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RELATIONSHIP BETWEEN SOLDIERS' BODY HEIGHT-WEIGHT CATEGORY AND CHANGES IN THEIR SPINAL COLUMN KYPHOTIC CURVATURE DURING A LONG-TERM MILITARY MISSION

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ABSTRACT

Prolonged physical load can unfavourably influence the human vertebral column. Thirty-six well-trained male soldiers from the Estonian ESTCOY-8 infantry company were examined before and after a 6-month military mission to assess the effect of long-term physical load on soldiers' spinal column kyphotic curvature in relation to their body build (height-weight category). Body height and weight of the men under study were measured before and after the 6-month-long military mission. BMI was calculated as the body weight (kg) divided by the square of the standing body height (m). Body height-weight category was assessed according to Kaarma et al. 2008. Spine kyphotic curvature in the sagittal plane was recorded using pantography. The results of the study showed that significant kyphotic curvature appeared in half of the well-trained soldiers. Changes in kyphotic curvature were related to the person's body build (height-weight category). Subjects with a larger body seemed to have greater stability of kyphotic curvature.

INTRODUCTION

Prolonged difficult physical challenges during military service expect physical fitness and reliability of whole body systems of the army personnel. During prolonged physical load impairment of different body systems (including the immune system, cardiovascular system) is well known [2, 9]. It is also known that long-lasting high physical load can

lead to biomechanic malfunction of the vertebral column [5, 6]. Besides body weight tolerance, conservation and maintenance of the central nervous system and contribution to trunk motion, the thoracic part of the spine or the kyphotic curve supports and protects the heart and the lungs. Increasing curvature of the spine can lead to problems in normal functioning of the body (for example to overstretch of the posterior muscles, problems in breathing etc.) [9]. We were interested in examining well-trained soldiers before and after a high-load military mission to assess the effect of long-term physical load on soldiers spinal column kyphotic curvature in relation to their body build (height-weight category).

MATERIAL AND METHODS

Thirty-six well-trained male soldiers from the Estonian ESTCOY-8 infantry company were examined before and after a 6-month military mission in Afghanistan. This study was a small part of a larger examination of the Estonian ESTCOY-8 infantry company soldiers conducted by the Department of Cardiology, University of Tartu, supervised by Prof. Jaan Eha, that has been partly reported by Salum et al. in 2011 [7]. The study was approved by the Institutional Ethics Committee and an informed consent was given by each participant. Body height and body weight were measured according to Martin and Saller (1956) [4] in an ordinary way. BMI was calculated as the body weight (kg) divided by the square of the standing body height (m). Body height-weight category was assessed according to Kaarma et al. 2008 [3]. We used the Estonian height and weight norms for adult Estonian men and a height-weight classification [3] to assess the height-weight category of each participant in the study.

Spine kyphotic curvature in the sagittal plane was recorded using pantography [11, 12].

Statistical analysis was performed using the SPSS software package version 17.0 (SPSS, Inc., Chicago, Illinois). Paired Samples Test was used to compare a person's variables before and after military mission. The level of $p<0.05$ was selected to indicate statistical significance.

RESULTS

Mean height and weight and BMI of the studied men before and after the 6-month-long military mission are shown in Table 1.

Table 1. Body height, body weight and BMI of the studied soldiers before and after the 6-month long military mission

Variable	Mean		SD		Median		Significance of the change by Paired Samples Test
	Before mission	After mission	Before mission	After mission	Before mission	After mission	
Body height (cm)	180.71	180.07	7.00	7.05	179.03	178.75	P<0.0001
Body weight (kg)	78.49	78.35	10.96	10.24	76.75	78.00	NS (p=0.830)
BMI (kg/m^2).	24.03	24.13	3.02	2.81	23.35	23.90	NS (p=649)

Table 2. Distribution of soldiers by body height-weight categories

Body height-weight category	n	%
1 – small	9	25.0
2 – medium	8	22.2
3 – large	4	11.1
4 – leptomorphic	11	30.6
5 – pycnomorphic	4	11.1
Total	36	100

One third of the studied soldiers belonged to the leptomorphic category, which means that they were tall and relatively light in comparison with Estonian men of the same age. Most of the soldiers (58.3%) belonged to height-weight concordance categories (small, medium, large). A smaller part (41.7%) of the investigated men represented categories of discordant height and weight (leptomorphic and pycnomorphic categories). Large and pycnomorphic participants were in the minority among the well-trained soldiers under study. More than half (n=20, 55.6%) of the participants were small or leptomorphic. Half (50%) of participants had important kyphotic curve changes (more than 4º) during the mission and both kyphotic changes – flattening of the kyphotic

curvature and increasing of kyphotic curvature – were distributed relatively equally (22% and 28% respectively).

Figure 1 shows that increasing of kyphotic curvature during the military mission was more characteristic of leptomorphic men. Flattening of the kyphosis was characteristic of soldiers of the small category. We could not detect any large or pycnomorphic persons with increasing kyphotic curvature and any medium category men with flattening of the kyphotic curvature.

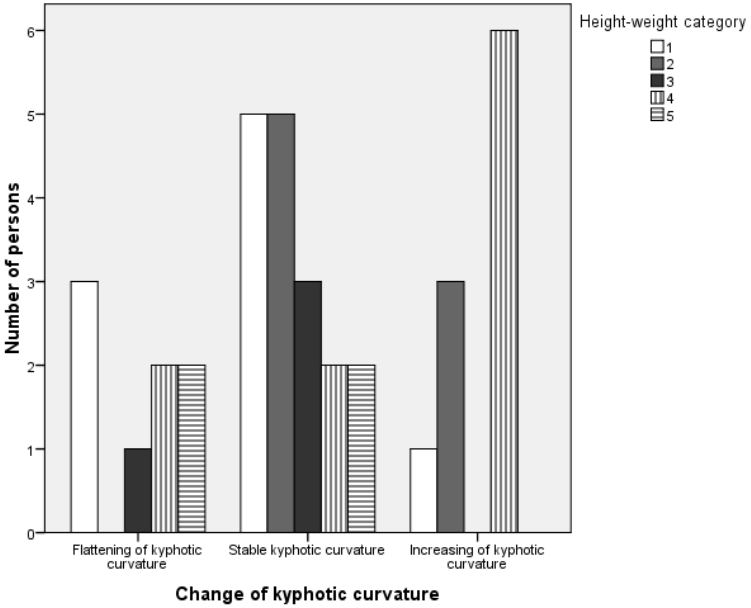

Figure 1. Relations between the height-weight category and changes of kyphotic curvature during the long-term military mission. (Height-weight categories: 1 – small, 2 – medium, 3 – large, 4 –leptomorphic; 5 – pycnomorphic).

DISCUSSION

The normal shape of the vertebral column helps the body to bear the compressive loads. The level of physical load must not exceed the boundaries of an even well-trained organism's adaptational capacity.

The level of permissible load is individual. Overload of the spine can cause deformities of the vertebral column or alteration of spinal curvatures, e.g. a flat back. Monitoring of long-term physical load effect on the musculoskeletal system could prevent the development of latter serious pathologies that could otherwise be unnoticed and untreated due to insufficient clinical symptoms [1, 6, 8].

We examined soldiers to find the effect of long-term physical load on their spinal column kyphotic curvature situation. Changes of kyphotic curvature were observed in half of the young well-trained soldiers. The five-class height-weight classification has been suggested by different studies [3, 10] as a usable basis for analysing whether the differences in distinct persons are related to their body build as a whole or not when different characteristics of the persons are studied. Our study confirmed the applicability of the height-weight classification in getting a systematic overview of relations between body build relations and changes in kyphotic curvature during a military mission. Although the number of studied soldiers was relatively small, methodical following of the changes in kyphotic curvature by body height-weight categories enabled us to notice the relationship between the body build and kyphotic curvature changes. We saw that, as Estonian young adults in general [3], the studied soldiers were also characterized by lepto-morphic body build that could be predisposed to increase of kyphotic curvature. Vice versa, well-trained soldiers with a pycnomorphic body build seems to have higher adaptational capacity to bear a high load for a long time. The large body also seems to be favourable in relation to stability of kyphotic curvature. The reason could be that the high load makes up a smaller proportion of the bigger body size. The overall changes in body height also showed that the long-term mission affects the soldiers spinal column statistically significantly. In our opinion the body build should be taken into account in military service to prevent possible later unfavourable changes in men's health, especially if the person is repeatedly involved in such long-term military missions.

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