Swiss ball training versus stable surface training for the treatment of low back pain in male judo athletes

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B Data Collection
C Statistical Analysis
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Abstract

Background & Study Aim: Between 60% and 80% of the population suffers from low back pain at some point in their lives. This disease is commonly observed in judo, with a prevalence of around 35%. Therefore, any instrument, program or training method for the treatment of this disease is very important. Apparently, unstable surface training can be effective in reducing low back pain. However, there are not many studies that have been conducted in this regard, and the few existing ones have not opted for any particular training method. The purpose in this study is knowledge about the effect on low back pain of two different training programs, one using Swiss ball and the other with stable surface.

Material & Methods: Thirty-six active volunteers, all of them judo athletes, participated in the study. They were randomly assigned to either the training group (exercising on a Swiss ball) or the control group (training on stable surface). Pain intensity was measured at the beginning and at the end of the 8 weeks in both groups by the Spanish version of the Roland Morris Disability Questionnaire (RMDQ).

Results: The results of paired t test showed a significant decrease in RMDQ after treatment in both groups compared with before treatment ($p<0.001$), while the ANCOVA revealed no significant differences among groups on the post measurement score of RMDQ, with pre-treatment scores as the covariate.

Conclusions: The training on unstable surfaces does not provide any significant improvement versus training on stable surfaces and might be at least as good as training on a Swiss ball in the reduction of low back pain for judo athletes.

Keywords: disability, lumbar, martial arts, Roland-Morris Disability Questionnaire, treatment

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Introduction

Roland Morris Disability questionnaire (RMDQ) – a widely used health status measure for low back pain [44].

Visual Analogue Seale (VAS) – is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum [45].

Between 60% and 80% of the population suffers from low back pain at some point in their lives [1-4]. The prevalence is also quite high for athletes [5] and it is commonly observed in judo, reaching around 35% [6-8] as a result of repeated falling, lifting, stretching and twisting. The prevalence of lumbar radiological abnormalities in this sport is approximately 90% in the middle weight and heavy weight categories [8]. Also, the importance of having a history of low back pain in competition has been demonstrated, as judo athletes in this situation, exhibit deficits in hip rotation and greater asymmetry between limbs [9]. Therefore, any instrument, program or training method for the treatment of this disease is very important for judo athletes.

Apparently, unstable surface training can be effective in reducing low back pain [10]. However, there are not many studies that have been conducted in this regard, and the few existing ones have not opted for any particular training method [11].

One of the main arguments of this research stating that unstable surface training can decrease low back pain, is the development of core muscles [12-15]. Since the column is unsteady, one of the main roles of these muscles is to increase the stiffness during movements that cause instability [16], so unstable surfaces should provide adequate stimulus for their development. There is a clear correlation between the decreased stability and increased risk of low back pain, so training the core muscles could be positive to improve this aspect [12,16-20].

Coordination of the core muscles is vital to prevent and avoid low back pain, since the ligaments in this area have limited potential to stabilize the vertebral column [21]. Hodges and Richardson demonstrated it, concluding that contraction of transversus abdominis was significantly delayed in patients with low back pain with all movements, while isolated differences were noted in rectus abdominis, erector spinae and oblique abdominal with movements in specific directions [22,23]. Therefore, the postural control of persons with low back pain is affected, and may influence the occurrence of other injuries or in a further delay in their recovery. Hence the importance of stabilizing the spinal system, involving the ability of the core muscles to anticipate (feed -forward mechanism) and answer (feedback mechanism) to stimuli that constitute the segmental movements and expected or unexpected external shocks [11].

Since 25% of maximum voluntary contraction is enough to achieve the stiffness of a vertebral joint and the efficiency of the multifidus can be improved with training loads of 30-40% of maximum voluntary contraction [14], Behm and Colado [21] suggest that it is unnecessary to use excessive loads and unstable surface training could be at least as valid as stable surface training for the treatment of lumbar pain. They also focus on the fact that lower loads with higher repetitions would be the most appropriate [21], forgetting that this training can also be executed on stable surfaces. In fact, there are no rigorous studies that compare the effect of the different unstable surfaces or that compare them with a stable surface.

Most of the studies conducted in relation with unstable surface training and patients with low back pain have used Swill Ball. Marshall and Murphy [24] analysed 8 healthy participants who performed, during 12 weeks, 4 exercises on and off a Swiss ball: inclined press-up, upper body roll-out, single-leg hold, and quadruped exercise. They found a significant increase in the activation of the rectus abdominus with performance of the single-leg hold and at the top of the press-up on the Swiss ball. However, they only measured the activation patterns of muscles associated with the global and local stability, but not the possible reduction in low back pain.

Shen et al. [25] investigated the influence of Swiss ball exercises on clinical efficacy and stability of lumbar vertebra in thirty patients with protrusion of lumbar intervertebral disc. Roland Morris Disability questionnaire (RMDQ) and Visual Analogue Seale (VAS) were selected as pain assessment before treatment, 2 and 4 weeks after Swiss ball exercises. The control group only performed the lumbar traction, and the results showed a significant decrease in pain in patients who followed the training program with the Swiss ball. Carter, Beam, McMahan, Barr and Brown [26] examined the effects of Swiss Ball training on spinal stability in twenty sedentary persons. After 10 weeks of training, they found significant improvements in spinal stability in experimental group, while the control group, with no training at all, registered no changes. Again, in these cases, no comparison with stable surface training was done.

Some authors point out other several shortcomings in the studies conducted to date, such as the small sample size, the choice of control group, the method of assessment or the training programs, stating that much more research is needed to confirm whether unstable surface training may be better than

stable surface training for the treatment of low back pain [11]. In fact, no study has been conducted comparing both types of surfaces in the treatment of low back pain.

The purpose of this study is knowledge about the effect on low back pain of two different training programs, one using Swiss ball and the other with stable surface.

Material and methods

Ethics Statement

The Ethical Board of the Spanish Team Sports Association approved the experimental design of the study. The informed consent document that all the participants signed before data collection was also approved by the Ethical Board of the Spanish Team Sports Association. We confirm that our research meets the highest ethical standards for authors and co-authors. The study was performed following the guidelines of the Declaration of Helsinki, last modified in 2008.

The authors certify that the present research was carried out in the absence of any financial, personal or other relationships with other people or organizations that could inappropriately influence it and lead to a potential conflict of interest. The authors confirm that all ongoing and related trials for this intervention are registered. The trial was registered in SLCTR under the number U1111-1154-9313. The full protocol can be accessed by sending an email to the Spanish Team Sports Association (asesdeco@asesdeco.com). There were no funding sources for this study.

Participants

Thirty-six active volunteers, all of them men, participated in the study. They were randomly assigned to either the training group (9 men, 9 women: age = 30.9 ± 3.1 years, height = 172.2 ± 5.1 cm, weight = 70.0 ± 6.8 kg) or the control group (9 men, 9 women: age = 30.2 ± 2.7 years, height = 174.4 ± 7.5 cm, weight = 72.1 ± 7.9 kg).

The inclusion criteria included: 18-50 years old; be physically active, lumbar pain of at least 3 months´ duration within the last 2 years; and failure of conservative therapy (physiotherapy, medication trial). Exclusion criteria were significant anatomic deformity and any severe illness.

They were recruited from several Universities in Madrid (Spain) and they were either studying or working in them. They were approached by the researchers in the sport facilities of those Universities in the last two weeks of September 2013. All participants were informed that they could withdraw from the program at any time.

Group allocation was done in a 1:1 ratio, with block sizes of 2, 4, and 6. Participants were randomized by a person who had no relation with any other part of the investigation.

Table 1. Demographic data of the participants (Mean+SD)

Variables	Training group (UTG)	Control group (CG)
Age (y)	30.9 ± 3.1	30.2 ± 2.7
Weight (kg)	70.0 ± 6.8	72.1 ± 7.9
Height (cm)	172.2 ± 5.1	174.4 ± 7.5

Exercise intervention

Participants were allocated to one of the two groups: Unstable Training Group (UTG) or Control Group (CG). All training sessions of both groups, lasting approximately 20 minutes, took place at the Dys-Gym Laboratory (Madrid, Spain), for 8 weeks, starting on October 7th, 2013. Exercises were demonstrated and supervised by an assistant blinded to the outcome assessment.

UTG

The 8-week program had two phases. The first phase, week 1, focused on correctly learning the technique of exercises. In the second phase, weeks 2-8, the following exercises were executed:

1. Press-up. The initial position was with the hands placed on the Swiss ball directly beneath the shoulder joint, the arms fully extended and the feet on a bench. This initial position of each subject's feet and the hands distance was marked and held consistent during all trials. The bottom of the press-up was recorded after the participant had flexed the elbow joint to approximately 90°, without the trunk making contact with the ball.

2. Contralateral single-leg hold. The participant lays on a Swiss ball with the sacroiliac joint being the most distal part of the trunk supported, the right foot on the floor throughout the exercise, and the left leg manually assisted to reach approximately 90° of hip and knee flexion. From this position, the subject had to extend the knee first and then the hip until the thigh was parallel to the prone trunk position. This position had to be maintained for 3 seconds.

3. Bridging. The initial position in this case was lying on the floor in a supine position, and with the feet on a Swiss ball. The participant had to slowly lift his bottom pushing through his ankles and heels, until knees, hips and shoulders were in a straight line. In that position, they had to tighten the gluteus muscles and hold for 3 seconds. Then they slowly lowered back down.

A 65 cm Swiss ball was used, to ensure that the trunk position was consistent compared with that of the stable condition.

CG

Control group performed the same exercises, which are often used for lumbar pain treatment, on a stable bench 65 cm high instead of the Swiss ball.

During the first week, one set of 5 repetitions for each movement was performed, on Monday, Wednesday and Friday. For the following 7 weeks, three sets of 10 repetitions of each exercise were performed, 5 times a week. After 8 weeks of training, all participants were asked to completely stop their exercise.

Main outcome measures

Pain intensity was measured at the beginning and at the end of the 8 weeks in both groups by the Spanish version of the Roland Morris Disability Questionnaire (RMDQ), validated by Kovacs et al [27]. This 0–24 scale questionnaire, with lower scores indicating less severe disability [28], is a widely used patient-completed measure of health outcome for low back pain that has shown to be reliable and sensitive to change over time [28,29]. The sum of the scores is used to measure disability, and it has been shown that a change of 2 to 3 points indicates a significant difference [30].

Primary objective was to measure the average difference in RMDQ for the participants of both groups.

Statistical analysis

All statistical analysis was carried out with SPSS (version 17.0, SPSS, Chicago IL, USA). Kolmogorov-Smirnov test was used to assess the normality of the distribution before and after treatment. Normal distribution was observed in both groups.

Paired t test was used to determine any significant change in RMDQ at the end of treatment compared with initial scores in both groups. Analysis of covariance (ANCOVA) was used to asses differences between groups in post-test measurements, with pre-test scores used as covariates in the analysis. The test for homogeneity of regression coefficient was conducted so that the application of the ANCOVA was valid. A $p < 0.05$ was considered to represent significant difference.

The effect of treatment was estimated as the mean change scores from baseline as this was the only method that remedied substantial skew in the data.

Results

Pre and post treatment scores for RMDQ in UTG and CG and the results of paired t test are provided in Table 2. Paired t test showed a significant decrease in RMDQ after treatment in both groups compared with before treatment. The results of ANCOVA revealed no significant differences among groups on the post measurement score of RMDQ, with pre-treatment scores as the covariate.

Table 2. Pre and post treatment scores for RMDQ in the participants

Group	Before treatment Mean ± SD	After treatment Mean ± SD	P value
UTG	11.3 ± 5.9	4.9 ± 3.0	< .001
CG	10.1 ± 4.1	3.2 ± 3.0	< .001

Discussion

In the Roland-Morris Disability Questionnaire, the higher the number of yes responses, the greater the disability [31]. In this case, the results revealed a significant decrease in RMDQ scores for both groups after 8 weeks of training. This means a significant improvement in low back pain intensity and disability after training, either on stable and unstable surfaces.

The RMDQ may not be appropriate for samples with initial scores under 4 and over 20 [32]. As initial scores were 10.1 and 11.3 for the groups analysed, this questionnaire was appropriate for this study.

The improvement found in this study is in line with previous research that indicated reduction of pain and disability following different exercises on Swiss ball in subjects with low back pain [25,26,33,34]. However, to our knowledge, this is the first study to directly compare the effect on low back pain of Swiss ball training versus stable surface training.

Mannion et al. [35] found that advising people with low back pain to keep active by carrying out the type

of physical activities that they most enjoy was just as good as administering a supervised rehabilitation program. Our study confirms that this recommendation can be applied not only to the type of activity, but also to the type of surface. So, that advising can include any type of stable surface. In judo, chronic injuries typically affect lower back [36], so these exercises (press up, contralateral single-leg hold and bridging) have demonstrated to be good in the treatment of this disease, despite the surface.

Automatic activation of deep abdominal muscles is considered as a protective mechanism for the lumbar spine [37]. Previous studies have shown delayed activity of these muscles in subjects with low back pain [38]. Marshall and Murphy [24] found a significantly higher increase in the activation of the rectus abdominus in several exercises performed on a Swiss ball than in those subjects performing them on the floor. If our study found no difference between the UTG and the CG in terms of low back pain reduction, this might mean that abdominal muscles activation might not have relation with that decrease or, at least, that a minimum activation might be enough to reach the positive effects of the exercise.

It is necessary to mention that training on unstable surfaces does not only provide beneficial effects to the lower back. On the contrary, sometimes it might even increase the feeling of discomfort [39-41]. So, we can state that training on stable surfaces might be at least as good, if not better, as training on a Swiss ball for judo players with low back pain.

This study was based on a questionnaire and therefore had some limitations. To properly evaluate the impact of the training program, more information regarding the participants would be needed, such as the number of years of practice, the duration of the low back pain, etc., as all those factors could have an impact in the results. In addition, there was not a clear definition of low back pain, and the participants were personally deciding whether they had it for more than three months, regardless of the severity.

Perhaps, it would be interesting for future research to check some authors suggestion that programs aimed at reducing low back pain should include several steps, being the last working on unstable surfaces [41-43]. This study could have been improved also by recording the range of motion of the hip and lumbar spine before and after the intervention.

Conclusion

The training on unstable surfaces does not provide any significant improvement versus training on stable surfaces and might be at least as good as training on a Swiss ball in the reduction of low back pain for judo athletes.

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Competing interests

The authors declare that they have no competing interests.

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