight leg raising; FFD, finger-floor distance; *, p < 0.05;
d, Cohen's d (t-test); r, effect size index of Mann–Whitney U test

Table 5 Medical screening results of the backs and forwards

	Backs				Forwards			
	Control (n = 24)	LBP (n = 5)	p	ES	Control (n = 25)	LBP (n = 8)	p	ES
Pelvic tilt angle (°)	12.7 ± 5.6	9.6 ± 3.4	0.24	*d* = 0.60	14.4 ± 4.6	10.4 ± 6.3	0.06†	*d* = 0.81
ROM (°)								
Hip IR								
Mean	37.9 ± 14.2	40.5 ± 11.7	0.71	*d* = 0.19	34.0 ± 11.6	43.2 ± 13.8	0.11	*d* = 0.71
|R - L|	5.0 ± 5.3	5.0 ± 3.5	0.76	*r* = 0.05	5.0 ± 5.3	3.6 ± 3.8	0.63	*r* = 0.08
Hip ER								
Mean	54.4 ± 12.1	59.0 ± 7.4	0.42	*d* = 0.40	57.0 ± 9.9	55.4 ± 5.5	0.68	*d* = 0.18
|R - L|	7.9 ± 6.9	8.0 ± 4.5	0.79	*r* = 0.04	4.0 ± 4.8	5.7 ± 4.5	0.32	*r* = 0.17
Tightness test								
HBD (cm)								
Mean	4.4 ± 4.5	5.1 ± 0.8	0.70	*r* = 0.07	6.9 ± 4.2	4.7 ± 3.6	0.21	*d* = 0.55
|R - L|	0.7 ± 1.0	1.4 ± 1.1	0.12	*r* = 0.29	1.7 ± 1.4	0.5 ± 0.5	0.03*	*r* = 0.38
SLR (°)								
Mean	89.6 ± 13.7	80.5 ± 8.0	0.17	*d* = 0.70	86.8 ± 11.5	85.4 ± 15.2	0.79	*d* = 0.12
|R - L|	5.4 ± 4.4	3.0 ± 4.5	0.24	*r* = 0.21	6.4 ± 5.7	8.1 ± 11.0	0.88	*r* = 0.02
Thomas test (°)								
Mean	0.8 ± 2.8	-2.6 ± 2.3	0.02*	*d* = 1.22	0.2 ± 4.2	2.7 ± 1.5	0.13	*d* = 0.67
|R - L|	2.6 ± 2.0	2.1 ± 2.7	0.45	*r* = 0.14	2.5 ± 1.6	3.6 ± 2.6	0.16	*d* = 0.59
FFD (cm)	-7.0 ± 6.9	1.2 ± 14.1	0.06†	*d* = 0.93	-0.5 ± 11.7	-4.8 ± 10.5	0.28	*r* = 0.20
Body sway (cm)								
Eyes open	41.4 ± 14.0	50.1 ± 11.8	0.21	*d* = 0.64	44.7 ± 11.9	62.4 ± 21.2	0.04*	*r* = 0.37
Eyes closed	46.3 ± 16.5	68.0 ± 19.9	0.02*	*d* = 1.26	48.5 ± 13.9	59.7 ± 16.1	0.07†	*d* = 0.78

LBP, low back pain; ES, effect size; IR, internal rotation; ER, external rotation; R, right; L, left; ||, absolute value;
HBD, heel buttock distance; SLR, straight leg raising; FFD, finger floor distance; *, $p < 0.05$, †, $p < 0.10$,
r, effect size index of Mann–Whitney U test; d, Cohen's d (t-test)

surveys such as the Roland-Morris Disability Questionnaire, which is simple and easy to use for defining LBP; however, because it is subjective, its lack of precision has been criticized (Smeets et al., 2011). In a consensus statement, the International Rugby Board announced a definition of injury in rugby; and time-loss injury was part of its recommendation (Fuller et al., 2007). Based on this statement, setting the definition of LBP to the specific condition of "not being able to participate in training sessions and rugby matches" could provide a more accurate assessment of LBP.

In the LBP group of both positions, a common feature was greater body sway in standing balance. Standing body sway (with eyes closed) was greater in the LBP group in both positions. The LBP group of forwards tended to have a larger body sway (with eyes open). This study showed that a lack of standing balance was a factor in LBP among athletes. Several previous studies have reported greater body sway in patients with LBP (Hamaoui et al., 2004). The results of the present study supported those findings. However, many of the previous studies were cross-sectional, used questionnaires to evaluate LBP, and did not limit participation to athletes. Regarding balance ability and sports injury, although ankle injuries were shown to be related to balance ability (McGuine et al., 2000), its relevance to LBP is unknown. The present study provides new evidence for the evaluation of LBP in a time-loss injury experienced by rugby players, and it implicated poor standing balance as a risk factor. Regardless of playing position, an increase in body sway in the standing position appeared to be a factor in LBP.

Forwards in the LBP group tended to have a small pelvic tilt, possibly compressing the anterior tissues of the lumbar region. In rugby, the axial stresses to the lumbar spine and intervertebral discs increase as one player collides with another with the shoulder during a scrum or tackle. In addition to tackles, forwards frequently participate in scrums; and both apply compression stress to the lumbar spine in the axial direction. The scrum, one of the major roles of forwards in rugby, involves pushing the opponents in a state in which the lower extremities are bent. The magnitude of the summed forward forces during a scrum was 4,430-16,500 N (Trewartha et al., 2015). The lineout is another characteristic part of the game for forwards. The teams lift their teammates into the air to contest for the ball mid-air as it is thrown down the middle (the tunnel) between the two lines of forwards (MacQueen and Dexter, 2010). Lifters who support a teammate overhead are exposed to compression stress on the lumbar region. The jumper who lands from a high place is also subjected to compressive stress on the lumbar region with the impact of landing. The forwards often also participate in rucks or mauls in which they help carry the ball forward by pushing against opponents or teammates by using extension torque of the lower extremities. Like scrums and tackles, rucks and mauls increase compressive stress on the trunk, including the lumbar spine. Therefore, forwards are more likely than backs to be involved in close-contact activities that involve pushing, lifting, and wrestling for the ball (Coughlan et al., 2011), all of which place compressive stress on the lumbar spine. In the present study, the mean pelvic tilt angle of the LBP group was significantly lower than that of the control group. A small pelvic tilt angle meaning posterior pelvic tilting tends to increase pressure stress on the lumbar discs. Poor posture is one factor contributing to injury in collision sports (Watson, 2001). The spine should always be maintained in its strongest position for resisting front-on axial forces and sideways axial torques; thus, a tackle should be performed with a neutral straight spine and natural lordosis (Michael and Wayne, 2008). Additional axial pressure arising from the posterior pelvic tilt may increase stress to the lumbar forward structure and may be related to LBP. Previous studies have reported no association between alignment and LBP (Christensen and Hartvigsen, 2008; Laird et al., 2014). Conversely, other previous studies have reported a relationship between alignment and LBP (Jackson and McManus, 1994; Smith et al., 2008). Norton et al. (2004) reported an association with alignment that depended on LBP type. Although the relationship between lumbopelvic alignment and LBP has been unclear, the present study helped clarify the relationship between LBP and pelvic tilt angle by narrowing the target to rugby players.

Among backs, height and weight were significantly greater in the LBP group. These significant items might be associated with playing position characteristics. Regarding physical demands during play, the backs cover a greater total distance than the forwards and have a higher average speed (Coughlan et al., 2011). Because backs are involved in faster tackles than forwards, the impact of the tackle is higher, as is the rate of injury (Quarrie and Hopkins, 2008). A tall player who receives a tackle to a higher part of the upper body has a longer distance between the point of impact and the waist (i.e., a long lever arm), increasing the stress on the lower back. In addition, because the tackle speed is faster, the force of impact is increased in a heavier player. Furthermore, a taller and heavier back player experiences a greater inertial force to the lumbar region during a change in velocity. In other words, turns, acceleration and deceleration at fast speeds can increase the shear force on the lumbar region in any direction due to the inertia of the upper body. Therefore, because the backs experience large impact and inertial forces, stress on the lumbar region may be even greater in tall and heavy players. Protection of the waist requires trunk stability that exceeds the force of impact and inertia.

Iliopsoas muscle flexibility measured by Thomas test was higher in backs in the LBP group than in the control group. Although iliopsoas muscle tightness is considered a risk factor for LBP, a previous study suggested its irrelevance (Hellsing, 1988). Thus, the association between iliopsoas flexibility and LBP is unclear. The fact that FFDs tended to be greater in the LBP group than in the control group suggests reduced flexibility of the posterior part of the body. The high flexibility of the iliopsoas muscle and low flexibility of the posterior part of the body, resulting in a poor balance of flexibility between the anterior and posterior pelvis, may affect the occurrence of LBP.

The findings of the present study suggest several points for the prevention of LBP in rugby players. First, rugby players should improve inferior balance capability regardless of playing position. Furthermore, because stability training for the trunk improves standing balance (Kaji et al., 2010), the ability required for trunk stability may have decreased in players with large body sway in this study. Trunk stability training may, therefore, be effective for improving balance. Second, posterior tilting of the pelvis should be avoided to reduce axial pressure in collisions and avoid stress on the lower back. It is recommended that back players improve the flexibility balance between the anterior and posterior pelvis. If these problems are observed in pre-season screening, it may be possible to avoid LBP by taking the approaches described above.

This study had certain limitations. The subjects belonged to a top-level university rugby team, but there were differences in level among the players. However, because it was necessary to limit the cohort to one team of the same environment and exercise content, differences in level among players could not be prevented. Although the LBP criteria based on time-loss injury could be evaluated more strictly than with a questionnaire, in the backs, fewer players met the criteria. Therefore, the characteristics of backs at risk of LBP might be affected by other factors. Moreover, because the features should be investigated by classifying diagnosis and LBP types, there is a need for further study. This study was not able to monitor changes in the physical condition of players during the period between pre-season screening and the onset of LBP. During this period, due to the influence of other pain or injury, it is possible that a player's physical condition may have changed. Furthermore, posture and muscle tightness might have changed with mental state and fatigue during the period. Mental state and fatigue are affected by the type and amount of exercise used to enhance skill, strength and fitness. Ideally, the findings from the study will be utilized as a reference for monitoring day-to-day conditions. Thus, it is necessary to monitor day-to-day player conditions and examine the influence of the type and amount of exercise used to enhance skill, strength and fitness.

5. Conclusion

The common physical characteristic of the players who developed LBP during the season tended to include large standing body sway regardless of player position. Furthermore, features that tend to cause LBP differed between positions. Forwards tended to be older and have a small pelvic tilt, while backs tended to be taller and heavier with high flexibility of the iliopsoas muscle and low flexibility of the posterior muscles in the body.

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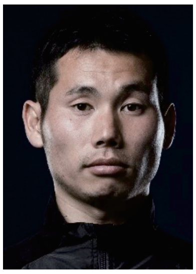

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