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Effects of thigh holster use on kinematics and kinetics of active duty police officers

Abstract:

Background: Body armour, duty belts and belt mounted holsters are standard equipment used by the Swedish police and have been shown to affect performance of police specific tasks, to decrease mobility and to potentially influence back pain. This study aimed to investigate the effects on gait kinematics and kinetics associated with use of an alternate load carriage system incorporating a thigh holster.

Methods: Kinematic, kinetic and temporospatial data were collected using three dimensional gait analysis. Walking tests were conducted with nineteen active duty police officers under three different load carriage conditions: a) body armour and duty belt, b) load bearing vest, body armour and thigh holster and c) no equipment (control).

Findings: No significant differences between testing conditions were found for temporospatial parameters. Range of trunk rotation was reduced for both load carriage conditions compared to the control condition (P <0.017). Range of hip rotation was more similar to the control condition when wearing thigh holster rather than the belt mounted hip holster (P <0.017). Moments and powers for both left and right ankles were significantly greater for both of the load carriage conditions compared to the control condition (P <0.017).

Interpretation: This study confirms that occupational loads carried by police have a significant effect on gait kinematics and kinetics. Although small differences were observed between the two load carriage conditions investigated in this study, results do not overwhelmingly support selection of one design over the other.

Keywords

Gait analysis; Load carriage; Kinematics; Kinetics; Police; Thigh holster

1. Introduction

Load carriage is a necessary part of the physical activities of police. The mandatory equipment worn by police can be conceptualised as part of a human factors model where the individual, equipment and tasks are components of a system which interact to affect health and wellbeing (Salvendy, 2012). Body armour and duty belts worn by police can subsequently be considered to affect the individual and their ability to perform job related tasks.

Studies investigating the effects of occupational load carriage on health and wellbeing have generally been divided into two areas, one focusing on physiological variables (Dempsey et al., 2013; Lewinski et al., 2015) and the other on biomechanical variables (Birrell and Haslam, 2010; LaFiandra et al., 2003). Research to date has focused mainly on backpack weight and design in military personnel and hikers while very little attention has been directed towards load carried by other occupational groups, including police.

The impact of police body armour and duty belt on activities performed by police was investigated by Dempsey et al. (2013) who demonstrated that mobility was reduced when performing key occupational tasks and that a greater physiological effort was required to perform specific tasks as the weight of the load carried increased. Decreased sprinting velocity and acceleration were also found to be associated with use of duty belts and body armour (Lewinski et al., 2015). The biomechanical effect of relocating equipment from a duty belt to a so-called load bearing vest was studied among a group of Swedish police (Ramstrand et al., 2016). Results showed no major impact on temporospatial parameters of gait but a restriction in lateral trunk bending, trunk rotation and anterior pelvic tilt when wearing the load bearing vest.

In studies of backpack load carriage, a decrease in stride length, pelvic and thoracic rotation with a resulting increase in stride frequency has been associated with bearing loads of 40% body weight (LaFiandra et al., 2003). Changing the load carriage design and consequently the mass distribution of load carriage systems in military personnel has been shown to have a limited effect on ground reaction force parameters (Birrell and Haslam, 2010). There is some indication that load carriage weight, placement and design has an effect on pain experienced by the wearer, however results are inconsistent and limited evidence is available (Golriz and Walker, 2011). The extent to which load carried by police affects pain is unclear, although body armour and duty belts have been associated with an increased incidence of pain and restrictions in movement and work performance (Brown et al., 1998; Dempsey et al., 2013; Ramstrand and Larsen, 2012; Stubbs et al., 2008).

Low back pain is experienced one day per week or more by 43 % of active duty police officers in Sweden (Elgmark et al., 2013) and use of a duty belt and body armour is perceived as contributing to low back pain by Swedish active duty police (Ramstrand and Larsen, 2012). The duty belt worn by Swedish police officers houses an extendable baton, torch, handcuffs, OC spray, radio, weapon and extra ammunition which, together with body armour, adds between 6-7 kg of weight (Ramstrand et al., 2016). Equipment is preferably placed anteriorly and laterally on the duty belt in order to increase sitting comfort when driving fleet vehicles. The size and shape of the officer determines if this placement of the equipment is possible. Smaller females for example may have to place some equipment posteriorly in order to fit everything on their belt.

In some regions of Sweden, relocating the weapon from a belt mounted hip holster to a thigh holster (also termed tactical or drop leg holsters) has been an option for police officers experiencing low back pain. Due to regional differences in opinion regarding thigh holsters, the opportunity to test a thigh holster varies across the country. To date the only study investigating use of thigh holsters versus belt mounted hip holster has compared draw performance and demonstrated that this is not affected by holster position (Campbell et al., 2013).

The aim of the present study was to investigate gait kinematics and kinetics in active duty police fitted with an alternate load carriage system incorporating a thigh holster in comparison to standard police load carriage system incorporating a belt mounted hip holster.

2. Methods

2.1 Participants

Twenty participants were recruited for the study including eleven women and nine men. All participants worked as active duty police officers in a middle-sized municipality in Sweden. To be eligible for the study the participants could not have any musculoskeletal injuries or lower back pain at the time of data collection. One female participant was excluded due to insufficient footwear on the day of data collection which resulted in a total of nineteen participants in the study. All testing procedures were approved by the Regional Ethics Committee in Linköping, Sweden (dnr 2010/261-31)

2.2 Procedures

2.3 Load carriage

Use of a duty belt is the standard load carriage system among Swedish police and the weapon is to be carried in a belt mounted hip holster attached to the duty belt. Use of a thigh holster is an alternate load carriage system for the weapon. In this case the holster is firmly attached around the thigh with a complementary attachment to the waist belt. Each participant in the present study was tested under three conditions wearing: a) body armour and duty belt (standard load carriage) b) load bearing vest, body armour and thigh holster (alternate load carriage condition) and c) no equipment. Throughout all three conditions participants wore their standard issued boots and body armour (SAFE4U, Stockholm, Sweden). The weight of the body armour varied between gender and size of each individual (1690-1850 g for males and 1290-1450 g for females). The body armour was adjustable above the shoulders and around the lateral sides of the thorax to ensure optimal fit to the individual's body shape.

In the standard load carriage condition all equipment was borne in the duty belt issued by the Swedish police. If participants wore additional equipment in the duty belt at the time of testing they were asked to remove these. In the alternate testing condition, a load bearing vest was specially designed to fit on top of the body armour and included pockets for extra ammunition, torch, handcuffs and pepper spray. Baton and weapon (standardised dummy) were carried in a thigh holster, which together weighed almost 1500g. All testing conditions were randomised and each participant had a five-minute warm up on a treadmill at self-selected walking speed to familiarise themselves with the set-up before each testing condition. During all trials participants were requested to walk at their self-selected speed as defined by Ralston (1958).

2.4 Three-dimensional gait analysis

Kinematic and kinetic data were collected using an eight camera Qualisys motion analysis system (Qualisys AB, Gothenburg Sweden) and two AMTI force plates

(Advanced Mechanical Technologies, Inc., Watertown, MA, USA). A standing calibration file was collected for each participant and for each condition and a minimum of three walking trails were collected for each condition. A total of 38 reflective markers where placed on each participant's body based on the principle of the cluster marker model proposed by Cappozzo et al. (1997), see Table 1. Due to the placement of duty belt and body armour it was not possible to use the standard marker placement around the pelvis (left and right ASIS and mid sacrum) during dynamic testing. To overcome this problem, a specially designed rigid u-shaped carbon fibre frame was mounted on the sacrum carrying three reflective markers. The three markers on the sacrum cluster were used as tracking markers for the pelvic segment during dynamic testing. Using three markers placed on the sacrum has been proven to be as repeatable in tracking pelvic movement during normal gait as standard marker configurations (Borhani et al., 2013). Marker placement on the right thigh also had to be adjusted due to the position of the thigh holster. The standard placement of three markers on a rigid cluster placed on the lateral aspect of the thigh was replaced with three makers mounted on the skin on the anterior aspect of the thigh for all test conditions.

Marker trajectories were filtered using a fourth-order zero-lag Butterworth low-pass-filter, with a cutoff frequency of 15 Hz for kinematic data. Ground reaction force data were filtered with a cutoff frequency at 20 Hz (moments) and 30 Hz (powers). Visual 3D™ software (C-Motion, Inc. Germantown, USA) was used to calculate temporospatial parameters and kinematic and kinetic variables. The body weight of participants was adjusted to account for the weight of the load carried for relevant trials.

Insert Table 1

2.5 Data analysis

Comparison between load carriage conditions for temporospatial, kinematic and kinetic data were conducted using a Friedman test for non-parametric related samples. When a significant difference was found, pairwise comparisons were performed (SPSS Statistics, 2012) with a Bonferroni correction for multiple comparisons. A symmetry index (SI) based on temporospatial parameters was calculated to compare left and right sides. The

SI was initially proposed by Robinson et al. (1987) for comparison of ground reaction forces and several authors have adapted it to investigate symmetry in temporospatial data (Arazpour et al., 2015; Blazkiewicz et al., 2014; Petersen et al., 2010).

3. Results

When wearing their standard uniform all nineteen participants chose to carry their weapon on their right side. Eighteen participants chose to wear the weapon it in a belt mounted hip holster and one wore it in a thigh holster. Details of the participants are included in Table 2. Average age and height for the whole group was 33 years (SD = 4.6; range 26-41) and 1.75 m (SD = 0.07; range 1.61-1.93). Average age for female and male police separately were 32 years (SD = 4.2; range 26-41) and 34 years respectively (SD = 4.9; range 27-40). Average height for female police was 1.70 m (SD = 0.06; range 1.61-1.80) and male police 1.80 m (SD = 5.2; range 1.74-1.93). For the whole group, average body weight without equipment was 75.2 kg (SD = 11.3; range 59-105) and for female and male police separately 69.2 kg (SD = 6.2; range 59-78) and 81.8 kg respectively (SD = 12.2; range 62-105). The average weight of equipment carried, body armour and footwear was 6.2 kg (SD = 0.3; range 5.8-6.6).

Insert Table 2

3.1 Temporospatial data

Temporospatial data are presented in table 3. Comparisons of temporospatial data across conditions showed no significant differences for cycle time, velocity, stride length and stride width ($P<0.05$). No significant differences between conditions were observed in symmetry between left and right sides for cycle time, step length, stance and swing time.

Insert Table 3

3.2 Range of motion data

Table 4 presents range of motion data for all body segments. Significant differences were observed in range of trunk rotation, right hip range of motion and range of right knee ab/adduction.

Significant differences in transverse plane trunk rotation were found during the stance phase of the gait cycle. After a Bonferroni correction, pairwise comparisons revealed that both the standard and alternate load carriage conditions resulted in less range of trunk motion than the control condition ($P < 0.017$).

For both stance and swing phases, the range of rotation of the right hip was significantly greater in the alternate load carriage condition compared to standard load carriage ($P < 0.017$). No significant difference was observed between the alternate load carriage condition and the control condition, however significantly greater hip rotation was observed for the control condition compared to the standard load carriage during the stance phase ($P < 0.017$).

The frontal plane range of motion of the right knee in the stance phase was significantly greater for the alternate load carriage condition than the control condition ($P < 0.017$). During the swing phase the alternate load carriage condition was significantly greater than both the control condition and standard load carriage ($P < 0.017$).

Insert Table 4

3.3 Kinetic data

Table 5 presents sagittal and frontal plane kinetic data for the hip, knee and ankle during the stance phase of the gait cycle. In the sagittal plane significant differences were observed in left hip power, left knee moments and all moments and powers for the left and right ankle joints. Significant difference was also observed for ab/adduction moments about the left hip.

In the sagittal plane significant differences were observed for both left hip power and left knee moments. In both cases the alternate condition was found to be significantly greater than the control condition ($P < 0.017$).

A significantly greater left hip moment was found in the frontal plane when comparing the standard load carriage condition to the control condition (*P* <0.017).

Both left and right ankle moments and powers were significantly greater for the alternate load carriage conditions compared to the control condition (*P* <0.017). Similar differences were observed for the standard load carriage condition but only for left ankle moments and powers and right ankle moments (*P* <0.017).

Insert Table 5

4. Discussion

This study focused on the relative effects of two load carriage systems on kinematic and kinetic variables measured during level walking in active duty police officers. The results have demonstrated that load carriage has most effect on kinematics at the hip joint on the side of the body upon which the weapon is located and on kinetic variables at the ankle of both left and right sides. No differences were observed in temporospatial parameters including symmetry indices.

Use of a belt mounted hip holster in the present study resulted in less range of rotation in the hip joint on the side of the body bearing the weapon as compared to the thigh holster and control condition. Range of rotation in the hip while wearing a thigh holster was not significantly different to that of the control condition which suggests that using a belt mounted hip holster was more restrictive. When wearing a belt mounted hip holster, the pistol is typically positioned slightly anterior to the greater trochanter. It is possible that this interferes with normal rotational movement of the hip. The range of hip rotation on right side was greater in the present study than that reported by Ramstrand et al. (2016) where kinematics of police wearing a specially designed load bearing vest were evaluated. In the Ramstrand study, however, holster type was not controlled and half of the participants wore thigh holsters.

Greater motion was also observed for the right knee range of ab/adduction during the stance phase, where the alternate load carriage condition showed greater movement than the control condition. It is possible that the weight of the thigh holster affects the frontal plane kinematics of the right knee, however one must also consider the potential for errors that are induced by soft tissue artefacts of the thigh when performing three dimensional gait analysis. Transverse and frontal plane kinematics of the thigh segment are recognised as having greater measurement error that other body segments (Leardini et al., 2005; McGinley et al., 2009).

Kinematics of the trunk showed less range of rotation during the stance phase for both of the load carriage conditions as compared to the control condition. These findings are similar to those of Ramstrand et al. (2016). Ramstrand et al. also identified limitations in pelvic rotation and lateral trunk bending associated with use of load bearing vests during gait. Restrictions in mobility when performing key police tasks were found by Dempsey et al. (2013). When considering all available evidence, findings confirm that the mobility of police officers is affected by the system they use to carry their work equipment, but there is no evidence yet to suggest that one load carriage system is superior to another.

While significant differences were observed between load carriage conditions, the angular differences in the present study are relatively small and unlikely to contribute to the increased incidence of low back pain previously reported in the literature (Brown et al., 1998; Dempsey et al., 2013; Ramstrand and Larsen, 2012; Stubbs et al., 2008). Nevertheless, the differences cannot be ignored and the long term effects of load carriage on active duty police must be investigated in longitudinal studies.

Gait kinetics have not previously been reported for police officers. In the present study ankle moments and powers were found to increase in both load carriage conditions compared to the control condition. According to basic biomechanical principles, any increase in the mass carried by an individual will result in increased moments and powers, assuming all other parameters remain unchanged. As there were no significant differences in temporospatial parameters across the conditions tested in the present study, we can assume that all other parameters were indeed unchanged. We can subsequently assume that the weights carried caused the observed increase in moments and powers. These results are supported by Birrell et al. (2007) who studied the effect of military load carriage on the vertical and anteroposterior components of the ground reaction force (GRF). Their study demonstrated a linear relationship between the magnitude of the GRF and increases in load while walking at a constant velocity.

Injury risk in the feet and shanks are associated with increased load carriage which has mainly been demonstrated in military personnel and recreational hikers who have increased risk of sprains, stress fractures (eg. Tibia, calcaneus and metatarsals), plantar fasciitis and non-specific foot pain (Knapik et al., 1996; Lobb, 2004; Orr et al., 2014). Given that the present study has identified increased moments and powers related to police load carriage, it is likely that an increased injury risk for foot and shank complications would also be present in this population. Once again results of the present study did not identify significant differences between conditions and do not suggest that one type of load carriage was any better or worse than the other.

The greatest error inherent in three dimensional gait analysis studies is related to the placement of skin mounted markers (McGinley et al., 2009). In the present study we attempted to minimise this error by having one person take responsibility for placement of all markers. A standardised marker model formed the basis of marker placement, but had to be modified due to the position of the police belt, thigh holster and body armour which covered anatomical landmarks about the hip, pelvis and thigh. As a consequence, tracking markers were mounted directly on the skin on the anterior aspect of the right thigh as opposed to the left side where the tracking markers were mounted on a rigid cluster on the lateral aspect of the thigh. This marker set up was used for all conditions without exception, nevertheless, placement of markers on the skin of the thigh could introduce inter-marker movement. Use of a pelvic cluster was also a necessary deviation from the standard marker model, but this technique has been successfully used in other studies (Borhani et al., 2013; Lerner et al., 2014). When processing data, the extra weight carried was accounted for by adjusting the body mass in the gait analysis software. It is important to recognise, however, that the distribution of load was localised and may have affected the inertial properties of the trunk and thigh in particular.

Compared to the Ramstrand et al. (2016) study, participants only had limited time to adjust to a new testing condition. A longer accommodation period with the new load carriage was not feasible in this study design as changing the position of the weapon without sufficient training could affect draw performance and compromise the safety of the police involved in the study. In this study, no consideration has been given to anatomical differences between male and female police. Given that females typically have a wider pelvis, the relative effects that load carriage design may have on the genders would be an interesting area for future investigation.

5. Conclusion

The load carriage system worn by police is an integral part of their work environment. The equipment carried is mandated by police authorities, as is the design of the load carriage system. While alternate load carriage designs exist for police, little is known of the relative effects of design choices on biomechanical variables. This study has demonstrated that load carriage has a significant effect on kinematic and kinetic variables. Use of a thigh holster was not demonstrated to affect variables to a greater extent than the existing load carriage system. Based upon results of this study there appears to be no evidence for excluding the thigh holster as an alternative for active duty police.

Conflict of interest

This study was partially founded by the Swedish National Police Board. The authors are not employees of the Swedish police and declare no conflict of interest.

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Authors' contribution to the study

Louise Bæk Larsen – Study design, data collection, data analysis and drafting of the manuscript.

Roy Tranberg – Study design, data collection, data analysis and proof-reading of the manuscript.

Nerrolyn Ramstrand– Study design, data collection, data analysis and drafting of the manuscript.

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Table 1

Marker placement

Segment	Tracking markers	Proximal landmarks	Distal landmarks
Foot	1st and 5th metatarsal heads and heel	Medial and lateral malleoli	1st and 5th metatarsal heads
Shank	Rigid cluster with three makers on lateral aspect of shank	Medial and lateral femur epicondyles	Medial and lateral malleoli
Thigh (left)	Rigid cluster with three makers on lateral aspect of thigh	Greater trochanter and hip joint centre	Medial and lateral femur epicondyl
Thigh (right)	Three makers mounted on the skin anterior on the thigh	Greater trochanter and hip joint centre	Medial and lateral femur epicondyl
Pelvic	Rigid cluster with three markers mounted on sacrum	Right and left superior iliac crest	Right and left greater trochanter
Trunk	Right and left acromion and C7	Right and left superior iliac crest	Right and left acromion

Table 2

Characteristics of study participants

	Sex	Age	[a] Weight	Height	Years as police
1	Male	29	62	174	2
2	Female	33	70	177	2
3	Male	37	80	178	4
4	Female	32	66	163	4
5	Female	33	78	180	0.5
6	Female	31	64	174	3
7	Male	39	92	180	8
8	Male	36	82	182	11
9	Female	29	66	168	4
10	Female	26	78	171	3
11	Female	29	59	161	4.5
12	Female	41	67.2	166	8
13	Male	32	74	181	2
14	Female	28	75	174	2
15	Male	40	105	179	10
16	Female	35	69	167	7
17	Male	29	82	179	3.5
18	Male	27	86	193	3.5
19	Male	38	73.6	178	3

[a] Weight without uniform, duty belt and safety vest

Table 3

Temporospatial data across load carriage conditions (median values)

	Control	**Standard load carriage**	**Alternate load carriage**	***p***
Cycle time (steps/sec)	1.10	1.10	1.10	0.409
Velocity (m/s)	1.35	1.33	1.36	0.692
Stride length (m)	1.48	1.48	1.48	0.368
Stride width (m)	0.12	0.12	0.14	0.143

Table 4

Range of motion of body segments (median values). Values given in degrees.

Segment	Phase of gait cycle	Control	Standard load carriage	Alternate load carriage	*p*
Trunk flex/ext	stance	5.79	5.75	5.74	0.692
	swing	5.32	4.25	3.34	0.128
Trunk lateral bending	stance	8.38	8.35	8.21	0.949
	swing	4.61	4.11	4.31	0.949
Trunk rotation	stance	13.78	**12.56**[a]	**11.12** [a]	0.000
	swing	11.28	10.83	10.02	0.080
Pelvic tilt	stance	4.32	4.07	4.48	0.368
	swing	3.13	2.74	3.18	0.076
Pelvic obliquity	stance	6.59	7.03	6.31	0.268
	swing	3.53	4.19	4.03	0.229
Pelvic rotation	stance	6.97	5.90	7.17	0.623
	swing	5.60	4.02	5.17	0.229
Hip flex/ext (left)	stance	41.46	40.62	42.46	0.854
	swing	31.48	32.66	32.67	0.790
Hip ab/adduction (left)	stance	12.20	12.25	12.38	0.810
	swing	8.03	7.47	7.60	0.230
Hip rotation (left)	stance	12.58	10.95	12.53	0.692
	swing	12.81	11.45	13.37	0.161
Hip flex/ext (right)	stance	46.42	47.25	46.42	0.196
	swing	37.91	35.36	35.51	0.143
Hip ab/adduction (right)	stance	13.39	13.08	12.08	0.080
	swing	7.23	8.70	7.55	0.050
Hip rotation (right)	stance	**18.29**[b]	15.47	**19.38**[b]	0.007
	swing	16.51	16.38	**20.19**[b]	0.014
Knee flex/ext (left)	stance	42.76	46.71	44.04	0.623
	swing	70.75	68.65	69.81	0.120
Knee ab/adduction (left)	stance	5.74	5.93	5.81	0.623
	swing	9.38	11.14	10.03	1.000
Knee rotation (left)	stance	15.39	14.39	15.66	0.368
	swing	15.38	16.36	15.03	0.193
Knee flex/ext (right)	stance	44.06	43.90	44.13	0.854
	swing	67.17	65.14	66.44	0.504
Knee ab/adduction (right)	stance	8.53	7.56	**9.79**[a]	0.016
	swing	11.12	11.11	**13.81** [a b]	0.040
Knee rotation (right)	stance	19.92	17.70	20.22	0.368
	swing	19.40	19.36	19.04	0.949
Ankle dorsi/plantar flex (left)	stance	24.60	24.54	23.89	0.331
	swing	20.16	19.31	20.23	0.494
Ankle ab/adduction (left)	stance	10.42	10.63	10.78	0.331
	swing	7.46	6.25	7.24	0.662
Ankle rotation (left)	stance	14.08	13.60	14.54	0.150
	swing	8.96	9.35	8.84	0.838
Ankle dorsi/plantar flex (right)	stance	23.66	24.54	24.86	1.000
	swing	20.94	22.30	20.50	0.150

Ankle ab/adduction (right)	stance	11.12	9.79	10.36	0.532
	swing	5.85	6.15	5.80	0.104
Ankle rotation (right)	stance	14.90	15.58	14.30	0.949
	swing	10.88	10.08	10.41	0.504

[a] Significantly different from control condition (P<0.017)
[b] Significantly different from standard load carriage condition (P<0.017)

Table 5

Sagittal and frontal plane peak moments and powers during the stance phase

Moments (Nm/BW)	**Control**	**Standard load carriage**	**Alternate load carriage**	***p***
Hip flex/ext (left)	0.96	1.05	1.06	0.027
Hip ab/adduction (left)	1.21	**1.22** [a]	1.24	0.006
Hip flex/ext (right)	1.13	1.15	1.15	0.409
Hip ab/adduction (right)	1.26	1.29	1.27	0.060
Knee flex/ext (left)	0.33	0.32	**0.38**[a]	0.002
Knee ab/adduction (left)	0.51	0.54	0.50	0.179
Knee flex/ext (right)	0.32	0.37	0.36	0.047
Knee ab/adduction (right)	0.50	0.49	0.48	0.378
Ankle dorsi/plantar flex (left)	1.66	**1.70** [a]	**1.66** [a]	0.001
Ankle ab/adduction (left)	0.04	0.04	0.06	0.349
Ankle dorsi/plantar flex (right)	1.59	**1.70** [a]	**1.71** [a]	0.001
Ankle ab/adduction (right)	0.04	0.06	0.05	0.090
Powers (W/BW)				
Hip flex/ext (left)	1.56	1.46	**1.88** [a]	0.018
Hip ab/adduction (left)	0.90	0.98	0.98	0.228
Hip flex/ext (right)	2.14	2.33	2.02	0.409
Hip ab/adduction (right)	1.17	1.01	1.07	0.378
Knee flex/ext (left)	1.01	1.12	1.12	0.717
Knee ab/adduction (left)	0.29	0.30	0.30	0.661
Knee flex/ext (right)	0.89	0.93	0.98	0.776
Knee ab/adduction (right)	0.57	0.62	0.54	0.520
Ankle dorsi/plantar flex (left)	3.38	**3.71** [a]	**3.84** [a]	0.005
Ankle ab/adduction (left)	0.08	0.14	0.10	0.297
Ankle dorsi/plantar flex (right)	3.18	3.50	**3.58** [a]	0.026
Ankle ab/adduction (right)	0.17	0.13	0.13	0.443

[a] Significantly different from control condition (P<0.017)