ISSN: 2586-6028
JSAS Website: http://www.kjsas.or.kr
doi: http://dx.doi.org/10.13106/jsas.2023.Vol7.no3.19

Effect of Functional Rehabilitation Exercise for Correct Posture on Physical Balance and Physical Factors

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Received: August 31, 2023. Revised: September 13, 2023. Accepted: September 14, 2023.

Abstract

Purpose: This study attempted to investigate the effect of functional rehabilitation exercise for posture correction on physical strength factors and physical balance. **Research design, data, and methodology:** It consisted of 40 experimental groups that applied functional rehabilitation exercises to 80 people with posture imbalance and 40 comparative groups that performed general exercises, and was conducted four times a week, once for 40 minutes, and for 12 weeks. **Results:** D.S. (p<.o1) among F.M.S., a moving assessment. It increased significantly from the dictionary, and H.S. (p<.o5). I.L(p<.o5). S.M(p<.o5). A.S.L.R(p<.o5). T.S.P(p<.o01). It was confirmed that R.S. (p<.o5) decreased more after than before. In other words, Functional rehabilitation exercise was effective in improving physical balance. PAPS flexibility (bending forward) (p<.o1). Muscle strength (grip strength test) (p<.o1). Quickness (long jump) (p<.o1). Functional rehabilitation exercise was found to be effective in muscle strength, agility, and flexibility, but not in cardiopulmonary endurance. **Pain:** Based on the NRS scale (1-10 points). The experimental that there was a significant interaction between the groups.(F=38.583, P=.000). In the comparative group, there was no significant difference in the pre-post, and it was found that the pain level in the experimental group decreased after the pre-post (p<.001). **Conclusion:** As a result of the above study, it was confirmed that functional rehabilitation exercise improves physical strength factors and physical balance ability, and also affects physical pain reduction due to physical imbalance.

Keywords: Functional rehabilitation exercise, Posture correction, Correct posture, and Physical Strength Factors

JEL Classification Code: I10, I12, I18

1. Introduction

The third stage of functional rehabilitation exercise is the restoration of range flexibility and intensity, the stabilization of reflexes and coordinated exercise patterns, and the preparation for returning to the desired sport (Lee, 2002). Functional rehabilitation exercise can be said to be a stretching and muscular exercise performed to balance the right posture and the body up, down, left, and right by applying it to ordinary people with incorrect posture and body imbalance. One of the important factors to be considered as suitability for individuals performing exercise in these functional rehabilitation exercises is 'bilateralism'. Bilateral movement is a movement that uses both left and right equally, and on the contrary, unilateral movement is a movement that uses one side extremely (Kim, 2008; Seo, Lee, & Shin, 2005). The negative effects of such unilateral exercise are also seen in the general public, and in most adults, even if they are not professional athletes, muscle activity on either the left or the right

*This study was supported by the research grant of the KODISA Scholarship Foundation in 2023.
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is dominant, and the other side is lower. Right-handed people have greater muscle strength, endurance, agility, and stability in the right hand than in the left hand, and this trend is seen not only in the arms and legs but also in the trunk (Boldori, Solda, & Marelli, 1999). In the exercise of leisure activities, (Oh, 1999) stated that bilateral exercise increases body stability and improves mechanical function rather than unilateral exercise, which is a result of encouraging bilateral exercise to the general public. However, existing series of gymnastics aimed at correct posture correction and physical strength improvement do not take into account the two-sidedness necessary for individuals, so the effect of posture correction is insufficient. Therefore, it is necessary to develop a realistic program that can correct posture abnormalities and improve flexibility, muscle strength, and physical balance by using warm-up and organizing exercises of serial gymnastics.

2. Method

2.1. Subject of study

Among 300 IN-BODY, FMS, and YBT tests in the third grade of H middle school in Gyeonggi-do, the subjects of this study were divided into 40 men, women, and 40 women who applied the functional rehabilitation program. The subjects of the study are shown in <Table 1> below.

Table 1: Subject of study

Athletic Group	Physical Condition	Form of Motion	Average Height (cm)	Average Weight (kg)	Man	Women	Sum
E.G	Posture Imbalance	**FREE Program (Application)**	**171.8**	**52.7**	**20**	**20**	**40**
C.G	Posture Imbalance	**FREE Program (No Application)**	**165.7**	**63.1**	**20**	**20**	**40**

2.2. Measurement Methods and Items

The functional rehabilitation exercise program was set to 40 minutes each, four times a week for 12 weeks, and exercise measurement was performed by receiving 1:1 feedback from leaders with experience in exercise guidance.

2.2.1. Functional Exercise System (FMS)

The Functional Exercise System (FMS), a movement evaluation, is a test tool used to evaluate seven basic movement patterns of individuals without pain disease or musculoskeletal damage, not to diagnose orthopedic problems but to show opportunities to improve individual movements. Therefore, it is possible to improve the quality of exercise performance by evaluating and correcting it through a functional exercise system (FMS) test that measures and evaluates the quality of movement. The functional exercise system (FMS) measures O.H. Deep Squat, Hurdle Step, In-line Runge, Shoulder Mobility, Active Straight Leg Raise, Trunk Stability Push-up, and Steady 7 rotational movements. Each test is required to be performed three times for each item, but the movement pattern of the object can be sufficiently examined in the first and second times. The Functional Exercise System (FMS) scores range from 0 to 3, 0 points are pain, problems requiring SFMA details or consulting a health care professional, 1 point is incapable of executing or completing functional movement patterns, 2 point is capable of executing functional movement patterns, but 3 point is undoubtedly.

2.2.2. Y.B.T.(Y-Balance testing)

Y.B.T. (Y-Balance testing) measures the measurer's strength, stability, and balance in various directions, with the measurer balanced on one leg and extending the other leg as far as possible in three directions: forward, backward, and rearward. The Y.B.T. composite score is evaluated by summing the lengths in three directions, and is calculated by normalizing the length of the lower body (pelvic-ankle bone). In the case of asymmetry, there is a difference in the reach on the right and left.

Y.B.T. demonstrated a very good level of terra-test reliability (ICC=0.80-0.85) when measured by an entry-level Ph.D. physiotherapy student (9). To support this, we find that the ICC (intra-class correlation coefficient) for intra-rater reliability is between 0.85 and 0.91, and the range of terra-rater reliability is between 0.99 and 1.00. The

reliability of the composite reach score was 0.91 for intra-ter and 0.99 for inter-ter reliability (10). The method of calculating the score is as follows.

Absolute value (cm) = R1+R2+R3 / 3

Relative value (%) = Overall value / Length of upper extremity (lower extremity) x 100
Total value (%) = R1+R2+R3 / 3 times the length of the upper extremity (lower extremity) x 100

2.2.3. Student Health and Physical Fitness Test (PAPS)

For the PAPS test, muscle strength (grip strength), flexibility (sitting and bending in front of the upper body), quickness (position long jump), and cardiopulmonary endurance (round-and-round running) were measured, and the student health physical test was based on.

2.2.4. Pain

For pain, the degree of pain was measured using a pain scale. The pain scale is a method of evaluating the intensity of subjective pain and is used in hospitals and others to measure patients' pain. The pain scale used in this study is a simple and easy measurement tool that is suitable for patients aged 12 and older who can communicate clinically with musculoskeletal problems and understand the concept of numbers and can be measured in less than a minute (Krebs et al., 2007; Mannion et al., 2007). The range of pain intensity is 0-10, expressed in numbers, 0 indicates no pain at all, and 10 indicates very severe pain, recording the intensity at which the subject feels pain on average (Hawker et al., 2011).

3. Results

3.1. Changes in Physical Strength Factors

The change in the physical strength factor of the experimental group applying functional rehabilitation exercise for 12 weeks is as described in <Table 2>.

3.1.1. Cardiopulmonary endurance (shuttle run)

The analysis results of cardiopulmonary endurance are presented in <Table 3>. As a result of the analysis, it was found that the difference between groups had no significant interaction effect (F=1.091, p=.298). There was no significant difference in differences between groups, and there was no significant difference only between pre and post.

Table 3: Results of changes in cardiopulmonary endurance level according to the application of functional rehabilitation exer cise programs(all data are presented as mean ±*SD*.)

Athletic Group	Pre-inspection	Post-inspection		F	p
E.G	37.66±2.75	37.53±2.75	Pre Post	0.992	.321
C.G	37.93±2.68	43.48±2.68	Pre Post A.G	1.091	.298
			A.G	1.306	.255

3.1.2. Flexibility (bending forward)

The analysis results of flexibility are presented in <Table 4>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=4.057, p=).046). There was a significant difference between groups (F=4.676, p=.032), there was also a significant difference in pre- and post-post (F=9.064, p=.003). A comparative analysis of pre- and post-mortem was conducted for each group. In the comparative group, there was no significant difference between the dictionary and the post, and the level of flexibility of the experimental group increased significantly than before after the FREE program was implemented (p<.01).

Table 4: The results of the change in flexibility level according to the application of functional rehabilitation exercise programs (all data are presented as mean ±*SD*.*p<.05, **p<.01)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	10.79±0.94	11.72±0.94	Pre Post	9.064	.003**
E.G	10.93±0.92	15.61±0.92	Pre Post × A.G	4.057	.046*
			A.G	4.676	.032*

3.1.3. Strength (Grasp)

The analysis results of the difference between the absolute values of R and L of muscle strength are presented in <Table 5>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=5.788, p=.017). There was a significant difference between the groups (F=4.249, p=).041), there was also a significant difference in pre- and post-mortem (F=10.616, p=.001). A comparative analysis was conducted on the pre- and post-mortem for each group. In the comparative group, there was a significant difference between pre and post, and it can be seen that the difference between the strength R and L of the experimental group decreased more post than before after the FREE program was implemented (p<.01).

Table 5: Results of changes in muscle strength level according to the application of functional rehabilitation exercise programs (All data are presented as mean ±*SD*. *p<.05, **p<.01)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	4.29±4.72	4.71±1.86	Pre Post	10.616	.001**
E.G	4.11±2.13	6.95±3.17	Pre Post × A.G	5.788	.017*
			A.G	4.249	.041*

3.1.4. Quickness (Long Jump)

The analysis results of the instantaneous force are presented in <Table 6>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=4.122, p=.).044). There was no significant difference between groups (F=3.778, p=.054), it was found that there was a significant difference between pre and post (F=8.725, p=.004). A comparative analysis was conducted on the pre- and post-mortem for each group. In the comparative group, there was a significant difference between before and after, and the experimental group's agility level increased significantly than before after the FREE program was implemented (p<.01).

Table 6: Results of the change in the level of agility according to the application of the functional rehabilitation exercise program (all data are presented as mean ±*SD*. *p<.05, **p<.01)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	159.08±5.89	164.45±5.89	Pre Post	8.725	.004**
E.G	158.58±5.74	187.55±5.74	Pre Post × A.G	4.122	.044*
			A.G	3.778	.054

3.2. Changes in Body Balance

3.2.1. Functional Exercise System (FMS)

■ Deep Squat

First, the analysis results of deep squats among FMS are presented in <Table 7>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=9.103, p=.).003), there was no significant difference in differences between groups, and there was a significant difference only between pre

and post (F=8.193, p=.005). In the post-group comparison, the experimental group's deep squat level increased significantly after the FREE program was implemented (p<.01).

Table 7: Results of deep squat level change according to the application of functional rehabilitation exercise program (all data are presented as mean ±*SD*. **p<.01)

Athletic Group	Pre-inspection	Post-inspection		F	p
			Pre Post	8.193	.005**
C.G	2.23±0.10	2.35±0.11			
			Pre Post × A.G	9.103	.003**
E.G	2.20±0.11	2.73±0.10			
			A.G	2.375	.125

■ Hurdle Step

The analysis results of the absolute value difference between the hurdles R and L in the FMS are presented in <Table 8>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=5.926, p=.016). There was no significant difference in differences between groups, and there was a significant difference only between pre- and post-mortem (F=4.353, p=).039). In the comparison by post-group, it can be seen that the difference between the hurdle steps R and L of the experimental group after the FREE program was further reduced afterwards than before (p<.05).

Table 8: Results of the difference between Hurdle Steps R and L according to the application of the functional rehabilitation e xercise program (all data are presented as mean ±*SD*. *p<.05)

Athletic Group	Pre-inspection	Post-inspection		F	p
			Pre Post	4.353	.039*
C.G	0.33±0.47	0.35±0.53			
			Pre Post × A.G	5.926	.016*
E.G	0.40±0.50	0.08±0.27			
			A.G	1.635	.166

■ Inline lunge

The analysis results of the absolute value difference between inline lunge R and L among FMS are presented in <Table 9>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=4.990, p=).027), there was also a significant difference in differences between groups (F=4.990, p=.027), there was also a significant difference between pre and post (F=12.321, p=.001). In the comparison by post-group, it can be seen that the difference between inline lunge R and L in the experimental group after the FREE program was reduced more after than before (p<.05).

Table 9: Results of the difference between inline lunge R and L according to the application of functional rehabilitation exercise program (all data are presented as mean ±*SD*. *p<.05, **p<.01)

Athletic Group	Pre-inspection	Post-inspection		F	p
			Pre Post	12.321	.001**
C.G	0.48±0.60	0.38±0.59			
			Pre Post × A.G	4.990	.027*
E.G	0.48±0.51	0.03±0.16			
			A.G	4.990	.027*

■ Shoulder Mobility

The analysis results of the absolute value difference between shoulder mobility R and L among FMS are presented in <Table 10>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=4.382, p=).038), there was a significant difference between groups (F=6.120, p=.014), there was also a significant difference in pre- and post-post (F=4.382, p=.038). In the comparison by post-group, it can be seen that the difference between shoulder mobility R and L in the experimental group after the FREE program was reduced more after-hours than before (p<.05).

Table 10: The results of the difference between shoulder mobility R and L according to the application of functional rehabilitation exercise programs (all data are presented as mean ±*SD*. *p<.05)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	0.33±0.47	0.33±0.47	Pre Post	4.382	.038*
			Pre Post × A.G	4.382	.038*
E.G	0.30±0.46	0.03±0.16	A.G	6.120	.014*

■ Active Straight Leg Race (A.S.L.R)

The analysis results of the absolute value difference between active straight leg races R and L among FMS are presented in <Table 11>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=4.593, p=).034). There was a significant difference between groups (F=6.115, p=.014), it was found that there was no significant difference between pre and post (F=0.679, p=.411). In the comparison by post-group, it can be seen that the difference between shoulder mobility R and L in the experimental group after the FREE program was reduced more after-hours than before (p<.05).

Table 11: Results of difference between active straight leg race R and L according to the application of functional rehabilitation exercise program (all data are presented as mean ±*SD*. *p<.05)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	**0.30±0.56**	**0.40±0.59**	Pre Post	**0.679**	**.411**
			Pre Post × A.G	**4.593**	**.034***
E.G	**0.28±0.45**	**0.05±0.22**	A.G	**6.115**	**.014***

■ Trunk stability push-up (T.S.P)

The analysis results of trunk stability push-up among FMS are presented in <Table 12>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=10.138, p=).002), there was a significant difference between groups (F=8.452, p=.004), it was confirmed that there was also a significant difference in pre- and post (F=4.312 and p=.039). A comparative analysis of pre- and post-mortem was conducted for each group. After implementing the FREE program, the level of trunk stability push-up in the experimental group increased significantly than in advance (p<.001).

Table 12: Results of trunk stability push-up level change according to the application of functional rehabilitation exercise program (all data are presented as mean ±*SD*. *p<.05, **p<.01)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	2.20±0.09	2.10±0.10	Pre Post	4.312	.039*
			Pre Post × A.G	10.138	.002**
E.G	2.18±0.19	2.65±0.10	A.G	8.452	.004**

■ Rotary stability (R.S)

The analysis results of the absolute value difference between rotary stability R and L among FMS are presented in <Table 13>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=5.592, p=.019). There was a significant difference between the groups (F=7.030, p=).009), there was also a significant difference in pre- and post-mortem (F=4.318, p=.039). After implementing the FREE program, it can be seen that the difference between rotary stability R and L in the experimental group was reduced more after than before (p<.05).

Table 13: Results of Rotary Stability Level Changes in Functional Rehabilitation Exercise Program (all data are presented as mean ±*SD*. *p<.05, **p<.01)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	0.48±0.72	0.50±0.64	Pre Post	4.318	.039*
E.G	0.45±0.50	0.06±0.20	Pre Post × A.G	5.592	.019*
			A.G	7.030	.009**

3.2.2. YBT(Y-Balance Testing)

The analysis results of the absolute value difference between the arm (upper extremity) total value R and L are presented in <Table 14>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=4.603, p=).033), there was a significant difference between groups (F=5.195, p=.024), it was confirmed that there was also a significant difference in pre- and post (F=4.905, p=.028). After implementing the FREE program, it can be seen that the difference between the total arm (upper extremity) value R and L of the experimental group decreased more afterwards than before (p<.05).

Table 14: Results of changes in arm (upper extremity) level according to the application of functional rehabilitation exercise programs (all data are presented as mean ±*SD*. *p<.05)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	3.63±2.98	3.60±3.31	Pre Post	4.905	.028*
E.G	3.57±2.68	1.78±1.10	Pre Post × A.G	4.603	.033*
			A.G	5.195	.024*

The analysis results of the absolute value difference between the total value R and L of the legs (lower extremity) are presented in <Table 15>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=4.467, p=).036). There was a significant difference between groups (F=9.351, p=.003), there was also a significant difference in pre- and post-post (F=4.440 and p=.037). After implementing the FREE program, it can be seen that the difference between the total value R and L of the legs of the experimental group decreased more afterwards than before (p<.05).

Table 15: Results of leg (lower extremity) level change according to the application of functional rehabilitation exercise program **(**all data are presented as mean ±*SD***.** *p<.05)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	**5.81±5.53**	**5.81±5.16**	Pre Post	**4.440**	**.037***
E.G	**5.18±2.90**	**2.40±2.04**	Pre Post × A.G	**4.467**	**.036***
			A.G	**9.351**	**.003****

3.3. Changes in Pain

3.3.1. PAIN

NRS(Numeral Rating Scale) Pre- and post-evaluation

In this study, the pain test was measured in a pain section from 1 to 10 points based on the NRS scale, which is a pain scale, and in the case of the measurement, the first week of pre-pain test was performed, and the 12th week of post-pain test was also performed. The results of the pain analysis are presented in <Table 16>. As a result of the analysis, it was found that the difference between groups had a significant interaction effect (F=38.583, p=).000). There was a significant difference between groups (F=57.637, p=.000), there was also a significant difference in pre- and post-mortem (F=14.409, p=.000). There was no significant difference between pre- and post-mortem in the comparative group, and it can be seen that the pain level of the experimental group decreased after the FREE program was implemented (p<.001).

Table 16: Results of pain level change according to the application of functional rehabilitation exercise program (all data are presented as mean ±*SD*. $^{*}p<.05$, $^{**}p<.01$)

Athletic Group	Pre-inspection	Post-inspection		F	p
C.G	6.40±1.48	6.93±1.31	Pre Post	14.409	.000***
E.G	6.10±1.35	3.93±1.35	Pre Post × A.G	38.583	.000***
			A.G	57.637	.000***

4. Discussion

The key to the functional rehabilitation exercise program is to strengthen ligaments and muscles at the same time through ligament and muscle recovery, and basically recover ligaments first through four-way stretching and lunge swing stretching, and then recover muscles step by step. Accordingly, the composition of the functional rehabilitation exercise program consisted of four-way stretching, four-way sit-up, hurdles stretching, bunched start, deep squat, and butterfly. In order to verify the validity of these functional rehabilitation programs, the research direction was discussed based on the opinions of experts consisting of three secondary physical education teachers, two university professors, two rehabilitation center directors, two clinical rehabilitation athletes, and one gymnastics program expert. In addition, functional rehabilitation exercises (clinical rehabilitation exercises), stretching gymnastics, and bare-handed gymnastics were conducted with the opinions of experts with more than 3 years and less than 15 years of guidance.

In the scope of rehabilitation exercise, exercise movements are increasingly interested not only in the field but also in researchers in related fields, and functional rehabilitation exercise programs are believed to be helpful. Functional rehabilitation exercises should be prescribed and used under various conditions such as the subject's physical condition, posture imbalance, moderate contraction muscles, necessary relaxation muscles, and physical strength factors. However, in terms of how to perform the movement, it was found that it consisted of movements that were difficult for ordinary students to follow to apply in the actual field. The ultimate purpose of the rehabilitation exercise movement is not to make it applicable to the subject, but to identify and extract the movements necessary for the subject, and it is an essential condition for conducting a functional rehabilitation exercise program.

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