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LIFE STYLE INFLUENCE ON BODY STABILITY FOR YOUNG SUBJECTS

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Abstract: *The paper presents a stage of the research on the influence of lifestyle on the body stability. This stage refers to the body equilibrium for a sample of 12 young persons. These were chosen as part of the three categories: subjects who regularly practice equilibrium sports (the first one), who practice other sports, not involving body equilibrium (the second) and who do not practice any sports (the third). For each person it was applied the same testing procedure, in four postures. It was proved that the for the first category, body equilibrium was much better than for the third category (about 35 ÷ 40%). Besides, for the second category, the body equilibrium was also much better than for the third category (about 30 ÷ 35%).*

Key words: *subjects, sports, COM, equilibrium, postures.*

1. Introduction. Body Stability in Everyday Life

As a result of its position bipod, body balance issues present a particular importance in the quality and safety of life. The balance of the human body manifests interest in the static (when standing) and dynamic (when walking, running, dancing, or playing some specific sports), Figure 1.

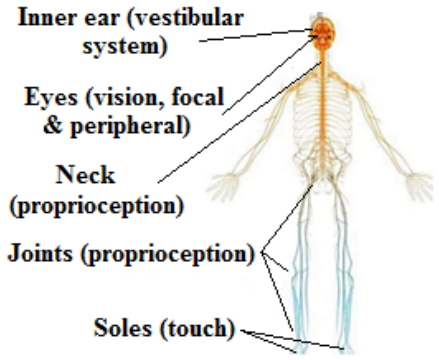

Fig. 1. *Equilibrium system* [11]

Reported to the equilibrium system, many researches were made on different aspects: visual field and acuity on body stability, postural stability [2], vestibular system influence [6], [9], feet joints or soles [4], [9]. There are many researches on stability, because any loss of balance may cause injury, fear, insecurity in sports and daily activities.

2. Life Style Influence on Body Stability as Hypothesis

It is known that not only the age, but especially the health statuses can decisive influence the equilibrium and body stability. Besides, body physical state, health state influences also in mental [8], [9]. Another aspect refers to the lifestyle in terms of practicing or not of any regular sport activities [3], [11]. It is not about performance sports, rather regularly sports activities practicing, at least weekly. For

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this reason, in this paper it was took the problem if any sports, especially those who invoke the equilibrium could influence the body stability. If yes, then how could these influence the body stability: positively or negatively [7]? To answer this question, some researches, described in the paper, were made for this reason.

3. Applied Method

To find in which way could or nor influence the life style the body stability, a group of 12 persons was tested. Six of them practice frequently sportive activities, and the other six persons do not practice any sports.

3.1. Subjects Selection

For the experiment on stability, a number of 12 subjects aged between 18 and 40 years were tested. Intentionally, the selection criterion was the following: first half of them practice regularly different sportive activities and the other half do not practice any sport. Of those who practice sports, three subjects practice weekly sports that involve body balance (skating, skiing, roller skating, jogging and so no) (meaning the first category). Other three persons practice sports that involve in a lesser extent the body balance (swimming, polo, snooker) (the second category) and the other six subject do not practice any sports (the third category).

The reason, for which the subjects were chosen to be aged between 18 and 40 years, was the following: for young people, the life style could influence the body stability in a greater extent than in case of old people. In case of children, testing is more difficult, because it would be hard to explain to them what to do during the experiment.

The tests were made in orthostatic position, being assessed the degree of displacement of the centre of mass (COM). Experimentally, this procedure proved to be the most effective and relevant in terms of body equilibrium [11].

3.2. Used Equipment

For the body stability evaluation of the 12 tested persons it was used a Kistler force plate, containing four piezoelectric sensors, in each plate's corner. These can measure the forces and displacement amplitudes in relation to all three Cartesian axes.

The main technical and functional characteristics of the force plate are presented in Table 1. The main advantage is that the force plate can be addressed by two types of hardware interfaces (the first one is analytic, the second being digital).

The main advantage when using this plate force, is that for each measuring cycle, both and simultaneously the displacements along X and Y axes can be acquired. This means that for each registering it can be obtained information on COM displacement amplitudes along sagittal and lateral planes, both.

Technical and functional characteristics of the used force plate Table 1

Dimensions (L x l x h) [m]	**Forces and displacements directions**	**Signal acquisition via hardware interfaces**	**Software environment**
0.5 x 0.4 x 0.04	along all axes (X / Y / Z)	- PC CARD DAS 16/16 acquisition board for analog input/output data; - PC CARD D24/CTR3 acquisition board for digital input/output data	- Bioware

The software environment associated to the Kistler plate, Bioware, allows acquiring the measured parameters as signals via PC cards. It allows displaying force and displacement distribution along one or more axes, as diagrams (Figure 2).

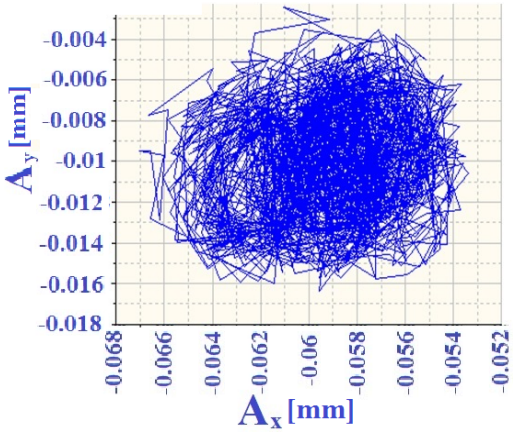

Fig. 2. *Example of COM displacements in both sagittal and lateral plane for a tested subject, displayed in Bioware*

Besides, the software environment allowed saving data into EXCEL files, containing numeric values on the measured parameters. These were subsequently processed.

3.3. Tests Methodology

Each subject followed a procedure meaning four steps: testing on Kistler plate in orthostatic posture, in head slightly bowed, in head strongly bowed and in head leaning slightly back (Figure 3). They were chose these postures because these are the most representative cases in terms of body stability for the daily activities (walking, standing, climbing and descending stairs) [10], [11]. Each testing step involved repeating the experiment three times, first in small base disposing on the plate (feet together), second in medium base and third in large base (feet apart) (Figure 4).

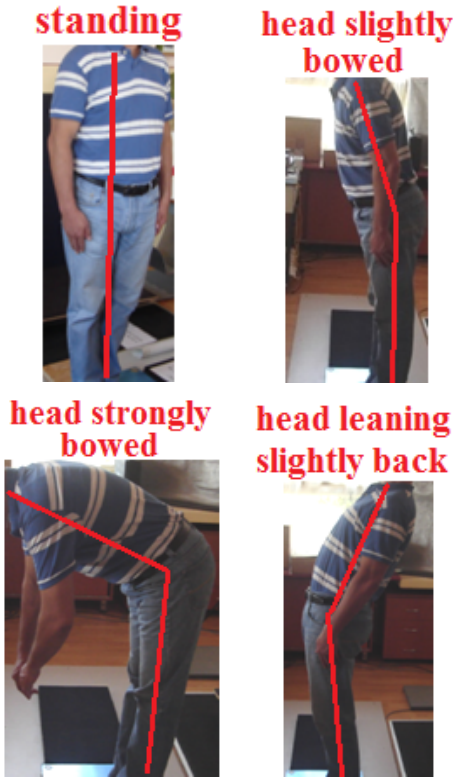

Fig. 3. *The steps followed for testing, meaning the four postures on Kistler force plate*

Therefore means that each subject was subjected to 12 recordings on Kistler plate. For each registering (via Bioware software) it was exported one EXCEL file, to be further processed.

For one registering, experimentally was established that a duration equal with 20 seconds was ideal for stability evaluation [1], [2]. On the one hand, this timing proved to be enough to capture the body behaviour in terms of stability. On the other hand, a longer period could lead to loss of concentration from the tested subject, leading to a non-relevant stability result.

After all persons have been tested, the calculation meant the COM averaged displacements for each subject. More exactly, for each one, it was determined both COM averaged displacements in sagittal and lateral planes.

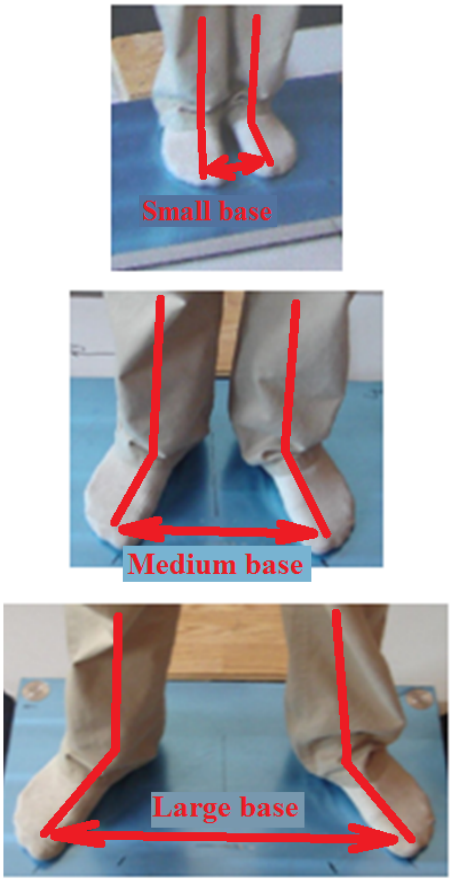

Fig. 4. *The three cases of disposing on Kistler plate when testing*

For this reason, the following calculus steps were done: determining the COM displacement for each posture (orthostatic, head slightly bowed, head strongly bowed and head leaning slightly back). These depended on the three registering, each time (small, medium and large base).

$$COM_{XY\_i} = \frac{C_{S\_XY\_i} + C_{M\_XY\_i} + C_{L\_XY\_i}}{3}, \quad (1)$$

where:

- COM_{XY_i} represents the COM displacement in sagittal (X) and in lateral (Y) plane for each posture in which the test has been performed;
- $C_{S\_XY\_i}$ - COM displacement when testing in small base;
- $C_{M\_XY\_i}$ - COM displacement when testing in medium base;
- $C_{L\_XY\_i}$ - COM displacement for large base, where i represents the current number associated to each posture on the Kistler plate (i = 1 to 4); i = 1, for orthostatic, i = 2, for head slightly bowed, i = 3, for head strongly bowed and i = 4, for head leaning slightly back posture.

Once determined the COM displacements for all testing postures, then it proceeded to determine the COM displacement as averaged values between the COM for all four postures, in sagittal (COM_X) and in lateral planes (COM_{XY}):

$$COM_{XY} = \sum_{i=1}^{4} COM_{XY\_i}. \quad (2)$$

The procedure and calculus relationships were applied for each tested subject. The calculus algorithm was used by taking data from all previously generated EXCEL files.

In this way, the measuring results could be obtained very efficiently and clearly [5]. The files to be processed have been obtained due to the Bioware software (paragraph 3.2).

4. Results and Discussion

As a result of the COM displacements values determination for all people, they could draw important conclusions about each person category (paragraph 3.1). First of all it is about their life style. In this regard, the results on body stability were centralized as follows: in Tables 2, 3 and 4 there are presented the results for the first, the second and the third category.

For each category, the results were centralized, using calculus relationships described in Equations (3÷5).

Table 2

The results on COM displacement amplitudes for the first category of investigated subjects

Tested person	COM displacement in sagittal plane [mm]	COM displacement in lateral plane [mm]
1st subject	13.65	13.97
2nd subject	12.96	12.25
3rd subject	17.25	13.70
Average	**14.62**	**13.31**

Table 3

The results on COM displacement amplitudes for the second category of tested subjects

Tested person	COM displacement in sagittal plane [mm]	COM displacement in lateral plane [mm]
1st subject	16.48	15.93
2nd subject	16.94	12.53
3rd subject	16.21	11.22
Average	**16.54**	**13.23**

Table 4

The results on COM displacement amplitudes for the third category of tested subjects

Tested person	COM displacement in sagittal plane [mm]	COM displacement in lateral plane [mm]
1st subject	20.52	23.68
2nd subject	32.16	20.90
3rd subject	24.43	19.45
4th subject	18.48	18.08
5th subject	15.61	19.06
6th subject	27.63	25.15
Average	**23.14**	**21.05**

In fact, there was calculated the arithmetic mean, providing from the values of the COM displacements in both planes, in case of each category of evaluated subjects:

$$COM_{SSE\_X/Y} = \frac{1}{3} \cdot \sum_{k=1}^{3} COM_{k\_X/Y}, \qquad (3)$$

where $COM_{SSE\_X/Y}$ represents the average mean of the COM displacement in sagittal and lateral planes for all subjects in the first category (paragraph 3.1) (Table 2). $COM_{k\_X/Y}$ means the COM displacement in sagittal/lateral plane for all three mentioned persons (Table 2) (k = 1 to 3):

$$COM_{SS\_X/Y} = \frac{1}{3} \cdot \sum_{l=1}^{3} COM_{l\_X/Y}, \qquad (4)$$

$COM_{SS\_X/Y}$ represents the average mean of the COM displacement for all tested subjects in the second category (values in Table 3) (l = 1 to 3):

$$COM_{SN\_X/Y} = \frac{1}{3} \cdot \sum_{m=1}^{6} COM_{m\_X/Y}, \qquad (5)$$

$COM_{SN\_X/Y}$ represents the average mean of the COM displacement in both planes for all tested subjects in the last category (Table 4) (m = 1 to 6).

It was find that for the first people category, the COM displacement in sagittal plane was 36.82% lower than for the last category. Also the COM displacement in lateral plane for the first category proved to be 36.77% lower. Besides, for the second category, the COM displacement in sagittal plane was 28.52% lower than for the third category. It was also demonstrated that the COM displacement in lateral plane for this category was 37.15% lower. The results were centralized as COM evolution diagram (Figure 5).

This means that in case of persons who regularly practice sports like skiing, skating or jogging, the body equilibrium in both planes is about 35% ÷ 40% better than for sedentary people. Also, for persons who weekly practice sports like

swimming, polo or snooker, the body equilibrium is about 35% ÷ 40% better in sagittal plane and about 25% ÷ 30% better in lateral plane. These results led to the conclusion that also conceptually balance and equilibrium is recommended regularly practicing sports, especially body equilibrium sports.

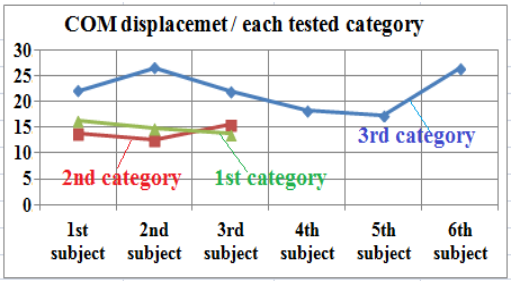

Fig. 5. *COM displacement evolution for each person category*

The achieved actual results refer yet to a small sample of subjects, meaning that the research will continue. In this conditions, the developed method, applied on the above mentioned sample of subjects will be in the future be used for on a much larger sample of people. Beside, the tests will address also persons in other age categories.

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