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Effectiveness of Balance Training on Ankle Range of Motion (ROM) Among Youth Silat Athletes

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I. INTRODUCTION

Ankle injuries remain one of the most common musculoskeletal problems among young Silat athletes, largely due to the sport's explosive movements, repetitive kicking, and rapid changes in direction. Although balance training has been widely used to improve proprioception and reduce lower limb injuries in sports like soccer and basketball, very little research has examined its effect specifically in Silat. This traditional Malay martial art involves unique footwork patterns that place high demands on ankle stability and postural control. The gap in sport-specific evidence becomes even more concerning when considering youth athletes aged 13 to 17, whose neuromuscular coordination is still developing, putting them at greater risk of injury. This study aimed to determine whether a four-week balance training program could improve ankle range of motion and balance among youth Silat athletes in a controlled setting.

II. METHODS

A true experimental design with pre-test and post-test measurements was used in this study. Ten youth Silat athletes from Sekolah Sukan Malaysia Terengganu (SSMT) aged between 13 and 17 years old were recruited. All participants were actively training in Silat and free from any lower limb injuries at the time of the study. They were randomly assigned into two groups: an intervention group ($n = 5$) that underwent a four-week balance training program in addition to their regular Silat training, and a control group ($n = 5$) that continued with only their regular Silat sessions. The four-week intervention was conducted three times per week, with each session lasting between 30 to 40 minutes. The balance training program was adapted from previous research and progressively increased in difficulty. Exercises included single-leg stance, dynamic balance drills, and unstable surface training using mats and balance discs. Ankle range of motion was measured using the Weight Bearing Lunge Test (WBLT), while balance was assessed using the Stork Balance Test. Measurements were taken at baseline and immediately after the four-week period. Data were analyzed using Jamovi software, with paired sample T-Tests used to compare within-group differences and independent T-Tests to compare

between-group differences. Statistical significance was set at $p < .05$.

III. RESULTS AND DISCUSSION

Balance performance was assessed using the Stork Balance Test before and after the four-week intervention period. Table I presents the comparison of pre-test and post-test scores for both the intervention and control groups.

TABLE I
BALANCE PERFORMANCE

Variable	N	Mean	SD	Minimum
Stork Pre (Right)	10	8.60	1.35	6
Stork Post (Right)	10	11.30	2.41	8
Stork Pre (Left)	10	8.00	1.56	6
Stork Post (Left)	10	9.90	2.77	6

The intervention group showed significant improvements in balance for both legs following the four-week training program. The right leg improved by 2.70 seconds ($p = .001$), while the left leg improved by 1.90 seconds ($p = .032$). The control group also showed significant improvement in the right leg ($p = .035$) with a mean difference of 2.44 seconds, but no significant change was observed in the left leg ($p = .374$). When comparing between groups, the intervention group performed significantly better than the control group in post-test balance score for both legs, confirming that the improvements were due to the training program rather than regular Silat practice alone.

Ankle range of motion was measured using the Weight Bearing Lunge Test (WBLT) before and after the intervention. Table II presents the pre-test and post-test results for both groups.

TABLE II
ANKLE RANGE OF MOTION

Variable	N	Mean	SD	Minimum
WBLT PRE (RIGHT)	10	7.95	2.19	4.50
WBLT POST (RIGHT)	10	8.55	2.01	5.00
WBLT PRE (LEFT)	10	6.43	2.46	4.00
WBLT POST (LEFT)	10	8.40	1.96	5.00

For ankle range of motion, the intervention group demonstrated a statistically significant improvement in the left ankle ($p = .018$) with a mean difference of 1.97 cm. The right ankle also showed improvement (mean difference = 0.60 cm) but did not reach statistical significance ($p = .089$). The control group showed no significant changes in either ankle (right ankle $p = .678$; left ankle $p = .842$). These findings indicate that regular Silat training without specific intervention does not contribute to improvements in ankle range of motion.

The main finding of this study is that four weeks of balance training significantly improved balance performance among youth Silat athletes, but only partially improved ankle range of motion. These results align with previous research showing that proprioceptive training enhance postural control by improving neuromuscular coordination and joint stability. The significant improvement in balance for both legs within the intervention group, and the between-group difference favouring the intervention group, support the effectiveness of structured balance exercises in a sport-specific context.

The improvement in the control group's right leg balance was unexpected, though not entirely surprising. Regular Silat training involves weight-shifting movements and single-leg stance during kicks, which may naturally challenge balance to some extent. However, the absence of significant improvement in the left leg suggests that without targeted intervention, balance adaptations may not transfer symmetrically.

Regarding ankle range of motion, the significant improvement only in the left ankle raises interesting questions. It is possible that the left ankle, being the non-dominant limb for most participants, had more room for improvement compared to the right ankle, which may already be more stable and mobile due to daily functional use. Another explanation is that four weeks may not be sufficient to produce measurable changes in joint flexibility, as improvements in range of motion often require longer intervention periods. These findings are consistent with studies on other martial arts, where balance improvements occurred faster than changes in joint mobility.

Several limitations should be acknowledged. The small sample size limits the generalizability of the findings, and the short intervention duration may not have been adequate to detect all possible adaptations. The use of the Stork Balance Test, while practical, measure static balance rather than dynamic balance, which may be more relevant to Silat performance. Future studies should consider larger samples, longer intervention periods, and dynamic balance assessments such as the Y-Balance test.

IV. CONCLUSIONS

This study provides evidence that a four-week balance training program can significantly improve

balance among youth Silat athletes, though its effects on ankle range of motion may be limited. The intervention group showed clear improvements in both legs compared to the control group, suggesting that balance exercises should be incorporated into regular Silat training enhance stability and potentially reduce injury risk. However, for coaches aiming to improve ankle flexibility as well, longer training periods may be required. These findings contribute to the limited body of knowledge on injury prevention strategies specifically tailored for Silat, offering practical guidance for coaches, trainers, and sports science practitioners working with young athletes in traditional martial arts.

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