Research on Health Behaviour Factors in the Hungarian Defence Forces: in Order to Group Similar Patterns, Estimate Morbidity and Improve Conditional Physical Capabilities

Abstract of the PhD Thesis

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1. Introduction

Health is a symbol of certain occupations and professions, and as such, social perception and judgment are formed accordingly in the consideration of a nation or a state. It is undisputed that the persons who constitute the armed forces belong to this category. The Hungarian Defence Forces (HDF), as one of the largest employer in the country, needs to monitor the status of the human resources in particular. As my research field I chose the examination of health behavioural factors of paramount importance at individual and community level, from the respect of prevention, within the special population of the personnel of the HDF. As a new challenge the increasing expedition activities - the participation in the international operations and offers of NATO – require strong military, physical and psychological preparedness. The major orientation of these fundamental requirements includes the consideration of maintaining the health of the personnel as an organisational interest. We need to be able to prepare the personnel to build the ability to take, endure and fight stress, due to enhanced pressure and exposure, according to the principles of immediate reaction and continuous alert that justify the persistent monitoring of the changes of the physical, health and psychological status of the personnel.

The results of the longitudinal research carried out by the U.S. Army showed that due to the relevant screenings and regulations the persons entering the armed forces can be considered exceedingly healthy. The self-rated health status of the 75% of the staff going to external service fell into the “very good” category, while this ratio was 60% upon return. It was found that the decline is the result of stress and the challenges they needed to face during external service and the circumstances of the service. They focused on changes in stress tolerance level within the returning personnel. The results showed that stress tolerance level inversely correlated with age; the personnel over the age of 40 had stress tolerance level twice as low as the personnel belonging to the age group 21-25. The occurrences of mental diseases were higher among men and they were more likely to develop sleep apnoea as well.

After the termination of service and employment, the health status benefits of the soldiers decreases and they have worse health conditions than the civil members of the society. The health behaviour of the soldiers already left service is worse than that of the

civilians; they are more likely to smoke, have an unhealthy diet and do sports less frequently.

The health behavioural research of the HDF, similarly to that of the U.S Army, showed that due to the selecting system of the suitability assessment, the health status of the soldiers who gained acceptance is higher than that of the average population. Within the personnel who underwent the health screenings between 2011 and 2015, the prevalence values of the 5 most common diseases followed the trend of the previous years; cardiovascular diseases occurred most frequently (12%) among the personnel of which the most likely is hypertension. The second in the ranking were endocrine, nutritional and metabolic disorders (4.99%), within which obesity, thyroid disorders and disturbances of the blood sugar level occurred most frequently.

The third is musculoskeletal disorders (2.24%), the fourth is respiratory diseases (1.71%) and the fifth most common group of diseases is digestive diseases (1.33%). The top chronic non-communicable diseases (NCDs) within the morbidity structure of the staff can be prevented by healthy lifestyle and preventive health behaviour or can be favourably influenced by these. The main aim of medicine within the scope of the armed forces is maintaining and developing of the health status and deployability of the personnel, and reducing the occurrences of chronic NCDs. In the Hungarian Defence Forces they first created a health risk map according to the results of the 2004-2007 screenings and compared the troops from the respect of health behaviour.

According to the comparative longitudinal study based on these results, within the priority ranking of risk factors, unbalanced diet is the 12^{th} (467 persons; 12.5%), lack of physical activity is the 13^{th} (318 persons; 8.5%) and smoking more than 20 cigarettes a day is the 14^{th} (246 persons; 6.6%) in the ranking. However, from the respect of health behaviour these factors were ranked the highest as these are factors that threaten not only health status but all time deployability and the maintaining of the high standard conditional abilities as well.

2. Objectives

In my empirical research I set the goal to, by improving the existing database, on one hand, organise the soldiers who took part in the health screenings between 2011 and 2015 and showed the same pattern into groups by using health behavioural data, on the other hand, to draw some conclusions with regards to morbidity prospects and their physical status. My objectives included examining the effects of specific lifestyle related factors compared to the occurrences of chronic NCDs. Also, revealing the interdependences between physical abilities necessary for military service and health behavioural factors. In addition, to identify those non-conditional lifestyle parameters that can affect cardiovascular fitness and the strength ability of the muscles of the arms and the trunk. Another aim was to form relevant health profiles by mapping health behavioural habits within the HDF that can help execute health development activities more effectively and make the changes in health behavioural habits measurable.

The present research was designed to test the following assumptions:

1. Relevant grouping can be executed, covering the whole research sample, according to the health behavioural factors within the personnel of the Hungarian Defence Forces.
2. With regards to the dietary habits examined, the frequency of vegetable, fruit and dairy product consumption and the amount of fluid intake have an effect on the occurrences of diseases.
3. The frequency of sporting activities is inversely proportional to the occurrences of diseases.
4. Backache as a psychosomatic symptom, intraday fatigue, waking up feeling tired and mental well-being are in connection with effect on the occurrences of diseases.
5. From the dietary habits examined, the optimum choice of vegetable, fruit, grain and dairy product consumption, from the respect of the overall scores obtained by the forms of exercise used in the Hungarian Defence Forces Physical Fitness Test (HDF PFT), as well as the endurance and strength ability indicators show different patterns that are specific to them.

6. There is a correlation between the overall scores that can be acquired with psychosomatic backache as a symptom, smoking status, age, body mass index and the forms of exercise used during HDF PFT and the overall scores that can be acquired during the endurance and strength ability tests.

7. Within the personnel of the Hungarian Defence Forces the top group of the clusters performed above average in all assessed health behaviour factors while the worst-ranked group performed below average.

3. Methods

For our research we conducted a cross-sectional study in the Hungarian Defence Forces including the professional personnel and the staff recruited on a contractual basis who underwent the health screenings between 2011 and 2015, completely filled in the health screening data sheet (HSDS) and their screening data had been recorded electronically in a way so that they can be assessed and used. According to the processed data of health behavioural factors we carried out three tests. In the first case, each soldier's (N=5,475) health behavioural pattern has been processed. Based on the similarities between the patterns I formed groups that covered the whole sample.

In the second case, I examined the occurrences of morbidity according to the chosen factors based on the health behavioural data (N=1,705) of the year 2015.

In the third case, I took the health behavioural data of the year 2015 for my examination and expanded the available database (N=490) with the results I had found on the PFT forms of the year 2015. The variable of the examination was the score adjusted by age groups, that could be achieved during the compulsory annual physical assessments for the personnel under 50 years old and which contains the running test assessing the cardiovascular fitness and the push-up and sit-up tests assessing the strength of the trunk and the arm muscles. The examination focused on revealing the connection between the chosen health behavioural factors and the scores that could be achieved during the PFT.

During data collection and data analysis I placed great emphasis on complying with the ethical requirements. The participants gave informed consent and the analysis of the data was carried out without breaching anonymity. The results will hereinafter be communicated in full compliance with the ethical rules.

According to the socio-demographic data of the *first* examination sample (N=5,475 persons) the average age was 36.93 ($\pm$7.46 years). 21.1% of the examined population was women.

In respect of the *second* sample (N=1,705 persons), the average age was 40.1 ($\pm$ 7.9 years), the ratio of women was 28.2%.

In my *third* examination the average age of the sample (N=490 persons) was 34.1 ($\pm$ 6.91 years), the ratio of women in the examined population was 13.5%. As the conditional abilities were also assessed in this research, based on the suitability assessment test, I find it necessary to define the following parameters as well, in order

to characterize the sample. The average height of the sample was 177.64 centimetre (±7.49 cm), the average weight was 78.94 kilogram (±12.07 kg). The Body Mass Index of the total sample was 24.99 kg/m^2 (±3.34 kg/m^2), of which men's was 25.08 kg/m^2 (±3.37 kg/m^2), women's was 24.41 kg/m^2 (±3.1 kg/m^2).

Research Methodology

For the *first* examination I carried out the data collection of health behavioural factors according to the ESF. The occurrences of diagnosed morbidity (ICD) and Body Mass Index (BMI) were also included in the research, among other "hard" indicators (objective variables). Within the "soft" indicators (subjective variables) included in the research, with respect to eating habits, in addition to quantitative variables, qualitative variables - vegetable, fruit, dairy product, grain and meat consumption, as well as the use of flour and fat in the kitchen - were also subjects to the research. Furthermore, as regards the regularity of main meals (breakfast, lunch, dinner), I examined the frequency of having main meals on workdays on a weekly basis. In respect of physical activity, beyond the frequency of sporting activities, the mode of transport used to travel to the workplace (public transport, car, bicycle) or, in the absence of these, walking have also been included. The time spent with travelling to work has been recorded in a categorized way. In order to evaluate the types of sports carried out purposefully, I used the heart rate control method and the level of fatigue after doing sporting activities. With regards to psychosomatic symptoms, I examined the frequency of backache, fatigue, headache, stomach ache and abdominal pain, bad mood, irritability and nervousness.

Apart from the quality of waking up - feeling fresh or tired - I also examined the occurrences of sleep apnoea (OSAS) with the help of the Berlin questionnaire.

The responses options for each factor have been scored by taking international and national scientific literature into account. Thus, the minimum number of points to be reached was -47.5 points and the maximum was 48.5 points.

The scoring system of the variables included in the research was developed as follows:

Objective variables: Age [-2; 0 points]; gender [-1; 0 points]; diagnosed disease (chronic non-communicable disease recognised by a doctor) [-9; 0 points]; body Mass Index (BMI) [-5; 1 points]. *Variables based on subjective assessment: nutrition* [-12, 5; 13,5 points];
in respect of *smoking status* [-5; 0 points]; *physical activity* [-5; 22 points]; *sleep* [-4; 3 points]; *Mental Toughness* (MTQ) [-3; 8 points]; m*sychosomatic symptoms* [-6; 0 points].

In the case of the *second* test, I formed two groups to examine the health behaviour of the personnel: health protection and health risk behavioural factors. Within the scope of the health protection factors we examined the frequency of sporting activities and the quality of nutrition. In respect of physical activity, we asked about the frequency and scope (duration) of doing exercises and the possible categories of answers were set out as follows: (1) *minimum 30 minutes daily,* (2) *2 or 3 times/week, minimum 30 minutes/occasion;* (3) *4 times/month, minimum 30 minutes/occasion;* (4) *less frequently than the categories mentioned above* and (5) *never.* When analyzing the quality of nutrition, with regards to the different types of food (vegetable, fruit, dairy product) consumed, we set out a 3-grade scale for the possible answers as follows: eating the specific type of food (1) *less frequently than once a week*; (2) *2 or 4 times a week* and (3) *every day*. The daily fluid intake is measured in litres, thus it is recorded as a continuous variable in the model. Within the group of health deteriorating forms of behaviour I examined smoking habits. I formed three categories according to the recommendations of the World Health Organization (WHO): (1) *smokes*; (2) *has stopped smoking* and (3) *has never smoked*.

Concerning psychosomatic symptoms, first, the prevalence of backache and fatigue in the last 6 months was examined on a 5-grade scale: (1) *daily*; (2) *several times a week*; (3) *weekly*; (4) *monthly* and (5) *less frequently or never*. Within the scope of psychosomatic symptoms, I also examined the quality of waking up in the morning, forming two categories: usually (1) *wake up feeling tired* or (2) *wake up feeling fit*. I also examined the MTQ level and inserted in my model.

With regards to the *third* test, the results recorded during the PFT along with the ESF data were also included as means of the examination. To evaluate the fitness of the cardiovascular system, the completion of 3200-metre running within the shortest

possible time was used. The results of these were recorded after correcting by gender and age groups.

The scores ranged between 0 and 160. During the strength ability test, scores gained by carrying out the maximum number of bent-knee sit-ups normally within 2 minutes and the maximum number of push-ups were recorded, again, after correcting by gender and age groups. The scores ranged between 0 and 100. According to the HSDS, eating habits within the sample were examined from the respect of the impact of the frequency of vegetable, fruit, grain and dairy product consumption, psychosomatic waist pain, smoking status and BMI. With regards to vegetable, fruit, grain and dairy product consumption, we used a 7-point Likert Scale and for psychosomatic backache we used a 5-point Likert Scale. In the former case, the options that could be chosen were *never, less often than once a week, 2-4 times a week, 4-5 times a week, every day* or *several times every day* as regards consumption. In the latter case, the options *daily, several times a week, weekly, monthly* or *less often than monthly* were recorded.

Statistics

During the *first* test, I used the cluster analysis model, for distance measure the Euclidean metric, and used hierarchical clustering as the method. In my *second* test, I used the logistic regression model, in which the variables, defining health status, chosen by myself, were the input factors and the output variable was health condition that could have only two values: in the case of the presence of a disease with ICD Code: 0; or in the case of no disease: 1. I examined the odds ratio values compared to 1, where those smaller than 1 can decrease the probability of being healthy, while those bigger than 1 can increase it. To set up the model I used multiple logistic regression then I divided the data into two parts, one was the learner part and the other was the test part (80-20%), in order to test the validity of the model. Model diagnostics was carried out with the deviance values and the Hosmer-Lemenshow Goodness Of Fit test (GOF), and the Wald χ^2 test was used to examine the effect of the coefficients of the most important factors on our model. In my *third* test, I used the multiple linear regression model as the most appropriate to justify my assumptions. The analysis was carried out in R environment with the R-Studio software.

4. Results

As a result of the cluster analysis, we found 16 distinct profiles appropriate for testing from which 10 differed significantly ($p < 0.05$) from each other. According to the 24 factors being examined, the minimum score was -47.5 and the maximum was +48.5. The lowest achieved point value was 3.1 points and the highest 26.2 points. The cluster with the highest average age (43.51±7.2 years) achieved the least points, 8% of the sample, in which the ratio of women was the highest (46%). The two clusters with the highest scores, 2.9% and 5.5% of the sample, were the two groups with the lowest average age (33.7±7.1 years and 34.3±7.9 years).

From the respect of the frequency of main meals on workdays, I did not find a significant difference between the specific clusters; the majority of the sample has breakfast (76%), lunch (86%) and dinner (85%) regularly. From the respect of the types of grain, the majority of the sample (77%) consumes food made from brown or wholemeal flour. From the respect of meat consumption, the ratio of those who only eat white meat is low (32%), the majority (63%) consumes both red and white meat together. Those who consume white meat only are mainly in cluster 9 (40%), which is first ranked, while they are also in cluster 5 but with the smallest ratio (23%), ranked last but one, according to the total scores.

With respect to modes of transport to the workplace, 43% of the soldiers tested use car and almost 34% of the soldiers tested use bicycle or go on foot. The members of five groups (2, 6, 7, 8, 14) use only their car to get to their workplace. There was only one cluster in the sample (cluster 10) in which everybody walks or uses a bicycle. 7 percent of the soldiers tested spend more than one hour in the car during commuting. Nobody uses a car to get to their workplace in six clusters (4, 9, 10, 11, 12, 13).

As regards sporting activities, among the 16 clusters there was only one (cluster 5) that contained persons doing sports less than once a week. Conversely, there were four groups (2, 7, 9, 12) in which they did the most sporting activities. More than 51% of the sample does sports at a satisfactory level (2-3 times a week, for minimum 30 minutes with moderate or higher than moderate intensity). 31% of the soldiers do sports for at least 30 minutes per day.

The scores related to sporting is calculated by the number of people in the different sporting categories (i.e. daily regularity, 2-3 times a week, weekly, less often)

in case of each cluster, the number of items was multiplied by the scores assigned to each category and then the result was divided by the number of persons in the cluster. 87% of the sample monitored their heart rate while doing sports and more than 81% of them experienced a medium level of fatigue after doing sport. 47% of the sample has never smoked. In five clusters (3, 6, 7, 9, 11) there are only those who have never smoked and in five clusters (1, 5, 8, 10, 15) those who presently smoke.

The ratio of smokers and those who gave up smoking was almost the same in the sample (27% vs. 26%). The highest ratio of smokers was in cluster 13. In clusters 2, 3, 4, 6, 8, 9, 11, 12, 13, 14 and 16 the ratio of those waking up feeling fit in the morning was the maximum (100%). Almost everybody (99%) in clusters 7 and 10 wake up feeling fit in the morning, while 90% of cluster 5 does not feel tired in the morning. In clusters 1 and 15 there was nobody (0%) who wakes up feeling fit or not tired in the morning. From respect of OSAS, 91.7% of the sample had scores 6 or under. The remaining 8% were fragmented among all of the clusters; there was no such group that contained OSAS negative soldiers exclusively. Their highest ratio (98%) was in cluster 13 and the lowest (68%) in cluster 1. The results of psychosomatic symptoms (backache, headache, stomach ache and abdominal pain, bad mood, irritability, nervousness and fatigue) ranged between minus 3 and 0 points. The sample average was -0.341 points.

The cluster with the highest average value (-0.182$\pm$0.2 points) was cluster 9, while the one with the lowest (-0.906$\pm$0.6 points) was cluster 1. I analyzed backache separately as in our previous research the frequency of backache had the greatest influence on the appearance of diseases from the psychosomatic symptoms. Based on the research, on average, 61.2% of the sample contained soldiers who had backache as a symptom very rarely or never. Their highest ratio (79%) of them was in cluster 7 and the lowest (27%) was in cluster 1. From the respect of MTQ, the average value of the sample was 2.21 points after scale transformation had been carried out. Due to this, the points ranged between -3 and +8. The cluster with the lowest average value (1.76$\pm$1.0 points) was cluster 1, while the one with the highest (2.54$\pm$1.0 points) was cluster 9.

In my *second* (N=1,705) test, regarding to eating habits, I did not find significant difference between the age groups from the respect of vegetable and dairy product consumption. The difference between the age groups was barely 5%. However, from the

respect of fruit consumption I experienced a significant difference as an increasing number of the members of the older age group consumed more fruits every day ($p<0.05$). According to the logistic regression test, the odds ratio values concerning the frequency of vegetable consumption compared to those who consume vegetables less than once a week in case of those who consume vegetables 2-4 times a week are OR=0.410; (p=0.154) and in case of those who consume vegetables daily are OR=0.499; (p=0.274).

The odds ratio values concerning the frequency of fruit consumption compared to those who consume these less than once a week in case of those who consume fruits 2-4 times a week are OR=0.381; p=0.249 and in case of those who consume fruits daily are OR=1.464; p=0.546.

The odds ratio values concerning the frequency of milk consumption compared to those who consume it less than once a week in case of those who consume milk 2-4 times a week are OR=0.895; p=0.701 and in case of those who consume milk daily are OR=1.714; p=0.247.

Fluid intake, as a continuous variable, is included in the model; the daily average fluid intake of the sample was 3.031 litres (min: 1 litre; max: 5 litres). The odds ratio values are OR=0.993; p=0.922.

Based on the results of the sporting activities, it can be concluded that with aging physical activities and sporting activities show a continuously failing tendency ($p<0.05$). While 82% of the participants under the age of 30 do physical activities daily or at least 2-3 times a day, only about 50% of those over 50 do so.

The result of the Wald χ^2 test concerning sporting activities: $\chi^2=12.3$; df=4; p=0.015. On the basis of the logistic regression test, the odds ratio values concerning the frequency of physical activities compared to those who do physical activities daily in case of those who do sports *2-3 times a week* for minimum 30 minutes are OR=0.945; p=0.786. In case of those doing sports *weekly* for minimum 30 minutes these are OR=0.776; p=0.343. For those who do sports *less frequently* then the above mentioned persons these are OR=1.330; p=0.576. In case of the physically *inactive* persons OR=0.566; p=0.013.

In respect of smoking, as a health deteriorating form of behaviour, more than half (51.8%) of the young (aged 18-30) have never smoked, while 15.2% have stopped

and 33% of them still smoke. In the age group of 31-40, 44.7% have never smoked in their lives, 27.1% have stopped and 28.2% of them are still smokers. In the age group of 41-45, 49.5% have never smoked, 28.4% have stopped and 22.1% still smoke. In the age group of 46-50, 46.5% have never smoked, 23.8% have stopped and 29.5% still smoke. In the age group above 51, 46.7% have never smoked, 32.5% have stopped and 20.7% still smoke.

On the basis of the logistic regression test, the odds ratio values concerning smoking compared to those who have never smoked in case of those who have already stopped but were smokers previously are OR=0.922; p=0.617. In case of those who still smoke, these are OR=0.801; p=0.176.

In our model I examined what roles age and gender have in health status. The average age of the sample was 40.1 ($\pm$7.9 years), the ratio of women was 28.2%. The age group distribution of the model is the following: 11.2% of the participants were between 18 and 30 years of age, 42.6% between 31 and 40, 17.5% between 41 and 45, 18.7% between 46 and 50 and 9.9% between 51 and 65. The number of women was higher in age groups above 46. The result of the Wald χ^2 test concerning age was: χ^2=121.9; df=4; p=0.000. On the basis of the logistic regression test, the odds ratio values compared to those under the age of 30 are the following according to the age groups. In case of those between the age of 31 and 40: OR=0.380; p=0.008. In case of those between the age of 41 and 45: OR=0.220; p=0.000.

In case of those between the age of 46 and 50: OR=0.106; p=0.000. In case of those between the age of 51 and 65 as the oldest age group: OR=0.058; p=0.000.

On the basis of the logistic regression tests, with regards to gender, compared to men in case of women these were OR=1.386; p=0.000. The result of the Wald χ^2 test concerning gender: χ^2=4.4; df=1; p=0.036. In the model I analyzed 6 months of prevalence data of backache and fatigue. The frequency of backache experienced less frequently than once a month or never in age groups under 46-50 shows a decrease, over this, it shows an increase in tendency. In respect of the quality of waking up, those who wake up feeling tired in the morning showed an increasing tendency with age. 3.1% of those younger than 30, 4.5% of those between the age of 31 and 40, 6% of those between the age of 41 and 45, 7.5% of those between 46 and 50 and the 8.9% of those above 50 years wake up feeling tired in the morning. The frequency values of fatigue

occurred almost at the same rate within all age groups. The result of the Wald χ^2 test concerning backache was: χ^2=31.8; df=4; p=0.000.On the basis of the logistic regression test, the odds ratio values concerning the frequency of backache, compared to backache occurring daily, in case of those who experience backache *several times a week* are the following OR=1.739; p=0.235. In case of backache occurring *weekly* they are OR=1.891; p=0.133 and in case of backache occurring *monthly* they are OR=1.973; p=0.085. In case of backache occurring *less frequently than above* or *never* they are OR=4.048; p=0.000.

The odds ratio values concerning the frequency of fatigue compared to fatigue occurring daily, in case of fatigue occurring *several times a week* are OR=1.354; p=0.59. In case of fatigue occurring *weekly* they are OR=0.799; p=0.682 and in case of fatigue occurring monthly these are OR=0.944; p=0.915. In case of fatigue occurring *less frequently* than above or *never* these are OR=1.120; p=0.834.

With respect to the quality of waking up in the morning, there was a significant difference between those waking up feeling tired and those waking up feeling fit ($p<0.05$), and the occurrence of waking up feeling tired in the morning is more frequent in the older age group. We found a linear relationship between age and waking up feeling tired in the sample examined ($p<0.05$). The result of the Wald χ^2 test concerning the quality of waking up was: χ^2=5.6; df=1; p=0.018*. On the basis of the logistic regression test, the odds ratio values compared to those waking up feeling fit in case of those waking up feeling tired are OR=0.537; p=0.018.

In our earlier examinations the average value was between 57 and 60. In our present sample the average value was 59.37 points (min: 20 and max: 93). 57% of the examined personnel belonged to the range with points below average and 17% belonged to the range with points above average. On the basis of the logistic regression tests, in case the MTQ point changes by 1 point the values are OR=1.015; p=0.117.

On the basis of the results of the *third* test (N=490 persons), it can be concluded that the frequency of vegetable and fruit consumption is in connection with the possible maximum scores. With respect to vegetable consumption, even the smallest increase in the frequency of consumption had the beneficial effect of gaining almost 40 points more from the possible maximum scores.

The same applies to fruit consumption, to a smaller extent, however, the increase in frequency in this case resulted in gaining between 8 and 24 points more. In respect of the examination of the frequency of fruit consumption, the category of *less frequently than once a week* served as a benchmark that I merged with the category of those who *hardly ever* consume fruits. Those consuming vegetables and fruits *4-5 times* a week gained the most. In the former case 48 points and in the latter case 24 points were gained. Regarding to eating habits, while examining the frequency of grain and dairy product consumption, I did not find a significant connection with the total scores.

Psychosomatic backache occurring monthly had a positive impact on the total scores. However, smoking habits within the specific sample did not influence the total scores of the tests. A unit change in age meant almost half a point of advantage, which is insignificant in this case. A unit change in body mass meant almost 2 points deficit in this case. According to the characteristics of the sample [BMI = 24.99 kg/m^2 ($\pm$ 3.34 kg/m^2)] the result is significant. Between the points of the running test, examining the fitness of the cardiovascular system, and of consuming vegetables, I did not find any significant connection. When examining fruit consumption, in case of consuming 2-4 times a week and 4-5 times a week I found significant connection with the points received during the running test. Unexpectedly, all the frequency variables of the scale of those consuming grains showed significantly less points according to those who hardly ever consume grain. The extent of this was close to constant, ranging between the deficit of 29 and 32 points.

With respect to dairy product consumption, we received adverse results to grain consumption. As regards all frequency, we perceived between 36 and 42 points gain according to those who hardly ever consume them. In this case, we did not find any connection when examining the frequency of backache. Surprisingly, those who smoke achieved better results during the running tests. Our results showed that being an active smoker meant more than 5 points gain, which is significant. Former research, carried out with sportsmen and sportswomen in several cases, showed that smoking had health protecting effects, even if it does not apply to performance. An increase in body mass meant 2 points less for the participant. In respect of strength ability points, the consumption of vegetables and fruits 4-5 times a week earned the most points in the model. We did not find connection between the frequency of grain consumption and

doing exercises like push-ups or sit-ups. With the increase of the frequency of milk consumption, the points received during the strength ability tests showed significant decrease; they were between 43 and 56 points. Backache occurring monthly meant almost 20 points gain according to backache occurring daily. Changes in smoking habits, age or body mass did not show any significant alteration with respect to the points received during the strength ability test.

5. Conclusions

In the Hungarian Defence Forces there has not been such an examination that aimed at the grouping of the health behavioural patterns of the soldiers or focused on determining health profiles. My research made it possible to gain access to the health behavioural habits of the personnel of the HDF who participated in the health screenings between the years 2011 and 2015 and filled in the data sheet correctly.

1. **Relevant grouping can be established in the personnel of the Hungarian Defence Forces on the basis of health behaviour factors, which covers the entire test sample.**

I proved the reality of my hypothesis with cluster analysis, by modelling, and found 16 clusters worth investigating, out of which 10 were significantly different ($p < 0.05$) from each other.

2. **The frequency of the consumption of vegetables, fruit and dairy products and the amount of fluid intake in the staff of the Hungarian Defence Forces has an impact on the likelihood of the occurrence of a disease.**

I could not prove my assumption within the logistic regression model, as I did not find any significant correlation between the frequency of consumption of vegetables, fruit and dairy products, the amount of liquid intake and the appearance of chronic non-infectious diseases. Therefore, I rejected my second hypothesis.

3. **There is an inverse correlation between the frequency of sporting habits and the chances of the occurrence of illness in the personnel of the Hungarian Defence Forces.**

I was able to partially support and prove my assumption with the logistic regression model. I have identified *inactivity* as a disease prediction factor. Compared to at least those exercising at least 30 minutes a day, *inactives* are significantly ($p < 0.05$) more than 40% less likely to suffer from chronic non-infectious diseases.

4. **In the personnel of the Hungarian Defence Forces, the psychosomatic back pain, the daytime fatigue, the feeling of tiredness after awakening, and the MÁQ are related to the chances of the disease appearance.**

My results showed that the daily symptoms of psychosomatic back pain have predicted the appearance of chronic non-infectious diseases significantly ($p < 0.001$) four times higher (OR = 4.048) than monthly complaints. The difference between those waking up tired and fresh was almost 50% (OR = 0.54). Those waking up fresh were significantly ($p < 0.05$) less likely to suffer from chronic non-infectious diseases than those waking up tired. In the other cases, no significant correlation was found. Therefore, I have found my assumption partly proven.

5. **In the staff of the Hungarian Defence Forces, the *optimal* choice of consumption of vegetables, fruit, cereal and dairy products examined from the dietary habits gives higher results with respect to the total scores obtained by the different exercises done during the HDF FÁF (physical endurance test), and the endurance and strength indicators show a typical, separate pattern.**

Among the examined factors of nutritional habits, we found significant difference ($p < 0.05$) between less frequently than weekly and 4-5 times per weekly consumption of vegetables and fruits. The consumption of vegetables 4-5 times a week implicated 48, while the same frequency of fruit consumption 24 points during the FÁF. There was no proof of the hypothesis regarding the consumption of cereals and dairy products. Significantly different patterns were found for the endurance and strength test points (160, 200 points) and for dairy consumption amongst the analysed nutritional factors. Compared to *almost never*-consuming persons, the higher frequency in the points for the endurance test meant higher scores (36-42 points) regarding dairy product consumption, while for the strength test lower ones (43-45). In the light of the results, I consider my assumption to be partially justified.

6. **In the personnel of the Hungarian Defence Forces, a relationship can be established between the total achievable points for the psychosomatic back pain as a symptom, the smoking status, the age, the body mass index and the exercise patterns used in the HDF FÁF; and the points achieved in the endurance and strength test.**

In my linear regression study, I showed an inverse correlation between the body mass index and the total scores obtained during the FÁF and the scores obtained during the endurance test. A unit increase in body mass index (0.1) resulted in significant ($p < 0.005$) less (-1.7-1.9 points) points. The number of sit-ups and push-ups within 120 seconds in the strength assessment showed significant ($p < 0.05$) correlation with the frequency of back pain as a symptom. The *monthly* frequency meant almost 20 points more than the frequency of the *daily* incidence. For the other variables, I could not detect a significant correlation in the linear regression model, so I consider this assumption partly justified.

7. **The highest ranked group within clusters formed in the personnel of the Hungarian Defence Forces performs above the average in all examined health behaviour factors, while the lowest ranked performs below the average.**

Among the clusters (16) formed, the group ranked first was below average in terms of nutritional habits (regarding consumption of fruit and dairy products), while the other variables were above average. The last-ranked cluster performed above average for vegetable and cereal consumption and daily physical activity, while it has showed average results for exercising habits. I rejected this assumption as a whole.

As regards the usability of the results, it is considered that the results received during the research presented in the dissertation can be useful if they are implemented in the practices of the health improving activities of the Hungarian Defence Forces; also the research may help the work of the regulatory bodies.

In addition to the health improving programmes at individual and community levels aiming at mobilizing soldiers, the Body Composition Programme of the HDF can help the participants either with being familiar with the Soldier Health Behaviour Profiles or with recognizing the connections between health behavioural factors and conditional abilities.

List of own publications

Publications related from the PhD thesis:

1. **Novák A**, Hornyák B, Rázsó Zs, Szalánczi Sz, Juhász Zs, Sótér A, Nyakas Cs. (2018) Predicting How Health Behaviours Contribute to the Development of Diseases Within a Military Population in the Hungarian Defence Forces. J R Army Med Corps, 164 (2): 107-111.

2. **Novák A**, Hornyák B, Rázsó Zs, Szalánczi Sz, Juhász Zs, Sótér A, Nyakas Cs. (2019) The Introduction of a Health Behavioural Profile in the Hungarian Defence Forces: A Cluster Analysis of Lifestyle Factors According to the Health Screening Tests Performed Between 2011 and 2015. Int J Occup Med Environ Health. 32 (1):99-114.

Publications unrelated from the PhD thesis:

3. **Novák A**, Sótér A, Rázsó Zs, Juhász Zs. (2017) Fight against obesity: Military Body Composition Programme. Honvédségi szemle (Military Review): Central journal of the Hungarian Defence Forces, 145 :(3) 74-86.

4. **Novák A**, Rázsó Zs, Kenessey F. (2016) The Opportunity of Exercise Therapy and Dietetic Guidelines of the Obese-related chronic diseases in the Hungarian Defence Forces. Honvédorvos (Hungarian Military Medicine) 67 :(1-2) 5-15.