Linear regression correlation of health behaviour factors and fitness skills in the Hungarian Defence Forces

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Research

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Abstract

Background

The observance of health behaviour recommendations is particularly important in the armed forces where about a certain level of the different physical abilities has to be given account of regularly during work too. The aim of the research is to analyse certain areas of the soldiers' lifestyle how much they influence the reached scores on the physical tests used by the Hungarian Defence Forces.

Sample and Method

During examination we compared the results of the prevention data sheet of the soldiers (n=490) appeared on the annual health screening in 2015 against their points obtained on the annual physical fitness test (PFT). The average age of the sample test was 34,1 years (± 6,91 years) and the proportion of the women was 13,5%. In the test our participants' average height was 177,64 cm (±7,49 cm), the average weight was 78,94 kg (±12,07 kg). According to the prevention data sheet we analysed the eating habits, frequency of psychosomatic waist pain, body mass index (BMI), the relationship between age and smoking status in relation to scores obtained by stamina and strength endurance practices. To assess the physical fitness of the cardio-vascular endurance we used the results of the 3200 m flat race and for the strength endurance survey we used the results of the scores from lying on the back sit-up with bent legs and arm bending in push-up performed within 2 minutes in a maximum repeat number.

Results

The growth of the body mass index with 0,1 meant 2 points loss. Regarding the frequency of vegetable-, fruit-, cereal-, and dairy product consumption we found a significant difference ($p \leq 0,05$) in correlation of the obtained scores on the PFT. The back pain as a symptom appearing monthly meant an advantage on the strength endurance tests, as for smoking on the physical fitness tests. Age did not influence the results of the physical tests significantly.

Conclusion

The detection of the connection between certain health behaviour factors and the physical parameters can be one of the strategic tasks of the military supply service.

Background

The observance of health behaviour recommendations is particularly important in the armed forces where about a certain level of the different physical abilities has to be given account of regularly during work too. Health is the symbol of certain jobs and professions, and as such, the social picture, opinion is formed accordingly in the thinking of a nation, state. These jobs require a certain level of the different physical abilities which has to be given account of regularly during work too. Thanks to this it can be said that both domestic and internationally, the health and physical condition of service beginners exceeds the

status of the civil society's members with similar parameters.[1,2] The occupational health professionals who are responsible for ensuring the physically fit workforce, use the physical fitness tests to assess the physical fitness of the army. The most beneficial tests are those which are related closely to the critical tasks from the perspective of general work.[3] In the Hungarian Defence Forces (HDF) also – such as in other nation's army – the proper general physical state has been determined as selection criteria and it has been checked yearly, assuming that these abilities – cardiovascular physical fitness as well as the trunk-, shoulder-, arm muscle strength endurance – are required not only for maintaining health but also for singularity of military service's supply. The quantitative and qualitative indicators of the nutrition, the smoking habits, the psychosomatic burden are critical elements of the soldiers' health and efficiency. The occurrence of a risk factor is related to a statistically significant decrease in performance.[4,5] In addition, it can be detected that the appearance of health risk is associated with the reduction of physical fitness.[6]

The military appropriateness has rigorous physical stature standards, but the lowest guidelines are applied with respect of health risk thresholds, the appropriate level of the physical performance closely related to this is placed between the two poles.[7] The correct eating habits are strongly related to medical condition, physical fitness as well as every dimension of psychosocial status to support mental and physical performance, allowing to reach the military standby.[8] The energy imbalance by this the change of the body shape – body fat mass growth in most cases – spoil the soldier's physical load capacity.[9,10] The domestic studies show that people who possess the normal body mass index (20–25 BMI) reach the highest fitness level regardless of the age group.[10] It can be stated that health behaviour habits closely related to physical activity – e.g.: sport activities – improve the physical fitness of the armed forces.[11,12,13] It is also clear that the eating habits connect to the soldiers' physical condition.[14,15]

Our goal was to reveal the relationships between the physical skills necessary for military service and some of the health behaviour factors and also to identify those non-physical lifestyle parameters which could influence the cardio-, vascular training rates, as well as the muscle strength endurance of arm and trunk muscles.

Sample And Method

To create our database, we have made a cross-sectional analysis in the circle of those professional and contractual staff members of the HDF who appeared on health screening in 2015, filled in the health screening form (HSF) completely and their screening data have been fixed electronically in an assessed and usable manner. During statistical analysis we included only those questionnaires, which the test person gave a written consent to use the data for statistical purposes and the examined variables were filled in completely. We put a big emphasis on following the ethics rules in relation to data collection and analysis (informed consent form, analysis inadequate for personal identification), the results will be communicated with the compliance of ethics rules hereinafter. According to HSF we analysed our samples regarding to eating habits – frequency of consumption of vegetable, fruit, cereal, dairy product – frequency of the occurrence of psychosomatic waist pain, smoking habits and the effect of body mass

index (BMI). We have used 7-degree scale regarding the consumption of vegetable, fruit, cereal and dairy product as for psychosomatic back pain 5-degree Likert-scale. In the former case it could be chosen among *never, less than a week, 2–4 times a week, 4–5 times a week, every day or more than once daily* regarding consumption. In the latter case *daily, more than once a week, on a weekly basis, monthly or more infrequently* occurring symptoms have been recorded.

Furthermore, the corrected points according to age groups have been got into the analysed variables which can be obtained on the yearly physical survey (PCS) – which contain the tests regarding the heart-vascular system physical fitness survey like running as well as the trunk-, shoulder- and arm muscles strength endurance survey from push-up arm bending and from lying on the back sit-up tests - carried out compulsory under the age of 50. The goal was to assess the physical fitness of the heart-vascular endurance with completion of the 3200 m flat race within a shorter time. The obtained results were recorded according to a point system appropriate for sex and age group. The obtainable score could spread from 0 to 160 points. During the strength endurance survey the obtained scores are normally from lying on the back sit-up with bent legs and arm bending in push-up performed within 2 minutes in a maximum repeat number. The obtainable score spread from 0 to 200 points.

The average age of the sample test (N = 490 persons) was 34,1 years (± 6,91 years) and the proportion of the women was 13,5%. The distribution of the sample by age groups was as follows: 18–30 age 32%, 31–40 age 48% 41–45 age 15%, 46–50 age 4%, older than 51 years 1%. In the test our participants' average height was 177,64 cm (± 7,49 cm), the average weight was 78,94 kg (± 12,07 kg). The body mass index of the entire sample was 24,99 kg/m^2 (± 3,34 kg/m^2), the men's was 25,08 kg/m^2 (± 3,37 kg/m^2) as for women's was 24,41 kg/m^2 (± 3,1 kg/m^2). According to the results obtained on the PCS the average score of the sample regarding strength endurance was 140,95 points (± 29,27 points), as for the average score of the test regarding stamina was 135,47 points (± 26,04 points).

In our statistical procedure – we used R-studio program in R environment – we created a multiple linear regression model. The 0,05 value of the significance level was determined. A graphical fitting test (QQ-plot) was performed for the validity of the model (1., 2., 3. diagram)

Results

Regarding to vegetable consumption compared to those who have almost never consumed vegetables each category meant additional points in respect the total score (1. Table). Referable to fruit consumption we compared the other categories to *less than a week* consumer. Accordingly, the results came out similarly like regarding vegetable consumption, the more frequent fruit consumption resulted in extra points on the PCS (1. table). In relation to cereal consumption those people, who almost entirely ignored cereals from their diet, were taken as benchmark. In our research we didn't find a significant correlation between the frequency of cereal consumption and the total score obtained on the physical fitness test.

With regard to dairy products similar results came out as far as the cereal consumption was concerned. The *almost never* consumers were taken as benchmark. In this case we didn't find a significant correlation between the frequency of dairy product consumption and the total score obtained on the physical fitness test also.

Referring to psychosomatic back pain the following results were obtained in relation to *daily* appearing symptoms. The *several times a week* appearing symptom meant 4 points, and the *weekly* regularity meant 8 points in respect the loss of the total score. The *monthly* appearing symptom possessed more than 21 points and the *more infrequently* appearing back pain 10 points, however the differences did not exceed the significance level specified by us.

Considering smoking compared to those who do not smoke and have not smoked at all we correlated to those who have already quit smoking and smoke currently. Accordingly, in the model almost any kind of difference was not observed among those who have already quit smoking and have never smoked in relation to the total score. Referring to age every single year meant about half point plus, but this result was not significant. The increase of the body mass index with 0.1 brought almost two points loss (1. table). The reliability of the correlation between the above mentioned examined variables and the total scores obtained by PFT is presented to Fig. 1. by QQ plot.

Stamina pattern

In our research we didn't find a significant correlation between the frequency of vegetable consumption and the total score obtained on the physical fitness test.

Referable to fruit consumption we compared the other categories to *less than a week* consumer. The more frequent fruit consumption resulted in extra points (2. table).

Surprisingly in the model compared to those who almost entirely ignored cereals from their diet, got less points than every other more frequent consumer category (2. table).

With regard to dairy products the *almost never* consumers taken as benchmark the increase of the score could be observed with the increase of the frequency (2. table).

Referring to psychosomatic back pain we didn't get a significant difference in relation to changes of the frequency factors and the total score obtained on the physical fitness test. Between smoking status and the obtained score on the heart-vascular endurance test we found that no smoking meant less points in the model than quit smoking more than 1 and active smoking more than 5 points (2. table).

The age growth meant 0.3 points plus – not significantly – the body mass index meant almost 2 points minus (2. table). The reliability of the correlation between the above mentioned examined variables and the scores obtained by one of the part of PFT (cardio-vascular) is presented to Fig. 2. by QQ plot.

Strength endurance pattern

Similar to the previous ones, all the categories meant plus points regarding vegetable consumption compared to those *who have almost never consumed* vegetable (3. table).

Referable to fruit consumption we compared the other categories to *less than a week* consumer.

The more frequent fruit consumption resulted in extra points regarding the total score obtained on the strength endurance test (3. table).

In our research we didn't find a significant correlation between the frequency of cereal consumption and the total score obtained on the strength endurance test.

With regard to dairy products' consumption the *almost never* consumers taken as benchmark the decrease of the strength endurance score could be observed with the increase of frequency.

Referring to psychosomatic back pain we analysed the results in relation to *daily* appearing symptom. We found a significant difference in relation to monthly appearing symptom regarding the strength endurance scores (3. table).

In respect of smoking status, age and the body mass index we didn't find a significant correlation in relation to scores on the strength endurance test. The reliability of the correlation between the above mentioned examined variables and the scores obtained by one of the part of PFT (cardio-vascular) is presented to Fig. 3. by QQ plot.

Discussion

The soldiers' lifestyle influences the scores obtained on the physical tests strongly. The results of the U.S. Army's longitudinal follow-up analyses showed that the service beginners in the armed forces can be said to be especially healthy and fit thanks to relevant screening tests and regulations.[1] The health behaviour researches completed in the HDF showed, - similarly to U.S. Army – that the health status of the service beginners was higher than the status of the average population thanks to the selection of the aptitude test system.[2,16] By favour of the physical aptitude tests the fitness indicators represent a higher level of quality than average, which continue to rise after the training. However, after the termination of the service, work the positive yield of the health status reduces and they are in even worse health than the members of the civil society. The veterans' health behaviour is worse than the civils, they will smoke more likely, they will eat unhealthier and move less, their health and physical condition is poorer than average.[17,18]

Previous researches carried out on sportsmen – not on soldiers – have found a health protective effect in many cases in the circle of the younger smokers on both levels, domestic and international.[19,20,21] In the research samples – unexpectedly – the runtime results came out significantly better in the circle of smokers. Despite the fact, that smoking had advantages according to our results based on this sample regarding the scores obtainable on the endurance test, we recommend giving it up rather.

To explain this, further testing is necessary, similarly to the results obtained by the strength endurance pattern in connection to dairy product consumption. The increase of the frequency of dairy product consumption meant significantly less points regarding the total score obtained on the strength endurance test.

Our previously performed research has shown that the frequency of back pain as a psychosomatic symptom is closely related to the chance of the appearance of non-infectious diseases.[22] One of the results of our recent study was that the frequency of psychosomatic back pain was related not only to scores obtained on the strength endurance test but also to the chance of the appearance of chronic non-infectious diseases. The advantage of the monthly psychosomatic back pain regarding the strength endurance pattern can be justified by the participants' relatively young average age and by this the frequency of higher military physical ability. The proper nutrition is closely related to physical fitness and military standby.[18,23] Therefore, there is no question that the actual nutritionists have an important aim to define the qualitative and quantitative indicators. In our analysis it was confirmed – in accordance to earlier studies – that maintaining of the normal body weight (BMI 20–25 kg/m2) is essential to achieve the appropriate military physical skills.[10]

The ideal frequency of vegetable and fruit consumption has been identified, which can be the highest score available with, regarding the scores obtainable on the endurance as well as strength endurance tests. Age has not meant a significant difference in the correlation of the test variables thanks to the scoring system differentiated by age groups.

Conclusions

The food specialists of the armed forces can help with the logistics in their work by the compiling of the temporary food plan supported by research results. These results may facilitate the connection to healthy eating identity, this require making a strategy to be devised, which can increase the accuracy of the health promotion campaigns aiming to improve nutrition. The soldier's term of service has to be used for influencing to make efforts for a healthy lifestyle.

Declarations

Ethics approval and consent to participate: The HDF MC DHP reviewed protocol EFO 5/7-198874/2015 and determined it was exempt from IRB oversight. We obtained only deidentified data.

Consent for publication: Our manuscript was approved for publication by our public affairs officer.

Availability of data and materials: Not applicable.

Competing interests: We have no conflicts to report.

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Authors' contributions:

Attila Novák Dr. planned the study, researched methodology, interpreted of results and submitted the study.

Bea Hornyák conducted the survey.

Zsófia Rázsó prepared of references and interpretted of the results.

Szabolcs Szalánczi made the statistical analysis.

Andrea Sótér Dr. collected material.

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Tables

Table 1: Linear regression correlation between the test variables and the total score obtained on the physical fitness test (N=490)

Compared to those who have almost never consumed vegetable				
	E	SE	t value	p value
Less than a week	41,8922	23,3506	1,794	0,07346 .
Weekly	43,6248	22,1123	1,973	0,04911 *
2–4 times a week	39,3362	22,0652	1,783	0,07529 .
4–5 times a week	48,8168	22,1211	2,207	0,02782 *
Every day	46,3158	22,4889	2,059	0,04001 *
More than once daily	47,5770	22,6344	2,102	0,03610 *
Compared to those who consume fruit less than a week				
Weekly	8,5708	7,3249	1,170	0,24258
2–4 times a week	10,1371	7,4287	1,365	0,17305
4–5 times a week	24,5991	8,4549	2,909	0,00380 **
Every day	11,0446	9,1618	1,206	0,22863
More than once daily	20,2025	9,9391	2,033	0,04267 *
Age	0,4882	0,2792	1,749	0,08099 .
Body mass index	-1,7159	0,5683	-3,019	0,00267 **
Significance code: ‘***’ 0,001 ‘**’ 0, 01 ‘*’ 0, 05 ‘.’0,1				

Table 2: Linear regression correlation between the test variables and the scores obtained on the cardio-vascular system physical fitness survey (N=490)

Compared to those who consume fruit less than a week				
	E	SE	t value	p value
2–4 times a week	9,0752	4,5356	2,001	0,0460 *
4–5 times a week	12,0836	5,1622	2,341	0,0197 *
Every day	8,0123	5,5938	1,432	0,1527
More than once daily	9,5176	6,0684	1,568	0,1175
Compared to those who almost never consume cereal				
Less than a week	-32,2597	14.0660	-2.293	0,0223 *
Weekly	-31,6852	13.4537	-2.355	0,0189 *
2–4 times a week	-31,9413	13.5568	-2.356	0,0189 *
4–5 times a week	-28,0676	13.5569	-2.070	0,0390 *
Every day	-31,4878	13.5693	-2.321	0,0208 *
More than once daily	-27,2796	13.5954	-2.007	0,0454 *
Compared to those who almost never consume dairy product				
Less than a week	42,2427	17,3464	2,435	0,0153 *
Weekly	37,7766	16,7634	2,254	0,0247 *
2–4 times a week	38,6932	16,6573	2,323	0,0206 *
4–5 times a week	36,1696	16,7584	2,158	0,0314 *
Every day	37,0793	16,7955	2,208	0,0278 *
More than once daily	38,5765	17,0060	2,268	0,0238 *
Compared to those who have never smoked				
Quit smoking	1,2051	3,0012	0,402	06882
Smoke	5,6454	2,7065	2,086	0,0375*
Age	0,3284	0,1705	1,926	0,0547.
Body mass index	-1,8988	0,3470	-5,472	7,32e-08 ***
Significance code: '***' 0,001 '**' 0,01 '*' 0,05 '.'0,1				

Table 3: Linear regression correlation between the test variables and the scores obtained on the strength endurance test (N=490)

Compared to those who almost never consume vegetable				
	E	SE	t value	p value
Less than a week	25,2977	16,0585	1575	0,11587
Weekly	28,9252	15,2069	1,902	0,05778 .
2–4 times a week	29,4051	15,1745	1,938	0,05326 .
4–5 times a week	37,2945	15,2129	2,451	0,01460 *
Every day	32,0190	15,4659	2,070	0,03899 *
Mora than once daily	32,0280	15,5659	2,058	0,04020 *
Compared to those who consume fruit less than a week				
Weekly	1,7266	5,0374	0,343	0,73195
2–4 times a week	1,0618	5,1088	0,208	0,83544
4–5 times a week	12,5156	5,8146	2,152	0,03188 *
Every day	3,0323	6,3007	0,481	0,63056
Mora than once daily	10,6850	6,8352	1,563	0,11869
Compared to those who almost never consume dairy product				
Less than a week	-43,1572	19,5385	-2,209	0,02768 *
Weekly	-50,5710	18,8818	-2,678	0,00767 **
2–4 times a week	-47,4528	18,7623	-2,529	0,01177 *
4–5 times a week	-55,8499	18,8762	-2,959	0,00325 **
Every day	-49,6796	18,9179	-2,626	0,00893 **
Mora than once daily	-54,8849	19,1550	-2,865	0,00436 **
Compared to those who have back pain as a symptom appearing daily				
More than once weekly	3,7992	11,0516	0,344	0,73118
Regularly weekly	-1,3874	9,7570	-0,142	0,88699
Monthly	19,7660	8,6482	2,286	0,02274 *
More infrequently	12,3168	8,0586	1,528	0,12710
Significance code: ‘***’ 0,001 ‘**’ 0, 01 ‘*’ 0, 05 ‘.’0,1				

Figures

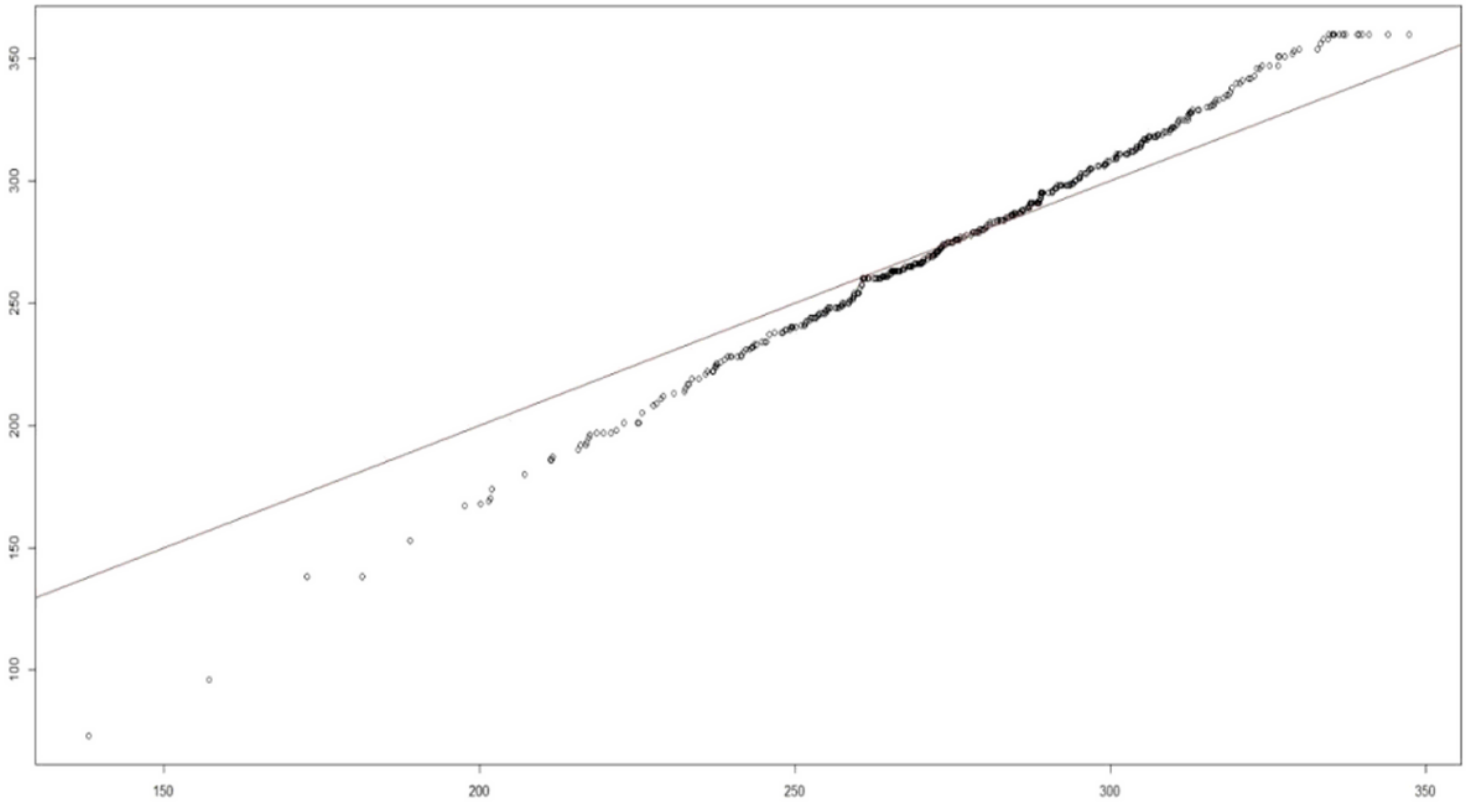

Figure 1

The graphic matching analysis of the test variables and the total score obtained on the physical fitness test (QQ plot), x-axis estimated scores, y-axis real scores, (N=490).

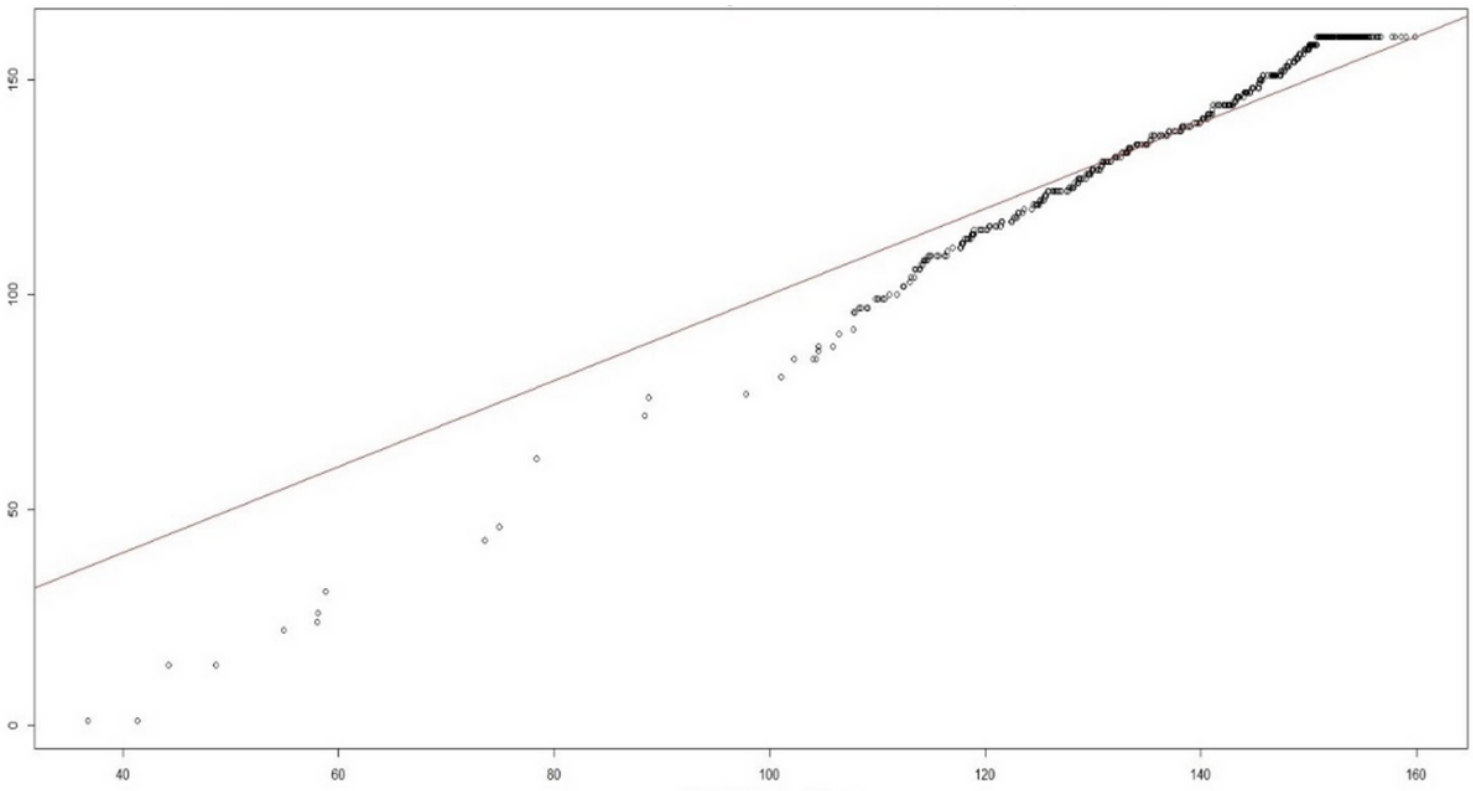

Figure 2

The graphic matching analysis of the test variables and the scores obtained on the cardio-vascular system physical fitness survey (QQ plot), x-axis estimated scores y-axis real scores, (N=490).

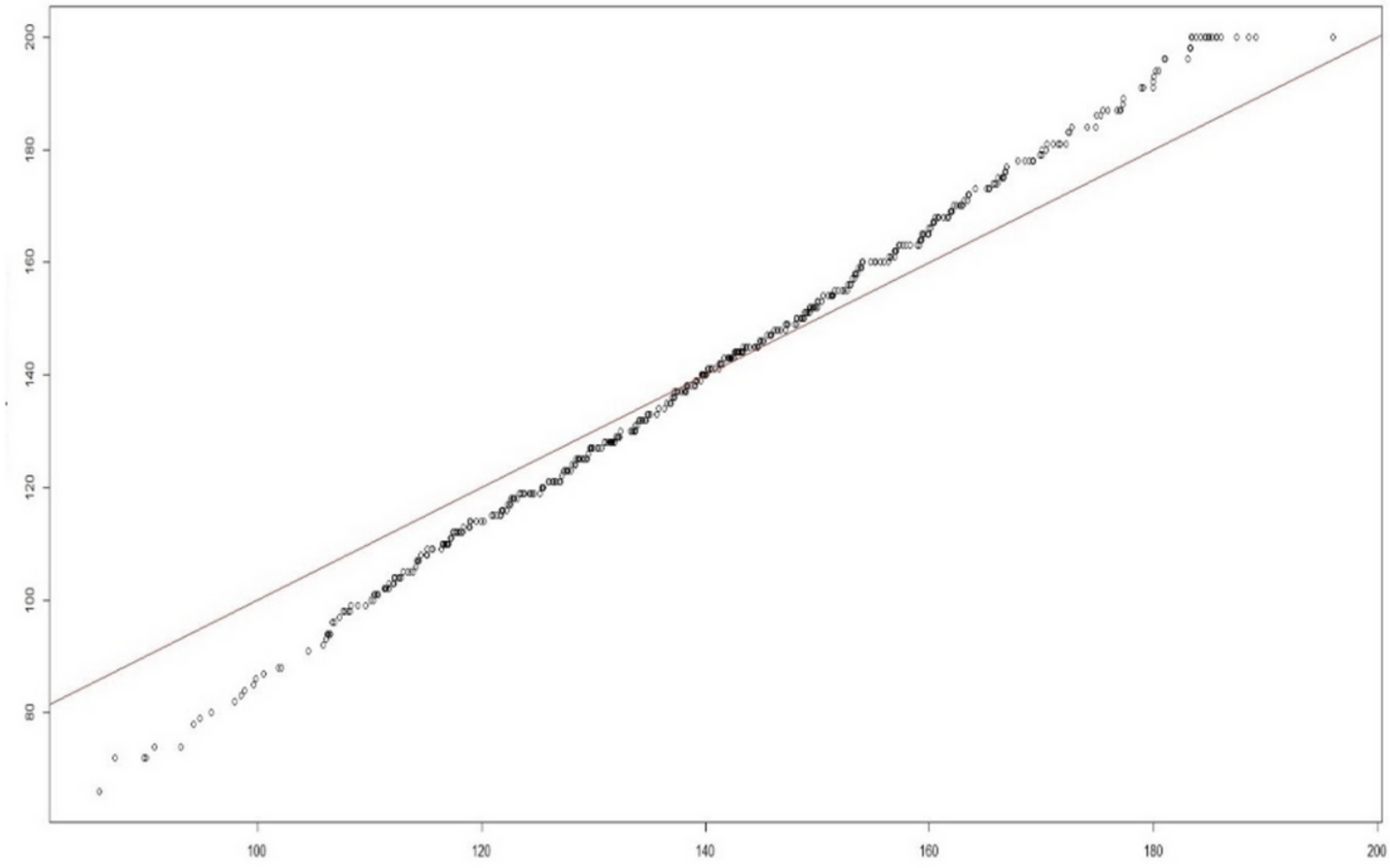

Figure 3

The graphic matching analysis of the test variables and the scores obtained on the strength endurance test (QQ plot), x-axis estimated scores y-axis real scores, (N=490).