STUDIA UBB EDUCATIO ARTIS GYMN., LVIII, 3, 2013, pp. 31 - 36
(RECOMMENDED CITATION)

THE EFFECTS OF HAND-EYE COORDINATION OVER POSTURAL BALANCE

COSMIN PRODEA[1], ADRIAN PĂTRAŞCU[1], LUCIA ANA-MARIA STANCIU[1]

ABSTRACT. *Premises.* Balance can be improved through physical exercises, both aerobic and anaerobic. Coordination and skills are motional customs also contributing to this action. Research in the field shows the importance of vestibular, visual and somatosensory system receptors in maintaining and improving balance. We will show that physical exercise influences and improves balance. *Objectives*. The objective of this study was to determine if the AMTI Netforce platform can be used as an objective measurement tool for the effects of hand-eye coordination over postural balance. *Methods*. We used the AMTI Netforce platform for all our measurements, focusing on two characteristics: the center of pressure's trajectory area and length. *Results*. These results suggest that the coordination movements really do have an effect over the postural balance. Specifically, our results suggest that when the subject executes coordination movements, the trajectory's length increases, thus consolidating our presumption that the force platform can give us an objective measurement tool for the coordination effects over postural balance. *Conclusions*. We have proven that the force platform does in fact offer us a reliable and objective way of identifying any difference between different positions or movements. Completing this first stage means that we found the objective tool to use in the next part of the research.

Key words: balance, hand-eye coordination, AMTI Netforce

REZUMAT. ***Efectele coordonării mână-ochi asupra echilibrului postural***. *Premize*. Menţinerea echilibrului poate fi îmbunătăţită prin exerciţii fizice atât aerobe cât şi anaerobe. Coordonarea şi îndemânarea sunt deprinderi motrice care contribuie şi ele la această acţiune. Studiile din domeniu arată importanţa receptorilor vestibulari, vizuali şi ai sistemului somato-senzitiv în menţinerea echilibrului şi îmbunătăţirea acestuia. Noi vom arăta că exerciţiul fizic influenţează şi îmbunătăţeşte echilibrul. *Obiective*. Obiectivul acestui studiu a fost de a determina daca platforma AMTI Netforce poate fi folosită ca o metodă obiectivă de măsurare a efectelor coordonării mână-ochi asupra echilibrului. *Metode*. Am folosit platforma AMTI Netforce pentru toate măsurătorile, concentrându-ne pe două caracteristici: lungimea şi aria centrului de presiune. *Rezultate*. Rezultatele

[1] „Babeş-Bolyai" University, Faculty of Psychology and Educational Sciences, Cluj-Napoca, Romania, prodeacosmin@yahoo.com

sugerează că mişcările ce presupun coordonare influenţează echilibrul postural. În special, rezultatele noastre sugerează faptul că atunci când un subiect execută mişcări de coordonare lungimea traiectoriei centrului de presiune creşte, astfel consolidând presupunerea noastră că platforma de forţă AMTI poate fi utilizată ca un instrument obiectiv de măsurare a efectelor coordonării asupra echilibrului. *Concluzii*. Am demonstrat că platforma de forţă ne oferă o metodă obiectivă şi fiabilă de a identifica orice diferenţă dintre diferite poziţii şi mişcări. Finalizând această primă etapă înseamnă că am descoperit o unealtă obiectivă pentru următoarele etape ale cercetării noastre.

Cuvinte cheie: chilibru, coordonare mână-ochi, AMTI Netforce

Background

Nowadays, research is becoming more and more thorough and detailed. The involved effort is increasingly complex, this being the reason why we propose this research. The central subject refers to balance. Coordination and skills are only a few of the motional customs influencing balance, along with the type of effort, aerobic or anaerobic. Of course, the examples can go on, but for the beginning, we will detail these items.

Balance is defined also as „the complex process involving the reception and organization of sensorial input and the schedule and execution of movements, elements which insure an erect posture, meaning the permanent keeping of the center of gravity within the support base". Or, shorter: „balance is the ability of maintaining or mobilizing the body without falling". The permanent control of posture is a feature of a healthy nervous system, allowing stability and the initiation of the desired movements. Any disturbance in balance or posture control highly impedes the efficiency of our actions (Sbenghe, 1999, page 262).

As we will later see, most studies refer to balance from the point of view of kinetotherapy, and not from that of physical exercise.

Balance can be improved through physical exercises, in aerobic and anaerobic effort, along with coordination and skills. All of the aforementioned types of effort can improve balance. (Grosu, Emilia, ”Psychomotricity”, 2009, GMI Publishing House, Cluj-Napoca)

For instance, walking and jogging contribute to the improvement of balance. Normal walking and crawling, quality execution jumping, for instance, jumping over a stretched string.

Static exercises for developing balance: balance on tiptoes, walking on tiptoes, support on one leg only (simple types of exercises). We can also add to these types of exercises, movements of the upper limbs or with balancing objects on the head, body control exercises (for instance, picking up objects scattered on the ground), thus becoming complex exercises for balance development. A fixed

string is used at the extremity, and someone spins it, adapting to the capacities of the person about to jump. When he/she manages to dose and reinitiate the force according to the various movements of the string, the passing of the string along with the movement of the body will be prevented. Thus, coordination of movements is also improved through the jumping and spinning of the string on his/her own, "reentering" the string.

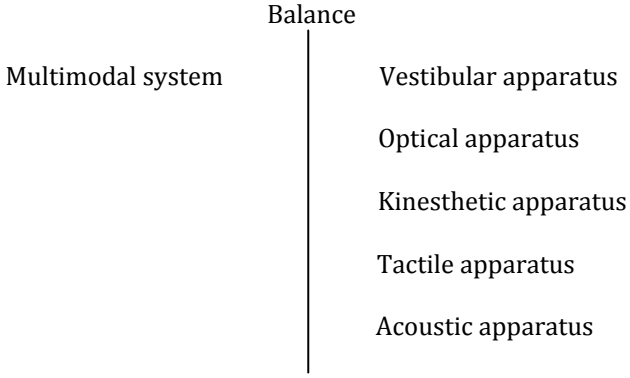

Fig. 1. *The balance chart* (Grosu, Emilia, *Psychomotricity* – 2009, GMI Publishing House, Cluj-Napoca, page 429)

According to Sbenghe, (p.263), the dynamic balance is a result of three factors: the individual, with his/her anatomical and functional capacities, the activities/movements performed by the individual at a certain point and the environmental conditions where the individual performs his/her activities. These activities are "daily activities", such as balance walking on a plank, various jumps, landing, walking over obstacles, light jogging on various types of soil, over obstructions, on narrow surfaces etc. Balancing tasks contribute to achieving motional and performance specific customs.

Furthermore, there are three main sources of peripheral inputs contributing to posture control, coming from somatosensorial, visual and vestibular receptors (bilateral). These sources are:

1. The peripheral somatosensory system (receptors in joints, ligaments, tendons, skin, muscles, etc.)
2. Visual receptors that offer central/focal information assisting us in orienting in the environment or peripheral/ambient information helping us to anticipate movements;
3. Vestibular receptors (internal ear), in charge of the movements of the body according to the gravitational line and head movements.

The performance of balance action is achieved by the locomotive system (posture and movement amplitude, movement force, endurance, coordination, ability), which keeps the body balanced. Walking represents a common activity which permanently challenges an individual's balancing system. These abilities can be trained through exercise. Also, the attention, memory and muscles contribute to keeping balance.

Examples of tests used to test balance: the classic Romberg test, the pushing test, the unipodal test, the postural stress test, the Tinetti balance test, the school of walking assessment. (Grosu Emilia, Florina (2001), *Motional learning and performance in sports,* GMI Publishing House, Cluj-Napoca, Vol. II)

Hypothesis

The AMTI Netforce platform can be used as an objective measurement tool for the hand-eye coordination movement's effects over the postural balance.

Methods and materials

Subjects

The subjects of this study were 170 students between the ages of 20 and 22 years old, all of them students of the Faculty of Physical Education and Sport, Babes Bolyai University. There were 120 boys and 50 girls that did both the initial and the final test.

Methods and the Steps of the Research

We used the AMTI Netforce for the initial and final balance tests. The tests consisted of measuring the postural balance of the subjects without and with some standard hand-eye coordination.

We measured and observed the evolution of two characteristics of postural balance: center of pressure's trajectory length and center of pressure's trajectory area. These two give us a clear and objective way to identify any modification in the postural balance prior and after the hand-eye coordination movements.

Results

A paired-samples t-test was conducted to compare the values of the two items that we registered during the initial and the coordination test.

When measuring the center of pressure's trajectory length for the boys, there was a significant difference in the scores for the initial test (M=10423.53, SD=5914.13) and the coordination test (M=289930.76, SD=113749.17); t(119)= - 28.13, p=.000. These results suggest that the coordination movements really do have an effect over the postural balance. Specifically, our results suggest

that when the subject executes coordination movements, the trajectory's length increases, thus consolidating our presumption that the force platform can give us an objective measurement tool for the coordination effects over postural balance.

When measuring the center of pressure's trajectory length for the girls, there has been a significant difference in the scores for the initial test (M=3776.53, SD=1656.06) and the coordination test (M=19199.09, SD=3738.68); t(119)= - 65.817, p=.000.These results suggest that the coordination movements really do have an effect over the postural balance. Specifically, our results suggest that when the subject executes coordination movements, the trajectory's length increases, thus consolidating our presumption that the force platform can give us an objective measurement tool for the coordination effects over postural balance.

When measuring the center of pressure's trajectory area for the boys, there was a significant difference in the scores for the initial test (M=4217.49, SD=19402.21) and the coordination test (M=19402.21, SD=3764.04); t(49)= - 36.610, p=.000. These results suggest that the coordination movements really do have an effect over the postural balance. Specifically, our results suggest that when the subject executes coordination movements, the trajectory's area increases, thus consolidating our presumption that the force platform can give us an objective measurement tool for the coordination effects over postural balance.

When measuring the center of pressure's trajectory area for the girls, there was a significant difference in the scores for the initial test (M=14, SD=2.93) and the coordination test (Mc=15.29, SDc=7.23); tc(13)= - 0.60, pc=0.557. These results suggest that the coordination movements really do have an effect over the postural balance. Specifically, our results suggest that when the subject executes coordination movements, the trajectory's area increases, thus consolidating our presumption that the force platform can give us an objective measurement tool for the coordination effects over postural balance.

Tabel 1. The 2-tailed t-test final results(both boys and girls)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence				
					Lower	Upper			
Pair 1	LUNG_B_1 - LUNG_B_2	-279507.2326	108834.96825	9935.22786	-299179.9760	-259834.4891	-28.133	119	.000
Pair 2	AREA_B_1 - AREA_B_2	-15422.5592	2566.90424	234.32523	-15886.5466	-14958.5719	-65.817	119	.000
Pair 3	LUNG_F_1 - LUNG_F_2	-311002.7716	102077.22778	14435.89999	-340012.7988	-281992.7444	-21.544	49	.000
Pair 4	AREA_F_1 - AREA_F_2	-15184.7180	2932.84472	414.76688	-16018.2232	-14351.2128	-36.610	49	.000

Tabel 2. The correlation values

		N	Correlation	Sig.
Pair 1	LUNG_B_1 & LUNG_B_2	120	.839	.000
Pair 2	AREA_B_1 & AREA_B_2	120	.818	.000
Pair 3	LUNG_F_1 & LUNG_F_2	50	.733	.000
Pair 4	AREA_F_1 & AREA_F_2	50	.677	.000

Discussion of the results

Considering the fact that the p values are lower than α=.05, and also there is a very strong correlation between the initial and after tests (over 0.7), we can surely conclude that our stimuli, the coordination movements, did in fact have a big influence over the postural balance. These results are encouraging because they open the way to an even bigger research in the domain. The fact that now we are sure the force platform gives us an objective result during coordination tests, we can now move forward and start the pilot test on the effects of maximal anaerobic effort over postural balance during a standard, computer assisted, hand-eye coordination test.

We have proven that the force platform does in fact offer us a reliable and objective way of identifying any difference between different positions or movements. Completing this first stage means that we found the objective tool to use in the next part of the research.

REFERENCES

Bull, Stephen (2011), *Guidelines for performance optimization,* Trei Publishing House, Bucharest

Grosu, E.F. (2009), *Psychomotricity,* GMI Publishing House, Cluj-Napoca

Grosu E.F. (2001), *Motional learning and performance in sports,* GMI Publishing House, Cluj-Napoca, Vol. II

Roman, Gh., Batali, Fl. (2007), *Sports training - Theory and methodics,* Napoca Star Publishing House

Sbenghe, T. (1999), *Theoretical and practical basics of kinetotherapy,* Medical Publishing House, Bucharest

Sbenghe, T. (2002), *Kinesiology – The science of movement,* Medical Publishing House, Bucharest