ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 01, pp.64264-64267, January, 2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

INFLUENCE OF THE MUSCLE STRENGTHS OF THE TRUNK OVER THE BALANCE

[1]*Bastiurea Eugen and [2]Stan Zenovia

[1]Professor, Laboratory of Motor and Somato-Functional Assessment, Department of Sports Games and Physical Education, Faculty of Physical Education and Sport,"Dunarea de Jos" University of Galati, Romania
[2]Associate Professor, Laboratory of Motor and Somato-Functional Assessment, Department of Sports Games and Physical Education, Faculty of Physical Education and Sport,"Dunarea de Jos" University of Galati, Romania

ARTICLE INFO

Article History:
Received 14th October, 2017
Received in revised form
26th November, 2017
Accepted 20th December, 2017
Published online 19th January, 2018

Key words:
Muscle Strengths,
Balance, Handball.

ABSTRACT

Objectives: This study aims to determine the correlations between the muscle strengths of the trunk and the balance in handball players.
Methods: We tested forty-one female athletes divided in three age groups. Ten subjects were 16 years old, seventeen subjects were 14 years old and fourteen subjects were 12 years old. We measured the weight, muscle strengths of the trunk (frontal and sagittal) and the overall balance. For the twenty-four correlations between these variables by age group, the values of **r** were between 0% and 0.57%.
Conclusions: In the 16-year-olds weight is not a determining factor for maintaining the balance, as the somatosensory, visual and vestibular systems being sufficiently developed. Instead, in the 14-year-olds and in the 12-year-olds, weight is significant for maintaining the balance. These conclusions must be accepted with caution as they only target this group of subjects.

Citation: Bastiurea Eugen and Stan Zenovia. 2018. "Influence of the muscle strengths of the trunk over the balance", *International Journal of Current Research*, 10, (01), 64264-64267.

INTRODUCTION

Balance assessment and variables that can influence body's stability have always been a concern for researchers. There is a permanent interest in external variables that may influence postural control, in addition to internal mechanism (somatosensory, visual and vestibular systems). Therefore, variables such as weight, sex, height, or a certain sport practiced by the test subjects were tested and some conclusions were reached (Grigg, 1994; Balter et al., 2004). The influence of the body's balance assessment during the execution of some technical procedures in different sports disciplines is constantly studied to improve the training of athletes. (Paillard, 2002, Davlin, 2004, Shaw et al., 2008, Boccolini et al., 2013). They were studied various relationships between the balance and the risk of injury in sports; with the conclusion that a permanent balance assessment is needed as a prevention and recovery strategy for injuries (Emery, 2003, Bastiurea et al., 2014 It has been found that motor skills to improve balance are increasing with the development of muscle strengths (Hrysomallis, 2011). The specialists recommend the use of unstable platforms to develop balance and muscle strengths in ankle, knee and hip movements (Kean et al, 2006).

Corresponding author: **Bastiurea Eugen,**
Professor, Laboratory of Motor and Somato-Functional Assessment, Department of Sports Games and Physical Education, Faculty of Physical Education and Sport,"Dunarea de Jos" University of Galati, Romania.

In volleyball, basketball or handball, jumping is an important part of the technical execution. Landings in a more stable position, ease the start of the next move, prevent injuries and ensure the performance of the game. Holm et al., studied in 2004 the effects of a neuromuscular training on the development of muscle strengths in elite handball players. Because we have developed a method and a device for assessing the imbalances of the trunk muscles (Stan et al., Patent, 2010) presented in (Marcu et al., 2008), we aim to investigate the correlations between the values of the muscle strengths of the trunk and the balance, in handball players. Can we find objective data on how the muscular force distributed in the frontal and sagittal plane of the trunk influences the balance of the body? How is the balance influenced by the differences between force plans (anterior-posterior and left-right)? Which strength plan has the greatest contribution to maintaining balance?

MATERIALS AND METHODS

Subjects: We tested forty-one female athletes divided in three age groups. Ten subjects were 16 years old, seventeen subjects were 14 years old and fourteen subjects were 12 years old. Please note that we tested only perfectly healthy athletes who were able to perform the tests correctly and with maximum efficiency.

Testing: We measured the weight, muscle strengths of the trunk (frontal and sagittal) by assessing the overall balance *The Overall Balance Test* (SDG - Spielman-De Gunsch) was carried out with a proprioceptive platform LIBRA PLUS under the Easytech platform at SC NEW Multimedica SRL Galati. (De Gunsch et al., 2017).The subjects performed the "fixed point" test, maintaining the balance on the plate for 30 seconds. The evaluation scale for this test is the following: optimal (9-11), good (11-12), satisfactory (12-13), weak (13-14) and very poor (14-16). Example: a very poor result for a 14-year-old athlete (Figure 1), the value being far away from the weakest requirements (21.5), a very good initial result for a 16-year-old athlete (Figure 2) with a value of 7.1, and a record of 3.1 points after three months. DOMIN (dominance) is the direction to which the subject was more unbalanced.

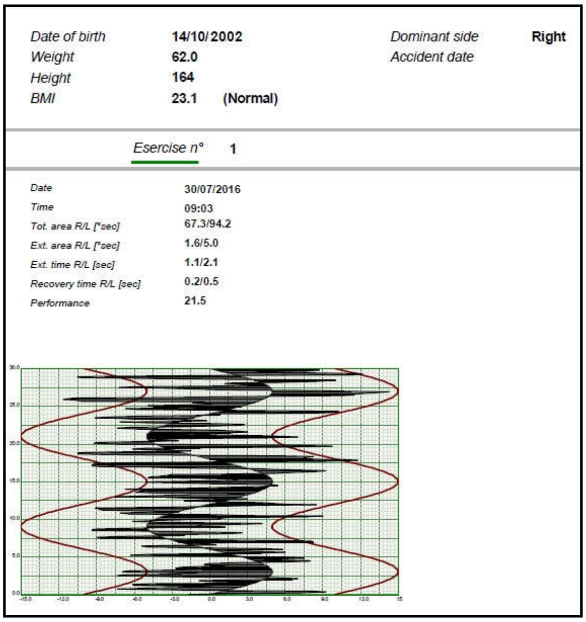

Fig. 1. Very poor result in SDG test

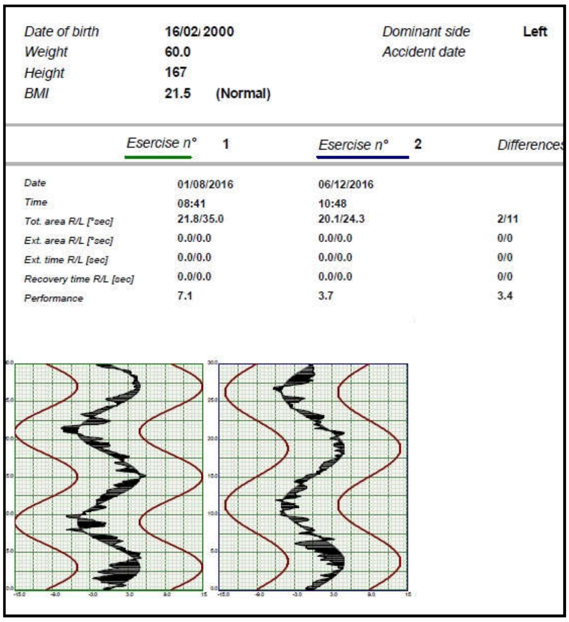

Fig. 2.Very good result in the SDG test

Testing of the muscular force of the trunk

For all subjects, we performed eight tests using a method and apparatus patented in Romania (Stan 2009): testing of the muscular strengths on flexion, from seated position (T1); testing of the muscle strengths on the left lateral tilt, from the seated position (T2); testing of the muscle strengths on extension from the seated position (T3); testing of the muscle strengths on right lateral tilt from the seated position (T4); testing of the muscle strengths on flexion, in orthostatism (T5); testing of the muscle strengths on left lateral tilt, in orthostatism (T6); testing of the muscle strengths on extension in orthostatism (T7); testing of the muscle strengths on right lateral tilt, in orthostatism (T8). The final results are graphically represented in Fig. 3. With the testing values obtained with this device, we calculated the strengths indexes for the anterior, posterior and lateral side of the trunk (Stan et al., 2016) detailed in Table 1.

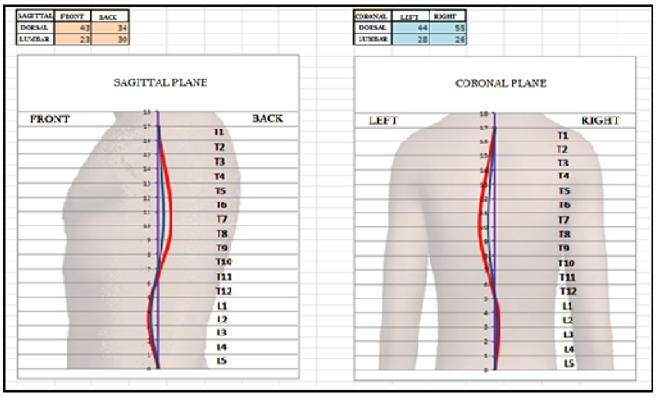

Figure 3. The graph muscle imbalances presented in coronal and sagittal plane

Table 1. Abbreviations used for the proposed muscle strengths indexes

Abbreviations	*The description of the strengths proposed indexes*
IFTSA	The average of the T1 and T5 test values based on weight (muscle strengths measured on the front of the trunk)
IFTSP	The average of T3 and T7 test values relative to weight (muscle strengths measured on the back of the trunk without T9)
IFTFS	The average of T2 and T6 test values based on weight (muscle strengths measured on the left side of the trunk)
IFTFD	The average of T4 and T8 test values based on weight (muscle strengths measured on the right side of the trunk)
IGFT	The mean T1-T8 test values relative to weight (total trunk's muscle strengths measured without T9)

Data Analysis

We were processing the collected data using SPSS v. 20 for Windows. The twenty-four correlations between these variables, by age group, have **r** values between 0% and 0.57%. The confidence coefficient for statistical significance is 95%. Table 2 shows the test results for the 16-year-olds with **r** values between 0% and 0.48%. Table 3 shows the results of the tests for the 14-years-olds, with values of the r between 0% and 0.49%. Table 4 shows the results of the tests for the 12-years-olds, with values of the r between 0% and 0.43%

RESULTS

In the 16-year-olds, the weight has no influence over the balance values. In the sagittal plane, the correlation for the anterior muscles and SDG is negative (r = -0.37%).

Table 2. **Balance and muscle strength assessment for 16-year-olds**

Nr.	SDG	DOMIN	G	IFTSA (kgf)	IFTSP (kgf)	IFTSP-IFTSA	IFTFS (kgf)	IFTFD (kgf)	IFTFD-IFTFS	IGFT (kgf)
1	7.3	St.	46.5	51.61	67.74	16.13	43.01	49.46	6.45	52.96
2	19	Dr.	44.6	33.63	71.75	38.12	35.87	37.00	1.13	44.56
3	14.4	Dr.	74.5	44.97	51.68	6.71	33.56	34.23	0.67	41.11
4	7.7	Dr.	50	50.00	82.00	32	46.00	39.00	-7	54.25
5	16.1	Dr.	57.3	48.87	48.87	0	34.90	36.65	1.75	42.32
6	16.5	Dr.	51.5	44.66	46.60	1.94	32.04	30.10	1.94	38.35
7	7.1	St.	60.4	52.15	76.99	24.84	43.05	47.19	4.14	54.84
8	11.9	St.	63	38.89	52.38	13.49	32.54	34.92	2.38	39.68
9	9.1	Dr.	56	30.36	37.50	7.14	25.00	27.68	2.68	30.13
10	11.6	Dr.	58	46.55	51.98	5.43	39.66	44.83	5.17	45.75
Correl (%)			0	-0.37	0,33	-0.15	-0.44	-0.48	0	-0.44

Table 3 - Balance and muscle strength assessment for 14-year-olds

Nr.	SDG	DOMIN	G	IFTSA (kgf)	IFTSP (kgf)	IFTSP-IFTSA	IFTFS (kgf)	IFTFD (kgf)	IFTFD-IFTFS	IGFT (kgf)
1	15.1	St.	60	29.17	49.17	20	36.67	38.33	1.66	38.33
2	8.9	St.	59	38.14	59.32	21.18	34.75	35.59	0.84	41.95
3	13	Dr.	38.5	61.04	77.92	16.88	51.95	45.45	-6.5	59.09
4	15.9	St.	41	43.90	58.54	14.64	41.46	42.68	1.22	46.65
5	10	St.	50.3	49.70	72.56	22.86	47.71	50.70	2.99	55.17
6	12.1	St.	87.7	28.51	52.45	23.94	33.07	30.22	-2.85	36.06
7	11.8	St.	47.5	47.37	50.53	3.16	40.00	34.74	-5.26	43.16
8	7.7	Dr.	50.5	51.49	63.37	11.88	46.53	41.58	-4.95	50.74
9	7.8	St.	69	40.58	49.28	8.7	36.96	38.41	1.45	41.30
10	20.3	St.	49	46.94	53.06	6.12	40.82	38.78	-2.04	44.90
11	13	Dr.	42	46.43	66.67	20.24	50.00	51.19	1.19	53.57
12	21.5	Dr.	63	34.13	43.65	9.52	30.95	30.16	-0.79	34.72
13	11.1	Dr.	60	40.00	59.17	19.17	27.50	31.67	4.17	39.58
14	12.7	St.	41	48.78	51.22	2.44	34.15	53.66	19.51	46.95
15	11.7	Dr.	60	49.17	47.50	-1.67	40.83	39.17	-1.66	44.17
16	11.5	Dr.	44	51.14	63.64	12.5	48.86	42.05	-6.81	51.42
17	12.5	Dr.	60	49.17	55.00	5.83	40.83	35.83	-5	45.21
Correl (%)			0.37	-0.49	0	0.57	-0.15	-0.24	-0.1	-0.2

Table 4. **Balance and muscle strength assessment for 12-year-olds**

Nr.	SDG	DOMIN	G	IFTSA (kgf)	IFTSP (kgf)	IFTSP-IFTSA	IFTFS (kgf)	IFTFD (kgf)	IFTFD-IFTFS	IGFT (kgf)
1	16.8	st	51	40.20	56.86	16.66	43.00	28.43	-14.57	38.97
2	17	st	33	54.55	51.52	-3.03	48.48	43.94	-4.54	49.62
3	12.2	dr	50	46.00	57.00	11	42.00	44.00	2	47.25
4	11.4	dr	54	43.52	51.85	8.33	34.26	35.19	0.93	41.20
5	17.3	st	44	27.27	37.50	10.23	25.00	26.14	1.14	28.98
6	10.3	st	38	63.16	75.00	11.84	38.16	35.53	-2.63	52.96
7	9.3	st	44	40.91	54.55	13.64	38.64	39.77	1.13	43.47
8	14.5	st	47	48.94	60.64	11.7	44.68	46.81	2.13	50.27
9	7.6	st	50.5	42.57	51.49	8.92	31.68	35.64	3.96	40.35
10	17.1	st	33	42.42	60.61	18.19	30.30	36.36	6.06	42.42
11	12	st	39	30.77	42.31	11.54	28.21	29.49	1.28	32.69
12	12.7	st	31	35.48	48.39	12.91	33.87	33.87	0	37.90
13	18.2	st	29	41.38	53.45	*12.07*	37.93	41.38	3.45	43.53
14	12.1	st	55	58.18	61.82	*3.64*	49.09	43.64	-5.45	53.18
Correl (%)			-0.43	-0.2	0	0	0	0	-0.16	-0.15

For the posterior muscles and SDF, the correlation is positive (r = 0.33%). The difference between the two force plans has a poor correlation with SDG (r = -0.15%). In the frontal right plan, the correlation value with SDG is higher (r = -0.24%) and with IGFT, r = -0.44%.

In the 14-year-olds, the weight is affecting the balance (0.37%). In the sagittal plane, there is the strongest relationship between SDG and the difference between the posterior and the anterior force index (r = 0.57). In the frontal plan, the value of r on the right side is higher (r = -0.48%) and with IGFT, almost non-existent (r = -0.02%). In the 12-year-olds the weight has the greatest influence on the balance values (r = -0.43%). In the sagittal and frontal plane, there is no correlation between the SDG and the force indices.

DISCUSSION

There is an interesting correlation between SDG and plantar fingerprint values by the baropodometry test (Stan et al., 2016), also to see to what extent the projection of weight over the plant influences the balance. Studies in younger subjects are rarer, but Cambier in 2001, did for the four-year-olds and for the five-year-olds a study to set specific values for this age. In the 12-year-olds, the weight center balance determines the balance of the body. The influence of age over balance has been studied since 1993 by Hytönen who demonstrated that the 50-year-olds were the most stable due to the development of proprioception over the postural balance, fact confirmed by our study due to differences in correlation values, depending on age.

Conclusion

In the16-year-olds, there is a better balance provided by a lower muscular strengths on the anterior and by a larger one on the posterior of the body. The development of dorsal muscles has a significant influence on the stabilization of the posture of the body when performing the movements. In the 14-years-olds, the importance of developing muscular growth over the body's balance is clearly seen. The fact that most athletes have the right arm as skilful has led to a tendency to correct the body's balance with the muscles on its side. In the 16-year-olds weight is not a determining factor in maintaining the balance, somatosensory, visual and vestibular systems being sufficiently developed. Instead, in the 14-years-olds and in the 12-years-olds, the weight is significant in maintaining the balance. In these cases, the posture is maintained due to the movement of the centre of gravity above the support area.

Acknowledgement

Special thanks to Mrs Nicoleta Ivan, professor, manager of SC NEW Multimedica SRL Galati, for providing the conditions needed for the Libra tests and to Mrs. Gabriela Artene, professor, president of Sports Club "Handball-Art" Galati for providing the girls handball teams.

REFERENCES

Balter S, Stokroos RJ, Akkermans E. Kingma H. 2004. Habituation to galvanic vestibular stimulation for analysis of postural control abilities in gymnasts. *Neuroscience Letters*. 366:71-75.

Baştiurea E, Stan Z, Rizescu C, Mihăilă I, Andronic F. 2014. The effect of muscle strength on the capacity of coordination in handball. International Scientific Conference „Sports, Education, Culture-Interdisciplinary approaches in scientific research”, Galaţi, 30-31 may 2013, *Procedia - Social and Behavioral Sciences*, I37 (2014) 3-10 (ISSN 1877-0428).

Boccolini G, Brazzit A, Bonfanti L, Alberti G. 2013. Using balance training to improve the performance of youth basketball players. *Sport Sciences for Health*. 9(2):37-42.

Bressel E, Yonker JC, Kras J, and Heath EM. 2007. Comparison of static and dynamic balance in female collegiate soccer, basketball, and gymnastics athletes. *Journal of Athletic Training* 42, 42-46.

Cambier D, Cools A, Danneels L, and Witvrouw E. 2001. Reference data for 4-and 5-year-old children on the Balance Master: values and clinical feasibility. *European Journal of Pediatrics,* 160, 317-322.

Davlin CD. 2004. Dynamic balance in high level athletes. *Perceptual and Motor Skills*. 98:1171-1176.

De Gunsch E, Cauquil L, Milling M, Di Palma E. 2017. Evaluation of certain parameters of ankle sprains using the Phyaction *Balance Board. Research Gate*.

Emery CA. 2003. Is there a clinical standing balance measurement appropriate for use in sports medicine? A review of the literature, *Journal of Science and Medicine in Sport*, Volume 6, Issue 4, 492 – 504.

Grigg P. 1994. Peripheral neural mechanisms in proprioception. *Journal of Sport Rehabilitation*. 1994; 3:2-17.

Holm I, Fosdahl MA, Friis A, Risberg MA, Myklebust G, Steen H. 2004. Effect of neuromuscular training on proprioception, balance, muscle strength, and lower limb function in female team handball players, *Clinical Journal Sport Medicine*. Mar.14(2):88-94.

Hrysomallis C. 2011. Balance abilities and athletic performances. Sports Medicine. 41:221-232.

Hytönen M, Pyykkö I, Aalto H, Stark J. 1993. Postural control and age. Acta oto-laryngologica 113, 119-122.

Kean CO, Behm DC, Warren BY. 2006. Fixed Foot Balance Training Increases Rectus Femoris Activation During Landing and Jump Height in Recreationally Active Women, *Journal Sports Science and Med*icine. Mar; 5(1): 138–148.

Marcu V, Stan Z, Baştiurea E, Chiculiţă C. 2008. Determining the muscle imbalances in the torso- method and apparatus, Academica Publisher, Galati.

Paillard T, Costes-Salon C, lafont C, Dupui P. 2002. Are there differences in postural regulation according to the level of competition in judoists? *British Journal of Sports Medicine*. 36:304-305.

Shaw MY, Gribble PA, Frye JL. 2008. Ankle bracing, fatigue, and time to stabilization in collegiate volleyball athletes. Journal of Athletic Training. 43:164-171.

Stan Z, Baştiurea E, Rizescu C. 2016. Relationship between pressures exercised on the foot plant and the distribution of the muscular forces at the trunk level, Ovidius University Annals. Series Physical Education and Sport/ Science, Movement and Health, Constanţa, Vol. XVI, ISSUE 1, ISSN 2285-777X (ISSN-L 2285-777X), pp. 110-115.

Stan Z, Bastiurea E, Rizescu C. 2015. Sensitivity testing study proposed by method and apparatus for determining muscle imbalances at the trunk level. Ovidius University Annals. Series Physical Education and Sport/ Science, Movement and Health,14(1), 62-69.

Stan Z, Baştiurea E, Marcu V, Chiculiţă C. 2010. Method and apparatus for determining muscle imbalances present in the torso. Patent nr. 123013/30.07.2010, issued by OSIM Bucureşti, România.

Stan Z. 2009. Theory and practice for gait providing, ZIGOTTO Publisher, Galati, 209 p. ISBN: 978-606-8085-19-7.

****