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The Impact of Basic Police Training and Scale Diet on Body Composition and Aerobic Performance of Police Officers Trainees

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ABSTRACT

Background: Body composition and aerobic performance have a significant impact on a police officer`s capacity to execute professional responsibilities. This study aimed to determine the impact of basic police training and scaled diet on body composition and aerobic performance among Nepal police officer trainees.

Methods: We conducted a cross-sectional analytical study among 570 Nepal Police recruits from Nepal Police Academy of Butwal and Kathmandu. We enrolled police recruits from March to May, 2019 using systematic random sampling. We collected data from the field on body weight, body fat, body mass index and aerobic performance of each participants before and after basic police training and scaled diet. basic police training and scaled diet was based on Nepal police basic exercise and diet protocol. We used Microsoft Excel 2013 for data entry and R program (version: 4.0.3) for statistical analysis. We presented numerical parametric data as mean and standard-deviation. Paired-t test was used to compare mean between before and after. The p-value <0.05 was considered statistically significant.

Results: The body fat and body mass index of the participants decreased significantly from 14.3±4.3% to 9.7±3.3% and 22.2±1.9kg/m2 to 21.9±1.9kg/m2 respectively after basic police training and scaled diet. There was a significant rise in aerobic performance (4.51±3.39ml/kg/min) and remarkable reduction in body fat (-4.49±2.33%) and body mass index (-0.433±1.00kg/m^2) after basic police training and scaled diet among participants with normal body mass index at the time of recruitment. Body fat was significantly reduced (-4.36±2.3%) and aerobic performance was significantly increased (6.93±4.70ml/kg/min) among overweight participants at the time of recruitment.

Conclusions: The methodology adopted in basic police training and scaled diet of Nepal Police was effective in reducing body mass index and fat, improving the physical capacity.

Keywords: Aerobic performance; body fat; body mass index; physical training; scale diet.

INTRODUCTION

Body weight and body composition, among other anthropometric variables, may have a major effect on an officer's ability to perform critical job functions.[1] BMI levels have been used several times to assess the health and nutritional status of police officers, as well as to provide a rough approximation of body composition.[2] Since increased body mass and body fat mass are linked to decreased occupational physical activeness and performance and an increased risk of injury, achieving and maintaining a healthy body mass and body composition is usually a priority in training.[3] In that regard, after enrollment the young trainees are required to perform regular physical training programs in order to prepare for the duties of the police officers.[4]

Thus, this study aimed to determine the impact of basic police training and scale diet on body composition and aerobic performance among Nepal police officer trainees.

METHODS

This was a cross-sectional analytical study conducted among Nepal Police Recruits at Nepal Police Academy

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of Butwal and Kathmandu as per the criteria of Public Service Commission of Nepal. Null hypothesis was made "there is no difference of aerobic fitness and body composition before and after the basic police training and scaled diet (BPTSD)".

We calculated sample size assuming 80% power, 5% (two sided) level of significance, 0.3 change in body fat percentage after the BPTSD with standard deviation of the change to be 2.5. [5] and 5% non-response rate The calculated sample size was 571. We employed systematic random sampling on recruits listed by the Public Service Commission. There were total 8723 Nepal police recruits. A random participant from 1st to 10th in the list of recruits generated by Public Service Commission was selected using lottery method and every 15th participant was chosen. The spacing or interval between selections was determined by the ratio of the population size to the sample size (N/n).

As per protocol of Nepal Police, body fat, height, weight and aerobic performance of all trainees before the training and after three months of training are recorded on regular basis. We collected the data from the record book to determine the effect of physical training and scale diet on body composition and aerobic performance. We enrolled all the recruits recorded from March to May, 2019 who met the eligibility criteria in the study.

The participants aged 18-25 years were included in the study. The participants with comorbid conditions, who are smokers and those who are under medication were excluded from the study.

The physical training and scale diet is a part of recruitment process in Nepal police. [6] All the study participants went through standard training protocol of basic police physical training and scale diet for 3 months. The training period is based on the considerations described in the Nepal Police Training manual.[6] Basic police training ranges from short run to circuit and obstacle training. The physical exercise is rated in terms of metabolic equivalents (METs). Each trainee on a regular day performed activities including running 7 Miles per hour with 11.5 METs per hour, aerobic calisthenics and circuit training with 8 METs per hour, parade of 6 METs per hours and obstacle ground training of 8 METs per hour. Each program lasts at least for an hour on regular days followed by long run, reverse parade, moderate level hiking, rock climbing, trekking and tactical training incorporated within the course period all of more than 6 METs per hour. Before conducting the VO2 Max measurement, every trainee attends the motivational and orientation class to make the measurement accurate. All the anthropometric and laboratory measurements, diet, exercise and academic performance are recorded during interval as per training protocol.

The scale diet provided to trainees by the government contains 3800 kilocalories with 115 grams of protein. Fluid intake by trainees is titrated based on urine color and concentration.

As per protocol of Nepal Police, body fat, height, weight and aerobic performance of all trainees before the training and after three months of training are recorded regularly.

A scientific skinfold caliper for the measurement of body fat is used at nine anatomical sites on the right side of the body- biceps, triceps, chest, axillary, subscapularis, abdominal, suprailiac, medial thigh, and calf. Nepal Police follows the guidelines proposed by the International Society for the Advancement of Kinanthropometry for anatomical landmarks.[7] All measurements are done twice. A third measurement is performed if there is a difference of 2mm. We calculated the mean of measurements from nine anatomical sites to determine body fat percentage. Skinfold caliper had better validity and reliability factor as per "YMCA protocol " and "Jackson & Pollock sum- of-3 equations".[7]

Weight of the trainees is measured with the help of digital weighing machine with the capacity of 150 kilogram and a precision of 100 gram. Height is measured using an inelastic and inextensible tape, with a length, width, and precision of 2.0 meter, 2.0 centimeter and 0.1 centimeter, respectively.

Aerobic Performance (VO2max): Aerobic performance and cardiopulmonary fitness in trainees using standard "12 minutes Cooper test".[8] In this method, trainees are asked to run as fast as they cab in a 12-minute span. A stopwatch is used to ensure that each trainee ran for the appropriate period of time. After 12 minutes, the whistle is blown, and the trainees come to a halt. The distance covered by each trainee in a 12-minute period is recorded.

We used Microsoft Excel 2013 for data entry and R program (version: 4.0.3, 2020-10-10), available from the comprehensive R Archive Network (http://cran.r-project.org/) for statistical analysis. The categorical variables were presented with frequency

and percentages. We presented categorical variables with frequency and percentage whereas parametric numerical variables with mean and standard deviation. We calculated mean change in BMI, body fat and VO2max. Paired t-test was applied to compare BMI, body fat and VO2max before and after training. Mann-Whitney U test was applied to compare changes in BMI, body fat and VO2max between two independent groups. All tests were carried out at 95% confidence interval and p-value less than 0.05 was considered as statistically significant.

We obtained permission letter from Nepal Police Academy and ethical clearance from the Ethical Review Board, Nepal Health Research Council (Reference number: 1935) before conducting study. We maintained the confidentiality and anonymity of each participant throughout the study.

RESULTS

Table 1 presents the characteristics of the study participants. Of total trainees, 413(72. %) were males and 157(27.8%) were females. The age of the participants ranged from 19 to 26 years with the mean age of 21.2±1.3 years. Majority of the participants (94.6%) had completed class 10 and above. Before training, 91.1% participants had normal BMI and 8.4% were overweight.

The body weight, fat percentage and BMI of the participants decreased significantly from 59.1±5.9 kg to 57.6±6.2kg (p-value<0.001), 14.3±4.3% to 9.7±3.3% (p-value<0.001) and 22.2 ±1.9kg/m2 to 21.9±1.9kg/m2 (p-value<0.001) respectively after training. The aerobic performance was significantly increased from 52.6 ml/kg/min to 59.1 ml/kg/min (p-value<0.001) among participants after training.

The effect of physical training and scaled diet on BMI, body fat and aerobic performance among males and females are presented in table 2. There was a significant rise in aerobic performance; and significant decrease in BMI and body fat after scale diet and training for three months in both males and females. The average change in BMI, body fat and aerobic performance were -0.47 ± 1.07kg/m^2, -4.39 ± 2.32% and 3.82 ± 2.65ml/kg/min among males and -0.75 ± 1.38 kg/m^2,-4.71 ± 2.37% and 7.05±4.53ml/kg/min among females respectively.

Table 1.Characteristics of the study participants (N=570).

Characteristics	n(%) or mean±SD
Gender	
Male	413(72.5)
Female	157(27.5)
Age(in years)	21.2±1.3 [min=19, max=26]
Education	
Below 10 class	31(5.4)
10 class	376(66.0)
Above 10 class	163(28.6)
Obesity classification	
Underweight	3 (0.5)
Normal	519 (91.1)
Overweight	48 (8.4)

n: frequency, SD: standard deviation, min: minimum, max: maximum

Mean decrease in BMI was significantly higher in females compared to males (p-value=0.030). Similarly, mean decrease in body fat (p-value=0.026) and mean increase in aerobic performance (p-value=<0.001) was higher among females than males when Mann-Whitney U test was applied.

Table-2. Effect of scale diet and physical training on BMI, body fat and aerobic performance stratified by gender (N=570).

Parameter	Male (n=413)				Female (n=157)			
	Before	After	Change	P-value	Before	After	Change	P-value
BMI (kg/m^2), mean±SD	22.10±1.65	21.62±1.83	-0.47±1.07	**<0.001**	22.55±2.43	21.80±1.98	-0.75±1.38	**<0.001**
Body fat (%), mean±SD	13.18±3.92	8.77±2,79	-4.39±2.32	**<0.001**	17.14±3.82	12.43±3.19	-4.71±2.37	**<0.001**
VO2 Max (ml/kg/min), mean±SD	55.13±2.17	58.96±2.19	3.82±2.65	**<0.001**	46.10±4.47	53.15±3.37	7.05±4.53	**<0.001**

Test applied: paired-t test; SD: standard deviation; n: frequency

Table3. Effect of scale diet and physical training on BMI, body fat and VO2max stratified by obesity status at baseline (N=570).

Parameter	Normal (n=519)				Overweight (n=48)			
	Before	After	Change	p-value	Before	After	Change	p-value
BMI (kg/m^2), mean±SD	21.87± 1.45	21.43±1.66	-0.433±1.00	<0.001	26.29±1.09	24.42±1.75	-1.86±1.84	0.114
Body fat (%), mean±SD	14.02±4.18	9.53±3.14	-4.49±2.33	<0.001	17.00±4.46	12.63±3.88	-4.36±2.3	<0.001
VO2max (ml/kg/min) mean±SD	52.88±4.96	57.40±3.69	4.51±3.39	<0.001	49.90±5.01	56.84±3.20	6.93±4.70	0.004

Test applied: paired-t test; SD: standard deviation; n: frequency

४ हाल रा.प्र.प्र.प्रतिष्ठानमा कार्यरत प्रहरी कर्मचारीहरु तथा विभिन्न उन्नत तालीममा रहेका प्रशिक्षार्थीहरुले दैनिकरुपमा खाने खानाको कुल क्यालोरी सहितको सप्ताहीक मेनु सहितको विवरण :-

बार	समय	नास्ताको विवरण	प्राप्तहुने क्यालोरी (Kcal)	खानाको विवरण	प्राप्तहुने क्यालोरी (Kcal)	कुल क्यालोरी (Kcal)
आईतबार	बिहान	चना (५० ग्रा.), अण्डा(१ वटा), चिया (१ कप)	३३६	भात (२९० ग्रा) ,मिक्स दाल (५०ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५मि.लि.), मसला (३० ग्रा.), अचार (२० ग्रा)	१४८०	३७४१
	दिउसो	तरकारी (१प्लेट)समोसा १पिस, चिया (१ कप)	२५०			
	बेलुका	भात (२९०ग्रा) ,मिक्स दाल (५० ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५मि.लि.), मसला (३०ग्रा.), खसीको मासु (१६६.६६ ग्रा.), सलाद (२० ग्रा.)			१६७५	
सोमवार	बिहान	पाउरोटीजाम (२पिस) , अण्डा (१ वटा) , चिया(१ कप)	३२६	भात (२९० ग्रा) ,मिक्स दाल (५०ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५मि.लि.), मसला (३० ग्रा.), अचार (२० ग्रा)	१४८०	३७५६
	दिउसो	चिउरा (६० ग्रा)तरकारी (१ प्लेट) , चिया (१ कप)	३२५			
	बेलुका	भात (२९०ग्रा) ,मिक्स दाल (५० ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५ मि.लि.), मसला (३०ग्रा.), गेडागुडी (४० ग्रा.), सलाद (२० ग्रा.)			१६२५	
मंगलवार	बिहान	जेरी (१ पिस) , पुरी (२ पिस) , तरकारी (१ प्लेट), चिया (१ कप)	५५०	भात (२९० ग्रा) ,मिक्स दाल (५०ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५मि.लि.), मसला (३० ग्रा.),अचार (२० ग्रा.)	१४८०	३८१०
	दिउसो	चाउमिन (१ प्लेट), चिया (१	३००			
	बेलुका	भात (२९०ग्रा) ,मिक्स दाल (५० ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५ मि.लि.), मसला (३०ग्रा.), अचार (२०ग्रा.)			१४८०	
बुधवार	बिहान	चना(५० ग्रा)अण्डा (१ पिस) , चिया (१ कप)	३३६	भात (२९० ग्रा) ,मिक्स दाल (५० ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५ मि.लि.), मसला (३०ग्रा.), कुखुराको मासु (१५० ग्रा.), अचार (२० ग्रा.)	१७६१	३९७७
	दिउसो	चिउरा (६० ग्रा)तरकारी (१ प्लेट) , चिया (१ कप)	४००			
	बेलुका	भात (२९०ग्रा) ,मिक्स दाल (५० ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५ मि.लि.), मसला (३० ग्रा.), अचार (२०ग्रा.)			१४८०	
बिहिबार	बिहान	चना (५० ग्रा) , अण्डा (१ पिस), चिया (१ कप)	३३६	भात (२९० ग्रा) ,मिक्स दाल (५०ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५ मि.लि.), मसला (१५ ग्रा.), गेडागुडी (४०ग्रा), अचार (२० ग्रा.)	१६२५	३७६६
	दिउसो	चिउरा (६० ग्रा)तरकारी (१ प्लेट) , चिया (१ कप)	३२५			
	बेलुका	भात (२९० ग्रा) ,मिक्स दाल (५०ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५ मि.लि.), मसला (३० ग्रा.), सलाद (२० ग्रा.)			१४८०	
शुक्रबार	बिहान	जेरी (१ पिस) , पुरी (२ पिस) , तरकारी (१ प्लेट), चिया (१ कप)	५५०	भात (२९० ग्रा) ,मिक्स दाल (५०ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५ मि.लि.), मसला (१५ ग्रा.), कुखुराको मासु (१५०ग्रा.), अचार (२०ग्रा.)	१७६१	४२४१
	दिउसो	भेज पकोडा (१प्लेट) , चिया (१	४५०			
	बेलुका	भात (२९०ग्रा) ,मिक्स दाल (५० ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५ मि.लि.), मसला (३० ग्रा.), अचार (२०ग्रा.)			१४८०	
शनिबार	बिहान	चना (५० ग्रा) , अण्डा (१ पिस)	३३६	भात (२९० ग्रा) ,मिक्स दाल (५०ग्रा), सिजनेवल तरकारी (१००),	१४८०	३७४१

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		चिया (१कप)		आलु (५०), तेल (१५मि.लि.), मसला (३०ग्रा.), अचार (२० ग्रा)		
	दिउसो	रोटी (२ पिस)तरकारी (१ प्लेट), चिया (१ कप)	३००			
	बेलुका	भात (२९०ग्रा) ,मिक्स दाल (५० ग्रा), सिजनेवल तरकारी (१००), आलु (५०), तेल (१५ मि.लि.), मसला (३० ग्रा.), गेडागुडी (४० ग्रा.), अचार (२० ग्रा.)			१६२५	

Table 3 presents the effect of scale diet and physical training on BMI, body fat and aerobic performance stratified by obesity status at baseline. There was significant rise in aerobic performance (4.51 ± 3.39 ml/kg/min) and significant fall in body fat (-4.49 ± 2.33 %) and BMI (-0.433 ± 1.00 kg/m^2) after training among participants with normal BMI at baseline. Body fat was significantly reduced (-4.36 ± 2.3%) and aerobic performance was significantly increased (6.93±4.70 ml/kg/min) after training among overweight participants at baseline.

Mean decrease in BMI (p-value=<0.001) and mean increase in aerobic performance (p-value=<0.001) was significantly higher in overweight participants compared to normal when Mann-Whitney U test was applied.

DISCUSSION

Primary findings of this study recommended that 12 weeks of basic police training and a scale diet decreases the BMI and body fat percentage whereas increases the aerobic performance (VO2 max) of the police officer trainees. Furthermore, improvement in BMI, body fat percentage and VO2 max were significant in female and overweight trainees compared to male and those with normal BMI status during entry into the academy.

A study done by Leandra in military recruits over the duration of 12 weeks showed no significant change in body weight and BMI in contrast to our study whereas in accordance to our study fat percentage decreased significantly (14.1±7.3% to 11.8±6.1%).[9] A study conducted in Finland military service showed significant decrement in weight by 0.7%, and fat percentage by 6.6%. Similar to our study, more beneficial changes in body composition were observed in overweight men who reported being inactive prior to military service compared to those who reported being physically active.[10] Our results indicate substantial changes in body composition after 16 weeks of training, these results are in accordance with those of previous studies involving various populations.[11,12]

Our study finding was in accordance with other military based articles where obese teenagers, even a few days of exercise per week has a positive impact on fat percentage, and the effects of exercise on various measures of obesity display a good dose-response relationship.[13,14] Findings of our study were consistent with previous military articles, which had shown that depending on the form and period of training, varying levels of weight loss and changes in lean tissue can be observed.[15,16]

FLAMENCO project, a randomized controlled trial showed similar results; decrease in BMI and fat percentage.[17] In contrast, findings of our study were different from the study done by Grossman and Payne which did not find any decrease in fat mass measurements.[18] A study was conducted in Saudi Arabia to examine the effectiveness of a weight reduction intervention based on caloric restriction, low-impact aerobics (LIA), and a resistance-training program in improving body composition, metabolic parameters and cardiovascular disease (CVD) risk factors among obese students diagnosed with metabolic syndrome. Significant changes in BMI were observed in the trial following the diet-based intervention. Obese subjects, on the other hand, saw considerable weight loss in response to the diet plus aerobic and resistance training intervention.[19] Similarly, a study was conducted in India to investigate the effect of training on selected anthropometric, physiological and biochemical variables of Indian under 23-year field hockey players. When comparing field hockey players' baseline data to the prepared and competitive phases, a significant (P0.05) reduction in % body fat was seen.[20]

Resistance training has little impact on fat percentage reduction. In previously sedentary, overweight or obese adults, aerobic training was more successful than resistance training in reducing fat percentage. A mixed aerobic and resistance training program did not result in a greater reduction in fat percentage than aerobic alone. If the aim is to gain muscle mass and strength, resistance training programs should be incorporated in the basic training.[21]

The single best indicator of cardiorespiratory ability is maximal oxygen consumption (VO2max), which is used as a benchmark to calculate aerobic fitness.[22] In our study, VO2 max was increased by 12.3. This magnitude of increment was lower compared to a study which demonstrated 30% percent increase in VO2 in people with a low baseline level of fitness.[23]

Double indirect methods are the most commonly used technique to determine a participant's body composition, where one indirect measure (e.g., DXA) is used to verify a generalized estimate of body composition from another indirect measure (e.g., skinfolds). They are usually used in a clinical setting due to their practicality, expense, and availability.[24]

Bioelectrical impedance measurement, dilution techniques, air displacement technique, dual energy

X-ray absorptiometry, and magnetic resonance spectroscopy are some of the most widely used techniques. Three-dimensional photonic scanning and quantitative magnetic resonance are two examples of recent advances. These methods may be used to calculate weight, skeletal muscle, and other body parts.[25]

It is important to accurately assess cardiovascular fitness in order to determine fitness levels. VO2max and the maximum oxygen uptake that can be reached during maximal intensity exercise, is a common measure of cardiovascular fitness. [24]

Direct gas analysis is used to achieve the criteria calculation of VO2max during a maximum exercise test to volitional exhaustion. However, though maximal exercise testing in this type is extremely valid and effective, it is time intensive and costly, necessitates the use of trained staff, and is challenging on the participant. Researchers have developed a variety of statistical algorithms based on data from submaximal exercise protocols to avoid the drawbacks of maximal exercise testing.[26] In our study we applied the Cooper VO2max test for the calculation of aerobic fitness, the same test was used by Leandra in military recruit for VO2max calculation.[9]

A notable limitation of our study was that the sample of participants was not selected randomly. As this study was carried out among healthy recruits of Nepal Police Force, the result may not be generalized into the general population. Additionally, trainees' nutritional and dietary conditions were not monitored or managed during the training.

CONCLUSIONS

Scale diet and physical training for (period of time) has significant effect on improving aerobic performance and reducing body mass index and body fat. The impacts were significantly higher among female officers compared to males. These findings imply that general populations should also participate in structured exercise programs to improve and maintain their health, occupational performance and to decrease the incidence of the non-communicable disease.

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