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1      **Physical fitness and anthropometrics in Finnish soldiers during their early career: Prospective**  
2      **changes during a 3-year follow-up**

3

#### 4 Abstract

5 **Introduction** Physical fitness is a fundamental capability required of military personnel but studies  
6 focusing on longitudinal changes in physical fitness and anthropometrics in soldiers are lacking. The aim  
7 was to evaluate physical fitness and anthropometrics in soldiers during their early career.

8 **Methods** A 3-year prospective study included 180 male soldiers (baseline age  $26 \pm 2$  yrs.) with measures  
9 of a 12-min running test, standing long jump, sit-up and push-up tests, and body mass, height and waist  
10 circumference. Baseline data were stratified into tertiles and the changes within each tertile were analyzed  
11 using dependent t-tests and analysis of variance.

12 **Results** 12-min running test distance decreased on average by 2% (-54 m), sit-up performance 3% (-1.5  
13 reps/min), push-up performance 4% (-1.9 reps/min) and standing long jump performance 1% (-2.1 cm)  
14 over the 3-year period ( $p < 0.05$ ). Both aerobic and muscular fitness decreased consistently among the  
15 highest baseline tertile (12-min running test: -70 m, sit-ups: -3.2 reps/min, push-ups: -7.5 reps/min,  
16 standing long jump: -5.5 cm,  $p < 0.001$ ), whereas both aerobic and muscular fitness levels were maintained  
17 and push-up performance was improved ( $p < 0.05$ ) in the lowest baseline tertiles. Body mass increased on  
18 average by 4% (+3.4 kg) and waist circumference (WC) 4% (+3.9 cm) ( $p < 0.001$ ) and these increases were  
19 observed for all baseline tertiles ( $p < 0.05$ ).

20 **Conclusions** Small decrements in physical fitness and anthropometrics exist during the early career of  
21 soldiers. The changes in physical fitness differed according to baseline fitness levels. The results indicate  
22 that support for exercise training may be needed even in a soldiers' early career.

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25

26 **Key Messages:**

- 27 • Both aerobic and muscular fitness decreased during a 3-year follow up of early career in Finnish officers
- 28
- 29 • Body mass and waist circumference increased during a 3-year follow up of early career in Finnish officers
- 30
- 31 • The greatest decline in physical fitness was observed in military officers with the highest baseline fitness
- 32 level
- 33
- 34 • Body mass and waist circumference increased systematically across their baseline levels
- 35

## 36    **Introduction**

37    Physical fitness is one of the fundamental capabilities required of soldiers as it can directly affect  
38    occupational success and task completion. Therefore, physical fitness standards exist to ensure sufficient  
39    fitness levels required to succeeds in a variety of occupational tasks in the military. Physical fitness is not  
40    only related to completion of specific military tasks but is also inversely related to musculoskeletal  
41    injuries<sup>1,2</sup>, sick leaves<sup>3</sup>, and health outcomes<sup>4</sup>. In addition, physical fitness may mitigate stress responses  
42    during high psychophysiological challenges<sup>5</sup> that soldiers often meet in military operational settings<sup>6</sup>. Due  
43    to the requirements and multiple benefits of physical fitness for military occupational performance and  
44    readiness, information related to changes in physical fitness during soldiers` careers is of importance.

45    Previous studies have investigated time trends in physical fitness outcomes in the military, in part, because  
46    decreasing fitness levels might represent challenges for safe and secure task completion and appointments  
47    to tasks that require a high level of fitness, such as special operators. The largest studies to date have been  
48    conducted in conscript study samples in Finland and Switzerland. <sup>7-8</sup> In Finnish conscripts aerobic fitness  
49    has decreased since the 1970s but the decrease has diminished in the last decade. <sup>7</sup> In Swiss conscripts, no  
50    change in aerobic fitness and muscle power but increase in core stability and decrease in balance was  
51    observed over a 10-year period.<sup>8</sup> Nevertheless, there is less prospective information regarding changes in  
52    physical fitness during early career of officers.

53    In Norwegian Air Force cadets aerobic fitness was unchanged and a small reduction in percent body fat  
54    was observed during the cadets` academy education.<sup>9</sup> A recent study has shown in Norwegian male cadets  
55    that aerobic fitness decreased, while muscle power and muscular endurance increased, during their  
56    education period of 3-years.<sup>10</sup> Moreover, increased waist circumference and decreased sit up performance  
57    was observed in Air Force Reserve Officer` Training Corps (ROTC) cadets during the 4-year education,  
58    while push-up performance and aerobic fitness remained unchanged.<sup>11</sup>

59   Regrettably, these recent studies have only included cadets and, there is considerably less information  
60   about what happens after graduation and during the early career of an officer. In fact, to the best of our  
61   knowledge, there are not any studies addressing this issue. Therefore, the main aim of the present study  
62   was to prospectively examine physical fitness, including aerobic and muscular fitness, and  
63   anthropometrics in Finnish officers during the first 3-years of their professional officer career. Secondly,  
64   these trajectories were studied separately for each military branch including the associations between  
65   baseline physical fitness and anthropometric outcomes with their respective changes. It was hypothesized  
66   that physical fitness would be maintained or declined, whereas BMI and waist circumference would be  
67   increased.

68

## 69    **Methods**

70    The present longitudinal study design included 180 officers, who had graduated from National Defence  
 71    University in 2013 or 2014. In the Finnish Defence Forces (FDF), all soldiers perform physical fitness  
 72    tests and body composition measurements annually. The test results are recorded to the personal database  
 73    of the FDF and the information can be used to research and development purposes. Physical fitness and  
 74    body composition data were collected from the official database of the FDF for baseline results recorded  
 75    in 2013 or 2014 (PRE) and for the respective 3-year follow-up results recorded in 2017 and 2018 (POST).  
 76    Data for this present register-based study were provided to the research group in an anonymized form  
 77    from the administrative personnel data records after receiving a permission from the Personnel Division  
 78    of the Defence Command and ethical approval from the National Defence University (HM751).

79

## 80    *Participants*

81    The present prospective study design included 180 officers. At baseline, the participants who had started  
 82    their officer career in 2013 were  $27 \pm 2$  years old and those who started in 2014 were  $26 \pm 1$  years old. After  
 83    the 3-year follow up their ages were  $30 \pm 2$  and  $29 \pm 1$  years, respectively. Mean age for each military branch  
 84    at the follow-up were as follows: Army:  $29 \pm 2$ , Navy:  $29 \pm 2$  and Air Force:  $28 \pm 1$ . The body height was on  
 85    average  $180.5 \pm 9.8$  cm and body mass  $81.5 \pm 15.4$  kg.

86

## 87    *Physical fitness tests*

88    All physical fitness tests, protocols, and techniques were standardized according to the Fitness Test  
 89    Manual of the Training Division.<sup>12</sup> Aerobic fitness was measured by a 12-minute running test on a flat  
 90    400-m outdoor sport track in the autumn, spring and summer with results being recorded to an accuracy  
 91    of 10 meters. Muscular fitness tests consisted of standing long jump, sit-up and push-up tests, which were  
 92    assessed in indoor facilities. A supervised warm-up of 15 minutes consisting of jumping, running and

calisthenic exercises was completed prior to testing. When testing muscular fitness there was a recovery period of 5 minutes between each test. Lower body muscular power was assessed by standing long jump on a specifically designed gym mat. The longest jump of three trials was used for further analyses. Three trials were completed with a 1-minute of rest between trials. The distance was measured to the closest 1 cm. The participants were first instructed of the correct technique, before they performed a warm-up and some practice jumps. The participants were instructed to jump horizontally forwards as far as possible from a standing position without falling backward upon bilateral landing.

Muscular fitness was assessed with 1-minute push-ups and sit-up tests for trunk and upper body performance. The maximal number of repetitions completed were recorded for each movement.<sup>12</sup> The push-up test measures arm and shoulder extensor muscle endurance. At the start, the participants laid face down on the floor, feet at shoulder width apart and hands positioned so that thumbs could reach the shoulders while other fingers were pointing forward. Before starting the test, the participants were instructed to extend their arms to the start position and to keep the feet, trunk, and shoulders in the same line during the test performance. A successful repetition was counted when the participant lowered his torso by flexing his arms to an elbow angle of 90° and returned to the starting position by extending his arms. Sit-up test measured performance of abdominal and hip flexor muscles. At the start, the participant laid on his back while legs were supported from the ankles by an assistant. The knees were flexed at the angle of 90°, elbows pointing upward with fingers crossed behind the back of the head. A successful repetition was counted when the participant lifted his upper body from the starting position and brought elbows to the knee-level. The total number of repetitions during one minute were recorded.



117 *Anthropometrics*

118 Anthropometric variables (body height, body mass and waist circumference, body mass index (BMI))  
119 were measured by an instructor before the testing session. Body mass was measured wearing light sport  
120 clothing and without shoes using a commercial scale. Body height was measured in a standing position  
121 using a stadiometer. Waist circumference was measured at the level of iliac crest after exhaling using a  
122 tape measure.<sup>12</sup>

123

124 *Statistics*

125 Data was analysed with PASW-software (PASW for Windows 26.0.1). Descriptive statistics including  
126 means, standard deviations and 95 % confidence intervals were calculated. Normality of the data was  
127 assessed using Shapiro-Wilks test. Dependent t-tests were used to assess prospective changes in physical  
128 fitness and anthropometric variables between the PRE and POST conditions. Pearson correlation  
129 coefficients were used to assess correlations between the baseline fitness levels and baseline  
130 anthropometric measures with their respective changes. Physical fitness and anthropometric variables  
131 were stratified into tertiles based on the baseline fitness levels and the prospective changes within each  
132 tertile were detected and compared using analysis of variance (ANOVA). Similarly, the prospective  
133 changes were detected within each military branch (Army, Navy, Air Force) and compared using analysis  
134 of variance (ANOVA). The sample size varied depending on the outcome variable in the Army between  
135 125 and 135, 25-29 in the Navy, and 6-10 in the Air Force (tables 1 & 2). Significant difference was set  
136 at p-level <0.05.

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138

## 139    **Results**

### 140    **Changes in physical fitness and anthropometrics during the 3-year follow-up.**

141    For the whole study sample, aerobic fitness decreased on average by 2% (-54 m), sit-up performance by  
 142    3% (-1.5 reps · min<sup>-1</sup>), push-up performance by 4% (-1.9 reps · min<sup>-1</sup>) and standing long jump performance  
 143    by 1% (-2.1 cm) over the 3-year period (fig 1). These decrements were observed in the Army (p<0.05) but  
 144    not in the Navy and Air Forces (table 1). For the whole study sample, body mass, BMI and waist  
 145    circumference increased on average by 4% each (+3.4 kg, +1.0, +3.9 cm, respectively). These increases  
 146    were specifically observed in body mass, BMI, and waist circumference for the Army and Navy but not  
 147    the Air Force (p<0.05) (table 2).

148

### 149    **Associations of baseline levels with changes in physical fitness and anthropometrics**

150    Baseline levels in muscular fitness were inversely correlated with their changes after the 3-year follow-up  
 151    (sit-ups: r= -0.41, p<0.001, push-ups: r= -0.52, p<0.001, standing long jump: r= -0.24, p=0.001), and a  
 152    similar weak inverse correlation was found for aerobic performance (r= -0.19, p=0.018). Baseline waist  
 153    circumference was inversely but weakly correlated with its change (r= -0.27, p=0.001), whereas no other  
 154    significant correlations were observed in body composition characteristics. The changes according to  
 155    baseline tertiles revealed that push-ups were increased in the lowest tertile, while decreased in the mid and  
 156    highest tertiles (p<0.05). A decrease in sit-ups was observed in the mid and highest tertiles while standing  
 157    long jump and aerobic fitness decreased only in the highest tertile (table 1). Illustrations of the changes in  
 158    physical fitness variables according to the baseline tertiles are presented in figure 2. In addition, increases  
 159    in body mass, BMI and waist circumference were observed across all baseline tertiles (table 2).

160

## 161    **Discussion**

The present study revealed, on average, a small but significant decrease in both aerobic and muscular fitness and increases in body fat indices in Finnish officers during a 3-year period in their early career. In addition, both aerobic and muscular fitness were maintained in the lowest baseline fitness tertiles, whereas physical fitness consistently decreased in the highest baseline tertiles. Body mass, BMI and waist circumference were increased and the increases were evident for all baseline tertiles after the 3-year follow up.

Aerobic fitness decreased by 2 % and muscular fitness by 1-4 % in 29-30 years old officers after the 3-year follow-up period. The average changes were small in magnitude and the level of physical fitness was, on average, at rather good level compared to physical fitness norms in the FDF even after the decreases. Therefore, the trends observed in physical fitness and measures of body composition seem unlikely to compromise overall military operational readiness and performance. As an example, the current minimum requirements in the 12-minute running test for Service Personnel of the FDF vary from 2000m for headquarter duties to 2800m for operative field duties. Although the changes were small (1-4%) it must be kept in mind that the decreases existed after only a short period of 3 years during the early career of the Service Personnel. If these observed negative changes continue progressively in later phases of a military career, the trend would likely be of concern from the perspective of military performance and readiness particularly for military personnel with duties requiring higher levels of physical fitness such as military operative field duties. Previous studies among the general population suggests that physical fitness and muscle mass begin to decrease more pronouncedly during the third and fourth decade of the human lifespan.<sup>13</sup> Nevertheless, the present study findings suggest that in the Service Personnel, the decreasing trend in physical fitness and increasing trend in body fat indices may start earlier than commonly observed in general population. Similarly, 30-34 years old US army soldiers had lower aerobic fitness and higher body fat content compared to younger soldiers.<sup>14</sup> It may also be speculated that the decrease in physical

fitness is more a reflection of changes in physical training and nutrition behavior when moving from standardized restricted Military Academy life into the military working life of the service personnel. Although, there are no studies in military study samples, a previous study in police officers may indirectly support this view.<sup>15</sup> Aerobic and anaerobic fitness as well as muscular endurance were higher in Police cadets (~28 yrs.) when compared to incumbent police officers (~38 yrs.).<sup>15</sup> In addition, Police cadets had lower body fat content compared to incumbent police officers. Importantly, age was a modifying factor partly explaining these differences.<sup>15</sup>

To the best our knowledge, this is the first study investigating prospective changes in physical fitness among professional Military Service Personnel thus, direct comparisons cannot be made to other military study samples. Nevertheless, a recent study investigated prospective changes in physical fitness and anthropometrics of cadets with a similar 3-year follow-up period as used in the present study.<sup>10</sup> The investigated cadets were 3 years younger (~23 yrs. at baseline) than the participants in the present study, however, in line with the present study, Aandstad et al. (2020) observed a decrease in aerobic fitness. In contrast to the current study, however, the cadets improved their muscular fitness over the 3 year follow-up period. Similarly to the present study, the changes were of small magnitude ranging from 2-4% decrease in aerobic fitness to 3-20 % improvements in muscular fitness. Other prospective studies in cadets with 3-4 year follow-ups have reported mostly no change in physical fitness<sup>9,11</sup>, although improvement in muscular fitness and a decrease in upper body muscular endurance have also been reported.<sup>11</sup> Improvements in physical fitness in cadets have been more consistent in short-term follow-ups (< 1 year).

<sup>16-19</sup>

When comparing the findings of the present study and the previous studies with cadets it must be taken into account that some differences in the study and working environment exist in addition to differences

in the age of the participants. During cadet training, physical exercise and education is typically included in the curriculum to inform and teach the cadets how to train, whereas during the career of professional Service Personnel, such as the present study sample, similar support does not necessarily exist. In the FDF, for example, all professional soldiers are allowed to spend 2 hours of their weekly working hours exercising, but in most units the physical training is not supervised or controlled and thus, the outcome is dependent on individual knowledge and intrinsic motivation.

Interestingly, the observed decreases in physical fitness were most consistent in those with the highest fitness levels at baseline, whereas individuals in the lowest fitness levels could maintained muscular fitness and even improve push-up performance. Nevertheless, according to rather large standard deviations within the tertiles, there appears to be individual differences. In addition, these results indicate that individuals with lower fitness can adapt their exercise behavior during their first working years or that they benefit from peer support. Further studies assessing these predictive factors in the military environment are warranted. Collectively, however, the results obtained raise the question if support for physical training and thereby physical fitness maintenance needs to be more optimized by tailoring individual physical training programs based on previous baseline fitness levels.

Among the military branches, differences were observed between the Army, Navy, and Air Force. All physical fitness components decreased only in the Army officers, whereas body mass, BMI and waist circumference increased only in the Army and Navy officers. Some of the differences in these changes may be relate to different study sample sizes within a given military branch, as sample sizes were considerably lower in the Navy and the Air Force compared to the Army. It is, however, worth noting that physical fitness requirements may vary slightly between the branches thereby effecting either selection of personnel for a given branch or training and nutrition behavior accordingly.

234

235 There appears to be several factors during the early career of Service Personnel, which may be related to  
236 exercise behavior and thereby to physical fitness. Such factors may include new demands from military  
237 occupation in general, numerous military field training days, and, on the other hand, challenges in  
238 combining family and working life. Together these factors can induce a variety of changes in officers`  
239 behavior. As a consequence, these changes may be reflected as decreased physical training volume and  
240 non-optimal diet leading to negative changes in physical fitness and body composition in early career of  
241 the officers, as observed in the present study.

242

### 243 **Strengths and limitations**

244 The strengths of the present study include a 3-year follow-up period with a large and representative sample  
245 size. The results add previously undiscovered changes in physical fitness and anthropometrics during the  
246 early career of professional officers. The present study has also some limitations. First, when the data was  
247 stratified according to military branches, the Air Force included only 6-10 participants. Therefore, results  
248 of the Air Force should be interpreted with caution due to lack of statistical power. Second, although  
249 beyond the scope of the present study, no other background information other than age and military branch  
250 were available with no information about the exercise training and physical activity behavior. Further  
251 studies are therefore warranted to identify predictive factors explaining the changes in physical fitness and  
252 anthropometrics, such as exercise, physical activity and nutritional behavior, combining both quantitative  
253 and qualitative study methods.

254

### 255 **Conclusions**

Both aerobic and muscular fitness decrease and BMI and waist circumference increase among Finnish officers during a 3-year period of their early career. In addition, both aerobic and muscular fitness were maintained in the lowest baseline fitness tertiles, whereas physical fitness was consistently decreased in the highest baseline tertile. Body mass, BMI and waist circumference increased and the increases were evident for all baseline tertiles after the 3-year follow up. The small negative changes observed may be a result of altered exercise and nutritional behavior, which may be influenced by new demands when starting the military officer career, numerous military field training days during the early career, and, on the other hand, challenges in combining family and working life. The present results also indicated that baseline fitness levels were associated with changes in physical fitness. Therefore, officers with different fitness levels may need different kind of support in their exercise and nutritional behavior during early career in the military.

## References

1. Wardle SL, Greeves JP. Mitigating the risk of musculoskeletal injury: A systematic review of the most effective injury prevention strategies for military personnel. *J Sci Med Sport*. 2017; 20 (Suppl 4): S3-S10.
2. Dijkma I, Zimmermann WO, Hertenberg E-J, Lucas C, Stuiver MM. One out of four recruits drops out from elite military training due to musculoskeletal injuries in the Netherlands Armed Forces. *BMJ Military Health*. 2020; 001420.
3. Kyröläinen H, Häkkinen K, Kautiainen H, Santtila M, Pihlainen K, Häkkinen A. Physical fitness, BMI and sickness absence in male military personnel. *Occup Med (Lond)*. 2008; 58(4):251-256.
4. Vaara JP, Fogelholm M, Vasankari T, Santtila M, Häkkinen K, Kyröläinen. Associations of maximal strength and muscular endurance with cardiovascular risk factors. *Int J Sports Med*. 2014; 35(4): 356-360.
5. Wyss T, Boesch M, Roos L, Tschopp C, Frei KM, Annen H, La Marca R. Aerobic Fitness Level Affects Cardiovascular and Salivary Alpha Amylase Responses to Acute Psychosocial Stress. *Sports Med Open*. 2016; 2(1): 33.
6. Tornero Aguilera JF, Fernandez Elias V, Clemente-Suárez VJ. Autonomic and cortical response of soldiers in different combat scenarios. *BMJ Military Health*. 2020;019-001285
7. Santtila M, Pihlainen K, Koski H, Vasankari T, Kyröläinen H. Physical Fitness in Young Men between 1975 and 2015 with a Focus on the Years 2005-2015. *Med Sci Sports Exerc*. 2018; 50(2): 292-298.
8. Wyss T, Roos L, Studer F, Mäder U, Beuchat C, Staub K. Development of physical fitness performance in young Swiss men from 2006 to 2015. *Scand J Med Sci Sports*. 2019; 29(4): 586-596.
9. Aandstad A, Hageberg R, Sæther O, Nilsen RO. Change in anthropometrics and aerobic fitness in air force cadets during 3 years of academy studies. *Aviat Space Environ Med*. 2012; 83(1): 35–41.
10. Aandstad A, Sandberg F, Hageberg R, Kolle E. Change in Anthropometrics and Physical Fitness in Norwegian Cadets During 3 Years of Military Academy Education. *Mil Med*. 2020; 11.
11. Mackey CS, DeFreitas JM. A longitudinal analysis of the U.S. Air Force reserve officers' training corps physical fitness assessment. *Mil Med Res*. 2019; 6(1): 30.
12. Pihlainen K, Santtila M, Ohrankämmen O, et al. *Fitness Test Manual of the Finnish Defence Forces*. Tampere, Finland: Second edition. Prima Edita. 2011; ISBN 978951220534; 11-12.
13. Kenny GP, Yardley JE, Martineau L, Jay O. Physical work capacity in older adults: implications for the aging worker. *Am J Ind Med*. 2008; 51(8): 610-625. Review.
14. Abt JP, Perlswieg K, Nagai T, Sell TC, Wirt MD, Lephart SM. Effects of Age and Military Service on Strength and Physiological Characteristics of U.S. Army Soldiers. *Mil Med*. 2016;181(2): 173-179.
15. Orr, R.M., Dawes, J.J., Pope, R., & Terry, J. (2018). Assessing differences in anthropometric and fitness characteristics between police academy cadets and incumbent officers. *Journal of Strength and Conditioning Research*, 32(9), 2632-2641.
16. Daniels WL, Kowal DM, Vogel JA, Stauffer RM. Physiological effects of a military training program on male and female cadets. *Aviat Space Environ Med*. 1979; 50(6): 562–566.



17. Oliver JM, Stone JD, Holt C, Jenke SC, Jagim AR, Jones MT. The effect of physical readiness training on reserve officers' training corps freshmen cadets. *Mil Med.* 2017; 182(11): e1981–6.
18. Harwood GE, Rayson MP, Nevill AM. Fitness, performance, and risk of injury in British army officer cadets. *Mil Med.* 1999; 164(6): 428–434.
19. Borges JH, Hunter GR, Silva AM, et al. Adaptive thermogenesis and changes in body composition and physical fitness in army cadets. *J Sports Med Phys Fitness.* 2019; 59(1): 94–101.

324 Table 1. The differences between baseline (PRE) and the 3-year follow-up (POST) in physical fitness  
325 according to baseline fitness tertiles and military branches.

	Sit-ups (reps · min <sup>-1</sup> )	Sit-ups (reps · min <sup>-1</sup> )	Push-ups (reps · min <sup>-1</sup> )	Push-ups (reps · min <sup>-1</sup> )	Standing long jump (cm)	Standing long jump (cm)	12-min running test (m)	12-min running test (m)
	PRE	POST	PRE	POST	PRE	POST	PRE	POST
lowest tertile	40.7±5.3	41.3±6.4	33.7±5.4	36.7±9.7 *	222.7±12.0	223.2±16.2	2538±98	2512±142
mid tertile	49.8±1.5	47.7±5.5 *	46.2±2.8	44.2±7.8 *	243.6±4.0	241.2±11.7	2768±54	2729±165
highest tertile	56.4±3.3	53.2±4.8 ***	58.5±6.9	51.0±6.6 ***	261.7±7.3	256.2±10.0 ***	3066±157	2996±199 ***
Army (n=126-135)	48.7±7.6	47.2±7.6 *	45.2±10.7	43.1±10.4 *	241.6±18.5	239.3±19.8 *	2810±244	2761±264 ***
Navy (n=27-29)	47.0±7.6	46.2±7.2	49.0±11.8	47.5±7.3	241.2±17.1	238.9±16.7	2786±255	2763±253
Air Force (n=6-10)	48.4±6.5	45.8±7.2	41.2±10.1	40.7±5.9	229.2±18.2	229.9±12.5	2661±191	2584±135

326 \* p<0.05 compared to pre-value, \*\*\* p<0.001 compared to pre-value

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328 Table 2. The differences between baseline (PRE) and the 3-year follow-up (POST) in anthropometrics in  
329 the whole study sample and according to baseline anthropometric tertiles and military branches.

	Body mass (kg)	Body mass (kg)	BMI	BMI	Waist circumference (cm)	Waist circumference (cm)
	PRE	POST	PRE	POST	PRE	POST
All	81.4±9.9	84.8±10.6 ***	25.0±2.6	26.0±3.0 ***	86.9±8.5	90.8±8.9 ***
lowest tertile	72.0±5.0	75.6±7.3 ***	22.3±1.2	23.4±2.0 ***	78.6±4.4	84.4±6.7 ***
mid tertile	81.9±2.1	86.0±5.3 ***	24.8±0.5	25.8±1.3 ***	86.7±2.0	89.5±4.5 ***
highest tertile	93.1±5.9	95.5±7.3 ***	27.8±1.8	28.9±2.4 ***	96.8±5.4	99.6±7.5 *
Army (n=125-132)	87.4±8.5	91.3±9.1 ***	25.1±2.7	26.2±3.0 ***	82.0±9.9	85.6±10.7 ***
Navy (n=25-28)	85.4±6.2	89.1±6.5 *	24.6±2.0	25.4±2.2 *	79.6±8.9	82.2±9.6 *
Air Force (n=10)	85.3±12.1	89.0±10.7	25.0±3.7	25.5±3.9	79.4±12.1	81.0±11.3

330 \* p<0.05 compared to pre-value, \*\*\* p<0.001 compared to pre-value

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332 Figure 1. The differences between baseline (PRE) and the 3-year follow-up (POST) in physical fitness  
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349    Figure 2. Changes in physical fitness according to their respective fitness tertiles at baseline.

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