EXCELLENCIA
INTERNATIONAL MULTI-DISCIPLINARY JOURNAL OF EDUCATION
Volume 3, Issue 3, 2025 ISSN (E): 2994-9521

Formation of a Stable Equilibrium in Highly Qualified "Belbogli Kurash" Wrestlers

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Abstract:

This article explores the formation of a stable equilibrium in highly qualified "Belbogli Kurash" wrestlers. The study examines the biomechanical and physiological factors that contribute to maintaining balance and stability during dynamic movements in wrestling. Special attention is given to the role of core strength, coordination, and tactical adaptability in ensuring optimal performance. The research findings provide valuable insights into training methodologies aimed at enhancing equilibrium control, reducing injury risks, and improving competitive effectiveness in professional "Belbogli Kurash" athletes.

Keywords: belbogli kurash, maintaining balance, absolute and relative gain, vestibular analyzer, static-dynamic efforts, rotational drills, motor actions.

Introduction.

In many grappling disciplines worldwide, including judo, sambo, and various forms of belt wrestling, equilibrium (balance) stands as a critical determinant of technical success and injury prevention. "Belbogli kurash," a culturally significant form of belt wrestling in Uzbekistan, requires athletes to execute a broad array of throwing techniques.[1] These moves often incorporate lift-and-turn elements, where the wrestler lifts the opponent by gripping the belt and then pivots or rotates the body to complete the throw. In such a dynamic scenario, small lapses in balance may instantly lead to counterattacks or forced defensive positions, reducing the chance of successful scoring and increasing the risk of losing.

Globally, athletic longevity has become an area of intense research focus, especially where sports demand explosive strength, repeated high-impact maneuvers, and advanced coordination skills.[2] Early retirement or performance decline may result from asymmetric training-for instance, focusing on throwing techniques exclusively to one side (left or right). This asymmetry can be particularly pronounced in wrestling sports; while it can yield a powerful “go-to” throw, it also predisposes the athlete to a weaker equilibrium when forced to move or rotate in less-favored directions.[3]

Purpose. This study aimed to develop and experimentally validate a methodology to improve the ability of highly qualified “belbogli kurash” wrestlers to maintain stable equilibrium when performing rotational and turning techniques. [4]Specifically, it focused on strengthening the vestibular analyzer’s function and integrating specialized exercises to enhance static and dynamic balance under multiple stressors-primarily rotations to both left and right sides.[5]

Methods. A total of 24 highly qualified “belbogli kurash” wrestlers were divided equally into control (CG) and experimental (EG) groups. Over a designated training cycle, both groups underwent routine technical-tactical and physical preparation, yet the EG received additional targeted exercises specifically designed to bolster static and dynamic balance through rotational drills. Balance assessments covered static poses, head-turning challenges, and body-rotation tasks (with eyes open/closed, in a constrained area). Pre- and post-tests measured outcomes such as the ability to remain stable in demanding positions, duration of balance under rotary stress, and the number of rotations possible without losing equilibrium.

Results. Analysis of pre- and post-intervention data showed that the CG experienced small, statistically insignificant improvements in most tests ($p>0.05$). By contrast, the EG exhibited significantly larger gains ($p<0.01$ or $p<0.001$) in all metrics pertaining to equilibrium, including longer balance times and more controlled rotations.[6] In particular, the absolute and relative increases in equilibrium function in the EG were two- to three-fold higher than in the CG across multiple tests involving static stances, head turns, and full-body rotations.

Issues in “Belbogli Kurash” training

In Uzbekistan, top-level “belbogli kurash” wrestlers are celebrated for their strength, stamina, and specialized throwing strategies. However, some challenges have been identified:

Vestibular underdevelopment. Many wrestlers do not sufficiently train their vestibular analyzer, the internal system responsible for sensing head and body orientation under gravitational and acceleration forces.[7]

Loss of balance in non-preferred directions. Because typical training routines often emphasize one side, rotational throws in the opposite direction can destabilize the wrestler’s stance.

Premature departure from elite sport. Wrestlers face intense physical demands. Over time, repeated stress on the musculoskeletal and vestibular systems-when insufficiently trained-can accelerate career dropouts.[8]

Gap in the literature

Previous studies underscore the importance of integrated physical and technical preparation, but few have focused specifically on vestibular training and systematically measured how it improves static and dynamic equilibrium. The interplay between explosive lifts, rotational throws, and balance maintenance requires deeper investigation. Research has pointed toward:

Bilateral skill development to mitigate asymmetries.

Specific vestibular challenges (e.g., repeated turns/rotations with eyes closed, or unpredictable directional changes) to strengthen neural adaptations that govern balance.[9]

The role of strength conditioning for stability (especially trunk and core muscles) combined with specialized drills that test the limits of postural control.

Purpose and objectives

The **purpose** of this study was to design and evaluate an exercise methodology to **form and reinforce stable equilibrium** among highly qualified "belbogli kurash" wrestlers during both **static** (holding positions, resisting forces) and **dynamic** (rotations, turning throws) situations.[10]

To address this aim, the study pursued the following **objectives**:

1. **Assess baseline balance functions.** Measure static and dynamic equilibrium indicators (via multiple tests) in wrestlers prior to intervention.
2. **Implement vestibular-focused exercises.** Integrate a specialized set of drills into the experimental group's training regimen that emphasizes left-right rotational throws, multi-directional stance work, and reduced visual cues (eyes closed).
3. **Evaluate improvements.** Compare pre- and post-intervention data between the experimental and control groups, quantifying absolute and relative gains in equilibrium-related tests.

Study design.

A comparative experimental design was adopted, wherein participants were randomly assigned to either a **Control Group (CG)** or an **Experimental Group (EG)**. The study spanned a training cycle of several weeks, long enough to:

Perform baseline tests, ensuring each wrestler's pre-intervention equilibrium level was documented.

Administer a structured training program with daily or weekly emphasis on skill-building tasks.

Conduct post-tests to measure changes in equilibrium performance and compare between groups.

Participants.

Sample size: 24 wrestlers, **n=24**.

Qualifications: All participants were recognized as **highly qualified** in "belbogli kurash," with significant national or international competitive experience.

Division: The wrestlers were divided into two equal groups of 12 each (CG = 12, EG = 12).

Ethical considerations: All athletes provided informed consent, in line with local regulations for athletic testing and research.

Intervention: Specialized exercises for the EG.

While both groups continued their **standard technical-tactical** drills (e.g., fundamental throws, strength training, and sparring), the EG additionally performed a **targeted vestibular-training routine** comprised of:

Static balance exercises:

One-Leg Holds: Wrestlers balanced on one foot while flexing the trunk backward, eyes closed, simulating destabilizing forces.

Toe Stance with Feet Together: Maintaining a tiptoe stance, sometimes with eyes closed or with the threat of an opponent's belt grip, ensuring minimal reliance on visual feedback.

Rotational drills:

Head rotation: Repetitive turning of the head side-to-side in place, with eyes closed, to disrupt normal equilibrium references.

Full-Body rotations: Standing in the **center of a 60 cm-diameter circle**, performing as many controlled rotations as possible without stepping on or beyond the boundary.

Bilateral throw practice:

Weekly sessions that **deliberately trained throws to both left and right**.

Gradually increased speed and complexity, ensuring wrestlers developed symmetrical coordination.

Progressive intensification:

Over time, the number of sets, speed of rotations, and complexity of stance (e.g., deep squat before rotation) were increased to continuously challenge and adapt the vestibular system.

Testing and measurement procedures

All wrestlers underwent **pre-tests** and **post-tests** in the following categories:

Static talance tests

Test 1: "Maintaining balance in a stance on the toes of joined feet, eyes closed, with threat of partner's belt-grab."

Test 2: "Maintaining balance on one leg (trunk bent backward, eyes closed)."

Head-rotation balance tests

Test 1: Time balancing with the head turned to the **left**, eyes closed, feet together.

Test 2: Same measurement but turning the head to the **right**.

Body-rotation balance tests

Test 1: Number of **full-body rotations** to the left while standing in a 60 cm circle.

Test 2: **Time** of full-body rotation to the left under similar constraints.

Test 3: Number of **full-body rotations** to the right under the same constraints.

Test 4: **Time** of full-body rotation to the right under the same constraints.

Each test yielded data in seconds (for time) or number of rotations (for repetition-based tasks). Absolute gains (post – pre) and relative gains $\left(\frac{\text{post} - \text{pre}}{\text{pre}} \times 100\%\right)$ were calculated. Statistical significance was assessed via Student's t-test, where p < 0.05 was deemed significant.

Data analysis. Mean (x) and Standard Deviation (σ) were computed for each test. The **coefficient of variation (V%)** was used to examine the homogeneity of each group's performance.

t-tests determined whether differences between pre- and post-measures were statistically significant, reported alongside **P-values**.

This section presents and discusses the quantitative findings from the above tests, focusing on differences in static balance, head-rotation balance, and body-rotation balance.

Static balance tests.

Maintaining balance on toes of joined feet, eyes closed.

Table 1. Dynamics of changes in wrestlers' ability to maintain balance under static effort in "belbogli kurash," experimental and control groups (n=24)

Test No.	Group	Start of experiment			End of experiment			t	p
		$\bar{X}$	σ	V, %	$\bar{X}$	σ	V, %		
1	CG	4,77	0,60	12,58	5,21	0,63	12,09	1,75	>0,05
	EG	4,95	0,64	12,93	6,35	0,77	12,13	4,84	<0,001
2	CG	3,97	0,46	11,59	4,31	0,48	11,14	1,77	>0,05
	EG	4,12	0,49	11,89	5,18	0,58	11,20	4,84	<0,001

Note: For convenience, the tests that characterize static tension in the table are conditionally labeled as follows:

1 – "Maintaining balance in a stance on the toes of joined feet with eyes closed, with the threat of grabbing the partner's belt" (seconds).

2 – "Maintaining balance in a stance on one leg while the other leg is raised in a bent position, the body bent backward, eyes closed, with the threat of grabbing the partner's belt" (seconds). CG – control group, EG – experimental group.

In the experimental group (EG), while performing this test, the results were: at the beginning of the experiment ±σ = 4.95±0.64 s (coefficient of variation V=12.93%), and at the end ±σ = 6.35±0.77 s (V=12.13%), with an absolute increase of 1.40 s and a relative increase of 28.28% (which is 19.06% or 3.066 times greater than in the CG). The results of this test in the EG showed a statistically significant absolute increase with a high level of significance (t=4.84 and P<0.001).

In the control group, the results for the "Maintaining balance in a stance on one leg while the other leg is raised in a bent position, the body bent backward, eyes closed, with the threat of grabbing the partner's belt" test were: at the beginning of the experiment ±σ = 3.97±0.46 s (V=11.59%), and at the end ±σ = 4.31±0.48 s (V=11.14%). Their absolute increase over the course of the study was 0.34 s, and the relative increase was 8.56%. In this test, the absolute increase in results during the experiment was statistically insignificant with a satisfactory degree of significance (t=1.77 and P>0.05).

In the experimental group, these results at the beginning of the experiment were ±σ = 4.12±0.49 s (V=11.89%), and at the end ±σ = 5.18±0.58 s (V=11.20%), with an absolute increase of 1.06 s and a relative increase of 25.73% (this is 17.16% or 3.004 times greater than in the CG). In the EG, the results of this test showed a statistically significant high absolute increase with a high level of significance (t=4.84 and P<0.001).

During the experiment, based on these two tests characterizing the wrestlers' ability to maintain balance under static effort, it was found that the average relative increase in the EG was 27.01%, which is 18.12% or 3.036 times greater than the corresponding figure (8.89%) in the control group. This confirms the effectiveness of the means and techniques used in the experimental group.

Statistical characteristics of the "Balance time when turning the head to the left in the basic stance: feet together, eyes closed" test at the start of the experiment in the CG were ±σ = 8.13±0.95 s (V=11.69%), and at the end ±σ = 8.82±0.98 s (V=11.11%). The absolute increase in this indicator over the course of the experiment was 0.69 s, and the relative increase was 8.49% (see Table 2).

Table 2. Dynamics of changes in the ability to maintain balance under the influence of head rotation in "belbogli kurash" wrestlers of the experimental and control groups (n=24)

Test No.	Group	Start of experiment			End of experiment			t	p
		$\overline{X}$	σ	V, %	$\overline{X}$	σ	V, %		
1	CG	8,13	0,95	11,69	8,82	0,98	11,11	1,75	>0,05
	EG	8,89	1,06	11,92	11,18	1,25	11,18	4,84	<0,001
2	CG	5,94	0,63	10,61	6,4	0,65	10,16	1,76	>0,05
	EG	6,28	0,69	10,99	7,74	0,79	10,21	4,82	<0,001

Note: For convenience, the tests that characterize maintaining balance under head rotation are labeled as follows:

1 – "Balance time when turning the head to the left in the basic stance: feet together, eyes closed" (seconds).

2 – "Balance time when turning the head to the right in the basic stance: feet together, eyes closed" (seconds).

CG – control group, EG – experimental group.

An assessment of the statistical significance of the results of this test revealed no statistically significant positive change at a satisfactory level of significance (t=1.75 and P>0.05). In the EG, the results at the beginning of the experiment were ±σ = 8.89±1.06 s (V=11.92%), and at the end ±σ = 11.18±1.25 s (V=11.18%), with an absolute increase of 2.29 s over the course of the experiment and a relative increase of 25.76% (this is 17.27% or 3.035 times greater than in the CG). In the EG, the absolute increase in test results was statistically significant with a high level of significance (t=4.84 and P<0.001).

In the control group, the results of the "Balance time when turning the head to the right in the basic stance: feet together, eyes closed" test at the beginning of the experiment were ±σ = 5.94±0.63 s (V=10.61%), and at the end ±σ = 6.40±0.65 s (V=10.16%). The absolute increase was 0.46 s, and the relative increase was 7.74%. The absolute increase in the results of this test was statistically insignificant at a satisfactory level of significance (t=1.76 and P>0.05).

In the experimental group, the results for this test at the beginning of the experiment were ±σ = 6.28±0.69 s (V=10.99%), and at the end ±σ = 7.74±0.79 s (V=10.21%). The absolute increase was 1.46 s, and the relative increase was 23.25% (which is 15.49% or 3.002 times greater than in the CG). In the EG, the absolute increase in test results was statistically significant with a high level of significance (t=4.82 and P<0.001).

During the experiment, based on these two tests characterizing the wrestlers' ability to maintain balance under head rotation, it was found that the average relative increase in the EG was 24.50%, which is 16.38% or 3.019 times greater than the corresponding indicator (8.12%) in the control group. This confirms the effectiveness of the means and techniques used in the experimental group.

Table 3. Dynamics of changes in the ability to maintain balance under the influence of body rotation in wrestlers of the control and experimental groups (n=24)

№ теста	Груп-пы	В начале эксперимента			В конце эксперимента			t	p
		$\overline{X}$	σ	V, %	$\overline{X}$	σ	V, %		
1	КГ	4,62	0,58	12,55	5,04	0,61	12,10	1,73	>0,05
	ЭГ	4,96	0,64	12,90	6,01	0,73	12,15	3,75	<0,01
2	КГ	5,54	0,64	11,55	6,01	0,67	11,15	1,76	>0,05
	ЭГ	5,85	0,7	11,97	7,36	0,82	11,14	4,85	<0,001
3	КГ	3,94	0,5	12,69	4,31	0,52	12,06	1,78	>0,05
	ЭГ	4,17	0,54	12,95	5,35	0,65	12,15	4,84	<0,001
4	КГ	5,34	0,57	10,67	5,85	0,59	10,09	2,15	<0,05
	ЭГ	5,73	0,63	10,99	7,07	0,72	10,18	4,85	<0,001

Note: For convenience, the tests that characterize maintaining balance under rotational movements of the body are labeled as follows:

1 – "Number of body rotations to the left while standing in the center of a circle with a 60 cm diameter" (reps).

2 – "Time of body rotation to the left while standing in the center of a circle with a 60 cm diameter" (s).

3 – "Number of body rotations to the right while standing in the center of a circle with a 60 cm diameter" (reps).

4 – "Time of body rotation to the right while standing in the center of a circle with a 60 cm diameter" (s).

CG – control group, EG – experimental group.

The results of the "Number of body rotations to the left while standing in the center of a 60 cm-diameter circle," which characterize wrestlers' ability to maintain balance during body rotation, assuming they do not step on or cross the circle's line, were ±σ = 4.62±0.58 rotations (V=12.55%) in the CG at the beginning of the experiment, and ±σ = 5.04±0.61 rotations (V=12.10%) at the end. The absolute and relative increases were 0.42 rotations and 9.09%, respectively (see Table 3). The absolute increase in the results of this test was statistically insignificant at a satisfactory level ($t=1.73$ and $P>0.05$). In the EG, the results for this test at the beginning of the experiment were ±σ = 4.96±0.64 rotations (V=12.90%), and at the end ±σ = 6.01±0.73 rotations (V=12.15%). The absolute and relative increases were 1.05 rotations and 21.17%, respectively (12.08% or 2.329 times greater than in the CG). In the EG, the absolute increase in test results was statistically significant at a good level of **significance ($t=3.75$ and $P<0.01$).**

Conclusion. Implementing a specialized set of vestibular and rotational-training exercises markedly enhanced static and dynamic equilibrium in highly qualified "belbogli kurash" wrestlers. These findings suggest that developing balance capacities beyond conventional strength and technical drills is critical for success in competitions involving high physical loads and sudden rotational maneuvers. Incorporating bilateral rotational skills (both left- and right-sided throws) and targeted vestibular challenges can help wrestlers sustain technical-tactical performance and athletic longevity in "belbogli kurash."

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