

The Relationship between Physical Activity Participation, Physical Fitness Level, and Academic Performance in ROTC

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요약 : 본 연구의 목적은 학군사관후보생(ROTC)의 신체활동 참여습관, 체력수준, 학업성취능력의 관계를 조사하는 것이다. 본 연구의 참가자는 J 대학교에 재학중인 71명의 학군사관후보생을 선발하였다. 신체활동 참여습관은 국제신체활동설문지(Global Physical Activity Questionnaire, GPAQ)를 이용하여 조사하였고, 체력수준은 건강관련 체력평가로 측정하였다. 학업성취능력은 해당 학군단 장의 승인을 받은 대학성적자료(GPA)를 참가자 동의하에 수집하여 각각의 자료를 분석하였다. 신체활동 참여습관, 체력수준, 대학학점 간의 상관관계를 분석하였고, 체력수준별 학점을 비교하였다. 본 연구에서 신체활동 참여습관과 학업성취능력 사이에 통계적으로 유의한 상관관계가 없는 것으로 조사되었다. 반면 주요 과목과 총체력점수, 심폐체력, 근지구력, 유연성, 신체조성 간에는 통계적으로 유의한 상관관계가 나타났다. 체력 수준별로는 체력이 높은 그룹의 ROTC가 낮은 체력 그룹의 ROTC보다 통계적으로 유의하게 높은 학업 성취능력을 보였다. 또한 낮은 체력수준의 ROTC 그룹은 높은 체력수준의 ROTC에 비해 학업성취능력이 다소 낮은 것으로 나타났다. 결론적으로 체력수준이 높은 ROTC는 그렇지 않은 사람에 비해 학습능력 향상에 긍정적인 영향을 미쳤다. 본 연구는 자율적이지만 체계적인 체력훈련 프로그램을 제공하여 ROTC의 체력을 향상시키고 우수한 미래 장교를 양성할 것을 제안한다.

Abstract : The purpose of this study was to investigate the relationship between physical activity participation habits, physical fitness level, and academic performance among the Reserve Military Training Corps (ROTC). Participants in the current study were 71 ROTCs from J University. Physical activity participation was investigated using the Global Physical Activity Questionnaire (GPAQ), and the level of physical fitness was measured by health-related physical fitness evaluation. For academic performance, university grade data (GPA) was approved by the head of the relevant school district, and the data were collected with the consent of the participants, and each data was analyzed. The correlation between physical activity participation habits, physical fitness level, and GPA was analyzed, and GPA by physical fitness level were compared. This study found that there was no statistically significant correlation between physical activity participation and academic performance. Otherwise, there was a statistically significant correlation between major subjects and total physical fitness score, cardiorespiratory fitness, muscular endurance, flexibility, and body composition. By the level of physical fitness, the ROTCs in the high-physical fitness

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group showed statistically significantly higher academic performance than the ROTCs in the low-physical fitness group. In addition, low level of physical fitness ROTC group was lower than the other. In conclusion, ROTCs with a high physical fitness level had a positive effect on improving learning ability compared to those who did not. By recommending an autonomous but systematic exercise training program, it is suggested to improve the physical strength of ROTCs and to cultivate excellent future military officers.

Keywords : *Academic Performance, Physical Activity Participation, Physical Fitness, Reserve Officers' Training Corps(ROTC)*

1. Introduction

Regular physical activity participation is decreasing, due to the modern convenient life, a healthy life is threatened from numerous diseases or risk factors and the mortality rate is steadily increasing due to chronic diseases caused by lack of exercise[1]. Recently the distance traveled by foot due to using a own car or convenient public transportation system is gradually decreasing, and sedentary lifestyles such as TV watching, computer use or smart phone playing are also increasing in youth[2]. After graduating from middle and high school, opportunities to engage in physical activity participation other than few physical education classes as elective liberal arts classes at the college are gradually decreasing or not at all[3]. The college student period is a time to prepare for a career path, grow into an adult, and create one's own identity. Maintaining and habituating an appropriate amount of physical activity is very important because it is linked to physical activity habits and health in adulthood[4].

Lack of physical activity continuously increases the obesity rate in adults and is reported to be a cause of chronic diseases that cause problems such as cardiovascular disease, high blood pressure, and mental disease[5]. Regular physical activity can improve physical function, improve physical fitness level and

various health aspects, as well as provide emotional stability, relieve excessive tension and anxiety due to schoolwork, and promote mental disorders, self-esteem, and general psychological stability[6]. In addition, brain blood flow is activated, oxygen supply to the brain becomes smooth, and reaction time is shortened in people with good exercise ability. As a result of synthesizing previous studies on physical fitness and academic achievement, it is found that overall physical fitness has a positive effect on academic achievement[7].

Even in college students, the school military cadets are selected from the Reserve Officers Training Corps(ROTC) to select excellent elementary officers, after completing two years of university studies and military training, and then commissioning them as Korean elementary officers. Candidates for school military cadets should cultivate the qualities they have in nurturing strong combatants equipped with unit command and combat capabilities as talents who will become officers in the future. Adult males (19-24 years old) must have higher than average physical strength of adult males, such as an average grip strength of 43.5 kg, an average of 47.3 number/min sit-ups, and 10 cm of sit-up bending[8]. However, there is a phenomenon that the physical strength of the cadet cadets is declining in the double life of schoolwork and candidacy training at the same time. In addition, although many efforts are being made to improve basic physical strength by

operating programs for each district, it is difficult to expect results because the conditions are difficult and economic activities are also considered due to the nature of the district, which is autonomous compared to the military academy.

Since the school military candidates have different college majors and enlist only during the school break period to conduct military education for a certain period of time, the training is not continuous. The Student Military Education Group runs a variety of educational programs to train elementary officers. Among the educational programs, the physical training program guarantees autonomy according to the situation of the human rights era. J University's Student Military Education Group has been voluntarily recommending the physical fitness training program, which was conducted four times a week, as a sports activity for the purpose of fitness training once a week, every wednesday, starting in 2018. These training programs are not suitable for sufficiently increasing physical fitness.

Recently, there has been a growing interest in whether studies related to physical fitness and academic achievement have a lasting effect

from a long-term perspective. However, although studies on elementary, middle, and high school students are active, there are not many preceding studies on the physical strength and academic achievement of college cadets. Therefore, this study aims to analyze the relationship between physical activity participation habit, physical fitness level, and academic achievement among ROTCs.

2. Methods

2.1. Participants

The current study was conducted by R.O.T.C. of J University in J city. A total of 71 students from the 65th grade(Senior) and the 66th grade(Junior) were eligible to participate. Participants were instructed to fully explain the contents and procedures of this study and to participate in the study after obtaining informed consent from those who voluntarily participated. The physical characteristics of the participants of this study are as presented in <Table 1>. All study participants understood the research content, procedure, purpose, etc., and completed a

Table 1. Participants' Characteristics

Variables	Junior (n=40)	Control (n=31)	Total (n=71)	<i>p</i>
Age(yrs)	20.55±0.71	21.71±0.82	21.06±0.95	<.001
Height(cm)	173.91±4.62	176.12±4.24	174.88±4.54	.041
Weight(kg)	70.40±8.38	74.51±9.20	72.20±8.86	.054
Boby Mass Index (kg/m ²)	23.31±2.49	23.94±2.76	23.59±2.59	.320
Family Income(%) (10,000 won/month)				
<2,000	2.5	6.5	4.2	
2,000–3,000	15.0	9.7	12.7	
3,000–4,000	30.0	35.5	32.4	
4,000–5,000	12.5	16.1	14.1	
>5,000	37.5	22.6	31.0	
Smoking(%) (yes)	32.5	25.8	29.6	
Drinking(%) (yes)	75.0	77.4	76.1	

study agreement. This study was deliberated by J University Ethics Review Committee(IRB).

2.2. Research Procedure

In this study, the necessity of this study and the research plan were explained in order to investigate the physical activity participation habits and physical activity level and academic achievement of the candidates for the school district cadets that was approved (JJNU-IRB-2019-005-002), and the study was conducted. Physical activity questionnaires, health-related fitness(body composition, muscular strength, muscular endurance, flexibility, cardiorespiratory endurance) data of 71 subjects who voluntarily participated in J University's cadets. Academic achievements conducted in the first and second semesters of 2018 The data were analyzed.

2.3. Assessments

2.3.1. Physical Activity Participation Questionnaires

The amount of physical activity was investigated using the Global Physical Activity Questionnaire (GPAQ). It consisted of a total of 16 items, including activities related to work for a week, activities when moving from place to place, leisure time activities, and

sedentary activities. GPAQ defines the amount of physical activity as METs and converts the amount of physical activity into a score of METs-min/week by applying the calculation formula in <Table 2> according to the intensity and type of activity. METs are the body's unit of caloric production and refer to the amount of metabolism in the body in a stable state.

They were divided into 3 groups, High, Moderate, and Low, according to the level of physical activity metabolic rate. High is a minimum of 3,000 METs (min) consumed by at least 1,500 METs (min/week) through high-intensity physical activity on at least 3 days a week, walking 7 days a week or more, or any combination of moderate-intensity or high-intensity physical activity (/week) of exercise amount consumed. Moderate is any combination of at least 20 minutes of high-intensity physical activity per day 3 or more days a week, or at least 30 minutes of moderate-intensity physical activity or walking 2 days a week or more, or walking 5 or more days a week, moderate-intensity or high-intensity physical activity of at least 600 METs (min/week) of physical activity. Low refers to inactivity or not meeting the High, Moderate group <Table 3>.

Table 2. Calculation of Physical Activity the Following METs Values

Domain	METs Value
Work	Vigorous METs-min/week = 8.0 x vigorous-intensity activity minutes x vigorous days
	Moderate METs-min/week = 4.0 x moderate -intensity activity minutes x moderate days
Recreation	Vigorous METs-min/week = 8.0 x vigorous-intensity activity minutes x vigorous days
	Moderate METs-min/week = 4.0 x moderate -intensity activity minutes x moderate days
Transport	Walking METs-min/week = 4.0 x walking minutes x walking days

Table 3. Levels of Total Physical Activity

Total Physical Activity	Physical Activity Cutoff Value
High	<ul style="list-style-type: none"> • IF: $(P2 + P11) \geq 3$ days AND Total physical activity METs minutes per week is ≥ 1500 METs <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> • IF: $(P2 + P5 + P8 + P11 + P14) \geq 7$ days AND total physical activity METs minutes per week is ≥ 3000 METs
Moderate	<ul style="list-style-type: none"> • IF: $(P2 + P11) \geq 3$ days AND $((P2 * P3) + (P11 * P12)) \geq 60$ minutes <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> • IF: $(P5 + P8 + P14) \geq 5$ days AND $((P5 * P6) + (P8 * P9) + (P14 * P15)) \geq 150$ minutes <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> • IF: $(P2 + P5 + P8 + P11 + P14) \geq 5$ days AND Total physical activity METs minutes per week ≥ 600 minutes
Low	The value does not reach the criteria for either high or moderate levels of physical activity

- P2 : Vigorous-intensity Activities at work during a week,
- P3 : Vigorous-intensity Activities at work during a day,
- P5 : Moderate-intensity Activities at work during a week,
- P6 : Moderate-intensity Activities at work during a day,
- P8 : Travel to and from places during a week,
- P9 : Travel to and from places during a day,
- P11 : Vigorous-intensity Recreational Activities during a week,
- P12 : Vigorous-intensity Recreational Activities during a week,
- P14 : Moderate-intensity Recreational Activities during a week,
- P15 : Moderate-intensity Recreational Activities during a day.

2.3.2. Academic Performance

The academic performance was analyzed using the Grade Point Average (GPA) data for the first and second semesters of 2018 conducted at the university. After announcing the purpose of the study, obtaining approval from the head of the school district and obtaining consent directly from the district cadet candidates themselves, the grades were obtained and confirmed. Because it is personal information, it is only possible to identify it with a random number, and it is discarded after confirmation.

2.3.3. Health-Related Physical Fitness Assessment

1) Cardiorespiratory fitness: In the 1,600m run, 4 laps on the 400m track to reach the finish line were recorded in units of 1 second. Since the unit of recording is different for each physical fitness item, it was converted from 0 points to a maximum of 20 points. When measuring, prepare in a standing position at the starting line, run at the same time as the starting signal, and adjust the pace according to one's ability to return.

2) Muscular Strength: Grip strength (GS) was measured twice each on the left and right using a grip dynamometer (T.K.K. 5101, Japan), and the highest value was recorded in units of 0.1 kg. It was calculated using the calculation formula of relative grip force considering the weight of the subject, and since the unit of record is different for each physical fitness item, it was converted from 0 points to a maximum of 20 points. When measuring, stand in a comfortable position with both legs shoulder-width apart and pull the dynamometer with one hand as much as possible. In case of twisting the body or applying force with both hands, re-measurement was performed.

3) Muscular Endurance: The number of sit-ups was recorded by performing sit-up (Sit-up. UP) for 60 seconds using a sit-up table (KT2522, Korea). Since the unit of recording is different for each physical fitness item, it was converted from 0 points to a maximum of 20 points. When measuring, lay down with your ankles fixed on the fixture and place your hands on your chest. At the same time as the start signal, using the strength of the abdominal muscles, raise the upper body until the elbow touches the thigh.

4) Flexibility: For sit and reach forward bending (Sit and Reach, SR), using a left forward flexion meter (T.K.K.5103, Japan) was used to measure twice, then send a longer distance and record the measured value in units of 0.1 cm. Since the unit of recording is different for each physical fitness item, it was converted from 0 points to a maximum of 20 points. When measuring, sit barefoot on the left flexion system with both legs and knees straight. Put both hands together, bend the upper body forward and push the measuring instrument forward as far as possible with both middle fingers, stopping for about 2 seconds.

5) Body Composition: Height and weight were measured using JENIX (DONG SHAN JENIX CO., Korea), an automatic measuring

device, and the weight was recorded in 0.1 kg and height in units of 0.1 cm. Skeletal muscle mass, body fat mass, body mass index, body fat percentage, abdominal fat percentage, basal metabolic rate, and body development index were measured using a precision body composition analyzer, Inbody 720 (Biospace, Korea). The score of body composition using BMI was converted from 0 points to a maximum of 20 points. During the measurement, all metallic substances were removed from the body, and comfortable clothes were worn on an empty stomach. The gaze was gazing at the front, and both feet were raised according to the shape of the electrodes on the footrest, and then, with both hands, five fingers were placed in contact with the electrodes to hold them without force. The arm was naturally dangling down and the arm was spread out about 15° so that the armpit body did not touch, and the measurement was performed by maintaining the same posture without speaking during the measurement for about 2 minutes.

6) Total Physical Fitness Level: Because the records and units of physical fitness measurement items (cardiorespiratory endurance, muscle strength, muscular endurance, flexibility, body composition) are different, the score was converted from 0 to a maximum of 20 points, and the total was calculated as a maximum of 100 points, and the health-related fitness grade was calculated. It was divided into two groups based on the criteria. Group 1 was classified into 1st grade, 2nd grade, and Group 2 was classified into 3rd grade, 4th grade, and 5th grade.

2.5. Statistical Analysis

Statistical analysis for this study was performed using the Statistical Package for the Social Sciences (SPSS) 22.0 statistical program. Mean, standard deviation, and median were calculated for each measurement item. Correlation between the converted score for physical activity participation habit, each

converted score for each health-related fitness item, and the converted score for university academic achievement Spearman's Correlation method was used. Independent T-test was used to compare the academic achievements of the two groups according to their physical fitness level. One-way ANOVA was used to compare the academic achievement of the three groups according to the level of physical activity participation habit. All statistical significance levels were set to $p < .05$.

3. Results and Discussions

3.1. Physical Activity Participation in Participants

⟨Table 4⟩ shows the results of the survey on the physical activity, participation habits of ROTCs. The junior ROTCs, showed a higher transporting-related physical activity, recreation-related physical activity and total physical activity participation time than the senior ROTCs.

3.2. Body Composition in Participants

⟨Table 5⟩ shows the results of measuring the body composition in participants. The junior ROTCs showed statistically lower body fat mass and waist circumference than the senior ROTCs.

3.3. Physical Fitness Level in Participants

The following ⟨Table 6, 7⟩ shows the distribution of grades by physical fitness level in ROTCs. Both junior and senior were classified in higher than 3rd level in cardiorespiratory fitness and muscular strength, and were not classified in 1st level in muscular endurance and total physical fitness. In addition, some of junior and senior were classified in 5th level in flexibility and body mass index.

3.4. Academic Performance in Participants

⟨Table 8⟩ shows the academic performance in participants. There was no statistically significant difference between junior and senior.

Table 4. Physical Activity Participation

Variables	Junior (n=40)	Senior (n=31)	Total (n=71)
Work Vigorous(METs)	378.00±147.07 (0.00)	487.74±151.99 (0.00)	425.92±899.89 (0.00)
Work Moderate(METs)	1380.00±403.13 (0.00)	766.45±207.45 (0.00)	1112.11±2070.62 (0.00)
Transport (Cycling or Walking) (METs)	1250.40±152.75 (1200.00)	1449.29±536.13 (840.00)	1337.24±2085.33 (960.00)
Recreation Vigorous(METs)	800.40±90.13 (744.00)	577.55±101.77 (480.00)	703.10±575.38 (480.00)
Recreation Moderate(METs)	849.00±125.72 (720.00)	685.93±122.31 (480.00)	777.80±746.73 (600.00)
Total METs	4657.80±453.51 (3924.00)	3966.97±617.09 (3840.00)	4356.17±3124.41 (3840.00)
Physical Activity Total Time(minute)	1072.2±82.98 (915.00)	899.80±148.27 (780.00)	996.93±673.03 (852.00)

Values are Mean±Standard Deviation(Median Value),

Table 5. Body Composition Level

Variable	Junior (n=40)	Senior (n=31)	Total (n=71)	<i>P</i>
BFM(kg)	11.90±3.99	18.96±5.51	13.06±5.13	.031
PBF(%)	16.68±4.20	18.96±5.61	17.68±4.96	.054
LBM(kg)	58.62±6.11	60.34±5.23	59.37±5.77	.214
SMM(kg)	33.22±3.63	34.04±3.02	33.58±3.38	.312
WC(cm)	78.83±6.43	85.50±6.77	81.74±7.28	< .001

Values are Mean±Standard Deviation(Median Value),
BFM: body fat mass, LBM: lean body mass, PBF: percent body fat,
SMM: skeletal muscle mass, WC: waist circumference

Table 6. Physical Fitness Factors in Junior

Variables n(%)	1st Level	2nd Level	3rd Level	4th Level	5th Level
Cardiorespiratory Fitness	8 (20%)	19 (47.5%)	13 (32.5%)	0	0
Muscular Strength	18 (45%)	22 (55%)	0	0	0
Muscular Endurance	0	4 (10%)	36 (90%)	0	0
Flexibility	6 (15%)	3 (7.5%)	18 (45%)	7 (17.5%)	6 (15%)
Body Mass Index	15 (37.5%)	6 (15%)	10 (25%)	0	9 (22.5%)
Total Physical Fitness Score	0	23 (57.5%)	15 (37.5%)	2 (5%)	0

Table 7. Physical Fitness Factors in Senior

Variables n(%)	1st Level	2nd Level	3rd Level	4th Level	5th Level
Cardiorespiratory Fitness	4 (12.9%)	14 (45.2%)	13 (41.9%)	0	0
Muscular Strength	14 (45.2%)	15 (48.4%)	2 (6.5%)	0	0
Muscular Endurance	0	6 (19.4%)	23 (74.2%)	2 (6.5%)	0
Flexibility	4 (12.9%)	5 (16.1%)	11 (35.5%)	8 (25.8%)	3 (9.7%)
Body Mass Index	14 (45.2%)	4 (12.9%)	5 (16.1%)	0	8 (25.8%)
Total Physical Fitness Score	0	16 (51.6%)	13 (41.9%)	2 (6.5%)	0

Table 8. Academic Performance in Participants

Variables	Junior (n=40)	Senior (n=31)	Total (n=71)	<i>P</i>
Major(GPA)	2.94±0.63	2.88±0.81	2.91±0.71	.750
Liberal Arts(GPA)	2.77±0.88	2.40±1.02	2.64±0.94	.178
General Selective Subjects(GPA)	2.62±1.41	3.95±0.65	3.73±0.94	.068
Total score(GPA)	2.87±0.65	2.93±0.68	2.90±0.66	.680

Values are mean±Standard Deviation, GPA: Grade Point Average

Table 9. Correlation Between Physical Activity and Academic Performance

Spearman <i>r</i> <i>p</i>	Major	Liberal Arts	General Selective Subjects	Total score
Work	-.043	-.267	-.149	-.131
Vigorous(METs)	.726	.061	.387	.280
Work	.073	-.004	.309	.011
Moderate(METs)	.548	.977	.067	.931
Transport (Cycling or Walking) (METs)	-.004 .975	.275 .053	.089 .607	.042 .731
Recreation	.106	-.020	-.131	.117
Vigorous(METs)	.383	.893	.446	.335
Recreation	.063	-.079	.062	-.003
Moderate(METs)	.605	.586	.718	.980
Total METs	.029 .810	-.047 .747	.177 .303	-.032 .794

3.5. Correlation between Physical Activity Participation and Academic Performance in Participants

⟨Table 9⟩ shows the results of analyzing the correlation between the physical activity participation habits and academic performance in participants, and there was no statistically significant correlation.

3.6. Correlation between Physical fitness level and Academic Performance in Participants

⟨Table 10⟩ shows the results of analyzing the correlation between the

physical fitness level and academic performance. The major subject score showed a significant positive correlation with cardiorespiratory endurance, muscular endurance, flexibility, body mass index and total physical fitness score. Liberal arts score showed a significant positive correlation with flexibility and total physical fitness score. In addition, GPA showed a significant positive correlation with muscular endurance and total physical fitness score. However, there was no correlation between general selective subjects score and physical fitness level.

Table 10. Correlation Between Physical Fitness Level and Academic Performance

Spearman r <i>p</i>	Major	Liberal Arts	General Selective Subjects	Total score
Cardiorespiratory Fitness	.239 .046	.031 .833	.066 .701	.133 .274
Muscular Strength	.208 .084	.155 .284	-.048 .782	.151 .213
Muscular Endurance	.277 .020	.184 .202	-.058 .736	.253 .034
Flexibility	.261 .029	.315 .026	-.197 .250	.228 .057
Body Mass Index	.272 .023	.165 .251	-.047 .786	.207 .085
Total Physical Fitness Score	.464 < .001	.279 .049	-.093 .590	.365 .002

Table 11. Comparison of Academic Performance by Physical Fitness Level

Variables	Group 1 (n=39)	Group 2 (n=32)	<i>p</i>
Major(GPA)	3.20±0.58	2.58±0.72	< .001
Liberal Arts(GPA)	2.89±0.76	2.32±1.06	.031
General Selective Subjects(GPA)	3.57±1.14	3.9±0.64	.281
Total score(GPA)	3.11±0.58	2.64±0.66	.002

Values are Mean±Standard Deviation, GPA: Grade Point Average

Group 1: Physical Fitness Level 1st, 2nd

Group 2: Physical Fitness Level 3rd, 4th, 5th

3.7. Comparison with academic performance by total physical fitness level in participants

〈Table 11〉 shows the results of comparative analysis with academic performance by the total physical fitness level. The ROTCs in Group 1, who had a high level of total physical fitness level, showed higher major, liberal arts and total GPA than the ROTCs in Group 2, which was low fitness level.

The purpose of this study was to investigate the correlation between the amount of physical activity and the level of physical fitness with academic performance in ROTCs at the J

University.

In this study there was no statistically significant difference in the correlation between physical activity participation and academic performance. In previous study, physical activity participation habits had a positive effect on academic achievement. Regular physical activity can supply oxygen and energy to brain cells smoothly by increasing blood flow to the brain and reducing blockage of microvessels around the brain. In addition, BDNF (Brain Derived Neurotrophic Factor), a substance that aids brain activation and affects memory and cognitive function, is produced in

muscles during exercise and transmitted to the brain. It plays a role and improves the level of BDNF during moderate–intensity exercise, and nerve cells in the brain are further developed[9]. Through numerous studies, it has been found that it has a positive effect not only on disease prevention and life extension, but also on work ability, and regular physical activity is recommended for these effects. However, according to previous studies, the effect of regular physical activity is not statistically significant in some cases[10]. Since physical activity is one of such things as smoking cessation, alcohol consumption, and healthy nutrition, it is difficult to expect positive effects from physical activity alone. In addition, the measured physical activity data may not have a statistically significant effect due to the subject's answer error and the distribution of the study participants' physical activity data.

On the other hand, in this study, health–related physical fitness level including cardiorespiratory fitness, muscular strength, muscular endurance, flexibility, body composition, and total physical fitness level were statistically strongly associated with academic performance including major subjects, liberal arts, general selective subjects, and total GPA in both junior and senior ROTCs.

Previous study had reported that the positive correlation between physical fitness and academic achievement[11]. The higher the physical fitness can enhance the higher the active thinking and concentration. It is expected that physical fitness scores are high by participating in school life, and although the academic achievement of adolescents has a positive correlation with physical fitness, it is reported that the students who do not participate in leisure sports have higher grades. Other previous study especially reported that cardiorespiratory fitness and muscular endurance had a significant correlation with academic achievement, reported[12]. Cardiorespiratory fitness increases blood flow throughout the

body, and this effect can have a positive effect on work ability or learning ability because it increases cerebral blood flow. In addition, since cardiorespiratory endurance and muscular endurance can affect human persistence, it is thought to have a positive effect on concentration on study and maintenance of work hours compared to those with low cardiorespiratory endurance and muscular endurance[12].

Although the participants of this study were ROTCs, there was no best level of total physical fitness level. These results are considered to be the result of allowing students to exercise autonomously on their own, instead of performing mandatory physical training more than 4 times a week in the past. As the leader of the military, ROTCs were essential to manage physical strength and healthy body weight, so it will be necessary to improve the system to maximize the level of stamina although it is autonomous by providing an autonomous but more systematic exercise training program.

4. Conclusions

The purpose of this study was to investigate the correlation between physical activity participation habits, physical fitness level, and academic performance in ROTCs.

First, as a result of analyzing the correlation between physical activity participation habit and academic performance in ROTCs, no statistically significant correlation was found.

Second, as a result of analyzing the correlation between the physical fitness level and academic performance in ROTCs, statistically significant correlations were found.

Third, as a ROTC students, it was investigated that the level of physical fitness was somewhat low.

In conclusion, the current study proposes an effective exercise training program to improve physical fitness and academic achievement in

ROTCs.

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References

1. Booth F. W., Roberts C. K., Laye M. J., "Lack of exercise is a major cause of chronic diseases", *Compr. Physiol.*, Vol.2, No.2, pp. 1143–1211, (2012).
2. Biddle S. JH., Gorely T., Marshall S. J., Murdey I., Cameron N., "Physical activity and sedentary behaviors in youth: issues and controversies", *J. R. Soc. Promot. Health.*, Vol.124, No.1, pp. 29–33, (2004).
3. Wilson O. W. A., Panza M. J., Evans, M. B., Bopp M., "A scoping review on college student physical activity: how do researchers measure activity and examine inequities?", *J. Phys. Act Health.*, Vol.18, No.6, pp. 728–736, (2021).
4. Arnett J. J., "Are college students adults? their conceptions of the transition to adulthood", *J. Adult Develop.*, Vol.1, pp. 213–224, (1994).
5. Miles L., "Physical activity and health", *Nutri. Bulletin*, Vol.32, No.4, pp. 314–363, (2007).
6. Paluska S. A., Schwenk T. L., "Physical activity and mental health", *Sport. Med.* Vol.29, pp. 167–200, (2000).
7. Khan N. A., Hilman C. H., "The relation of childhood physical activity and aerobic fitness to brain function and cognition: A review", *Pedia. Exer. Sci.*, Vol.26, No.2, pp. 138–146, (2014).
8. Nam S., Kim J., "The effects of basic military training on physical fitness and self-efficacy of R.O.T.C. students", *J. Kor. Socie. Well.*, Vol.6, No.2, pp. 371–378, (2011).
9. Walsh J. J., Tschakovsky M. E., "Exercise and circulating BDNF: mechanisms of release and implications for the design of exercise interventions", *Appl. Physiol. Nutri. Metab.*, Vol.43, No.11, pp. 1095–1104, (2018).
10. Jekal Y., Kim E., "Comparison between level of leisure time physical activity and physical fitness as a correlates of body composition among male adolescents", *J. Korean Soc. Living Environ. Sys.*, Vol.17, No.1, pp 47–55, (2010).
11. Kim S., Jekal Y., "The relationship between the level of physical fitness & obesity and academic achievement among children", *J. Kor. Socie. Well.*, Vol.9, No.1, pp. 193–201, (2014).
12. Sardinha, L. B., Marques A., Minderico C., Palmeira A., Martins S., Santos D., Ekelund U., "Longitudinal relationship between cardiorespiratory fitness and academic achievement", *Med. Sci Sports Exerc.*, Vol.48, No.5, pp. 839–844, (2016).