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EXAMINATION OF FUNDAMENTAL MOVEMENT PATTERNS AND LIKELIHOOD OF INJURY IN AMATEUR RUNNERS FROM OPOLE REGION IN POLAND

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A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: The most common risk factors for running-related injuries are mistakes, such as insufficient warm-up and stretching exercises, during training. Good preparation and proper training reduces the risk of sport-related injuries.

Aim of the study: To examine fundamental movement patterns and likelihood of injury in amateur runners.

Material and methods: Twenty-four amateur long-distance runners from Opole region (Poland) were divided into two groups. The first group comprised 12 runners from the club "Kotwica Brzeg", who did a proper warm-up before training and stretching exercises after training. The second group comprised 12 runners from other clubs who did not undertake any warm-up or stretching exercises (control group). Fundamental movement patterns were tested by the Functional Movement Screen test (FMS).

Results: The mean FMS test score was higher in "Kotwica Brzeg" runners (17.08 points) than in the control group (15.50 points), but this was not statistically significant. The "Kotwica Brzeg" runners performed better in five of the FMS tests, but this was only significant for the rotational stability test.

Conclusions: Runners who did a proper warm-up and stretching exercises achieved better results in the FMS test, which may reduce the risk of running-related injuries.

KEYWORDS: FMS test, runners, risk of injury, prevention

Background

Regular running is a form of exercise that supports mental and physical health. Many amateur runners are not aware of the need to prepare physically for sports. Insufficient adaptation to physical exertion may result in injuries [1,2]. Available literature shows a highpercentage of injuries among long-distance runners [3,4]

Training mistakes are the most common precipitant of running-associated injuries. The errors include incomplete warm-up activity, inadequate training duration, incorrect intensity and frequency, along with too rapid advancement to the next stage of training. Anatomic and biomechanical factors also contribute to injuries in runners. These include physique irregularities, improper running shoes, age, the ground on which most training sessions occur and athlete experience [1,5,6]. Other precipitants of injury are previous injuries, their course and treatment [1,3]. Women are at greater injury risk than men [7,8].

Warming up, that is, preparing the whole body for a given physical activity is a broad concept. However, it is often understood that warming up is only to prepare the muscles involved in the ensuing activity. A proper warm-up enables a runner to engage fully in the run from the start, while assisting with psychomotor readiness, which allows the runner to get into the right running rhythm. A well-conducted warm-up also increases the effectiveness of training or competition. Insufficient or absent warm-up may lead the athlete to make many technical mistakes and be more vulnerable to injuries [9,10].

An important element of training is stretching, which facilitates proper joint mobility by maintaining appropriate muscle length. It also helps prevent muscle stiffening, which can happen, for example, after endurance training. If used regularly, stretching can reduce the risk of injury. Stretching should be performed after training, while active dynamic stretching exercises should be part of the warm-up [11].

Contemporary sports medicine puts considerable emphasis on injury prevention. An important element of prevention is a comprehensive assessment of fundamental movement patterns. Nowadays, running is fashionable with many people practicing medium- and long-distance recreational activities. Therefore, it is important to evaluate comprehensive functional assessment and the merit of well-conducted training sessions for health endurance athletes.

Aim of the study

To examine fundamental movement patterns and likelihood of injury in amateur runners.

Material and methods

This is a pilot study undertaken as a component of a master's thesis.

Participants

Twenty-four long-distance runners (5, 10, ~20 and ~40 km) from Opole region (Poland) were divided into two groups. The first group included 12 runners (7 men and 5 women) from a specific running club (Kotwic Brzeg) who performed warm-up exercises before training and stretching after training. The second (control) group comprised 12 runners (6 men and 6 women) from other clubs who did not perform exercises before or after training.

Each runner's height and weight were measured, and body mass index (BMI) calculated. There were no significant differences in the mean of age, BMI, number of running sessions per week and years of running between the two groups. Mean BMI was normal in both groups (tab. 1).

Research tools

The Functional Movement Screen (FMS) test was used to assess subject functional status. The FMS test provides a simple, accessible and measurable way to evaluate the quality of movement patterns and allows possible limitations or asymmetries to be identified.

The following are descriptions of the seven specific tests used in the FMS [12–14]:

1. Deep squat assesses bilateral, symmetrical and functional mobility of the hips, knees, and ankles. The dowel held overhead assesses bilateral and symmetrical shoulder and thoracic spine mobility.
2. Hurdle step assesses bilateral and functional mobility and stability of the hips, knees, and ankles. This movement requires proper coordination and stability between the hips and torso during the stepping motion as well as single leg stance stability.
3. In-line lunge evaluates hip and ankle mobility and stability, quadriceps flexibility and knee stability
4. Shoulder mobility screen assesses bilateral and reciprocal shoulder motion range, combining internal rotation with adduction of one shoulder and external rotation with abduction of the other.
5. Active straight leg raise tests ability to disassociate the lower extremity from the trunk while maintaining torso stability.
6. Trunk stability push-up evaluates trunk stability in the sagittal plane while a symmetrical upper extremity push-up motion is performed.
7. Rotary stability test assesses multi-planar trunk stability during a combined upper and lower extremity motion.

Each of the above tests was evaluated on a 4-level scale of 0 to 3 points. A score of 3 points was awarded for correct execution of the locomotor pattern with no apparent compensation. A score of 2 points was given when motion was performed with a compensation element, and 1 point was indicative of inability to complete the task. If pain was felt during the test, 0 points were given. If there was a difference in results between the left and right side in an asymmetry test, the lower result was used for the final score [15,16].

A total score of 18 to 21 points meant that the body had correct movement patterns and the risk of injury was low. A score of 15 to 17 points indicated that compensation and asymmetries occurred, with the probability of injury increasing to 25–35%. A result below 14 points was associated with an increased risk of injury of more than 50% [17].

Table 1. Descriptive statistics of "Kotwica Brzeg" and control groups

Variable	„Kotwica Brzeg" group		Control group		Student's t-test	
	$\bar{x}$	s	$\bar{x}$	s	t	p
Age, years	36.50	10.87	40.17	7.28	-0.97	0.34
Body Mass Index (BMI), kg/m^2	22.75	3.30	21.62	1.95	1.02	0.32
Number of running sessions per week	2.91	1.51	2.67	1.41	0.42	0.68
Number of years of running	2.63	2.76	4.75	3.56	1.62	0.12

Statistical methods

Descriptive statistics, which include the mean ($\bar{x}$) and standard deviation (s), were calculated using Statistica 12.0. Student's t-test for independent groups was used because the means did not differ significantly between groups, and their distributions were not significantly different from the normal distribution. Significance was defined as P = 0.05.

Results

The mean FMS test result was higher in the "Kotwica Brzeg" group (17.08 points) than the control group (15.50 points), but this was not a significant difference. The "Kotwica Brzeg" runners achieved better results in five of the FMS tests – hurdle step, in-line lunge, shoulder mobility, trunk stability push-up and rotational stability – although, only the rotational stability test was a significant difference. The control group obtained higher results in the remaining two tests, but the differences were not significant (tab. 2).

Tab. 3 shows the number of runners in each point range of the FMS test. In the "Kotwica Brzeg" group, five people attained the highest point category indicating lowest injury risk, five people were in the middle category (15–17 points) with an increase in injury risk of 25–35%, and two were in the lowest point category (below 14 points) and had an increase in injury risk exceeding 50%. For the control group, two people were in the highest level (lowest injury risk), six were in the middle, and four were in the lowest point category (highest risk).

Discussion

The FMS test is a valuable screening tool because it allows evaluation of functional status and the risk of injuries. This test enables assessment of the individual in a global way as it is the function of the whole body that is examined, not just the individual muscles or joints.

Both the "Kotwic Brzeg" and the control groups achieved a mean FMS test score above 14 points at 17.08 and 15.50, respectively. The arithmetic means were within the range of 15–18 points proving asymmetry and compensation among the tested runners, along with disturbed motor patterns and an increase in injury risk of 25–35% [14]. The most frequent injuries and dysfunctions in long-distance runners are hamstring injuries, plantar fasciitis, iliotibial band syndrome, stress fractures and lower back pain [1,3,18].

Siedlaczek et al. used the FMS test in volleyball players of the II-league team, who obtained an average test result of 14.73 points. The authors indicated that such a result may cause compensation and asymmetry, and increase the risk of injury and stress pains [19]. Sulowska et al. used the FMS test for risk assessment and prevention of injuries among floorball players (17.48 points). Their results were similar to ours runners from "Kotwica Brzeg" (17.08). These authors observed asymmetries between the right and left body sides in more than half of the participants, with results correlating with the injury history of the tested athletes [20].

The effectiveness of calculating the probability of injury using the FMS test was demonstrated by Kiesel et al. Professional football players were examined before the season and obtained a mean test result of 16.9. The individuals who suffered subsequent injuries obtained a mean result of 14.3. After analysis, the authors showed an increased probability of injuries in footballers who received a pre-season test score of 14 points or less [17].

Table 2. FMS test results for the two groups, presented as mean ($\bar{x}$) and standard deviation (s)

Test	„Kotwica Brzeg" group		Control group		Student's t-test	
	$\bar{x}$	s	$\bar{x}$	s	t	p-value
FMS test	17.08	1.97	15.50	2.07	1.92	0.06
DS – deep squat	2.42	0.51	2.50	0.52	-0.39	0.69
HS – hurdle step	2.25	0.45	2.00	0.60	1.15	0.27
ILL – in-line lunge	2.66	0.49	2.42	0.51	1.22	0.24
SM – shoulder mobility	2.75	0.45	2.25	0.87	1.77	0.09
ASRL – active straight leg raise	2.25	0.62	2.33	0.65	-0.32	0.75
TSP – trunk stability push-up	2.41	0.67	2.08	0.79	1.11	0.28
RS – rotational stability	2.33	0.49	1.92	0.29	2.53	0.02*

* $p < 0.05$

Table 3. Number of people in each FMS test score category

Total FMS score	„Kotwica Brzeg" group	Control group
18 – 21 points	5	2
15 – 17 points	5	6
≤ 14 points	2	4

Little research on FMS testing has been undertaken in endurance athletes. Loundon et al. studied long-distance runners who had a mean test score of 15.0 points. A statistically significant difference was seen between younger (< 40 years) and older (> 40 years) runners in favor of the younger players [21].

Agresta et al. conducted a study of amateur long-distance runners and observed a mean FMS test score of 13.13, which was in the lowest point range putting the injury risk increase to over 50%. There were no significant differences between beginners and advanced runners, and trainees with and without injuries [4].

Hotter et al. showed that deep squat and active elevation of the lower limb were effective methods of assessing injury risk amongst runners aged 18–24 years [22].

In our work, only the rotational stability test was statistically significant. This test assessed multi-planar trunk stability during a combined upper and lower extremity motion. Central stabilization depends on the deep trunk muscles, which have the main task of controlling the position and movement of the trunk over the pelvis [23,24].

The runners from "Kotwica Brzeg" conducted a proper pre-run warm-up, and general and stretching exercises after training. Perhaps these factors contributed to a higher level of rotational stability. Runners from "Kotwica Brzeg" achieved higher results in the rotational stability test (2.33) compared to the control group (1.92). These findings were also higher than observed by other authors. For example, the mean rotational stability results for weightlifters was 1.98, while for volleyball players and other runners it was 1.86 and 1.6, respectively [16,19,22]. A low rotational stability test result may contribute to lower back pain as weaker deep trunk muscles predispose the lumbosacral region of the back to dysfunction [16].

There were five women among the runners from "Kotwica Brzeg" and six women in the control group. It is possible that the difference in gender ratios in the groups contributed to the rotational stability test findings. However, studies by other authors do not support an effect of gender on rotational stability test results. Gołąsta et al. and Loundon et al. found no significant differences between women and men in the total test score or in the individual rotational stability test results [4,21].

Many publications have confirmed the role of central stabilization in rehabilitation, while fewer have studied the effectiveness of central stabilization training among athletes [23]. Mandacho et al. studied handball players and showed that improving stabilization of the pelvis and lumbar spine helped improve the kinematic chain of the throwing movement, and thus to the speed of ball throwing [25]. Dello Iacono et al. showed that training trunk stability affected the reduction in asymmetry of lower limb muscles in soccer players [26]. However, the studies by Okada et al. do not confirm the importance of trunk stability in functional movement [27].

Conclusions

1. The FMS test results indicated occurrence of asymmetry and compensation among the tested runners, as well as disturbed movement patterns and an increase risk of injury.
2. The better rotational stability and FMS test results in runners who used a proper warm-up prior to exercise and stretching after training, may indicate improved preparation for sports competitions and lower risk of running-related injuries.
3. The principal limitation of this work was the small number of research participants. Therefore, the presented results should be treated as indicative. Further research, using larger subject numbers, will allow a more accurate assessment of the functional status and risk of injury to runners.

References

1. Moczyński P. Różnicowanie uszkodzeń kończyny dolnej u biegaczy. Prakt Fizjoter Rehabil 2015; 66: 18–28. (in Polish).
2. Dziak A. Uszkodzenia sportowe i ich leczenie. Acta Clin 2002; 2(3): 217–224. (in Polish).
3. Złotkowska R, Skiba M, Mroczek A, Bilewicz-Wyrozumska T, Król K, et al. Negatywne skutki aktywności fizycznej oraz uprawiania sportu. Hygeia Public Health 2015, 50(1): 41–46. (in Polish).
4. Agresta C, Slobodinsky M, Tucker C. Funktional Movement Screen™ – normative values in healthy distance runners. Int J Sports Med 2014; 35(14): 1203–1207.
5. Sinclair J. The effects of barefoot and barefoot inspired footwear running on tibiofemoral kinetics. Hum Mov 2016; 17(3): 176–180.
6. Sinclair J, Dillon S. The influence of energy boost and springblade footwear on the kinetics and kinematics of running. Hum Mov 2016; 17(2): 112–118.
7. Sinclair J, Taylor PJ. Sex variation in patellar tendon kinetics during running. Hum Mov 2015; 16(2): 60–63.
8. Sinclair J, Shore HF, Taylor PJ, Atkins S. Sex differences in limb and joint stiffness in recreational runners. Hum Mov 2015; 16(3): 137–141.
9. Van den Tillaar R, Vatten T, von Heimburg E. Effects of short or long warm-up on intermediate running performance. J Strength Cond Res 2017; 31(1): 37–44.
10. Van den Tillaar R, von Heimburg E. Comparison of two types of warm-up upon repeated-sprint performance in experienced soccer players. J Strength Cond Res 2016; 30(8): 2258–2265.
11. Fletcher IM, Jones B, The effect of different warm-up stretch protocols on 20 meter sprint performance in trained rugby union players. J Strength Cond Res 2004; 18(4): 885–888.
12. Lemiesz G, Iwańczyk K, Biernat R, Godlewski J, Szymański M, Biernat U et al. Zastosowanie testu funkcjonalnej oceny w praktyce. Prakt Fizjoter Rehabil 2013; 39: 4–11. (in Polish).

13. Cook G, Burton L, Hoogenboom B. Pre-participation screening: The use of fundamental movements as an assessment of function–Part 1. N Am J Sports Phys Ther 2006; 1(2): 62–72

14. Cook G, Burton L, Hoogenboom B. Pre-participation screening: the use of fundamental movements as an assessment of function–Part 2. N Am J Sports Phys Ther 2006; 1(3): 132–139

15. Kochański B, Plaskiewicz A, Kałużny K, Dylewska M, Płoszaj O, Hagner-Derengowska M, et al. Functional Movement Screen (FMS) – kompleksowy system oceny funkcjonalnej pacjenta. J Educ Health Sport [online] 2015; 5(4): 90–101 [cit.20.03.2017]. Available from URL: http://www.ojs.ukw.edu.pl/index.php/johs/article/view/2015%3B5%284%29%3A90-101/pdf_91. (in Polish).

16. Adamczyk J, Pepłowski M, Boguszewski D, Białoszewski D. Ocena funkcjonalna zawodników uprawiających podnoszenie ciężarów z zastosowaniem testu Functional Movement Screen. Med Sport 2012; 28(4): 267–276. (in Polish).

17. Kiesel K, Plisky P, Voight M. Can serious injury in professional football be predicted by a preseason functional movement screen? N Am J Sports Phys Ther 2007 Aug; 2(3): 147–158.

18. Malliaroupulos N, Mertyri D, Tsaklis P. Prevalence of injury in ultra trial running. Hum Mov 2015; 16(2): 55–59.

19. Siedlaczek M, Srokowski G, Łukasiewicz H, Srokowska A, Kowalik T, Piekorz Z, et al. Zgodność pomiędzy wynikami testu FMS a częstością występowania kontuzji u siatkarek na przykładzie drużyny II ligowej. J Educ Health Sport [online] 2015; 5(8): 529–539 [cit.24.03.2017]. Available from URL: http://www.ojs.ukw.edu.pl/index.php/johs/article/view/2015%3B5%288%29%3A529-539/4613. (in Polish).

20. Sulowska I, Gattner H, Stosur A, Rembiasz K. Functional movement screen as a tool for functional evaluation and prediction of the risk of injury among floorball athletes. Antropomotoryka 2015; 72(25): 35–42.

21. Loudon JK, Parkerson-Mitchell AJ, Hildebrand LD, Teague C. Functional movement screen scores in a group of running athletes. J Strength Condit Res 2014 Apr; 28(4): 909–13.

22. Hotta T, Nishiguchi S, Fukutani N. Functional movement screen for predicting running injuries in 18- to 24-year-old competitive male runners. J Strength Cond Res 2015; 29(10): 2808–2815.

23. Hibbs A, Thompson K, French D, Wrigley A. Optimizing performance by improving core stability and core strenght. Sports Med 2008; 38(12): 995–1008.

24. Kibler W, Press J, Sciascia A. The role of core stability in athletic function. Sports Med 2006; 36(3): 189–198.

25. Mandacho C, Garcia-Ruiz J, Cortell-Tormo JR, Tortosa-Martinez J. Effect of core training on male handball players' throwing velocity. J Hum Kinet 2017; 56(1): 177–185.

26. Dello Iacono A, Padulo J, Ayalon M. Core stability training on lower limb balance strength. J Sports Sci 2016; 34(7): 671–678.

27. Okada T, Huxel KC, Nesser TW. Relationship between core stability, functional movement, and performance. J Strength Cond Res 2011; 25(1): 252–261.

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