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Fitness level comparison between police college freshman and senior students

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Abstract

Physical education as part of Police College program has important place in the preparation of future police officers for this responsible social role. Fitness level is directly connected with officer's health and ability to perform risky tasks. The aim of this paper is to compare fitness level of Police College freshman and senior students. In the time of testing the training process lasted 2 semester for freshman, and 8 semester for senior group. Sample consisted of 430 students. Muscle endurance (repetitive strength), aerobic endurance and anthropometry were evaluated by the selected tests. The existence of the differences between groups was determined by a T-test; statistical significance was defined at the level of $p < 0.05$ for the variables weight, waist, ratio of waist and height, the maximum number of push-ups and sit-ups in 60 seconds. The 2.4 km run test showed no statistical difference between two compared groups. Upper body and core muscle endurance were found to be better in senior, than in freshman students group. Aerobic endurance is almost at the same level, while anthropometric characteristics showed negative tendency according to waist results and waist to height ratio indicator (i. e. better results in the freshman group).

Keywords: Tactical athlete, testing, anthropometry, strength, endurance

Introduction

Physical fitness is an essential component of being prepared to do infrequent but often critical tasks of police officer, including pursuing fleeing subjects, close combat, handcuffing, use of firearms, as well as crowd control [8]. An adequate level of physical ability makes it possible to carry out professional tasks at appropriate speed, dexterity, strength, coordination, precision, with appropriate intensity and endurance [18]. Inability to perform physical aspects of police work may endanger public safety [4]. Dynamics and diversity of tasks that characterize the challenges of police work emphasize the importance of adequate physical preparation, which is one of the basic preconditions for the successful completion of daily professional police duties, which can also be assisting the threatened in natural catastrophes [13]. From the routines of shift-work and uneventful patrol to physical responses and actions required in critical incidents, police officers must be physically capable of performing all occupational requirements successfully, and in a way which maximizes safety and security of all those concerned [1]. Members of police force often have to make a fast adaptation from sedentary, passive positions and take action in a hostile environment [24]. Successful response to challenges of this kind requires corresponding level of physical activity and its monitoring during studying on police college/academy also after graduation, during work. Speed, strength, agility, and endurance training are required for physical preparation of tactical athletes, such as firefighters, military and police officers [16].

Repetitive strength measures assess the ability to generate continuous or repetitive submaximal forces [27], which are essential during repeated muscle activation while controlling those resisting arrest, grappling, and handcuffing a suspect. Strength supports the ability of police personnel to perform critical emergency functions while fulfilling the local government's legal responsibility to deliver adequate protection to the public [5]. Good muscular strength will have an impact on police ability to apprehend an agitated suspect, sprint up a set of stairs, or burst through a locked door [26]. Endurance is the key ability when it comes to chase a suspect running out of the car, through variety of terrains.

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It is a challenge that requires a police officer whose respiratory system can absorb this kind of effort and then quickly recover for possible next actions.

Low levels of physical activity have shown to promote increase in weight, body fat, and potential health issues [5]. Body mass increase caused by obesity can compromise this physical condition. Demands related to police job, such as the pace of daily work, occupational responsibilities, and distressing situations, as well as factors such as poor diet and physical inactivity can initiate health problems and affect quality of life among police officers [10]. The routine physical demands of this job, such as riding in a patrol car and preparing paperwork, are often inadequate for maintaining necessary physical fitness to perform these infrequent but possibly lifesaving critical functions. Although police officers, in their early career, are considered more physically active than the general population, studies indicate that they are more prone to being obese or having diseases related to obesity over time as result of physical and psychological work requirements that are sometimes in conflict with maintenance of physical fitness [11]. This is why constant monitoring of anthropometry (from entering police academy as a student and also during police officer career) is necessary. Measure of central adiposity-waist-to-height ratio have consistently shown to be more strongly related to several diseases or poor health outcomes than BMI in both genders [1]; in consequence it will be used in this research.

The main objective of research is to present data that shows the impact of continuous physical activity through comparison of fitness levels between cadets of first and last years of study within the Abu Dhabi Police College. Key performance indicators of fitness level within the AD Police in terms of body composition are waist circumference, weight and waist to height ratio (WHtR), and in terms of physical ability aerobic capacity and muscular endurance (repetitive strength). The main research hypothesis is that general fitness level is better in senior than in freshman students group.

Material and methods

Participants

Four hundred and thirty (430) healthy students (278 freshman and 152 senior) of the Police College in Abu Dhabi participated in this study. All respondents had a regular strength and endurance training at least five times per week during last two semesters. Freshman are aged between 18 and 20 and 23 – 25 for the senior group. All cadets who participated in this research have successfully passed a standardized fitness test, as part of preselection process.

Physical fitness training program approach for both groups used a weekly cycle, with daily tasks to increase endurance, hypertrophy, strength, or power for general health and physical conditioning. All fitness-training sessions, regardless of approach, began with a warm up lasting approximately 15 minutes that included activities of running, intensive basic movements with dynamic stretching and concluded with a cool - down lasting approximately 5 - 10 minutes, including a general focus on static stretching. The total length of each session was approximately 60 minutes. Training program was based on progressive increase of training complexity. From one to the next week cycle, the number of Push – Ups (PU), Sit – Ups (SU) and external load increased, while the running time for the same distances decreased. The number of sessions was same for both groups, but significantly more demanding for the older (senior) group in particular the amount of external load, repetition and intensity when it

comes to strength. Development of aerobic endurance was main objective of younger (freshman) group, in addition to bodyweight (calisthenics) exercises.

Every training started in the morning from 6 a.m. Afternoon training sessions were comprised of core stability training or exercise which would increase the level of fitness that in the trainer's opinion are considered as the class's weakness. Cadets who needed additional work and those whose efforts were not at an adequate level (as per the opinions of trainers' and other college staff), trained also during the weekend.

All the tests that we have chosen for the evaluation of the effects and changes caused by the application of educational and training programs for the Police College students have a psychometric properties, useful informativeness, objectivity, reliability, validity and economy of application:

- Body composition – weight, waist circumference and waist to height ratio (WHtR);
- Aerobic endurance test – running 2.4km distance;
- Core muscular endurance (repetitive strength) test – maximum number of Sit - ups in sixty seconds;
- Upper body muscular endurance (repetitive strength) test – maximum number of Push - ups in sixty seconds.

Test protocol

Freshman and senior students testing had the same routine. Weight, waist and height were measured at the beginning of procedure. This was followed by warming up and giving precise instructions to cadets, after which they did PU and SU test in sixty seconds in order to finalize the 2.4km running test. The cadets were tested in their sport uniforms - shorts, T - shirts and sport shoes. Testing team consisted of instructors from the Abu Dhabi Police College. Only perfectly done repetitions were counted, following high standard of testing rules. Shortening the range of motion or irregular contact with the ground for rest was not allowed [19].

Anthropometry

Weight (kg) and height (cm) data for the students were collected using standard procedures on a doctors beam scale (SECA, Germany). Waist circumferences were measured around the abdomen at the level of the umbilicus (belly button), using flexible, non – elastic measuring tape. After the collection of all the data, they were transferred in Microsoft Office Excel sheets and based on them the student's WHtR is calculated by dividing waist size by height.

Upper – body muscular endurance

For assessment of upper body muscular endurance 1 minute PU test was used. All students were required to begin the test with the body rigid and straight, the elbows fully extended, the hands positioned slightly wider than shoulder - width apart and the fingers pointed forward. The participants proceeded to bend their elbows, lowering themselves until their chest were in contact or close to the ground and then extending their elbows back to the “starting” position. The students continued repeating as many repetitions as possible within the 1 - min period. The test was terminated when a student was unable to perform this movement with proper technique, or when the 1 - min time limit expired.

Core muscular endurance

For assessment of core muscular endurance 1 minute SU test was used. All students were required to begin the assessment lying on their back with the knees bent to around 90° and the feet flat on the ground. Hands were in the middle of the chest

and placed on the opposite shoulder. The participants flexed their trunk, elevating them off the floor until hands (crossed on the chest) touched their knees. During this assessment student had a coach anchor their feet in place to assist in keeping the feet flat on the floor throughout the exercise movement. The students continued to do as many repetitions as possible within the 1 - min period. The test was terminated when a student was unable to perform this movement with proper technique, or when the 1-min time limit expired [12].

Aerobic endurance

Outdoor roads inside Police College facility were used to maximize future real working environment and factors such as hard concrete, weather conditions, heat, humidity, etc., which would influence the running time. General aerobic endurance of the body was estimated by using the 2.4 km (1.5 mile) running test.

Statistical analysis

All data were presented as mean values and standard deviations. From descriptive statistics, for each variable, measures of central tendency (arithmetic mean) dispersion (standard deviation), minimum, maximum and standard error were calculated. From comparative statistics, T test for independent samples was used with a statistical significance level of $p < 0.05$. Statistical analysis were performed using a statistical software package (SPSS, version 20).

Results

Anthropometry

Freshman students group had body mass of 67.3 ± 10.4 kg. Waist circumference was in average 76.6 cm with standard deviation of 7.7 cm. Mean WHtR was 0.441 with standard deviation of 0.042.

Senior students group had body mass of 70.3 ± 9.2 kg. Waist circumference was in average 79.5 cm with standard deviation of 6.7 cm. Mean WHtR was 0.459 with standard deviation of 0.036.

Table 1: Descriptive statistic and T test for anthropometric characteristics.

Variable	Semester	N	Mean	St. Dev.	Std. Error	Min	Max	T test Sig.
Age	2	278	19.025	.649	.038	18	20	.000
	8	152	23.907	.740	.060	23	25	
Weight	2	278	67.337	10.455	.627	31	105	.003
	8	152	70.348	9.274	.752	47	93	
Height	2	278	173.643	5.453	.327	160	190	.500
	8	152	173.269	5.574	.452	161	198	
Waist	2	278	76.651	7.742	.464	62	108	.000
	8	152	79.500	6.765	.548	63	98	
WHtR	2	278	.441	.042	.002	0.36	0.60	.000
	8	152	.459	.036	.003	0.35	0.55	

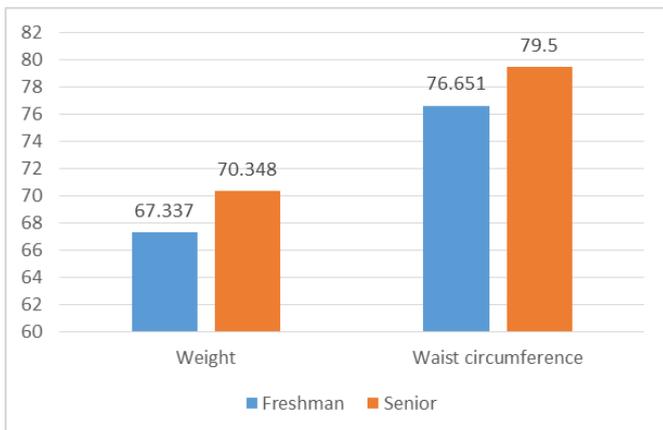


Fig 1: Mean weight and waist circumference

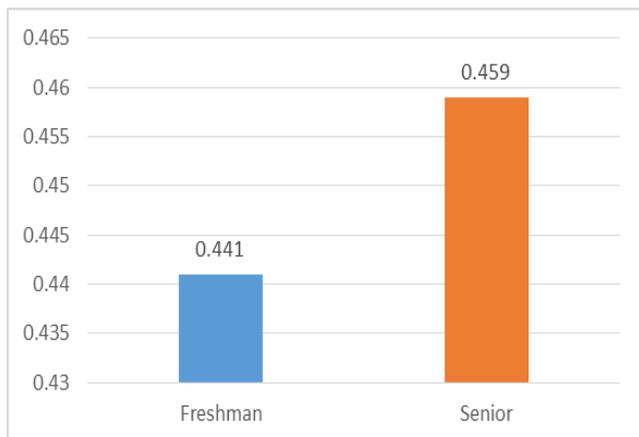


Fig 2: Mean WHtR for freshman and senior group

Physical Fitness

Cadets aerobic capacity was assessed using a 2.4 km run, which was completed by 2nd semester group in 621.1 ± 54.2 sec and for 8th semester group in 610.1 ± 24.6 sec. 2nd semester cadets also performed 29.2 ± 8.5 PU and 36.5 ± 6.1 SU, while 8th semester group performed 44.2 ± 6.3 PU and 50.0 ± 6.8 SU in a 60-second timed assessment of muscular endurance.

Table 2: Descriptive statistics and T test results for fitness characteristics of police academy cadets.

Variable	Semester	N	Mean	St. Dev.	Std. Error	Min	Max	T test Sig.
PU	2	278	29.208	8.506	.510	0	55	.000
	8	152	44.289	6.379	.517	38	67	
SU	2	278	36.557	6.127	.367	12	55	.000
	8	152	50.072	6.866	.556	40	74	
RUN	2	278	621.133	54.275	3.255	516	1065	.018
	8	152	610.105	24.618	1.996	512	635	

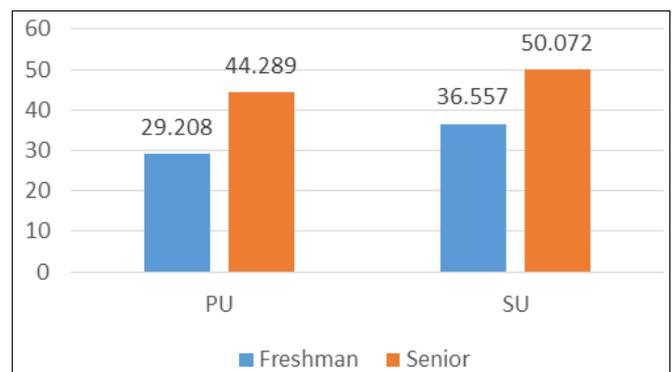


Fig 3: Mean number of PU and SU in 60 sec

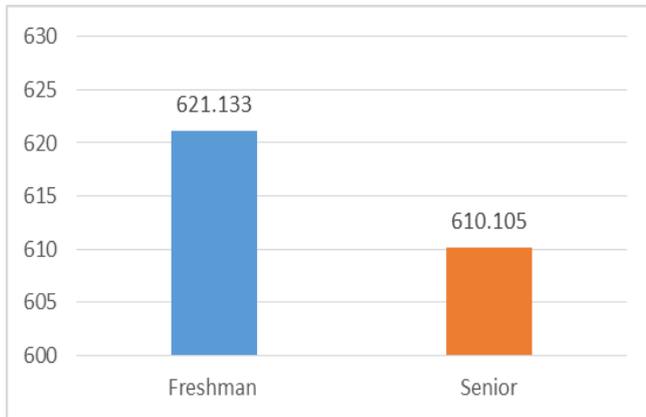


Fig 4: Mean running time for 2.4 km

A number of variables were found to have significant difference between two groups ($p < 0.05$). Considering anthropometry those variables are found to be waist circumference, weight and WHtR. As far as physical fitness measures there were significant differences in number of completed PU and SU (see Fig. 3).

Discussion

Anthropometry

Average weight in freshmen was 67.3 kg and in senior students group 70.3 kg. Difference is statistically significant and is part of normal process of weight increase in early 20s. From a practical point of view, greater body mass will make it easier to force criminal out of balance and make it more difficult for the struggling subject to take physical control of police officers [14]. From a health aspect, the Woodhall [29] study showed that 358 students gained an average of 1.67 kg between the beginning and end of freshman year. As the researcher concluded, changes in diet quality, sleep, and stress levels may have attributed to the weight gain observed in participants. In a wider context where a time range includes years spent at college, the transition between adolescence and adulthood and a period of stopped height grow (Table 1) and increased risk of excess weight gain is highlighted [23].

In the context of the worldwide epidemic of obesity, despite the training and increased muscle mass cadets are not fully protected from poor nutrition habits [25, 31], which can eventually lead to an increase in the waste circumference and worse WHtR results in 8th than in 2nd semester group. Average waist in freshman group is 76.6 cm and in senior students 79.5 cm, which had a direct negative transfer on the WHtR (freshman .441 and senior students .459). Values above .50 in WHtR indicate a potential health problem which means that average cadet is not in possible risk for illness or obesity. Continuous training and good nutrition are solutions for staying in acceptable values for WHtR after graduation - during the career of police officers.

Physical fitness

Tested abilities refers to the task-related characteristics of the future police officer such as upper body muscle endurance, core muscle endurance and cardiovascular endurance. Those characteristics are connected with physical activities that are performed at police work, such are carrying, running, lifting, climbing, pulling, dragging, jumping, wrestling, pushing, kicking, striking, wrestling etc. [2] Comparing both generations test results, we found better dynamic strength performance and average running time in older than in younger group.

PU test showed in average 29.2 repetition in 1 min for freshman, and on the other side 44.2 reps for senior students group, which is statistically significant difference ($p < 0.05$). The Cooper Institute (Fitness Intervention Technologies and FitForce) have conducted validation studies for 178 federal, state, and municipal agencies. The range of absolute test standards recommended for each organization was 25 – 34 PU repetitions [7]. 2nd semester students are in the middle, while the 8th semester students are far above this range.

SU test showed in average 36.5 repetition in 1 min for freshman, and on the other side 50 reps for senior students group, which is also statistically significant difference ($p < 0.05$). The Cooper Institute absolute fitness test standards for law enforcement recommended 30 – 38 Sit - Up repetitions [7]. 2nd semester students are in upper half of this range, while the 8th semester group is, as in the case of PU results, far above this range.

Cadet's aerobic capacity was assessed using a 2.4 km (1.5 mile) run test. Freshman results showed average time of 621 sec (10:21 minutes: seconds), while senior students completed same distance in 610 sec (10:10 minutes : seconds). In average 11 seconds less was needed for senior students to finish 2.4 km distance, but this difference was not found to be statistically significant. Analysing differences in key performance indicators between police college cadets in different semesters of their education Cvorovic and Maamari [9] presented similar results for 2.4 km (1.5 mile) run test. In his report homogeneity in the students results existed between 2nd, 4th and 8th semester. This research offered explanation that probable cause for results similarity is number of classes of physical education which included more aerobic training for 2nd semester than for 8th semester group. Identical training program was used for cadets that participated in our research, therefore homogeneity between freshman and graduates group appeared in both studies.

Age, anthropometry and physical fitness relations

Age, anthropometry and physical fitness of police cadets and police officers have been investigated by numerous authors [20, 13, 15] and study's results vary when variables age and physical performance are compared. For example, we found better performance in both core and upper body muscle endurance in older, senior group (average 23.9 years old), compared with freshman, younger group (average of 19 years). Running time is also better for graduates (11 seconds in average), although difference is not statistically significant. Dillern and associates [14] examined general physical fitness on sample of nineteen male police students. Contrary our results, the officers' age was largely and moderately correlated to the physical index and the arrest index. These correlations were negative, where the aggregated performances in both indexes decreased with increased age.

Comparing anthropometry and physical performance results of our research shows that with more weight, waist and WHtR – the better the core and upper body performance. There was no significant difference between running time, although senior students group had had better average result (11 sec). While some researchers found increased weight and body fat to negatively contribute to performance, i.e. the lesser the weight the better the performance [22, 27], others found weight to have no negative influence at all, or even a positive contribution. In research of Dillern *et al.* [14] regarding stature, body mass and BMI correlated with the physical index and the arrest index, and no significant findings were disclosed. Further, retrospective data for 76 male police officers was

obtained by Dawes *et al.* [12]. Data included anthropometric and physical performance measures and correlations between anthropometric measurement and fitness score were obtained. Estimated percentage body fat was not found to be significantly and negatively correlated with SU and 2.4 km run performance, which stand in with our findings. As Harman and Frykman [17] reasoned there are many fatter individuals who can run faster than leaner ones and many lean individuals who do not run as fast as expected. Future researches require detailed body composition analyze, using modern apparatus, such as bioelectric impedance method to determine the exact percentage of fat and lean body mass.

We assume that the continuity in training process (8 semesters comparing with 2 semesters) had bigger positive influence on test results than possible negative influence of poorer anthropometry in older group, which led to better physical fitness performance. Better fitness results in older students shows positive trend in AD Police College Physical Education department, which needs to be extended in future years, after graduation and during police officers career, because age differences between police officers and younger criminals together with poor physical conditioning may not only make their job more difficult but also more dangerous [27]. Examples of what should be the future tendency of AD police fitness program was presented by Boyce *et al.* in research from 2009 [6]. They found in a 12.5-year longitudinal study of police fitness that both male and female officers increased in strength well into their 30s and 40s. These results are showing the benefits of continuous and systematic work and testing of employees after graduation from Police College.

Conclusions

The research gave a certain amount of information about physical fitness and body composition in relation to the year of study. As noted earlier, differences among the groups and variables were identified and led to the following conclusions: Conclusion 1: Physical fitness is better in graduates, when compared to the freshman group, which clearly indicates the effectiveness of the applied training process during years of education and positive fitness level trend.

Conclusion 2: Anthropometry results are better in freshman, when compared to graduates group, which gives directions for improvement in diet regime and constant following of body composition using modern technology.

Conclusion 3: Vast majority of cadets are able to positively respond to World standard test norms, as required by the Abu Dhabi Police College, which offers evidence that they are fit to do their future job well and that they are at an acceptable fitness level.

Strengths and limitations

The large sample size and standardized protocol training of testers are a strong part of this study. Conversely it is limited by a relatively small variable sample. Future directive for expansion of this research is testing other physical abilities (through pulling, squatting, jumping, sprinting, hand grip power tests etc.) and use of more morphological parameters to better characterize differences between years of education.

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