HAAGA-HELIA
ammattikorkeakoulu

The relationship between cooper test and academic performance with National Defence University cadets.

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Tämä tutkimus tehtiin yhteistyössä Maanpuolustuskorkeakoulun (Mpkk) kanssa, jonka tehtävänä on kouluttaa upseereja vaativiin rauhan ja sodanajan tehtäviin. Hyvä upseeri omaa hyvän fyysisen kunnon ja menestyy hyvin myös sotatieteiden opiskelussa. Pääsykokeiden avulla etsitään näitä ominaisuuksia muun muassa kestävyyskuntoa mittaamalla.

Tämän tutkimuksen tavoitteena oli selvittää onko opiskelijoiden pääsykokeessa mitatulla kestävyyskunnolla (cooperin testi) yhteyttä opintomenestykseen kandidaatti-vaiheessa. Mukana aineistossa oli 531 kadettia vuosilta 1999- 2009 ja tutkimus suoritettiin kvantitatiivisena tutkimuksena. Mukana oli maa ja merivoimien kadetteja, joista 22 oli naisia. Tutkimuksessa taustamuuttujina käytettiin sukupuolta ja opintotaustaa (ammattikoulu tai lukio).Tutkimus tehtiin touko-marraskuun aikana vuonna 2012 ja aineisto on saatu asiakirjoina MPKK:n arkistosta tutkimuslupaa vastaan ja analysoitu tilastollisesti.

Tutkimuksessa selvisi, että pääsykoe cooperin ja opintomenestyksen välillä on heikko yhteys (r=0.1, p=0,033, N=510) kun tarkastellaan pelkästään miehiä. Naisilla yhteyttä ei löytynyt. Aineistona olevien kadettien kestävyyskunto on minimissään jo kohtuullinen (2600m) ja sen vuoksi korrelaatio jää pieneksi (r=0.10). Muissa vastaavissa tutkimuksissa selkeä yhteys on löytynyt verrattaessa riittävän eri kuntoisia henkilöitä. Syy voi olla myös se, että pääsykokeessa tähdätään tiettyyn tavoitetulokseen ja sen jälkeen yrittäminen ei ole enää maksimaalista. Kestävyyskunnon taso on tämän ryhmän kadeteilla Puolustusvoimien viitearvojen mukaan hyvä (2,5/5)

MPKK:n liikuntatilat ja palvelut ovat erinomaista luokkaa, joten huomiota tulisi kiinnittää enemmäkin opiskelijoiden omaan tietämykseen fyysisen suorituskyvyn merkityksestä ja antaa heille tosiasiallinen mahdollisuus liikunnan toteuttamiseen opintojensa ohessa. Tämän tutkimuksen tulokset ja aikaisemmat löydökset aiheesta tukevat väitettä, että kestävyyskunnolla on positiivia vaikutuksia kognitiivisiin toimintoihin. Liikunnallisen aktiivisuuden ja hyvän kestävyyskunnon positiivisia vaikutuksia pitäisi korostaa vieläkin enemmän, koska hyvällä kestävyyskunnolla on paljon positiivisia vaikutuksia myös fyysiseen ja henkiseen hyvinvointiin. Pitäisi keskittyä siihen että liikunnan harrastaminen myös koulupäivän aikana on positiivinen ja opiskelua edistävä asia. Liikunnan lisäämiseen ja opiskelupäivään sisällytettyyn liikuntaan tulisi kannustaa jokaista opiskelijaa. Hyvä kunto on hyväksi terveydelle, mutta sillä voi olla positiivinen vaikutus myös muille yllättävillekin elämänalueille.

Asiasanat
Kestävyyskunto, opintomenestys, cooperin testi, Maanpuolustuskorkeakoulu, kadetti, upseeri

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Abstract

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This study was made in co-operation with the National Defence University (NDU), which educates officers to demanding peace and wartime tasks. A good officer student has good physical fitness and succeeds in military science studies.With the qualification NDU is searching for these qualities, for example by setting minimum requirement for cardiorespiratory fitness.

The aim of this study was to find out, is there a relationship with the measured cardiorespiratory fitness (cooper test) and academic performance in NDU in candidate state. The subjects were 531 cadets from the years 1999-2009 and the study was quantitative. The cadets represented army and seaforces and 22 of them were women. As covariates was used sex and academic background (high-school or vocational school). The study was made between May and November in 2012. The data was given by the archive of NDU and the study was made based on study permit and analysed statistically.

In this study the relationship between cardiorespiratory fitness and academic performance was weak in men. (r=0.1, p=0,033, N=510) In women there was no relationship. The result supports the earlier studies made with similar topics, where there was found a relationship.The weak correlation (r=0.10) can be explained with the good cardiorespiratory fitness level even within the weakest subjects. The reason can also be the fact that the test aims for certain qualification limit and it might be that prospects don't try to do their best. The overall cardiorespiratory fitness is good, based on the reference values of Finnish Defence Forces (FDF) (2,5/5).

NDU: s sport facilities and services are excellent and available to cadets. The focus should be in increasing knowledge about the meaning of physical fitness and motivating cadets to maintain their cardiorespiratory fitness during the studies. The results of this study and former studies point out the positive effects of good carsiorespiratory fitness to cognitive functions. Good physical fitness and physical activity also have many positive effects on physical and mental health. The focus should be in the change of attitude towards exersise during studying or working hours, which could eventually increase the studying and learning efficiency. Every student should be engouraged to exersice, also during the day when studying. Beeing fit is good for health, but it can have also surprising values on other areas of life.

Key words
Cardiorespiratory fitness, academic performance, National Defence Univercity, cadet, officer

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1 Introduction

The mission of Finnish Defence Forces (FDF) is military defencing, support of other officials and international crisis management (11.5.2007/551). Soldiers and cadets are obliged to maintain their physical fitness through their career. The aim of FDF:s physical education is to maintain and advance physical activity in all personnel groups. (11.5.2007/551 § 43)

Officer's education system requires students to be physically in good shape, but also have good problem solving and stress managing skills. Studies increase the amount of sitting in the classroom and lectures. Sitting on the other hand is concerned as significant health risk. (Vasankari, T. 2012) Physical activity has been recognized to increase the satisfaction, relieve stress and help when treating mental illnesses such as mild depression. (Pihlainen, K. 2011, 17.) Based on that information, physical activity can help manage the stress caused by studies. Good physical fitness is beneficial in many ways, but is the good cardiorespiratory fitness in relationship with the academic performance?

Only 30% of Finnish people exercise enough to maintain their health, and 60% of Finnish working age men are overweight. In 30 years the amount of obese children has doubled or tripled. Obesity is a worldwide problem and causes a lot of other deseases. (Peltonen et.al 2007) The physical fitness of the conscrips has lowered 27% from the year 1974. The trend in today's world is to have everything easier and more comfortable way.

The future officers are in important role of giving example and couraging young men and women to maintain their physical fitness. That's why it is important that cadets, which are accepted to the Finnish national defence univercity (NDU), really understand their authority and impact on young men and women (conscripts) as their rolemodel. (Soldier 2005, 10). The enthusiasm of exercising might start from the army or be postponed for a long time.

In qualifications to NDU cooper test is used to evaluate applicants' cardiorespiratory fitness. The good quality students are wanted to the training of officers. The aim of this study is to find out the level of cardiorespiratory fitness and is there a connection between cardiorespiratory fitness (cooper test) and academic performance in NDU (in candidate state).

2 Physical fitness

Physical fitness can be described as ability to manage normal life without unpleasant physical feelings, even during some occasional hard physical efforts. (Keskinen 2011,102.) Physical fitness is also the ability to do musclework that requires skills and condition. Physical fitness and motoric skills creates physical ability, which is in touch with psychologigal ability and motivation. Good physical fitness is a good function of the cardiorespiratory and musculoskeletal system (power, speed, endurance and stamina of the muscles) and nervoussystem (coordination, balance and agility) (Kyröläinen et.al 2003, 12).
The maintenance of physical fitness requires physical training. Recommendation for health-enhancing physical activity in Finland is called physical activity pie (figure 1). The recommendation is created for 18-64 year-olds. It includes moderate aerobic training 2,5 hours a week or 1h 15min of vigorous aerobic training. In addition one should exercise muscle strenght and balance 2 times a week.

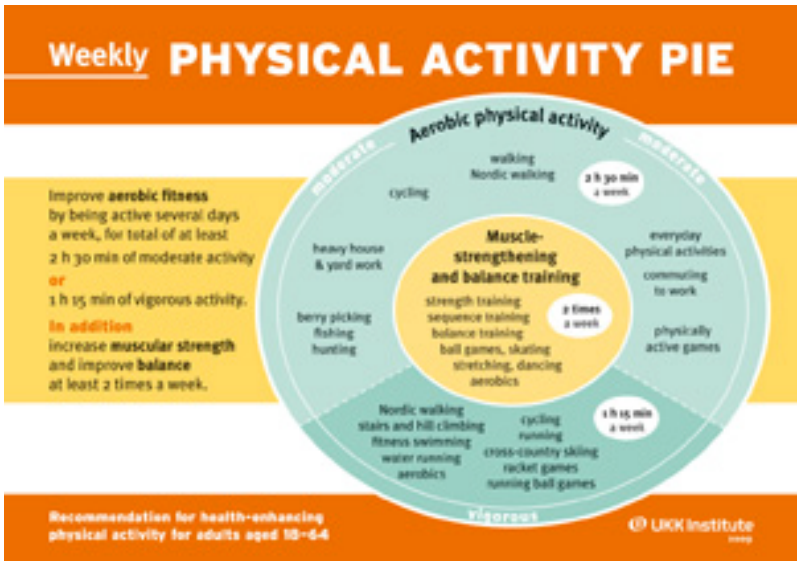


Figure 1 : UKK institute Physical activity pie, 2009.

The connection between physical activity and chronical deseases has been proven on many studies. The connection between inactivity and for example common mortality, coronary artery decease, obesity, heart attack, large intestine cancer and prostate cancer are statistically proven. Also conditions high bloodpressure, breast cancer, type 2 diabetes and osteoporosis are connected to inactivity (Lippincott W&W, 2000)
The minimum recommendation for healthrelated exercises for the personnel of FDF, is written down to"Exercise strategy of FDF 2007-2012". It recommends endurance training regularly 3-5 times a week, 20-60 minutes at a time (60-90% of VO2max) and strenght or

gymtraining 1-3 times a week. (Pihlainen, K. 2011, 17-27.) The recommendations are in line with the Ukk-institute's physical activity pie.

2.1.1 Cardiorespiratory fitness

The ability to avoid fatigue in long performances such as running can be called cardiorespiratory fitness. It can be divided to aerobic and anaerobic endurance based on the energy consumption. Good cardiorespiratory fitness also can reduce a risk to having serious deseases such as heart- or lung deseases or obesity. It might help also to sleep better, handle stress reactions more easily and recover from the workday. (Alen & Rauramaa 2011) Cardiovascular system delivers oxygen and nutrients to the muscles and eliminates waste products from the cells (Smith & Fernhall 2011, 3.). Good cardiorespiratory fitness is a important part of the physical working ability. It can be informed by VO2 maximal oxygen intake numbers, which is usually presented ml/kg/min.

2.1.2 Differences between genders in cardiorespiratory fitness

In this study men cadets and women cadets are on the starting point treated like they were equal physiologically. In fact there are a lot of physiological differences between male and female distance athletes. Men normally have larger VO2max levels and due to larger body sizes, also bigger hearts. Women tend to have more body fat and weaker running teqnigue. In elite female distance runners there is possibility to reach 70+ ml/kg/min and in male athletes 80+ (Mitchell et. al. 1992)
Also in a study made with sedetary young men and women (Bouchard et al, 1998) there was found on average 9ml/kg/min difference on the advantage of men. The requirement for qualifying in NDU is 46ml/kg/min. (Pihlainen, K 2011, 19.)

2.2 Physical inactivity and obesity

The lack of physical activity and obesity can lead to many serious diseases such as high blood pressure, diabetes, musculo skeletal symptoms or metabolic syndrome. All these symptoms can be dealed with exercise. Regular exercise can lower blood pressure and have positive effect on metabolism and help losing weight. Even small amounts of exersice have positive effets to health, when done correctry and wisely. Exersice and increasing the

energy consumption can also lower visceral fat more effectively than losing weight with diet. (Käypähoito recommendations,exercise 2012.).

2.3 Physical working capacity

Working capacity is a term which has a lot of different meanings. It has physical, social, ethical and mental meanings. Individual resources are the foundation for the working ability. The resources include health, physical and mental ability to work, knowledge, values and attitude. (Heikkinen &Ilmarinen 2001; Kyröläinen et.al. 2003, 12)

Physical working ability is affected by cardiovascular health and musculoskeletal system and the function of nervoussystem. It is comparable to physiological fitness due to its same physiological terms. (Kyröläinen et.al. 2003, 12) The sufficient physiological working ability guarantees managing all the challenges in work without overloading or having exessive fatique. Also studying requires working ability and can be assimilated to office work. In officer's work, it is accented, what kind of fitnesslevel is required either in peacetime or wartime activities. (Soldier 2005, 6)

3 Physical fitness testing

Physical fitness can be devided to cardiorespiratory fitness and muscle strength. Also abilities like muscular power and endurance, flexibility, coordination, speed or agility are measurable parts of physical fitness. (Kyröläinen et.al. 2003, 7) All these qualities are measurable, but in this study we focus on measuring the cardiorespiratory fitness.
Good quality fitness testing pays attention to specification, sensibility, validity, reability and controllability. The testing has to be safe and individual to the customer. (Keskinen 2011, 102.) The most important thing, what happens after the test result is presented is the guidance of the customer. Motivating the customer to do exersices or focusing on nutrition and also the regular monitoring the improvements in fitnesslevels. Fitness testing should be only a tool in the fitness quidance.

3.1 Physical fitness testing in Finnish Defence Forces

Finnish defence forces (FDF) is one of the few places who can demand yearly physical testing to their staff (soldiers). Usually fitness testing is volyntary, also in FDF to the civil workers. War and crisis management tasks and peace tasks has transformed to more rough and demanding for the soldiers and leaders. The requirements of the battlefields are the basis for combat capability. Physical fitness testing is useful in following your own fitness levels and in FDF also the remarkable factor in promoting officers and qualifying soldiers to international crisis tasks. Same sort of minimun fitness levels are used in firefighters career and policemen yearly requirements. (www.pelastusopisto.fi, Poliisilehti 2002/3) In FDF only a qualified person, who has done the FDF fitness testing course, can do the fitness testing to the personnel.(Pihlainen 2011, 7.)

3.2 Physical working ability and compat capability

Every year soldiers perform their combat capability tests. Tests include cardiorespiratory test (cooper or VO2max bike ergometer test), muscle strenght test, march, shooting and orienteering. The structure of the evaluation is presented in figure 2. Endurance index should be more than 1,5, if soldier wants to participate war practises. Rehabilitation is needed when cardiorespiratory fitnesslevels are inadequate.

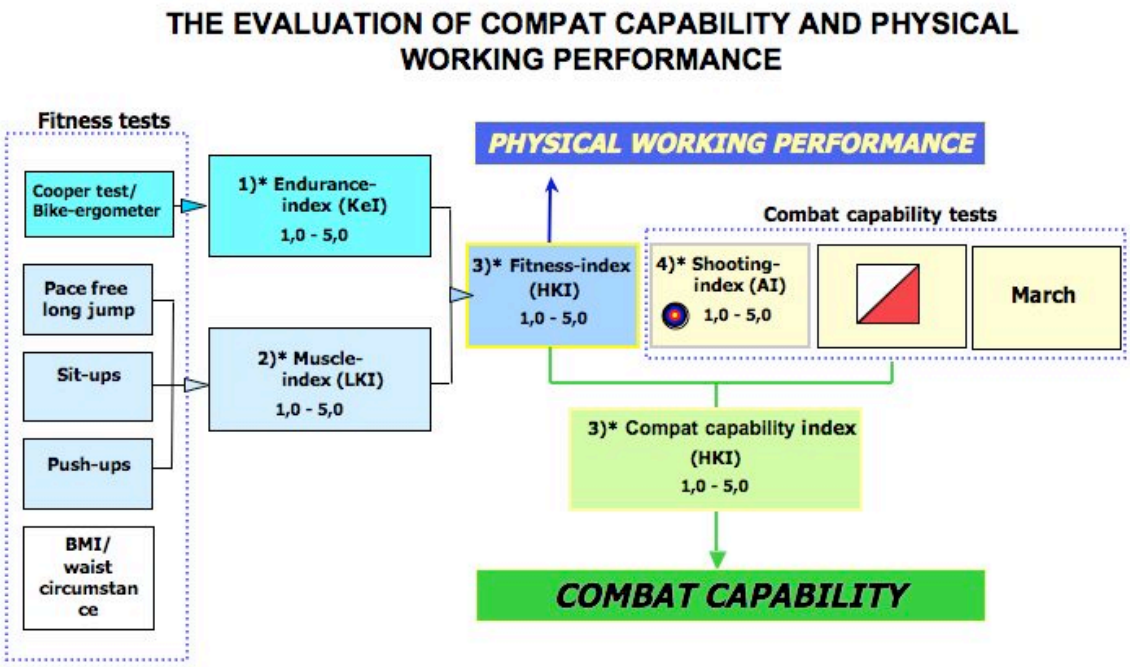


Figure 2: The definition of physical working ability and combat capability (FDF: modified)

In military work it is required to maintain certain fitness levels. Finnish law of Defence Forces (11.5.2007 /551, § 43) says that officers should maintain their professional skills and fitness on the level that his task requires. That means certain levels of fitness and VO2max. The levels are presented in table 1.

Supportive tasks require 45ml/kg/min which is also the qualification line to NDU. 53/ml/kg is needed in war tasks and in more requiring operative tasks 55ml/kg/min. The tasks of a soldier might require carrying heavy loads of packages, from 35 to 65 kilograms, so the muscle strength and durability has to be adequate (Lindholm 2008).

Table 1: VO2max levels for different soldier tasks

- Supportive tasks 45/ml/kg/min (2600m)
- War tasks 53/ml/kg/min (2800m)
- More requiring operative tasks 55ml/kg/min (3000m)

3.3 Cooper institutes 12-minutes running test

The cooper 12-minutes running test is designed by Kenneth H. Cooper (born in 1931) in 1968. It was created for military use and the aim is to run as long as you can in 12 minutes with steady pace. The result is based on the distance, age and sex. The result of the test measures maximal oxygen intake, when it is done correctly, which means good motivation and maximal performance. Cooper test result correlates well (r=0.3) with VO2max numbers (Martin, D & Coe, P.N. 1997).

Coopers running is easy to arrange. Minimal equipment is required and many participants can run at the same time. As a weakness can be weather conditions, the inadequate running technique with some people and the for the testing personnel the challenge is monitoring the test safely simultaneously for many participants.

The result from the cooper test tells about person's cardiorespiratory fitness and endurance. Cardiovascular system is composed of the heart, the vasculature and the blood. The maximal oxygen consumption is a common measure for overall fitness. It reflects to the capacity of transporting and using oxygen in muscles. 12-minutes running test result can be transformed to vo2max (See table 2). (Smith, D. 2011, 5-12; Cooper, K. 1968, 135-138)

Table 2: Transforming cooper test result to vo2 max result

(Distance covered in metres - 504.9) ÷ 44.73 = VO2 (ml/kg/min)

3.3.1 History of cooper test in Finnish Defence Forces

In Finnish Defence Forces there are conscript's coopertest statistics from the year 1974 forward. The conscripts run cooper test first at the beginning of their service. The mean of the test results has decreased from the year 1974 the best being year 1979 (2760m) and the weakest year 2004 (2430m). In the year 2011 the average was 2453m. Also the amount of weak results is increasing every year. (Santtila, M. 2011) These results represent the level of cardiorespiratory fitness in 18-21 year old men in Finnish population, and it is alarming

sign of the weak condition. This is also concerning to NDU when they are searching the best quality prospectives to the qualifications.
The physical test in qualification in NDU has chanced during 10 years. Until year 2001 the limit was 2600m both in men and women. The limit decreased from 2600m to 2500m in men and from 2600m to 2300m in women. (Table 3) At that point they were concerned about good quality students left out because of the too high limit and that was the reason for lowering the limit. (FDF: 111/5.2/D/I/2005)

From the 2006 they changed the limit back to 2600m and from that year until 2012 it has been the same to both men and women. A small study was made in NDU about the connection between cooper test result and academic performance with cadet course 88. It pointed out that there was found a connection and it was the argument for returning the higher limit. In the report it was said that there is a trend that cadet's physical fitness is lowering during the studies. If the starting point is better, one can presume the result is not lowering too low. (FDF: 111/5.2/D/I/2005)

Table 3: Qualification in cooper limits years 1999-2009

Year	Men (m)	Women (m)
1999	2600	2600
2000	2600	2600
2001	***2500***	***2300***
2002	***2500***	***2300***
2003	***2500***	***2300***
2004	***2500***	***2300***
2005	***2500***	***2300***
2006	2600	2600
2007	2600	2600
2008	2600	2600
2009	2600	2600

From the year 2011 there has been a norm, that everyone who graduates from the bachelor or masters degree must run the limit 2600m in coopers test. The test must be performed before graduating and also moving from first year to second. (Puolustusvoimat HF1221/26.10.2009) That gives more motivation to the students to maintain or improve their physical fitness during the studies.

4 Academic performance

Academic performance can be measured with numbers, grades or diplomas. In universities, the evaluation system after year 2005 has been from 1-5. (www.helsinki.fi/tutkinnonuudistus/tutuud/arv_asteikot.htm) After year 2006 they have used the same grades in NDU. In the studies of military sciences candidate (bachelor degree), the evaluation is based on first and second evaluation, and final evaluation.The subjects evaluated in the diploma are; operative skills and tactics, leadership, soldier pedagogic, techniques, strategy and security politics, war history, languages and thesis. (R2853/5.1/D/II).

The superiority queue is used in NDU to place the students to order based on performance in academic subjects and officer behaviour. The arguments to the evaluation can be found from the documents of the headquarters and the queue is formed by department of academic affairs (OAO). The superiority queue is used in evaluating the superiority of the course. It includes art of war, (tactics, operative skills, strategy and war history), soldier-pedagogic, leadership and war-techniques. (AH12702, Attachment 1, 2011) In the year 2012 the superiority queue is based 60% to warscientical studies and 40% to soldier professional studies. (AH 12702) In this study, the superiority queue is used to measure the academic performance and its relationship to the cardiorespiratory fitness.

4.1 Learning process

There are a lot of different ways to describe learning. Learning is active processing of information and it is affected by environment, behaviour, skills, values and motivation. Learning is realizing and finding connections between things. (Ilmarinen 2006, 225.) As a result of learning the knowledge, skills and emotions chance and due to that people chance their actions. By learning one can justify the chances in environment and ones actions in it. (Syväoja, H et.al. 2012, 4.) Learning is necessary when one wants to have good academic performance and succeed in working life.

4.2 Academic performance and physical activity

There are a lot of studies about physical activity and its relationship with cognitive functions such as learning. The studies based mostly on physical activity and were mostly made with children or adolescent. A systematic review made recently (Singh et.al. 2012) about physical activity and academic performance points out, that there is a connection between academic performance and physical activity, but it needs more high quality studies. The participation in physical activity is positively related to academic performance in children. They found good quality studies, but there is a need to examine further the dose-response relationship between academic performance and physical activity (Singh et.al.2012.)

The time spent in physical education in schools, does not weaken the academic performance in teaching of theory subjects (Pate et.al 2006; van der Mars 2006). Obesity has tripled in the past 3 decades in the 12-18 year olds, and they will be the challenge to the military trainers if they manage to come to the army (Kautiainen et,al. 2011). The results are seen also in the cooper test results within conscripts starting the army. The results have been monitored since year 1974 and the direction is downwards (Santtila 2011). According to Aberg et al. (2009), study made with Swedish conscripts (N=1,221,727) says, that cardiovascular fitness at age 18 predicts educational achievements later in life (10-36 years follow up) and the improved cardiorespiratory fitness is connected to better cognitive functions in 18-year-old men. Cardiorespiratory fitness seems to be one advancing factor in good performance in school and work later in life.

Numerous other things affect to the performance such as motivation, environment and possibilities to study. Physical exercise could be important instrument for public health initiatives to optimize educational achievements, cognitive performance as well as decease prevention at the society level. (Aberg et.al. 2009).

4.3 Self confidence through physical exercises

Physical fitness and the successfully performance of physical exercises might also improve self confidence and reflect on other areas of the life. (Vuori 2003, 32-33.) Though managing some result or goal in exercise plan brings the feeling that also other tasks might be doable. In exercise one can see the improvements easily and this might increase the moti-

vation also in other areas. This might affect best on those persons, which are not yet physically active. On the other hand there is a risk of failure and embarrassment during exercise is possible. (Alen& Rauramaa 2011, 30-31.) If the exercise for the beginner is done with professionals help, the risk of failure is smaller. The beginning and the first experiences of the exercise might either inspire or depress the inactive person. That's why motivating and cheering for the beginners is very important and has to be noted also in NDU:s physical education studies.

4.4 Obesity and cognitive skills

According to study made with obese adolescents, (Yay, Gastro, Tagani,Tsui& Convit 2012) obesity and metabolic syndrome can lower academic and cognitive skills in 14-20 year olds. The results reveal significantly lower performance in spelling, arithmetic, attention, mental flexibility and lower overall intelligence. This study did not ask about participants their exercise habits or test it in any way, but one can presume, that obese children who have metabolic syndrome as adolescent, are not physically active or have good cardiorespiratory fitness.

Cadets in NDU are approximately 21 year-olds when they start their studies. Based on this information, would it be reasonable also to monitor their body mass index or fat prosentage and keep the limits under the serious risk prosentage. (BMI under 25, fat prosentage under 20 in males) The body mass index is normal when it is between 20-25, excluded very muscular persons.

The problem is that even though there is a lot of knowledge about the positive effects of physical activity on academic performance, it is not used enough in schools or universities to help the students to have better results during their studies. This could be a huge potential to working environments, as people are demanded to work more efficiently in the future, also to NDU to have even better students and future leaders.

4.5 Academic performance, physical activity and function of brains

Our brains weight only 2% of the total body weight, but still brains utilize up to 20% of the nutrients and oxygen supplied by the cardiovascular system (Davenport, Hogan, Eskes, Longman and Poulin,2012.) Regular physical activity is known to increase the blood flow

in brains and help the concentration (Hillmann, Erickson &Kramer 2008). With that effect it could also have positive effects on learning and academic performance.

Exercise is known to bring to some of the people joy and refreshment. Happy and refreshed people should be able to learn better than tired and fed up people. Exercise might also affect psychological stress decreasingly due to its affect on brain delivered neurotoxin factor, which maintains plasticity in brain function. (Alen, M. & Rauramaa,L.2011, 49.) Even a small amount of movement which makes the blood flow faster, makes the children work more concentrated. Exercising during the long day at school effects on brain the way that blood circles more and metabolism of the brain is increased. Increased level of fitness has also a connection with improved cognitive function. (Davenport et. al. 2012.)

According to recent study (Holzschneider, Wolbers, Röder & Höttig, 2012) cardiovascular fitness impacts on brain on those parts of the brain, which are associated with spatial learning. There could be a strong intervention to prevent cognitive age-related decline. In one study (Auyeung, Lee, Kwok & Lee 2011) physical frailty was connected with future cognitive decline in older adults. This is not encouraging result since the working challenges get harder every year and the physical fitness keeps decreasing.

Physically inactive people are a threat to the working communities. In Finnish Defence Forces the responsibility of taking care of their physical fitness is written down on a norm, but this only comprehends soldiers. Inactive people are also a big expense to the nation, due to all deceases caused with inactivity and possible obesity. Inactivity and sitting are concerned as a significant health risk, but our society's work tasks get more passive and require sitting and working with computer (Vasankari 2012).

5 National Defence University

The Finnish National Defence University (NDU, former Military academy) is a military university located in Santahamina, Helsinki. NDU's goal is to advance research and educate students to serve motherland and humanity. It is an internationally recognised institute that offers developed academic teaching and good quality research. The aim of NDU is to train well performing and polite officers to different demanding peace and wartime tasks.

5.1 Student qualification

The students of NDU go through qualifications, where they are tested physically and mentally. Prospectives must have non-commisioned officer´s or reserve officer´s training before applying. Yearly there are approximately 400-600 applicants to the NDU and on average 160 students start the studies yearly. Qualification tests are performed in May and the testing includes cooper running test, psychological testing and material essay. (Selection guide NDU 2011, modified)

The studies in bachelor degree include for example history, technology, languages and behavioural science. The studies take place on Santahamina's military island and after first year also in service and branch schools. Altogether there are about 2000 students studying under NDU on different programs and courses on yearly basis. Officers begin their careers at the rank of Lieutenant after they complete the undergraduate course (bachelor degree). They can also carry on with master studies. In this study the focus is on undergraduate cadets. After the bachelor degree, they work 4 years and come back to study the master degree. Officer Cadets study to become instruction officers and military trainers to Finnish Defence Forces.

5.2 Future military trainers and rolemodels

Training of conscripts requires multiple qualities; training skills, leader skills, general military and branch related skills. Military trainers are important role models to thousands of young men and women every year. The role of physical education trainer is demanding and important, and might affect the attitudes towards exercise for life. Obesity and lack of physical activity are worldwide problems and cause lot of problems with health (Finnriski

2007). It is important that the future officers understand the importance and meaning of physical fitness at a very beginning of their career.

NDU offers their cadets and personnel high quality sport places such as gym, large gymnasium (sports hall), aerobic room, stretching and relaxing room and place for combat sports training. Outdoors there is a possible to use for example sports track, military cross training place, obstacle track and various ballgames. Also equipments for sport are offered. The physical education group (FYKA) also offers guidance regarding physical fitness, military sports, rehabilitation and nutrition. Physical education studies are offered as well; Basics of physical abilities (5 op) are obligatory to all students. Students, who are more interested of physical abilities, can choose specialized studies (16op) in physical abilities. (NDU study quide 2012, modified.)

5.2.1 **Changes in studies:**

The Military academy or on the other name National Defence College offered 4-year studies until year 2000. After 2001 there were changes in studies and the school was transforming to university. The changes are presented in table 4. Between years 2001 and 2006 there was an education system, where you applied straight to first-degree division, postgraduate division or staff officer course. (Liene 2000) There was a need to create a more united system and the process started in 2006.

Table 4: Changes in cadets candidate studies 1999-2009 (Liene 2000: Rautasalo, T.2012)

Year	**Education**	**Duration(y)**
1999	Military academy /National defense college (1993-1999)	4
2000	Military academy/ National defense college (1993-1999)	4
2001	1st degree division, postgraduate division or staff officer course	1-4
2002	1st degree division, postgraduate division or staff officer course	1-4
2003	1st degree division, postgraduate division or staff officer course	1-4
2004	1st degree division, postgraduate division or staff officer course	1-4
2005	1st degree division, postgraduate division or staff officer course	1-4
2006	National defense university Finland (Bologna), bachelor degree	3
2007	National defense university Finland (Bologna), bachelor degree	3
2008	National defense university Finland (Bologna), bachelor degree	3
2009	National defense university Finland (Bologna), bachelor degree	3

5.2.2 **Bolognas Process in Finnish National Defence University:**

The target of the Bologna process is to form a European Higher Education Area (EHEA) based on international co-operation and academic exchange that is attractive to European students and staff as well as to students and staff from other parts of the world. The degree was changed to fit the three cycle structure, so it's easier to plan your studies same way that in any other university. The degrees are also easier to compare. The EHEA will help the mobility of European students, graduates and staff. Its aim is to offer access to high-quality education, based on democratic principles and academic freedom. (http://www.ond.vlaanderen.be/hogeronderwijs/bologna/)

In NDU this meant, that the bolognas process changed the structure of the studies. In former system one could apply to bachelor's degree (180credits), master's degree (300 credits) or warrant officers education. The last course which graduated with old system was cadet course 92. It graduated from the master degree year 2011. After year 2006 the students started to study according to bolognas process. Then all the students applied to bachelors degree (180 credits) (also warrant officers) first, then worked 4 years inside defence forces and after applied to master's degree (120 credits). Now the study structure is more similar to other institutes and also affects civilian students to study military subjects.

6 The purpose of the study

The purpose of this study was to find out is there a relationship with qualification cooper test and academic performance in National Defence University in candidate state cadets? The specific study questions were:

1) What was the level of cardiorespiratory fitness measured by cooper test in men and women?
2) Was there any relationship between academic performance and cooper test results?

7 Methods

7.1 Subjects

As a data for this study are used the qualified and graduated cadets from NDU from the years 1999-2009. The studets per course are presented in table 5. This sample was chosen, because it was the newest group of students graduated from NDU bachelor degree. Later only 6 courses (86, 87,93,94,95 and 96) of that group was chosen. Women (N=21) represent 4% of the data. The largest group is course 93 (N=101) and the smallest course 95 (N=76). The total sample number is 531. The study is confidential and anonymous, and the data is used such way, no one can be identified from the results.

Table 5: Amount of students per course

Course/started (year)	N	Men	Women
Cadet course 86/1999	86	80	6
Cadet course 87/2000	84	81	3
Cadet course 93/2006	101	97	4
Cadet course 94/2007	89	86	3
Cadet course 95/2008	76	73	3
Cadet course 96/2009	95	93	2
Total	**531**	**510**	**21**

7.2 Study design

The study is made in co-operation with the NDU and physical education group. Before starting the study, it was obligatory to get a study permit. It included research plan and the arguments of getting the data needed for the study. It included rules about storing the confidential materials and the instructions of pre-evaluating and publishing the final materials. The permission for this study (see appendix 1) was applied from department of studies (OAO) and all the data has been used based on that permission.

Quantitative research method examines information numerally. It searches connection between things. This method was chosen, because there was no need to highlight certain re-

sults and the data was already available (Vilkka 2007, 14.). In this study all the data was stored in the archive, so NDU archive staff was helpful when searching the data.

7.3 Measurements

7.3.1 Cooper test

Cooper test result is from the qualification cooper 12-minute running test. The result is measured in qualification day by educated staff from NDU. The result is measured with 10m accuracy. Cooper test correlates well (r=0, 3) with the whole population's maximal oxygen intake (VO2max)**.** (Cooper, K. 1968, 135-138)

7.3.2 Academic performance

Academic performance was measured with superiority queue. Superiority queue is based on subjects in the degree. The students are placed on queue based on their academic performance within their own group of students. Dependent on a course, the study evaluation rules differ, based on curriculum that year. Cadet courses 86 and 87 studied in Military academy and 92-96 courses in NDU. Between courses 86-87 (maximum 100 points) and 93-96 (maximum 5 points) there were differences in evaluation system, so it was finally presented by using z-score. Z-score is used when there are differences in evaluation systems. It tells how far away from the groups mean the score is. The mean of the whole groups scores is always 0. With the z-score we could evaluate the whole group at once.

7.4 Statistical analyses

Statistical analyses were done by the SPSS for windows Statistical software 12.0. Means, standard deviations and coefficients of Spearman and Pearson correlations were calculated by standard methods. SPSS is commonly used to analyze research materials, which studies multiple variables. (Heikkilä 2004, 123 & 183) Statistical significance for all analyses was accepted at the level $P< 0.05$.

7.5 Correlation

The connection between variables is examined with correlation. The usual method is Pearson correlation. In Pearson correlation, the data must be formed normally. Spearman rho is a method for numbering the data, when it is possible to put the data to ordinal numbers.

Spearman correlation is used when the statistics are not formed normally and there is no even numbers in the data. In this study I used both Pearson and Spearman rho to analyze the data.

7.5.1 Co variances

As co variances was used sex (men 96% and women 4 %) and academic background (high school 96% or vocational school 4%). The data was collected to the excel files used in qualification test materials. Vocational school as a academic background was accepted from the year 2006. The study backgounds are presented in table 6.

Table 6: Academic background per course

Course	N	High school (lukio)	Vocational school (ammattikoulu)
86	86	86	0
87	84	84	0
93	101	89	11
94	89	84	5
95	76	73	4
96	95	94	1
Total	**531**	**510(96%)**	**21 (4%)**

8 Results

8.1 The level of cardiorespiratory fitness

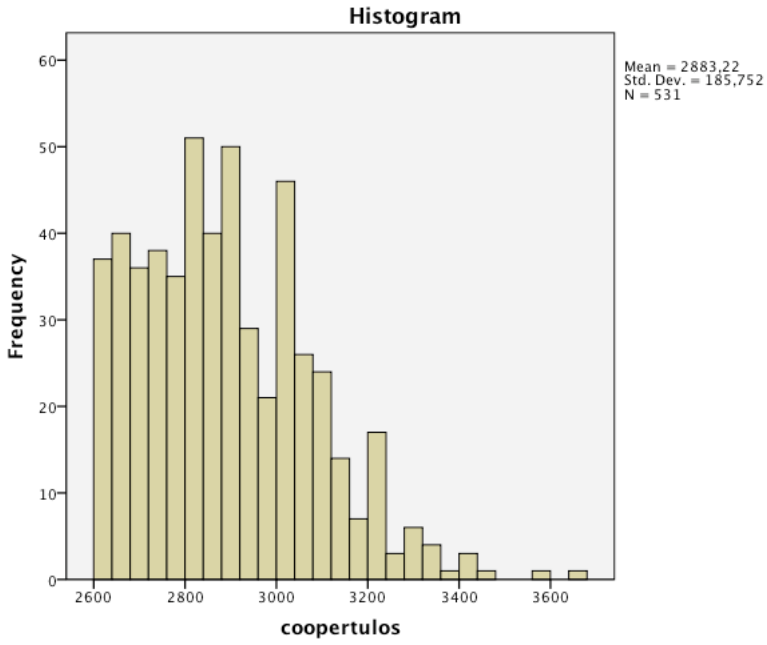
Table 7: The level of cardiorespiratory fitness in men and women

	Woman	Men	All
N	21	510	531
Mean	2706.67	2890.49	2883,22
St.deviation	107,661	184,751	185,752
range	370	1070	1070
Min	2600	2600	2600
Max	2970	3670	3670

In this group (N= 531) the mean of cooper test was 2883 m. The minimum result was 2600m, (qualification line) and maximum 3670m (table 7). In men (N=510) the mean was 2890.49m, ±184,751m, range 1070m and maximum result 3670m. In women (N=21) the mean was 2706.67m, ±107,661m, range 370m and maximum result 2970m. On average, men performed 6,4% better in the results.

When concerning the whole group the distribution of cooper test was not normal. Cooper test results are presented in chart 1. The statistical analyses where made with Pearson and Spearman rho, but there was not found significant difference, with the whole group.

Figure 1: Qualification cooper results distribution in whole group (N=531).



8.2 Academic performance

Table 8: Academic performance in men and women (z-szore)

sex		Mean	Standard deviation	N
Woman	academic performance	**0.2932172**	1.10115064	21
Men	academic performance	**-0.0120736**	0.99494745	510

In academic performance in women (N=21) the mean was 0,293 ± 1.01. Men's (N=510) mean was -0,012 ± 0.99. The results are presented in z-scores.

8.3 Cooper test and academic performance

Significant correlation was not found when women and men were at one group (N=531). The significant correlation was found between cooper test and academic performance in men (r=. 10, P=0.033, n=510), but not in women.

8.4 Academic background

Between different academic backgrounds high school (96%) and vocational school (4%) there was no difference in correlation between cardiorespiratory fitness and academic performance.

9 Discussion

The most important finding in this study was, that in men (N=510), there was found weak relationship between cooper test (cardiorespiratory fitness) and academic performance (r=. 10, P=0.033, n=510). The correlation coefficient was only 0.10, however it is statistically significant (P=0,033). In women, there was no correlation. The level of cardiorespiratory fitness was good (2,5/5).

In this group the subjects were already performing moderately in cooper test (2600m minimum), so there is not very weak results in cooper test. In the academic performance, there is weak results and excellent results, and that can be the reason for the weak correlation coefficient (r= 0.10). Within cooper test, the data does not split normally, and in this study only the best part of the results is examined. In this group even the subjects with the lowest result in cooper test, had moderate results. Also the fact that when a prospective reaches the 2600m or 3000m limit they might stop trying and that way the results might be worse that they could be.

There are studies, where a positive correlation between cardiorespiratory fitness and cognitive functions has been found. In similar studies, there were no minimum limits, only the measured fitness levels and the changes in it. The correlation could be stronger if there would be weak performance in cooper test and weak academic performance.
Physical fitness and its connections to mental and cognitive functions is current and interesting study topic. Lot's of similar studies have been done in past few years and the knowledge about the connection between cardiorespiratory fitness and cognitive functions is increasing.

According to Aberg et.al. (2009), cardiovascular fitness is associated with cognition in young adulthood (18years) within Swedish men (N = 1,221,727). Also the change in physical achievement between age 15 and 18 predicted cognitive performances at age 18. The increased fitness level predicted increased global intelligence scores. Male subjects with improved cardiovascular fitness had significantly greater intelligence scores than subjects with decreased cardiovascular fitness. Also the cardiovascular fitness during early adulthood predicted sosioeconomical status and educational attainment later in life. In the same study was found that a with 70-kg young male subject, one stanine unit of cardiovascular fitness corresponded roughly to 20W in maximal load on an ergonometric cycle.

9.1 Cadet's studies

NDU requires cadets to be in good condition. It is interesting, that good condition could have also other benefits, such as academic performance. Cadet's average age in the beginning of the studies is 21 years. The study (Aberg et.al 2009) claims strongly that cardiovascular fitness is positively associated with cognitive performance at age 18. During the studies it is important that cardiorespiratory fitness is maintained and that requires good motivation towards training. In NDU (2006) there was a concern, whether the qualification limit was too low (2500m in men, in year 2001-2006) and the level of fitness was decreasing too much during the studies. The small study made with the same topic revealed that in cadet course 88, there was s connection with the cooper test and academic performance. (FDF 111/5.2/D/I/2005). Also recent reviews (Singh et.al. 2012) point out the positive long term connection between physical activity and academic performance.

During the studies students normally sit long hours, even 8 hours a day. Only lately we have started to understand the risks of inactivity versus activity. The amount of sitting was found to be connected to common mortality regardless of exercise, BMI, age or sex or other usual risk factors (Vasankari 2012). New study methods should be thought (in all of the educative institutes), since sitting creates a health risk even to young persons with good physical fitness.

In academic performance, women (0,293) performed better than men (-0,012). Also other studies have found that the results of academic performance on average are better in girls than boys in several topics. Other things such as social background, motivation and quality of teaching affect to the end result (Mustaparta & Nyyssölä 2004, 7). Within this men-oriented field, the women have succeeded to maintain the trend of being better in academic performance.

9.2 Cardiorespiratory fitness

The level of cardiorespiratory fitness is based on age-specific reference values in Finnish Defence Forces. In men's group mean was 2890m and in reference values (20-24year) it was a good result (2.75 /5.00). Women's mean was 2707m and that in the same age group it gives 3.00/5.00, which is also good. Basically in reference value table, women performed 0.25 better than men.

Men are usually physically stronger than women (Cureton et. al. 1986) and it shows in the results of this study. The mean of cooper of men is 183.82m higher than in women. The difference between men and women is 6.3%. The standard deviation of women (107,661) is smaller compared to men (184,751), which also points out that women are physically weaker, and their results are at the lower part of the chart. Anyhow when concerning women or athlete women, the difference between men and women in this group is not as large as usual. Compared to study made with endurance athletes (Mitchell et al 1992) the difference in maximal oxygen intake can be up to 12.5% better in men.
It has to be noted that the group of women is significantly smaller (N=21) compared to men (N=510). Officer training is more attractive to men, and the amount of qualified women is not large. Also the qualification line, which is the same both in men and women, has to be noted.

The quality of the women qualifying to NDU is good when concerning cardiorespiratory fitness in this gropu (N=21). Women also perform better in academic performance in this group, so the NDU should want to have woman prospectives to qualifications. On the other hand, when facing a crisis task or for example war, strong soldiers are needed, regardless of the gender.
It can be said that women "mess" the result of this study based on their lower cardiorespiratory fitness and better academic performance. For women, the result 2600m represents better result than to men. Also the cooper test standard deviation in women (107,661) was smaller than in men (184.751). This can also be explained with the smaller amount of women in the data.

9.3 Equality

Equality is important value in Finnish Defence Forces and also in National Defence University in the training of officers. Men and women are treated with the same rules and go trough the same training. Based on these results, there should be minor differences when evaluating men and women based on cardiorespiratory fitness. Based on this study men and women with high cardiorespiratory fitness should be wanted to NDU.
The maximum result for soldier women in the FDF reference value table in cooper is (20-24y) 3100m and for men (20-24y) the result is 3300m. (Pihlainen, K. 2011, 47-52.)
Women rarely run (excluded elite runners) much more than 2600m in qualifications, because the next point 3000m (extra points) requires excellent cardiorespiratory fitness. It

could be that women also accept lower results more easily. Equality is important, but women's weaker fitness level should be noted. To women, it could be useful to keep the qualification line (2600m) the same, but lower the line to the extra points, for example to 2900m (now 3000m). This could courage the women to get to even better cardiorespiratory fitness before the qualifications. This could be argued based on several studies about the differences between genders in VO2 max numbers. (Mitchell et. Al. 1992.) It does not put women with remarkable advantage, but gives them more realistic chance to get extra points in qualification cooper and aim for the excellent cardiorespiratory fitness.

In women, there was no relationship between cooper test and academic performance. There can be several reasons for this result. The group of women was small (N=21) and based on that group the results are not reliable. Women have naturally weaker physiological abilities and the training of officers is designed originally for men's physique. The training includes for example shooting and handling the guns, carrying heavy loads during training and learning military subjects, which might be more interesting to men. Also working and studying in environment which is men- oriented, can be a challenge to students. Surprisingly, the mean of women's academic performance compared to men was better in this group of women. The motivation of the women coming to the officer training is probably excellent.

9.4 Validity and reability

Validity indicates the ability to measure, what was meant to be measured. In quantitative research this means; has the data been handled reliably, is there mistakes in transporting the data, and are the missing results important to the end result (Heikkilä 2004, 186; Vilkka 2007, 150.).

Some of the courses were left out because of the lack of the data and some inviduals were left out because of the missing parts of the data in the files. Air force cadets are not on the data because they don't perform qualification cooper. The data was transferred manually and mistakes are possible. It has to be noted, that in years 1999 (KADC 86) and 2000(KADC 87) there was different study system (military academy) and then only high school background was accepted to qualifications.

Internal validity means, that does the measurements match with the concepts shown in theory part of the study. External validity means in the study, that also other researchers inter-

pret the results the same way (Heikkilä 2004, 186; Vilkka 2007, 150.). This study measures the relationship between cardiorespiratory fitness and academic performance. The cooper test correlates well with VO2max numbers and the academic performance number measures the superiority of the students in NDU.
The reliability of the study evaluates the repeatability of the study. The study is reliable, when it is repeated and the same result occurs, independent of the researcher. The accuracy and other thing included to the study are monitored. The accuracy means how many random mistakes is included, the sample size and quality, how reliably the results have been entered and which kind of measurable mistakes there can be. (Vilkka 2007, 149–150.) The amount of subjects in this study was 530, and that amount is adequate to generalize the result in NDU.

Internal reliability can be noted by measuring the same statistical unit many times and external reliability means that are the measurements repeatable also in other studies. The validity is affected by low reliability, but reliability is independent of validity. (Heikkilä 2004, 187: Vilkka 2007, 149.) The data used in this study can be used again and the same results will come out. The data was collected from the archive, and those results not available at the moment were left out. When taking more results from the same cadet groups available, the result can be different. This study is based on only this certain group of people.

There are many studies which have found positive relationship between physical fitness and cognitive functions. In this case, the cognitive function is measured very simple way, by comparing two numeral things, and not focusing on time between the measures. In other studies the cognitive function is measured for example by physical activity (self reported) instead of cardiorespiratory fitness (Singh et.al. 2012), compared to spatial learning (Holzschneider et.al. 2012) and succeeding later in life (Aberg 2009), so the results are not fully comparable. The results can be generalized in NDU. Learning and succeeding in studies is a complicated process and during the studies there are a lot of variables, so the cardiorespiratory fitness can be one variable. Good cardiorespiratory fitness gives very important health benefits, so its meaning in young adult's life should be more emphasized.

9.5 Future of officer training

The cardiorespiratory fitness of Finnish young men has decreased 11% from the year 1974. (Santtila, M. 2011). There can be a challenge to get enough good quality prospectives in the future, if the numbers are lowering at this pace. The average age of cadet is 21 years and at this age they should be in their best physical condition. That's why it is very important that the education given by the NDU highlights the meaning of physical fitness. The cadets, which will be instruction officers, have to have enough knowledge about physical fitness and its training. Also their own attitude towards helping the conscripts with low physical fitness must be at place. It has to be highlighted, that they have big status as role models and getting Finnish young men and women to better shape.

This study searched the relationship between starting point (qualifications) cardiorespiratory fitness and the diploma of the studies at undergraduate state. There is no information about their condition at the end of the candidate state, even though they should be able to run at least 2600m. If the results would be available also from the finishing of the studies, they would be used also to compare. Nowadays it is obligatory to run 2600m in the cooper before graduation. The value of the academic performance superiority queue and it is formed from all the subjects, also officer behaviour. It could be useful to search connection with major subject or other parts of the diploma, if the results are available.

It would be interesting to see in the future:

1. Does the division to air, sea or army forces as co variances make a difference?
2. Does the comparison to major subject instead of superiority queue give the same results?
3. How much does the result of the cooper test chance during the bachelor degree? (Candidate state)

9.6 The meaning of the results of this study

This study gives information to the NDU about the meaning of good cardiorespiratory fitness during studies and also working life. The FDF exercise strategy already notices and supports physical working ability by offering fitness testing and 2h weekly exercise time to everyone working in FDF. The only requirement is fitness testing before getting the right

to use weekly exercise time. The advantage is major and it is not used enough within personnel. According to Pihlainen (2009) passive workers in FDF have higher possibility to health risks than active workers. In his study almost one third of the participants in the study pointed out, that even though they have the right to the weekly exercise, they have no time to exercise during working hours because of the busy working schedule. NDU could be the role model and trendsetter for other universities and working communities by understanding the benefits of good physical fitness. Good physical fitness should be noted and rewarded and inactive people should be given more opportunities to improve their fitness. Based on the one study (Aberg 2009) it could be even advantage in personnel qualification, that person is taking care of their physical fitness.

In conclusion, the present study revealed that there is a weak relationship with cooper test and academic performance in National Defence University in men. ($r=0.10$, $p=0,033$, $N=510$) In women, it could be useful to decrease the limit to extra points in cooper test from 3000m for example to 2900m. It would be more realistic to women to achieve, and as a result better performing women would qualify. Every now and then, there are suggestions about lowering the limits of qualification cooper. To NDU it is important to maintain or increase the limits of qualification cooper, because soldier has to be fit and healthy. It gives wrong impression, if the only physical test is too easy to achieve. Soldiers should have excellent cardiorespiratory fitness and based on recent studies, that also has affect on their academic performance. (Aberg 2009) With requiring better cardio respiratory fitness, there could be also better soldier in total.

The requirement of cadet's physical fitness and the structure of the school day are not on the same level. The structure of the school day should be formed such way, there is a time and possibility to exercise also between the lectures, to keep the cardiovascular fitness level high, and improve the academic performance.

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Appendices

Appendix 1: The study permit

MAANPUOLUSTUSKORKEAKOULU TUTKIMUSLUPA-ANOMUS

Johtamisen ja sotilaspedagogiikan laitos
Marke Hietapakka
Haaga-Helia university of applied sciences:
Master of sport studies,
Degree Programme in Sport Development and Management
20.8.2012

Kestävyyskunnon yhteys opintomenestykseen maanpuolustuskorkeakoulussa.

Haen lupaa opintoasiainosastolta seuraavien tietojen hankkimiseen: Opintorekisteriote sekä pääsykoe cooperin tulokset vuosilta 2002- 2012

Tutkija: Marke Hietapakka, Liikunnanohjaaja Amk, Pro Gradu opinnäytetyö
Tutkimuksen ohjaajana toimii Timo Vuorimaa (Haaga-Helia) ja Jani Vaara (Mpkk)

Tutkimuksen tarkoituksena on selvittää onko kestävyyskunto (12 minuutin juoksutesti) yhteydessä opintomenestykseen ja onko eri opiskelutaustalla vaikutusta opintomenestykseen (ammattikoulu, lukio, upseeriopinnot).

Tutkimuksen kohderyhmänä ovat vuosien 2002- 2012 kursseille hyväksytyt opiskelijat. (n.1500 hlöä) Opiskelijoiden henkilöllisyys pidetään salassa.

Tutkimus antaa Maanpuolustuskorkeakoululle tärkeää taustatietoa pääsykokeessa käytettävän 12 minuutin juoksutestin yhteydestä myös akateemiseen menestymiseen sotatieteissä. Tutkimuksen lopputulosta on tarkoitus hyödyntää Maanpuolustuskorkeakoulun pääsykokeita suunniteltaessa ja perusteltaessa.

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