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PREVENTION AND OUTCOME MEASUREMENT STRATEGIES TO REDUCE THE FUTURE IMPACT OF BACK PAIN IN HANDBALL

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Abstract

From a physical therapist's perspective, one of the best ways to prevent back pain is to try to identify variables determined to be predisposing factors and to control certain somatic-related factors in junior players. To take steps in this direction, in close correlation with theoretical arguments, we proposed as prevention tools some specific outcome measurement strategies to control and verify over time certain factors that predispose to back pain episodes, such as low levels of the trunk muscular endurance and coordination or lateral muscular asymmetries. The existence of muscle asymmetries was identified by bioimpedance performed with the Tanita MC 780 MA analyzer and trunk muscle endurance and coordination levels were checked with the McGill trunk muscle endurance test battery. Junior players showed poor trunk muscle strength and an imbalance between the three main muscle groups and some lateral muscle mass asymmetries between dominant and non-dominant body parts. Approaching and presenting this strategic vision for the prevention of back pain in handball players can provide professionals in the field with information to guide, evaluate, verify and implement a future individualized prevention program.

Introduction

Low back pain can occur in many different ways among athletes, often vaguely appreciated, but which over time can impose physical incapacity and, in severe and chronic cases, the premature end of an athlete's career. Handball is one of the sports that does not exclude this vulnerability and predisposition to the occurrence of low back pain. Because, in fact, their installation can be strongly influenced by the dynamic, demanding and repetitive nature of the sport.

Back pain is a common feature in handball players and is one of the most common causes of lost playing and training time [1]. Pain is most commonly reported in the lumbar region, with a reported incidence in adolescent athletes of 21% and a prevalence ranging from 37% - 66% [2]. The most common injuries that cause lower back pain in handball athletes are: lumbago, soft tissue injuries (sprains, muscle strains), lumbar disc herniation, spondylolysis and spondylolisthesis, Scheuermann's disease, vertebral stress fractures, Bertolotti syndrome, tumors, infections and inflammatory conditions of the lumbar spine [1].

The potential for tissue vulnerability takes on different valences in adolescent athletes through the lens of growth and development peculiarities that interfere with the specifics of performance sport [3, 4,5,6,7]. Acute injuries and low back pain due to overuse are the most common symptoms reported among adolescents, often considered non-specific and without structural changes, however, unappreciated and treated specifically can predispose in the long term to symptom recurrence, increase in severity, discontinuation and even abandonment early athlete [1,8,9,10].

There is a correlation between excessive exposure to competitive sports during adolescence and the incidence of low back pain and spinal injuries [11,12]. Senior players are exposed to spinal stresses from an early age and it is suggested that more years in competitive sports resulted in a higher rate of spinal disorders [13]. In particular, due to the repetitive movements that characterize performance sports, athletes are more likely to experience specific back pain or low back pain than the general population [14].

Professor Stuart McGill states that axial stability is not compromised by insufficient strength, but probably by insufficient stability and an imbalance between the muscle groups of the trunk [15], arguing studies showing the effectiveness of trunk muscle endurance training in reducing the risk of future back problems [16]. Dr. Stuart McGill made an analogy by describing the spine and trunk muscles as "a fishing rod supported by guide wires." In other words, the spine is a flexible structure, but stabilized by external influences. By analogy, when the bottom of the rod is placed vertically on the ground (the base of the spine) and a small load is placed on its tip (ie the top of the spine), it will quickly deform. However, if the guide wires (ie, the trunk musculature) are placed along its length, at different levels and in different directions, and if the tension of the wire is kept constant, then the load that the rod can successfully carry increases greatly a lot. Therefore, it will ensure stability even under massive compressive loads. This is the role of the trunk muscles in ensuring sufficient stability of the spine [15, 22].

Victora Ruas and Vieira Adriana in 2017 explored the potential associations of back pain episodes signaling low levels of strength and/or flexibility of the trunk, spine and hips, unilateral agonist/antagonist muscle imbalances, lateral muscle strength asymmetries between right and left or between dominant and non-dominant body parts as causes, consequences or influencing factors for the prevalence of low back pain episodes or chronic low back pain [17].

Some authors associate the factors related to the nature of performance sports with the intrinsic factors of the athlete such as the growth and development process of the spine, body composition, various structural anatomical disorders or anatomical and muscular imbalances, insufficient strength, reduced flexibility and general laxity of the joints as being a secondary disadvantage for the occurrence of spinal injuries with long-term health consequences influencing the career of handball players [18,19].

There are mainly two types of sports-related injuries, acute and overuse injuries, defined as those without a specific, identifiable event responsible for their occurrence [21, 22, 23]. Acute injuries are caused by a sudden traumatic event and overuse injuries are a category caused by repetitive use and dynamic stress, mainly in muscles, soft tissues and joints. This can be explained as a result of the accumulation of micro-injuries that occur over a period of time but also by the fact that not enough time was given to recover. Overuse injuries occur due to weak musculature around a joint exposed to repetitive motion and these weaknesses can cause muscle imbalances [22].

These overuse injuries are thought to occur predominantly in technical sports that involve repeating similar movement patterns, such as throwing and jumping [24, 25], team sports such as handball and volleyball, especially at the elite level and among young athletes, when the total load on the athlete in training and competition increases rapidly [26, 27].

Lumbar pain due to overuse in sports is notable for its own characteristics: the pain appears as a consequence of drastic or multiple repetitive demands, localized pain that decreases in intensity at rest, localized pain in the lumbar region whose X-ray does not reveal pathological changes. Morphofunctional changes (microlesions) may belong to muscle fibers, muscle insertions or microlesions of multiple capsular or ligamentous formations. The evolution of symptoms shows rhythmic exacerbations, especially during intense physical exertion, interspersed with periods of remission when physical exertion decreases [3].

Body composition is recognized as a determining factor of athletic performance and its monitoring has become an important component both in the dynamics of sports demands and in achieving maximum performance [20]. This allows an athlete, coach or team to monitor the athlete's physiological composition to determine, for example, whether training or recovery from an injury is effective [21].

Material-method

The aim is to assess the levels of endurance and muscle coordination of the muscle trunk and lateral muscle asymmetries in junior handball players. The subjects of the study were 32 male handball players (average age 14-16 years), members of the Suceava University Sports Club and the Suceava Sports High School. This assessment was conducted in September 2022.

The McGill trunk muscular endurance test battery was used to determine the level of endurance and muscle coordination of the trunck.

Table 1. Interpretation of the McGill test

Ratio of Comparison	Criteria for Good Relationship Between Muscles

Flexion:extension	Ratio less than 1.0
Right-side bridge:left-side bridge	Scores should be no greater than 0.05 from a balanced score of 1.0
Side bridge (each side):extension	Ratio less than 0.75

Another specific assessment was to determine if there are any muscle asymmetries between the left and right body segments of junior handball players. To identify somatic parameters we measured height and weight and to measure body composition we measured body fat (%), fat mass, fat-free mass, muscle mass, bone mass, skeletal muscle mass in different segments (upper, lower limbs, trunk). Body composition measurement was performed with the professional Tanita MC-780 MA analyzer. In the presentation of the obtained results, I highlighted only the height, body weight, BMI and muscle differences between the left and the right hemibody.

The research methods used: the specialized literature study method, the test method, the graphic and table method, the statistical-mathematical method. Statistical methods were used to calculate descriptive indicators of variables - arithmetic mean (M), standard deviation (SD), coefficient of variability (CV), minimum value (Min) and maximum value (Max) for the entire sample.

Results

Table 2. Results of McGill torso muscular endurance test battery

N	T**FET**	T**EET**	**TLET R.**	T**LET** L.	F:E	**RSB:LSB**	**RSB**:E	**LSB**:E
1.	49	48	43	41	1,02	1,04	0,89	0,85
2.	50	48	38	39	1,04	0,97	0,79	0,81
3.	53	47	40	39	1,12	1,02	0,85	0,82
4.	48	42	42	44	1,14	0,95	1,00	1,04
5.	54	46	39	42	1,17	0,92	0,84	0,91
6.	52	50	39	38	1,04	1,02	0,78	0,76
7.	48	50	41	43	0,96	0,95	0,82	0,86
8.	52	50	43	38	1,04	1,13	0,86	0,76
9.	51	43	45	42	1,18	1,07	1,04	0,97
10.	54	55	45	46	0,98	0,97	0,81	0,83
11.	53	51	40	41	1,03	0,97	0,78	0,80
12.	52	52	43	40	1,00	1,07	0,82	0,76
13.	50	48	39	37	1,04	1,05	0,81	0,77
14.	53	51	40	42	1,03	0,95	0,78	0,82
15.	56	54	44	45	1,03	0,97	0,81	0,83
16.	49	47	40	38	1,04	1,05	0,85	0,80
17.	50	48	40	42	1,04	0,95	0,83	0,87

18.	54	53	41	42	1,01	0,97	0,77	0,79
19.	51	49	43	43	1,04	1,00	0,87	0,87
20.	53	51	40	41	1,03	0,97	0,78	0,80
21.	52	52	42	40	1,00	1,05	0,80	0,76
22.	57	56	44	45	1,01	0,97	0,78	0,80
23.	53	49	42	40	1,08	1,05	0,85	0,81
24.	56	54	42	41	1,03	1,02	0,77	0,75
25.	55	51	41	40	1,07	1,02	0,80	0,78
26.	58	56	44	43	1,03	1,02	0,78	0,76
27.	52	51	40	38	1,01	1,05	0,78	0,74
28.	57	57	46	45	1,00	1,02	0,80	0,78
29.	51	50	42	40	1,02	1,05	0,84	0,80
30.	54	52	38	37	1,03	1,02	0,73	0,71
31.	60	58	45	45	1,03	1,00	0,77	0,77
32.	57	58	45	46	0,98	0,97	0,77	0,79
M	52,94	50,84	41,75	41,34	1,04[a]	1,01[b]	0,82[c]	0,81[d]
DS	2,97	3,91	2,24	2,65	0,05	0,05	0,06	0,07
CV	5,61	7,69	5,37	6,40	4,83	4,65	7,74	8,22
MIN	48,00	42,00	38,00	37,00	0,96	0,92	0,73	0,71
MAX	60,00	58,00	46,00	46,00	1,18	1,13	1,04	1,04

a – according to McGill torso muscular endurance test battery the criteria for a good relationship between flexors and extensors muscles is ratio less than 1.0. The initial rating (1,**04**) reveal a poor relation between flexors and extensors muscles;
b - according to McGill torso muscular endurance test battery the criteria for a good relationship between right-side bridge and left side bridge should be no greater than 0.05 from a balance score of 1.0. The initial rating (1,**01**) reveal a good relation between right-side bridge and left side bridge muscles;
c- according to McGill torso muscular endurance test battery the criteria for a good relationship between right-side bridge and extension should be less than 0.75. The initial rating (0,82) reveal a poor relation right-side bridge and extensors muscles;
d- according to McGill torso muscular endurance test battery the criteria for a good relationship between left-side bridge and extension should be less than 0.75. The initial rating (**0,81**) reveal a poor relation left-side bridge and extensors muscles;

M, mean; DS, standard deviation; CV, variability coefficient; **MIN, minumum value; MAX, maximum value;** n, number of subjects; TFET, trunk flexors endurance test; TEET, trunk extensors endurance test; TLET RS/LS, trunk lateral endurance test right side/left side; F:E, flexion:extension ratio; RSB:LSB, right-side bridge:left-side bridge ratio; RSB:E, right-side bridge:extension ratio; LSB:E, left-side bridge:extension ratio

Table 3. Results of muscle mass distribution - Tanita MC-780 MA analyzer.

Details			Muscle mass				
H	BW	BMI	LARM	RARM	LLEG	RLEG	T

1.	189	74,7	20,9	3,3	3,2	11,1	11,5	32,6
2.	170	69,4	24,0	2,4	2,4	9,1	9,5	27,1
3.	171	65,6	22,4	2,7	2,8	9,5	10,0	28,4
4.	194	99,6	26,5	4,1	4,0	13,3	13,6	39,2
5.	170	75,2	26,0	3,2	3,3	10,1	10,1	31,8
6.	195	72,0	18,9	3,4	3,5	11,2	11,5	32,0
7.	193	89,8	24,1	3,7	3,5	12,0	12,3	36,1
8.	165	52,5	19,3	2,0	2,0	7,7	7,8	23,4
9.	178	70,2	22,2	2,7	2,7	9,3	9,7	29,8
10.	171	62,0	21,2	2,7	2,8	8,6	9,0	28,5
11.	168	59,8	21,2	2,3	2,4	8,7	8,9	26,2
12.	185	74,2	21,7	3,4	3,4	10,9	11,0	33,0
13.	189	93,6	26,2	4,3	4,2	13,0	13,1	38,4
14.	185	84,4	24,7	3,2	3,4	11,2	11,4	34,0
15.	201	87,0	21,5	3,8	3,7	12,6	13,0	37,0
16.	186	87,4	25,3	3,8	3,8	11,8	11,8	35,7
17.	195	83,1	21,9	4,0	4,0	11,1	11,1	36,2
18.	183	97,3	29,1	5,1	5,4	13,4	13,7	39,7
19.	182	70,5	21,3	2,9	3,2	10,8	10,9	32,7
20.	188	102,6	29,0	3,7	3,7	12,6	12,8	37,7
21.	178	64,0	20,2	2,9	3,1	9,8	10,1	31,0
22.	178	65,7	20,7	2,8	3,0	9,9	10,1	29,2
23.	180	93,1	28,7	3,7	3,7	12,9	13,2	36,3
24.	176	70,4	22,7	3,2	3,4	9,5	9,7	31,0
25.	193	71,3	19,1	2,8	3,0	9,7	10,1	31,9
26.	184	56,0	16,5	2,5	2,6	8,1	8,5	28,3
27.	169	83,5	29,2	2,5	2,5	10,1	9,9	28,9
28.	187	76,4	21,8	3,5	3,5	11,4	11,5	34,6
29.	180	73,5	22,7	3,9	3,9	11,5	11,6	33,4
30.	176	57,3	18,5	2,7	2,5	8,7	8,9	27,3
31.	177	65,8	21,0	3,1	3,2	9,6	9,8	30,8
32.	180	67,3	20,8	3,4	3,6	10,1	10,4	31,9
M	181,75	75,48	22,79	3,24	3,29	10,60	10,83	32,32
DS	9,20	13,22	3,29	0,67	0,67	1,57	1,56	4,04
CV	5,06	17,52	14,45	20,57	20,20	14,80	14,40	12,50
MIN	165,00	52,50	16,50	2,00	2,00	7,70	7,80	23,40
MAX	201,00	102,60	29,20	5,10	5,40	13,40	13,70	39,70

H, height; BW, body weight; BMI, body mass index; LARM, left arm; RARM, right arm; T, trunk.

Discussions

According to the McGill trunk muscle endurance test battery, the results (Table 2) reveal a weak relationship between the flexor and extensor group and between each lateral bridge (right-left) and the extensor group. It is believed that poor muscle strength of the trunk muscles or an imbalance between the three main muscle groups can contribute to lower back pain.

Asymmetry appears to be part of nature and an integral part of human biology and behavior. As we can see, the junior handball players have some asymmetries between left and right leg or arm. Due to the specific and differentiated demands of sports (e.g. handball, volleyball, basketball, tennis, badminton) limb asymmetries can be stimulated [30] an adaptation of the body following the movements that an athlete performs in regularly and unfortunately this can cause muscle imbalances that could affect performance or predispose the athlete to injury [31].

There is a strong correlation between large asymmetries and reduced sports performance. Muscular balance between bilateral limbs is considered to be an imperative condition for an athlete to improve their performance on the field [32] and lateral muscle strength asymmetries between dominant and non-dominant body parts as causes, consequences or influencing factors for the prevalence of low back pain episodes or chronic low back pain [17].

Conclusions

Poor core muscle strength or an imbalance between the three main muscle groups can contribute to lower back pain. Asymmetries of lateral muscle strength between right and left or between dominant and non-dominant sides of the body as causes are influencing factors for the prevalence of episodes of low back pain or chronic back pain. Therefore, this situation can be reversed by having good muscle endurance and muscle balance between trunk muscle groups and by correcting lateral muscle asymmetries between right and left.

The Tanita MC 780 MA professional analyzer allows the identification and proposal of individualized interventions aimed to correcting lateral muscle asymmetries between right and left parts of the body both at the upper level and lower limbs. The use of the McGill trunk muscle endurance test battery can propose through its results specific interventions and training as a strategy to prevent back injuries and also to improve performance.

Approaching and presenting this strategic vision for the prevention of back pain in handball players can provide professionals in the field with information to guide, evaluate, verify and implement a future individualized prevention program. These can be a specific tools to control and check over time certain factors that predispose to episodes of back pain, such as low levels of trunk muscle resistance or lateral muscle asymmetries.

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