Movement activity and body stability as a part of life style in different life periods

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Original article

ANNA FAMUŁA[1], OLGA NOWOTNY-CZUPRYNA[1,2], JANUSZ NOWOTNY[3,4], MACIEJ PŁASZEWSKI[4]

[1] Institute of Kinesiology, Medical University of Silesia, Katowice, Poland
[2] Institute of Physiotherapy Backgrounds, Higher School of Administration, Bielsko-Biała, Poland
[3] Chair and Institute of Physiotherapy, Medical University of Silesia, Katowice, Poland
[4] Faculty of Physiotherapy, Higher School of Administration, Bielsko-Biała, Poland

Address for correspondence/Adres do korespondencji:
Dr n. o kult. fiz. Olga Nowotny-Czupryna
Zakład Kinezjologii
ul. Medyków 12, 40-752 Katowice

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Summary

Introduction. Physical activity is an important factor both composing human ability and influencing health status. Unspecific physical activity, especially in earlier life periods, generates a kind of potential, which can influence functioning of the elderly. Physical fitness, giving not only independence in some extend, but also abilities of coping with unpredicted situations, requiring involvement of coordination, skills, especially balance skills, are recognized as essential in such an age group It is presently one of leading research directions, conducted with priority of fall prevention among the elderly. Nonetheless, the question of posture and balance control applies to individuals of every age. An objective control of balance skills (body stability) seems important, as recognizing any deficits in this respect can be a valuable indication towards establishing specific preventive actions, soothing such deficits or minimizing consequences of a potential fall.

The aim of the study was to define the influence of level of previous physical activity on body stability in aged individuals.

Material and methods. Over 100 volunteers, aged 20 – 70 years, with some outnumber of females, took part in the study. Data about intensity and characteristics of present and past physical activity was taken from participants. Balance and body stability were measured with AMTI stabilographic platform. Balance regulation skills and stability (stability safety margin) were assessed. The stabilographic data, with subjects' age and physical activity, were analyzed statistically.

Results. The findings indicate interpersonal heterogeneity of body stability regulation ability, stability and reaction time. A tendency towards worse results was seen in subjects over 50 years of age, as compared to younger participants, especially in stability, manifested by increased [so called] safety margin, especially during backward swings. A tendency towards better results was observed in subjects formerly more physically active, regardless the age. The correlation was not thoroughly consistent, however

Conclusions. Interpersonal heterogeneity of body stability and tendency for its declining with aging indicate that risk of falls among aged people does appear, but varies interpersonally. Better results, normally achieved by more active persons, suggest it purposeful to treat physical activity as a long-distance prophylaxis. Physical activities engaging coordination and balance control to a greater extend seem more beneficial in this respect.

Key words: movement, life style, age, disability, prevention of falls

INTRODUCTION

Physical activity is a major factor, constituting one's physical fitness and influencing health status. Promoting healthy life style, specialty various forms of physical activity, is crucial in context of health promotion in aging societies. General physical fitness, especially in earlier life periods, produces a specific potential, which may have an implication for aged people [1]. Physical abilities, not only giving independence, but enabling to cope with unpredictable situations, where coordination and, especially, balance control skills,, are assumed to be of exceptional importance in this age group Presently more attention is paid to the issue of stability and spatial body stability training, especially in elderly – as a priority, which results from fall risk and their serious consequences, most often occurring in this age group. As balance control skills impair with aging, efficient replacement strategies are somehow needed to be fund, in order to reduce involutory processes, responsible for impairment of balance functions, and to decrease risks of weakened body stability [6,7,11]. It is presently one of leading research areas, mainly as regards fall prevention in aged people, however the matter of balance control applied to any age group. Objective measurement of balance control (body stability) abilities seems important, as defining any deficiencies can be a valuable indicator for performing a special preventive strategy, decreasing those deficiencies or reducing consequences of potential fall [1,12,13,14,15,16,17,18].

The aim of the study was to define the influence of physical activity in the past on present body stability in different age periods.

MATERIAL AND METHODS

The study involved 115 participants, aged 21 – 82 years (x = 43,98 ± 20,89), among them 79 females and 36 males, aged 21 – 82 years (x = 44,82 ± 21,85) and 21 – 73 years (x=42,13 ± 18,79), respectively. Subjects were divided into three arbitrally defined age groups: young (below 35 years of age), middle aged (between 35 and 60 years old) and seniors (61-64)

Participants were interviewed in order to assess their former and present characteristics and intensity of physical activity and on this basis were qualified into three subgroups of low, moderate and high levels of activity. Simultaneously, health status of each participant was recognized. Neurological and orthopaedic conditions, as well as medication influencing balance mechanisms were exclusion criteria.

Stabilographic parameters were measured, recorded and analyzed with AccuGait platform and Balance Clinic software (AMTI). Measurements were performed in upright position, feet shoulder – width, with eyes opened, then with eyes closed and, as a third part of the measurements, in the same position with maximal trunk movements in sagittal plane forward and backward, and in coronal plane side wards, with vision control (eyes opened) for safety reasons. Each trial took 30 seconds.

Finally, body stability was confounded by mimicking trunk and arm movements of reaching and catching an object falling in front of the subject. Participants started on an audio signal. Reaction time was measured by a photocell system, where the time measurement started with the sound Signac and ceased when the subject's arm crossed the light beam. The trials were performed three times and average values of measured parameters were computed.

Thus, movements of the projection of the center of gravity in upright position, with Or without sight control (with eyes opened or closed), during maximal trunk movements in different directions, as well as stabilographic parameters in circumstances of indisposed balance disturbances, were recorded. The areas of movements, stability margins, and the distance made by the projection of the Centre of gravity in the two trials with eyes opened and closed, were analyzed. The abilities of maximal body movements in various directions, in standing position, were also measured. During the last trial, reaction time and the magnitude of balance disturbances were studied.

The obtained parameters were analyzed with the Statistica software. The analysis was conducted with respect for defined age and physical activity groups. Individual age groups were compared and relationship of stabilographic parameters, age and physical activity were analyzed.

RESULTS

High levels of physical activity were fund in only 22.64 % of Young participants, and 13.21 % declared low activity. Thus, moderate levels of activity, recorded in 64.15 % of Young subjects, dominated. Similar findings regarded Middle age group, where high, moderate and low activity levels were represented by 15.79 %, 70.58 % and 10.52 % of participants, respectively. Of senior participants, none of the subjects declared high level of activity, 44.18 % declared moderate activity, while 55.81% described their activity as low level.

Individual measurements of the distance of movement of the projection of the Centre of gravity on the support plane varied considerably in the subsequent age groups, both in the opened – eyes trials and without the visual control. The best results (lowest side movements , shortest distance) were noticed in middle – aged participants, in contrast to the group of seniors. The findings worsened to some extend during measurements of closed – eyes trials, but in the majority of comparisons no statistical differences were found, with exception of moderately active young and highly active middle – aged participants. Differences in the aged subjects were bordering statistical significance.

Age group differences of the values of the distance of movements of Centre of gravity projection in stand-

ing position with eyes opened were significant only when groups of young and older participants were compared (t= 2.24; p<0.02). Comparisons of data obtained in closed – eyes trials, significant Inter – group differences between young and older (t = 2.59; p<0.01), as well as between middle aged and older subjects were observed, whereas young – middle aged differences were not significant.

The values of margins of stability in various sides, in comfort upright position with the visual control, were similar in subsequent groups.

Comparing margins of stability values in subsequent age groups, taking into account physical activity levels, Turing standing trials with eyes opened and closed, obtained results were not thoroughly homogenous.

Table 1. Range (min – max), mean values (X) and standard deviation (SD) of the length of the of the projection of the Centre of gravity movements in the trials in upright positions with eses opened and closed, and the level of differences (t/p) in subgroups of different age and physical activity level

physical activity	age group	eyes opened		eyes closed		statistical significance
		min max X	SD	min max X	SD	t/p
low	young	34.01 57.86 40.38	8.15	32.74 58.17 43.68	9.20	1.85; p >0.1
	middle aged	41.76 47.28 44.39	3.9	47.36 47.58 47.47	0.15	1.11; p >0.46
	seniors	26.24 70.74 45.82	15.62	26.87 21.64 58.03	39.65	1.98; p = 0.059
moderate	young	29.24 70.74 41.45	8.89	27.42 82.82 44.35	12.30	2.23; p<0.034
	middle aged	30.41 59.56 40.72	8.34	29.29 55.77 40.85	7.99	0.09; p>0.92
	seniors	29.94 81.39 46.96	12.13	30.74 121.71 53.21	21.37	2.04; p = 0.056
high	young	28.87 51.54 38.2	7.48	28.81 53.36 39.96	7.1	1.64; p>0.13
	middle aged	27.74 34.65 30.58	3.61	31.26 39.36 34.16	4.51	5.65; p<0.02
	seniors	—	—	—	—	—

Table 2. Age group comparisons and levels of significance of differences (t/p) of the length of movements of the centre of gravity projections in upright position trials with eyes opened and with eyes closed

upright position	compared groups		
	young / seniors	young / middle aged	middle aged / seniors
eyes opened	t = 2.24 p < 0.02	t = 0.55 p > 0.57	t = 1.86 p > 0.067
eyes opened	t = 2.59 p < 0.01	t = 1.17 p > 0.24	t = 2.05 p < 0.044

Table 3. The value of stability margin in upright position with Visual control, against support plane borderline in young, middle aged and senior age groups

age	values of stability margins							
	to the front		to the back		to the left		to the right	
	x	s	x	s	x	s	x	s
young	4.21	0.66	4.39	0.69	5.67	0.96	5.65	0.83
middle aged	4.21	1.56	3.94	2.43	5.84	2.60	5.77	1.16
older	4.13	1.04	3.2	2.82	5.01	2.09	5.26	1.07

In young group significant difference of the margin was only observed in moderate activity subgroup, on the left side (t = 2.3; p<0.03). Middle aged subjects manifested differences of stability margin from the back in the low activity and, interestingly, high activity subgroups, while in senior participants stability margin differed significantly from the front (t= 2.38; p< 0.02) and from the back (t= 5.02; p< 0.001) in low activity subgroup, only.

Mean reaction time in age groups, with respect to the activity level and gender, was also computed. Even first – sight analysis reveals clear inter – group differences, especially between young and older participants. When taking into account activity level, gender differences can be seen, only.

The greatest, and statistically significant differences in reaction time were found between groups of moderately active Young and older participants (t=5.26; p<0.001). Remaining significant differences were noted between groups of Young and older subjects, declaring low physical activity (t=5,26; p<0,001), as well as between middle aged and older subjects with low activity and between groups of young and middle aged subjects with moderate activity.

Inter – group comparisons of gender subgroups revealed, that the greatest differences occurred between young and older females (t= 5.71; p< 0.001), between young and older males (t= 2,56; p< 0,006), between Young and Middle aged males (t= 2.37; p<0.02), and between Middle aged and senior females (t= 2.71; p<0.09).

Comparisons of reaction time of males and females in the groups of young and older participants, with regard to physical activity level, significant difference is seen between young women and men of low physical activity (t= 3.01; p< 0.02), as well as between older women and men with low physical activity (t= 2.48; p<0.02).

Stabilographic parameters, recorded during above trial, were clear. Majority of subjects exceeded the bor-

Table 4. Age group comparisons and levels of significance of differences (t/p) of the margin of stability between upright position trials with eyes opened and with eyes closed, with respect to physical activity in young, middle aged and senior age groups

margin	**age**							
	young			**middle aged**			**senior**	
	activity			**activity**			**activity**	
	low	**moderate**	**high**	**low**	**moderate**	**high**	**low**	**high**
from the front	t = 0.34 p > 0.73	t = 0.86 p > 0.39	t = 0.07 p > 0.94	t = 2.53 p > 0.23	t = 111 p > 0.28	t = 0.89 p > 0.46	t = 2.38 p < 0.02	t = 0.64 p > 0.52
from the back	t = 0.018 p > 0.98	t = 0.05 p > 0.62	t = 0.51 p > 0.61	t = 1.32 p < 0.03	t = 0.01 p > 0.98	t = 4.45 p < 0.04	t = 5.02 p < 0.00	t = 0.87 p > 0.39
from the left	t = 1.07 p > 0.31	t = 2.3 p < 0.03	t = 1.03 p > 0.32	t = 1.74 p > 0.33	t = 1.67 p > 0.11	t = 2.26 p > 0.15	t = 1.22 p > 0.23	t = 0.56 p > 0.57
from the right	t = 1.23 p > 0.25	t = 1.29 p > 0.2	t = 0.41 p > 0.68	t = 0.17 p > 0.89	t = 2.02 p > 0.07	t = 0.7 p > 0.55	t = 1.28 p > 0.21	t = 0.31 p > 0.75

Table 5. Reaction time in photocell trial in subsequent age groups, with respect to physical activity level and gender

reaction time	**age**							
	young			**middle aged**			**senior**	
	activity			**activity**			**activity**	
	low	**moderate**	**high**	**low**	**moderate**	**high**	**low**	**high**
all	x=57.87 ±10.64	x=59.12 ±12.03	x=57.16 ±13.65	x=68.00 ±3.77	x=68.66 ±13.81	x=59.22 ±9.19	x=78.85 ±24.46	x=78.51 ±15.13
females	x=54.95 ±7.25	x=60.26 ±12.9	x=66.26 ±13.37	x=65.33 ±0.38	x=66.77 ±9.59	x= 52.33 ±0.52	x=85.62 ±23.58	x=77.00 ±12.71
males	x=78.33 ±0.32	x=56.12 ±9.43	x=50.66 ±10.2	x=70.66 ±0.12	x=74.33 ±24.84	x=62.66 ±9.89	x=59.66 ±15.99	x=81.55 ±20.15

Table 6. Age group comparisons and levels of significance of differences (t/p) of the reaction time, with respect to physical activity level

	activity						
	low			**moderate**			**high**
	age: young / older	age: young / middle aged	age: middle aged / older	age: young / older	age: young / middle aged	age: middle aged / older	age: young / middle aged
reaction time	t = 2.32 p< 0.02	t = 0.69 p> 0.5	t = 2.32 p< 0.02	t = 5.26 p<0.001	t = 2.58 p< 0.013	t = 1.87 p>0.07	t = 0.57 p> 0.57

derline of the support plane, but reacted quickly enough to avoid complete loss of balance. Thus, mean margin of stability was negative: – 0.33 cm, – 0.38 cm, and – 0.35 cm, in females, in males, and in the whole group, respectively. No statistical differences between subsequent subgroups were found, though.

DISCUSSION

Impairments of balance and centre of gravity placement control, progressing with age, and corresponding risks of repeated Falls, induce closer interest in this matter and in introducing preventive actions – i.e. defining, promoting, and implementing proper training improving this ability [2,3,4,5,7,10]. Observed differences among subjects of different levels of physical activity, revealing better stability control in persons highly and moderately active, can constitute a valuable argument, convincing of the preventive value of physical activity. Interestingly, better results were measured in Middle aged partiicipants than in Young subjects, chich can be explained by the fact that, as ballance abilities can be placed among coordination skills, their greatest development occurs in the middle of the second decade of life. Maintaining of the high level of these abilities, even in the Middle age, especially among physically active pe ople, constitutes an Imnortant argument, that by physical activity such abilities can be sustained and even improved. The fact, that the greatest impairments of body balance control were observed in older participants, is not surprising, Contributing factors are: history of injuries and illnesses, prezent disfunctions, but, firstly, decrease of general fitness, connected with the involutory processes, and, fairly common, lowering of physical activity in this age period [1,2,3,7,9]. While primary prophylaxis ought to Take place earlier, in elderly persons it is reasonable to introduce actions of a secondary prophylaxis specificity. Significant improvements of coordination skills Carnot be expected in this age, though, but the aim is a kind of stability practice, and, especially, training of proper behaviours in unexpected, surprising situations, requiring prompt and safe reactions [8,11,19]. The situation is, on the other hand, worsened by significantly longer re action time, found in older subjects, especially in women. Reaction time differences between males and females, shown most clearly in groups of low physical activity, encourage to further research, and seem to support results of other studies [16]. It applies for both young and older persons. Sufficiently prompt re action in unexpected situations, connected with the loss of stability, enables safe regaining control of the Centre of gravity placement. Over half of the subjects, including older participants, manifested abilities of that kind. The feature of the best control in the middle aged people was also confirmed.

The subject of stability control, especially in context of disturbances in its mechanisms, is very complex and requires a multi – aspect analysis. Life style modification, increasing of the physical activity level and individual scheme of stability training (especially in fall risk population) can be an import ant factor, preventing Falls and their serious consequences [17,18,19].

CONCLUSIONS

1. Balance and stability control worsens with age.
2. Better control of body stability in physically active persons encourages dissemination of physical activity in every age.
3. Various reaction times in men and women, in groups of both Young and older subjects, occuring in low activity subgroups, only, indicate greater influence of activity than gender on re action time.

The best stability control in Middle – aged subjects suport the notion of the highest level of this ability in the Middle of the second decade of life.

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