Evaluation of FSM Testing Before and After 2 Weeks of Physical Leisure Activities Coordinated by a Certified Personal Trainer

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Abstract

Introduction. Functional Movement Screen ™ (FMS ™) is a clinical tool designed to use movement behaviors to identify people at risk of injury. The current evaluator certification programs focus on extensive, individualized training. The screen innovative functional motion model (FMS) system used to evaluate customers or athlete's quality. **Objective**. The main purpose of this study was to determine the reliability of test-retest and FMS components, composite scores in young and healthy service members, when tested by a group of beginner evaluators in real time. Specifically, the agreement was evaluated on FMS component scores, while reliability, response stability, and error threshold measurements were obtained for FMS compound scores. The research hypothesis was FSM testing in the evaluation of subjects before and after 2 weeks of physical activity according to the FSM program adapted to each subject. **Methods.** The 10 subjects of the research were between the ages of 12 and 47, of which 8 were boys and 2 girls. During the research, all the subjects lived in Cluj-Napoca and practiced physical leisure activities in a setting organized under the guidance and coordination of a certified personal trainer. **Results.** The evaluation and centralization of the data was done on a Tablet with IOS operating system, on a platform specially designed by the Functional Movement Screen ™ (FMS ™) where only FMS certified members have access. The data is entered manually in the application, by the FMS Certificate evaluator following the analysis of the subjects. **Conclusions.** In conclusion, FMS ™ grows in popularity and use by fitness and rehabilitation professionals for functional screening of athletes, patients and clients. Total FMS scores ™ seem to be able to be reliably scored among trained assessors, while individual tests vary in their ability to be assessed with reliability.

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1. Introduction

Functional Movement Screen ™ (FMS ™) is a clinical tool designed to use movement behaviors to identify people at risk of injury. The current evaluator certification programs focus on extensive, individualized training. The screen innovative functional motion model (FMS) system used to evaluate customers or athlete's quality. The beauty of the functional motion screen is that a personal trainer, an athletics coach or a strength coach or sports instructor can learn the system and have a simple and quantifiable method of evaluating basic movement skills. (*Functional Movement Screening*, 2021)

Functional Movement Screen ™ (FMS ™) is a clinical tool designed to use movement behaviors to identify people at risk of injury. The current evaluator certification programs focus on extensive, individualized training. The screen innovative functional motion model (FMS) system used to evaluate customers or athlete's quality. The beauty of the functional motion screen is that a personal trainer, an athletics coach or a strength coach or sports instructor can learn the system and have a simple and quantifiable method of evaluating basic movement skills. FMS only requires the ability to observe the basic movement patterns already familiar to the coach or coach. The key to the functional motion screen is that it consists of a series of simple tests with a simple scoring system. (*Functional Movement Screening*, 2021)

FMS allows a coach or coach to begin the process of evaluating the functional pattern of movement in individuals without recognized pathology. The functional motion screen provides strength and conditioning to the coach or personal trainer with an evaluation option that closely links to what the athlete or client will actually do in training. In a certain sense, the tests are improved by working on variations in the skills tested. FMS enables evaluation with tools and models of movement that easily make sense to both the client and the coach or coach. The test consists of seven fundamental

models of movement that require a balance of mobility and stability. These fundamental motion patterns are designed to provide observable performance of the basic locomotor motor, manipulative movements and stabilizers. (*Are You Moving in a Functional Way? | FOUNDATION FITNESS*, 2022)

The tests place the individual in extreme positions where weaknesses and imbalances become visible if the appropriate stability and mobility are not used. It has been observed that many individuals who perform at very high levels during activities are not able to perform these simple movements. These individuals should be considered to use compensatory movement patterns during their activities, sacrificing effective movements for inefficient ones in order to carry out at high levels. If these compensations continue, weak movement patterns will be strengthened, leading to poor biomechanics.

FMS scoring Individual tests have certain criteria that must be met in order to achieve a high score. The score is divided into four basic criteria: a 3 is given if the individual can perform the movement without compensation according to the established criteria, a 2 is given if the individual can perform the movement, but must use weak mechanics and compensatory models to achieve the movement, a 1 is given if the individual cannot perform the pattern of movement even with compensations, and, finally, a 0 is given if the individual has pain during any part of the movement or test. There are five tests that require bilateral testing; this will result in two scores for these tests. The lowest test score is recorded for the overall score; however, for evaluation and data collection, both scores are required

The 7 FMS motion models are listed in order of priority from the most elementary and fundamental to the most complex and functional - the general order of importance in the Functional Movement Screen ™. Each motion model score contains a corresponding symbol that provides the recommended focus on evaluation or the development of exercise programs.

Three tests: Shoulder Mobility, Trunk Stability Push-up and Rotating Stability have compensation test associated with them, which are punctuated as pass/fail. If a person fails this part of the test, then a score of 0 is given as an overall score. FMS is an assessment technique, which seeks to identify imbalances in mobility and stability during fundamental patterns of

movement. This assessment tool is believed to aggravate individual compensatory movement problems, allowing for easy identification. These motion deficiencies can lead to rupture of the kinetic binding system, causing inefficiency and micro trauma during activity. FMS should be introduced as part of the physical medical examination to determine deficits that can be overlooked during traditional medical and performance assessments. In many cases, muscle flexibility and strength imbalances along with previous injuries may not be identified. These problems, which have been recognized as significant risk factors for injury, will be identified using FMS. This movement-based assessment will identify functional deficits related to proprioceptive weaknesses, mobility and stability. If these risk factors can be identified and addressed using FMS, then the decrease in injuries and improved performance should follow. (Khaled, 2021) FMS is used by various examiners to assess movement and predict wastes of time in various physical activities of free time and active participants (for example, young people in professional athletes, firefighters, members of military service).

However, the tools that evaluate movement to help predict those with the highest risk of MUSCULOSKELETAL DISORDERS and injuries were lacking both for the athletic population. The functional motion screen (FMS) is a relatively new tool that tries to address several factors of motion, with the aim of predicting the overall risk of the musculoskeletal system conditions and injuries. FMS has been designed to identify functional motion deficits and asymmetries that can be predictive of general MSDs and injuries, with the ultimate goal of being able to alter movement deficiencies identified by individual exercise prescriptions.

Preliminary research conducted by Kiesel et al. (2011) suggests that National Football League (NFL) players (n=46) who had a composite score less than or equal to 14 on FMS had an odds ratio of 11.7 (95% [CI] confidence interval: 2.5, 54.5) and a positive probability report of 5.8 (IC 95%: 2.0, 18.4) to suffer a loss injury over time.

Although the specificity was relatively high (0.9; IC 95%: 0.8, 1.0), sensitivity was low (0.5; IC 95%: 0.3, 0.7), indicating that FMS composite scores less than or equal to 14 may suggest a higher risk of injury, but FMS composite scores higher than 14 do not exclude the risk of future injuries. In

a separate study on a group of sailors, a composite score of less than or equal to 14 on FMS demonstrated the limited ability to predict all future musculoskeletal injuries (traumatic or overused) with a sensitivity of 0.45 and specificity of 0.71, while the same limit value was able to predict a serious injury (any injury serious enough to remove the participant from the training program) with a sensitivity of 0.12 and a specificity of 0,94. (Teyhen et al., 2014) FMS was also able to predict the risk of injury in collegiate sportswomen.

Finally, in another study, firefighters with previous history of injuries demonstrated lower FMS composite scores. However, it is not clear for which sport or FMS professions is optimal in predicting the risk of injury, what types of lethal injuries are predicted by low FMS composite scores, and whether the initial score less than or equal to 14 points on FMS is valid in different populations. In addition, the researchers found that FMS composite scores increased in football players, 13 firefighters, 6 and 8 service members following corrective exercises that addressed possible deficiencies associated with modified movement patterns noted in FMS component tests. In a group of sailors, 80% of those with a score less than or equal to 14 also demonstrated lower fitness scores on a standardized fitness test, compared to those who had an FMS composite score higher than 14.

However, Okada et al. (2011) found that FMS composite scores were not linked to performance or basic stability measures among healthy participants. The interpretation of FMS scores is limited by little evidence in terms of FMS psychometric properties and, in particular, the reliability of composite and individual component scores. An initial study by Minick et al. (2010) found acceptable levels of interternal agreement on FMS component scores among beginner and expert evaluators in a sample of participants active at college age (to include university athletes). However, this study had several limitations: (1) it did not evaluate the reliability of the test-retest, (2) all assessors evaluated the same movement pattern through video recorded analysis, and (3) only evaluated the agreement of individual scores of FMS components and did not evaluate the overall score of the FMS composite, which is usually used as the main risk indicator of injury. Traditionally, FMS is rated in real time without the benefit of video playback.

Therefore, a more robust reliability study is needed to improve the understanding of the psychometric properties of FMS. Although these initial FMS studies, which established the validity of FMS for predicting msyskeletal disorders of injuries and responding to training, are encouraging, their data is preliminary and not published in widely accessible journals. Exploring the psychometric properties of FMS in a large active population would enhance the generalizability of previous discoveries beyond a limited subgroup of athletes and professional students and colleagues.

2. Objective

The main purpose of this study was to determine the reliability of test-retest and FMS components, composite scores in young and healthy service members, when tested by a group of beginner evaluators in real time. Specifically, the agreement was evaluated on FMS component scores, while reliability, response stability, and error threshold measurements were obtained for FMS compound scores. The research hypothesis was FSM testing in the evaluation of subjects before and after 2 weeks of physical activity according to the FSM program adapted to each subject.

The subjects carried out their activity within the Kinetomed Recovery and Fitness Center Cluj-Napoca under the guidance of the Physical Therapist M.C., being the only certified member of the FSM in Cluj. In the second part of the research for the analysis of the movement called Functional Movement Screen ™ (FMS ™) we used the subjective sampling of the subjects, their inclusion in the research was made after a debate with the Personal Trainer having also the consent of the subjects to record the data to be presented in the paper. The subjects were chosen according to their level of involvement in physical leisure activities according to the legislation in force during the Covid-19 pandemic. We have selected a number of 10 practitioners of physical leisure activities, who carried out their activity in the Kinetomed Recovery and Fitness Center Cluj-Napoca under the guidance of the Physiotherapist.

3. Methods

The 10 subjects of the research were between the ages of 12 and 47, of which 8 were boys and 2 girls. During the research, all the subjects lived in Cluj-Napoca and practiced physical leisure activities in a setting organized under the guidance and coordination of a certified personal trainer. Therefore, in the second part of the research we chose as a hypothesis the Functional Movement Screen ™ (FMS ™) test in the evaluation of the subjects before and after 2 weeks of physical activity according to the FSM program adapted to each topic. Each subject was evaluated according to FMS tests after the analysis of the test the subjects were subjected to the exercise program created by the results after analyzing the obtained parameters. For two weeks the subjects did 6 workouts according to the schedule, 3 workouts per week, Monday-Wednesday-Friday, before each training, the protocol elaborated by FMS was applied. After the 2 weeks of physical activity, the subjects were subjected to the final evaluation of the FMS.

4. Results

The evaluation and centralization of the data was done on a Tablet with IOS operating system, on a platform specially designed by the Functional Movement Screen ™ (FMS ™) where only FMS certified members have access. The data is entered manually in the application, by the FMS Certificate evaluator following the analysis of the subjects. After entering the data in the system, the application offers data analysis, evaluation of subjects and the program of exercises to be followed by each topic. Next I will present the model of means recommended by the FMS application following the test. For the second part of the research in the application of FMS, a t-test was performed on pairs to compare the values. Sig. p. The Paired Samples Test is 0.005. This value is less than 0.05. because of this, we can conclude that there is a statistically significant difference between the Initial Test and the Final Test for FMS Testing and its protocol. Since our subject statistics box showed

that applying for 2 weeks the FMS protocol improved in most cases the FMS Final Testing, so we can conclude that FMS Testing has an effect on activities practiced in fitness rooms and beyond. Where FMS testing showed no signs of progress, it is recommended to use the FMS means recommended by the application for a longer time, 2 weeks not being necessary for the subjects. In Table no. 1 Paired Samples Test we have red colored the pairs where there is a significant statistical difference in FMS tests.

Table 1. T-Test Paired Samples Test

Paired Samples Test

		Diferențele perechilor							
					Gradul de încredere (95%)				
Pair (P)		Media	Deviația standard	Media erorii standard	Inferioară	Superioară	t	df	Sig. (p)
Pair 1	Squat_S_1 - Squat_S_2	-.800	.422	.133	-1.102	-.498	-6.000	9	.000
Pair 2	Squat_D_1 - Squat_D_2	-.800	.422	.133	-1.102	-.498	-6.000	9	.000
Pair 3	Squat_T_1 - Squat_T_2	-.800	.422	.133	-1.102	-.498	-6.000	9	.000
Pair 4	Hurdle_S_1 - Hurdle_S_2	-.400	.516	.163	-.769	-.031	-2.449	9	.037
Pair 5	Hurdle_D_1 - Hurdle_D_2	-.500	.527	.167	-.877	-.123	-3.000	9	.015
Pair 6	Hurdle_T_1 - Hurdle_T_2	-.400	.516	.163	-.769	-.031	-2.449	9	.037
Pair 7	Lunge_S_1 - Lunge_S_2	-.100	.568	.180	-.506	.306	-.557	9	.591
Pair 8	Lunge_D_1 - Lunge_D_2	-.300	.483	.153	-.646	.046	-1.964	9	.081
Pair 9	Lunge_T_1 - Lunge_T_2	-.500	.972	.307	-1.195	.195	-1.627	9	.138
Pair 10	Ankle_T_1 - Ankle_T_2	-.800	1.229	.389	-1.679	.079	-2.058	9	.070
Pair 11	ShouldMob_S_1- ShouldMob_S_2	-.400	.516	.163	-.769	-.031	-2.449	9	.037
Pair 12	ShouldMob_D_1 - ShouldMob_D_2	-.600	.516	.163	-.969	-.231	-3.674	9	.005
Pair 13	ShouldMob_T_1 - ShouldMob_T_2	-.700	.483	.153	-1.046	-.354	-4.583	9	.001
Pair 14	ShouldClear_T_1 -ShouldClear_T_2	-.500	.707	.224	-1.006	.006	-2.236	9	.052
Pair 15	Leg_S_1 - Leg_S_2	-.600	.843	.267	-1.203	.003	-2.250	9	.051
Pair 16	Leg_D_1 - Leg_D_2	-.300	.483	.153	-.646	.046	-1.964	9	.081

Paired Samples Test

		Diferențele perechilor							
					Gradul de încredere (95%)				
Pair (P)		Media	Deviația standard	Media erorii standard	Inferioară	Superioară	t	df	Sig. (p)
Pair 17	Leg_T_1 - Leg_T_2	-.600	.699	.221	-1.100	-.100	-2.714	9	.024
Pair 18	Trunk_S_1 - Trunk_S_2	-.200	.422	.133	-.502	.102	-1.500	9	.168
Pair 19	Trunk_D_1 - Trunk_D_2	-.200	.422	.133	-.502	.102	-1.500	9	.168
Pair 20	Trunk_T_1 - Trunk_T_2	-.500	.972	.307	-1.195	.195	-1.627	9	.138
Pair 21	Extension_1 - Extension_2	.100	.316	.100	-.126	.326	1.000	9	.343
Pair 22	Rotary_S_1 - Rotary_S_2	-.400	.516	.163	-.769	-.031	-2.449	9	.037
Pair 23	Rotary_D_1 - Rotary_D_2	-.500	.527	.167	-.877	-.123	-3.000	9	.015
Pair 24	Rotary_T_1 - Rotary_T_2	-.800	.789	.249	-1.364	-.236	-3.207	9	.011
Pair 25	Flexion_1 - Flexion_2	.200	.422	.133	-.102	.502	1.500	9	.168

Subject A.M. in The Initial Testing obtained a total score of 12 points and after applying the FMS exercise protocol to the Final Test he obtained a score of 17 points. This shows us an improvement in terms of correction of movements during tests. There has been an improvement in Shoulder Mobility, Active Straight-Leg Raise and Rotary Stability after applying the protocol. The A.T. subject in the Initial Testing obtained a total score of 8 points and after applying the FMS exercise protocol to the Final Test obtained a score of 17 points. This shows us an improvement in terms of correction of movements during tests. There was an improvement in Deep Squat, Ankle Clearing, Active Straight-Leg Raise Flexion Clearing and Extension Clearing after applying the protocol and the pain disappeared, both during the Final Testing and in practicing free time physical activities. Subject A.C. in the Initial Test obtained a total score of 13 points and after applying the FMS exercise protocol to the Final Test obtained a score of 19 points. This shows us an improvement in terms of correction of movements during tests. There was an improvement in Ankle Clearing, Active Straight-Leg Raise and Rotary Stability and the pain in the shoulder disappeared after

the protocol was applied. Subject C.C. in the Initial Test obtained a total score of 15 points and after applying the FMS exercise protocol to the Final Test obtained a score of 16 points. This shows us a small improvement in terms of correction of movements during tests. It is recommended to apply the FMS protocol for a longer period of time. There has been an improvement in Ankle Clearing but the yellow color of the Final Test result indicates that we take care with the subject and that we continue to correct the movement. Subject G.B. in The Initial Testing obtained a total score of 11 points and after applying the FMS exercise protocol to the Final Test he obtained a score of 16 points. This shows us an improvement in terms of correction of movements during tests. There was an improvement in Shoulder Mobility, Active Straight-Leg Raise and Rotary Stability and the pain in the shoulder and Rotary Stability disappeared after applying the protocol The M.S. subject scored 15 points in both the Initial Test and the Final Test. Even though the score was the same, there was an improvement in movements, better stability in Ankle Clearing and Active Straight-Leg Raise. The R.R. subject at the Initial Testing obtained a total score of 13 points and after applying the FMS exercise protocol to the Final Test obtained a score of 20 points. This shows us an improvement in terms of correction of movements during tests. An improvement was observed in Hurdle Step, Ankle Clearing where the pain disappeared and Shoulder Mobility after the protocol was applied. The R.H. subject in the Initial Testing obtained a total score of 9 points and after applying the FMS exercise protocol to the Final Test obtained a score of 12 points. This shows us an improvement in terms of correction of movements during tests, but we recommend applying the FMS protocol because it is noticed difficulties in execution during In-line Lunge, Ankle Clearing and Active Straight-Leg Raise. Subject S.M. in The Initial Test obtained a total score of 15 points and after applying the FMS exercise protocol to the Final Test obtained a score of 19 points. This shows us an improvement in terms of correction of movements during tests. An improvement was observed in the Shoulder Rotary Stability after applying the pain protocol, which also disappeared. The V.H. subject in the Initial Testing obtained a total score of 17 points and after applying the FMS exercise protocol to the Final Test he obtained a score of 20 points. This

shows us an improvement in terms of correction of movements during tests. There has been an improvement in shoulder mobility the movement being much more correct.

5. Conclusions

In conclusion, FMS ™ grows in popularity and use by fitness and rehabilitation professionals for functional screening of athletes, patients and clients. Total FMS scores ™ seem to be able to be reliably scored among trained assessors, while individual tests vary in their ability to be assessed with reliability. The current results agree with those found by the previous authors, which suggest that the FMS compound test battery ™ can be used with confidence by trained assessors to assess fundamental motion patterns and reach a total score.

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