

# The efficacy of NSAID in performance improving and pain management in military physical aptitude test. An observational study in the military medical personnel

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## Research

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## **Abstract**

## **Background**

The Chinese military is deepening the strengthening reform and enhancing physical training standards. The sudden increasing in training requirements and outline has increased the pressure of the logistics units, such as medical personnel. Using over-the-counter (OTC) analgesics, such as nonsteroidal anti-inflammatory drugs (NSAIDs) in the military physical aptitude test (MPAT), has been described as helpful for reducing of post-exercise myalgia (PEM) and improving performance. To verify this hypothesis, we designed and carried out this study. The objective was to explore the effect of NSAID in the performance improvement and relieving of PEM in MPAT.

## **Methods**

The research subject were military medical personnel who participated in the 2020 winter MPAT in Xi'jing Hospital and Air Force Medical Center both affiliated to Air Force Medical University. The information was collected in the form of measure yourself medical outcome profile (MYMOP2) questionnaires. PEM was assessed using the Visual Analogue Scale (VAS). Test scores including 3000m running and sit-ups were documented detailed. VAS assessment including muscles in lower extremities (LEs) as well as Abdominals (ABs). One of the most commonly used NSAID in clinical practice, etoricoxib, was used as an intervention agent in this study. Participants were divided into group A (etoricoxib group) and group B (control group). Given that training intensity and training habits as a impact on outcomes, hence, according to whether they persisted in physical exercise for more than three months, they were subclassified as two subsets: continuous exercise group (A1 and B1), no exercise group (A2 and B2). General information including gender, height, weight and BMI were recorded. MPAT results and PEM were compared and analysed between and within groups.

## **Results**

A sample of 97 participants were recruited. 41 people were classified as group A, while other 56 people in group B. They were further subdivided into A1 (17 cases) and B1 (27 cases) who had been exercising consistently; A2 (24 cases) and B2 (32 cases) groups that were not. The results showed that MPAT scores in the etoricoxib group are indeed better than those in the no-drug group. Similarly, the VAS score in group A was lower than group B, the difference was statistically significant ( $P < 0.05$ ). The overall results revealed potential effective for pain relief and performance, which meet the hypothesis. The comparison between subgroups showed that NSAID could alleviate PEM after MPAT regardless of whether exercise was insisted or not. Meanwhile, NSAID improved performance in the muscle explosiveness items (sit-ups), which is prone to cause PEM. However, for endurance items (3000m running), as a matter of fact, continuous physical training maybe demonstrated more effective.

# Conclusion

Taking NSAID while participating in MPAT, overall, did improve test scores and alleviate PEM, especially in the explosive force testing projects. Nevertheless, physical training may be more effective in enhancing endurance. To sum up, whether this practice will bring additional harm to the body and worthy of promoting, still needs further research.

## Introduction

According to the military training mobilization requirements issued by the China Central Military Commission, PLA is continuing to deepen the level and intensity of military physical training [1]. The ensuing problems are the increasing military training injuries and other issues surrounding MPAT [2]. The military medical personnel, which was required to reach a lower test standard than the field forces. However, in order to meet the needs of combat-specific tasks, they still need to achieve stated standards, which varies according to age and gender as well as to pace and distance to be achieved [3]. The MPAT for logistic personnel assesses including a series of items, such as sit-ups, push/pull-ups, long distance and shuttle runs. Scores ranges from insufficient to excellent. Like athletes, such training assessment items can cause muscular pain and even training injuries. Especially for military medical personnel whose training intensity is lower than that of field soldiers.

Analgesics, such as NSAID and paracetamol, are widely consumed by athletes worldwide [4]. Although these drugs are used to reduce short-term pain and inflammation, they have also been shown to modulate muscle protein turnover. Emerging evidence confirmed that NSAID might acutely improve important endurance parameters, possibly through increased pain tolerance [5]. Etoricoxib have been demonstrated to inhibit cyclooxygenase-2 (COX-2) activity, which might explain the reduced anabolic response to acute exercise bouts [6]. In addition to being used to treat arthritis, it is also widely used treated for minor injuries such as blisters, sprains, tendonitis and contusions. Though greater awareness and risk-benefit analysis were advocating among persons on the potential adverse effects of these drugs. Nevertheless, The use of etoricoxib in MPAT is still described widespread and therefore worthy of note.

In all classes of athletes, NSAID are one of the most commonly used medications for the treatment of musculoskeletal pain and inflammation associated with training, competition or soft tissue injuries, or to gain a competitive advantage [7]. In addition to injury treatment, NSAID usage is high as a prophylactic treatment for anticipated pain, as well as to enhance the recovery of injuries sustained during an athletic event [8][9]. Research of this phenomenon in the military environment are still limited because knowledge is needed for the military training, and the mechanisms of injury or simulations of the different activities. This research project aimed therefore to, first, determine the NSAID's effect on relieving PEM and, second, to determine whether NSAID is a factor for the performance improvement in MPAT.

## Methods

# Participants' characteristics

This study was approved by the ethical research board of Air Force Medical University, participants themselves decided whether to take medicine based on past habits. An initial questionnaire was administered to collect necessary information about the subjects. The content of the questionnaire mainly includes general information such as gender, age, height and weight, training time and intensity before the test, test score (3000m running and sit-ups), and PEM evaluation (VAS score of LEs, ABS). Inclusion criteria include: 1. Voluntary participation in the test and complete the form; 2. Age ranging from 25 to 35 years (The assessment criteria for this age range are similarly); 3. Completion of all MPAT items; 4. No serious underlying diseases that interfere with the evaluation results. Exclusion criteria were as follows: 1. Refuse to participate in the survey, or the contents of the form are incomplete; 2. BMI meets the obesity standard ( $> 25$ ); 3. No test score due to foul; 4. History of systemic chronic disease, such as heart disease, diabetes, neuro-musculo-skeletal system diseases; 5. History of allergy to non-steroidal anti-inflammatory drugs. Finally, 97 data were included in the study, demographic variables and participants' clinical characteristics are summarized in Table 1.

Table 1  
Basic data of the two groups

Group	Cases(n)	Gender(n)		Exercise		Age(yrs)	Height(cm)	Weight(kg)	BMI
		Male	Female	Y	N				
A	41	24	17	17	24	$29.89 \pm 3.08$	$170.54 \pm 5.22$	$65.59 \pm 7.92$	$22.43 \pm 3.86$
B	56	35	21	27	32	$30.39 \pm 3.63$	$170.45 \pm 5.07$	$65.91 \pm 8.10$	$22.63 \pm 4.04$
t/ $\chi^2$		0.156		0.181		0.527	0.086	-0.316	-0.478
P		0.693		0.670		0.600	0.932	0.753	0.633

BMI Body Mass Index. There was no significant difference in general data between the two groups ( $P > 0.05$ )

## Observation indicators

The MPAT program includes 3000m running, shuttle run, sit/pull-ups. Among them, 3000m running and sit-ups were seemingly more affected by drugs. The muscle endurance and explosive power were evaluated by these two exercises respectively. Two different muscle groups of the body were mobilized. Therefore, these two groups of muscles have been regarded as the main observation items due to more likely to induce pain. Another interfering factor is the training situation of the subjects. Exercise habits such as running and sit-ups were potential factors other than analgesics could have been responsible for the improvement scores and possibility of pain relieving. We recorded adherence to the exercise habit as "yes" or "no". Running performance is recorded in 'mins', while sit-ups are recorded in 'pcs'. The VAS score includes Lower Extremities (LEs) and abdominals (ABs).

# Statistical analysis

The data are expressed as means and standard derivations and were analyzed using SPSS20.0 software. The Wilcoxon rank-sum test and the Mann-Whitney U test were used to compare for the data inconsistent with normal distribution test, independent sample t test was used for comparison between groups, and paired t test was used for comparison within groups. A statistically significant difference was assumed at a probability of less than 0.05.

## Results

### Comparison of the overall situation between the two groups

The results in the two groups of 3000m running were  $15.21 \pm 1.64$  and  $16.22 \pm 1.59$  (mins), respectively. In sit-ups, the scores of the two groups were  $58.19 \pm 14.48$  and  $49.86 \pm 15.05$  (pcs), respectively. The improvement in 3000m running was approximately 6.2%, while in sit-ups, was approximately 16.7%. This may confirm that analgesics effective, especially in muscle explosive tests. Meanwhile, the VAS scores of LEs and ABs in group A were significantly lower than those in group B. They decreased from  $4.05 \pm 0.96$  (LEs) and  $4.32 \pm 1.34$  (ABs) in group B to  $2.41 \pm 0.84$  (LEs) and  $2.24 \pm 0.77$  (ABs) in group A, respectively. This confirms the assumption that analgesics can indeed improve MPAT scores and reduce PEM (Table 2).

Table 2  
Comparison of the MPFT results and PEM between the two groups

Group	Cases (n)	3km running (mins)	Sit-ups (pcs)	VAS (LEs)	VAS (ABs)
A	41	$15.21 \pm 1.64$	$58.19 \pm 14.48$	$2.41 \pm 0.84$	$2.24 \pm 0.77$
B	56	$16.22 \pm 1.59$	$49.86 \pm 15.05$	$4.05 \pm 0.96$	$4.32 \pm 1.34$
Z/t		-2.573	-2.629	-3.240	-4.751
P		0.010*	0.009*	0.001*	0.001*

\*Comparison between groups, the difference is statistically significant ( $P < 0.05$ )

### Comparison of sub factors intra groups

For 3000m running, as a matter of fact, whether taking analgesic or not had no obvious effect on the result intra sub-groups ( $P > 0.05$ ). It seems to support the factor which leads to a difference of performance in the running score mainly by exercise was insisted or not. This negation result denied, at least partially, the hypothesis that analgesic are effective in improving performance, especially in endurance events (Fig. 1). In terms of sit-ups scores, taking analgesic itself can improve test scores among people who didn't exercise regularly. Simply keeping exercise can also lead to good effect, which were similar to those of taking analgesic. Therefore, this may support the view that taking medicine is as effective as exercise (Fig. 2). In VAS (LES), these two factors have seemingly equal effect and an

interaction (Fig. 3). Analgesics are more effective in VAS (ABs) than exercising. This is just like the conclusion of our previous analysis: 3000m running is the evaluation of endurance, and sit-ups is the evaluation of explosive power. Analgesics seem to be more effective for muscle explosive tests and the pain after that (Fig. 4).

## Discussion

This is known as the first study on the effect of NSAID on the performance and analgesic in MPAT. Etocoxib are some of the most commonly used drugs in the world, 12% of adults report taking NSAIDs regularly [10]. This ratio is as high as 75% among young athletes [11]. NSAID have been demonstrated to inhibit cyclooxygenase activity, which might explain the reduced anabolic response to acute exercise bouts. Consistent with this, NSAID has been reported to interfere with muscle hypertrophy and strength gains in response to chronic resistance training in young individuals. The use of NSAIDs in the military is also common, but less reported. In the US Army, more than 80% of soldiers filled at least one NSAID prescription annually[12]. Although the use of NSAID may bring a series of complications and other possible hidden risks, including cardiovascular disease, peptic ulcers, hyponatremia, and even stress fractures [13][14][15]. However, the use of drugs is still widespread.

Anyway, our research confirms that etocoxib can indeed alleviate PEM after physical training. It has been proved that a COX-2 inhibitor has an analgesic effect by inhibiting the synthesis of prostaglandins [16]. This analgesic effect is obvious for musculoskeletal pain. People who adhere to exercise habits will produce fewer pain factors and lactic acid then gain the therapeutic effect on chronic pain [17]. Even so, NSAID still has an additional analgesic effects. This also proves that athletes have been training, but there are still people taking drugs. Explosive muscle tests were more likely to induce PEM, people are more inclined to take NSAID when participating in such projects [18].

Etocoxib was generally effective in improving MPAT results, at the same time, relieved PEM. The 3000m running performance was improved by nearly 1 minute, while in the sit-up event, the performance was improved by nearly 10pcs overall. Although some possible influencing factors of the two groups of data, including gender, age, BMI and other baseline data, have been proved to be balanced and comparable. However, considering the difference in daily training habits, a comparative analysis of two groups of two factors was carried out. Another promising finding was that etocoxib is not the decisive factor in the 3000m running performance. In contrast, daily endurance training was the decisive factor affecting performance. While in the sit-up test, for people who have not taken drugs, daily training can improve test scores. For people who have not, it can also have the same antalgic effect. This may indicate that NSAID was more effective for muscle power testing. This is in line with a recent Brazilian's study on military soldiers which demonstrated that training injuries of the LEs are the most common military training injuries [19]. Therefore, they came up with a series of recommendations for lower limb training. Our results are noteworthy that both systematic training and NSAID can significantly alleviate pain of the lower limbs. NSAID may not improve the evaluation results of endurance running events, but it can indeed

reduce the PEM of the lower limbs after the evaluation. Taking analgesic is especially effective for PEM for muscle power test. The abdominal muscle PEM after sit-ups was significantly improved by NSAID.

In the 3000m running test, the overall performance improvement seemed more like the benefits of continuous exercise than that of NSAID. Although the muscle pain was relieved during the test, it did not improve the cardiac and pneumonic functions of the participants. Therefore, we observed the above results in the detailed analysis. As the overall pain score after the assessment was mild to moderate, we did not advocate the use of drugs to relieve this pain. Studies have shown that this type of pain can be completely relieved after 48 hours of rest. The sit-up test showed a completely different conclusion. We speculate from this that NSAID may also significantly improve the performance of the 100-meter run and relieve muscle pain, although assessment items do not include such items as "sprint running". But in real combat field, short bursts of explosive running may be common [20].

There are a series of known and unknown risks associated with the use of NSAID, including hypernatremia, stress fractures, and muscle dissolution [21]. The usage of NSAID among the general public and athletes has always been questioned. Topical medication seems to achieve the same effect while reducing the side effects and risks of systemic medication. Given that systemic medication has many clear hazards, it is more concerned to find better ways to improve performance and relieve pain [22]. Additionally, applying of formulation of topical dosage forms locally in proximity to the affected area can provide effective concentrations at the local target tissues to limit systemic exposure as well as adverse effects [23]. Therefore, if NSAID are worthy of promotion, is it possible to consider topical preparations instead of systemic medication.

An obvious shortcoming of this study was investigation with broader cohort coverage was unable to conduct. Military medical personnel was a special group whose professional characteristics are more inclined to work in the office and therefore relatively lack of daily training, and therefore possible to lead to a overall fighting capacity decreased. This feature makes us select this population as the research object. Such research can better distinguish the actual effects of intervention factors and also has important value.

The sample size of our research is also insufficient, which limits the persuasiveness of the research results. It is a valuable practice to conduct a larger sample size survey among more military-related personnel groups, especially for prospective group-controlled trials.

To sum up, as far as we know, this is the first study on the use of NSAID during MPAT. Although there are still limitations, however, the research results have certain reference significance. We prefer not to recommend the use of NSAID in MPAT, because the effect has not been truly reflected. In addition, the cost-benefit ratio of this behavior is not clear, although the use of over-the-counter drugs is voluntary. The prospects in this regard need to be further deepened by colleagues.

Additionally, applying of formulation of topical dosage forms locally in proximity to the affected area can provide effective concentrations at the local target tissues to limit systemic exposure as well as adverse

effects. Therefore, if NSAID are worthy of promotion, is it possible to consider topical preparations instead of systemic medication.

## Conclusions

The results of this study support the NSAID's effectiveness in relieving muscle pain during the physical fitness test process and improving the assessment results, especially in the muscle power test items. However, continuous and regular physical training is equally important, which can also achieve the effect of reducing pain. And in the endurance test project, its role is more obvious. The risks and harms of short-term use of NSAID are not yet clear. Therefore, the military medical personnel should carefully choose to use analgesics during physical fitness assessments.

## Abbreviations

ABs

Abdominals

BMI

Body mass index

LEs

Lower extremities

MPAT

Military physical aptitude test

MYMOP2

Measure yourself medical outcome profile-2

NSAID

Nonsteroidal anti-inflammatory drug

OTC

Over the counter

PEM

Post-exercise myalgia

PLA

People's Liberation Army of China

VAS

Visual analogue scale

## Declarations

### Availability of data and materials

The datasets used during the current study are available from the corresponding author upon reasonable request.

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### *Contributions*

ML and ZJL designed this study; SGS, GZY and PL collected the data; CZ and JX were responsible for the statistical analysis; LG wrote the draft; JJD and ZJL revised this draft; LG finalized this manuscript. The authors read and approved the final manuscript.

## Ethics declarations

### *Ethics approval and consent to participate*

The study was approved by the Ethics Committee of Air Force Medical University.

### *Consent for publication*

Not applicable.

## Competing interests

The authors declare that they have no competing interests.

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## Figures

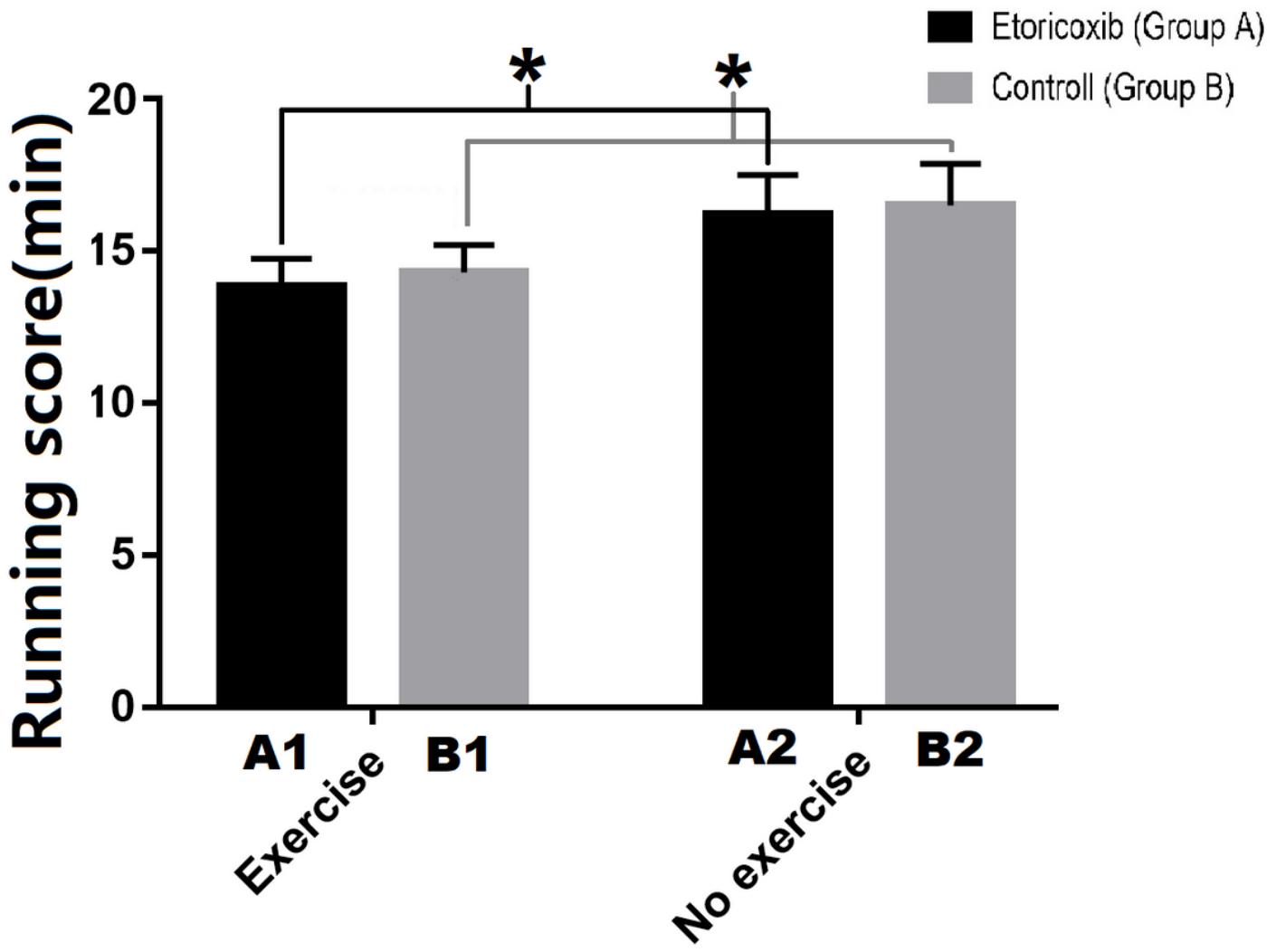


Figure 1

Comparison of 3000m test scores. Figure 1 is histogram which shows the test results of the subgroups in 3000 meter run, there was no significant difference between A1 and B1; A2 and B2, actually. On the contrary, "continuous excersice" has a significant impact on the results in this project (\*: P<0.05).

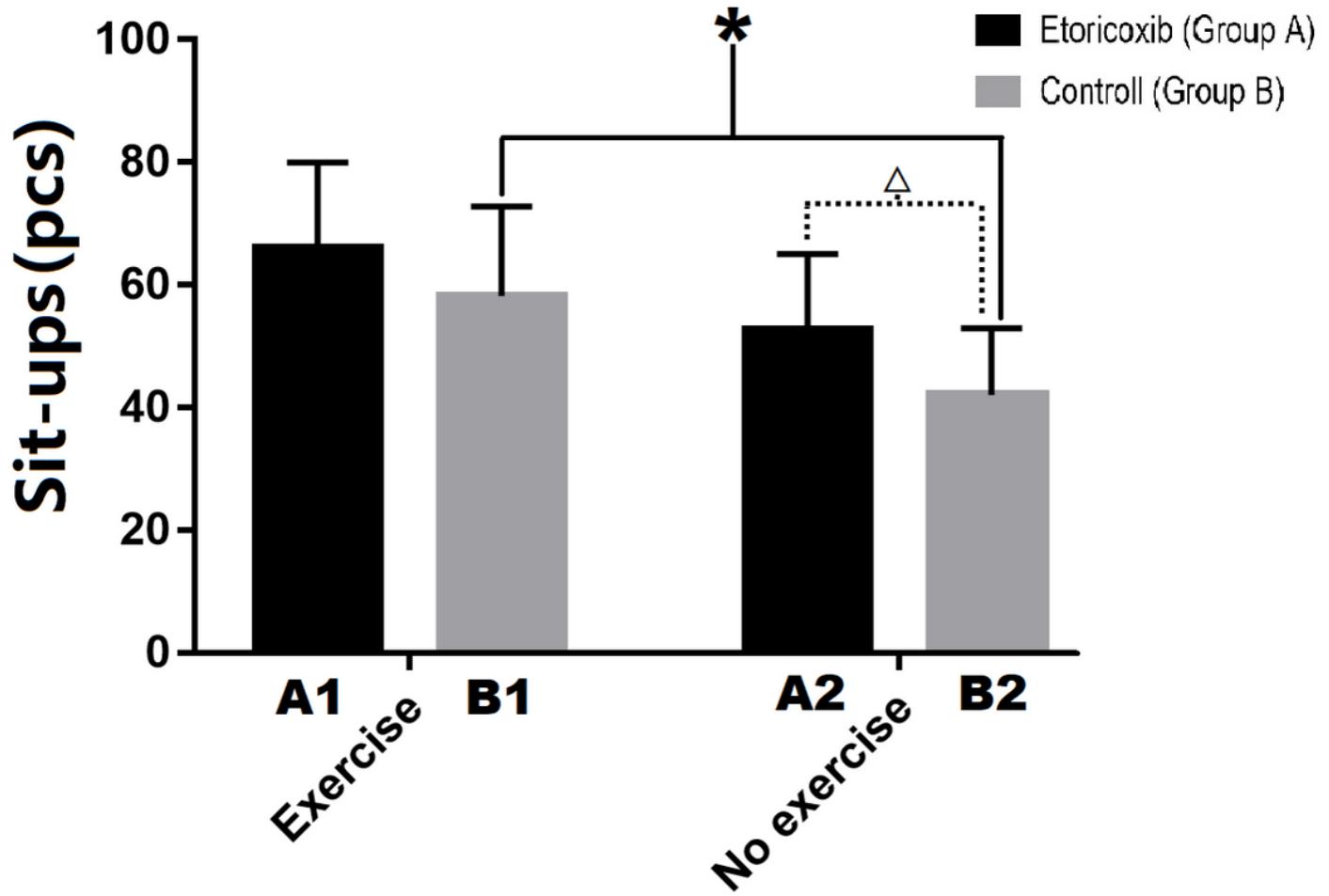
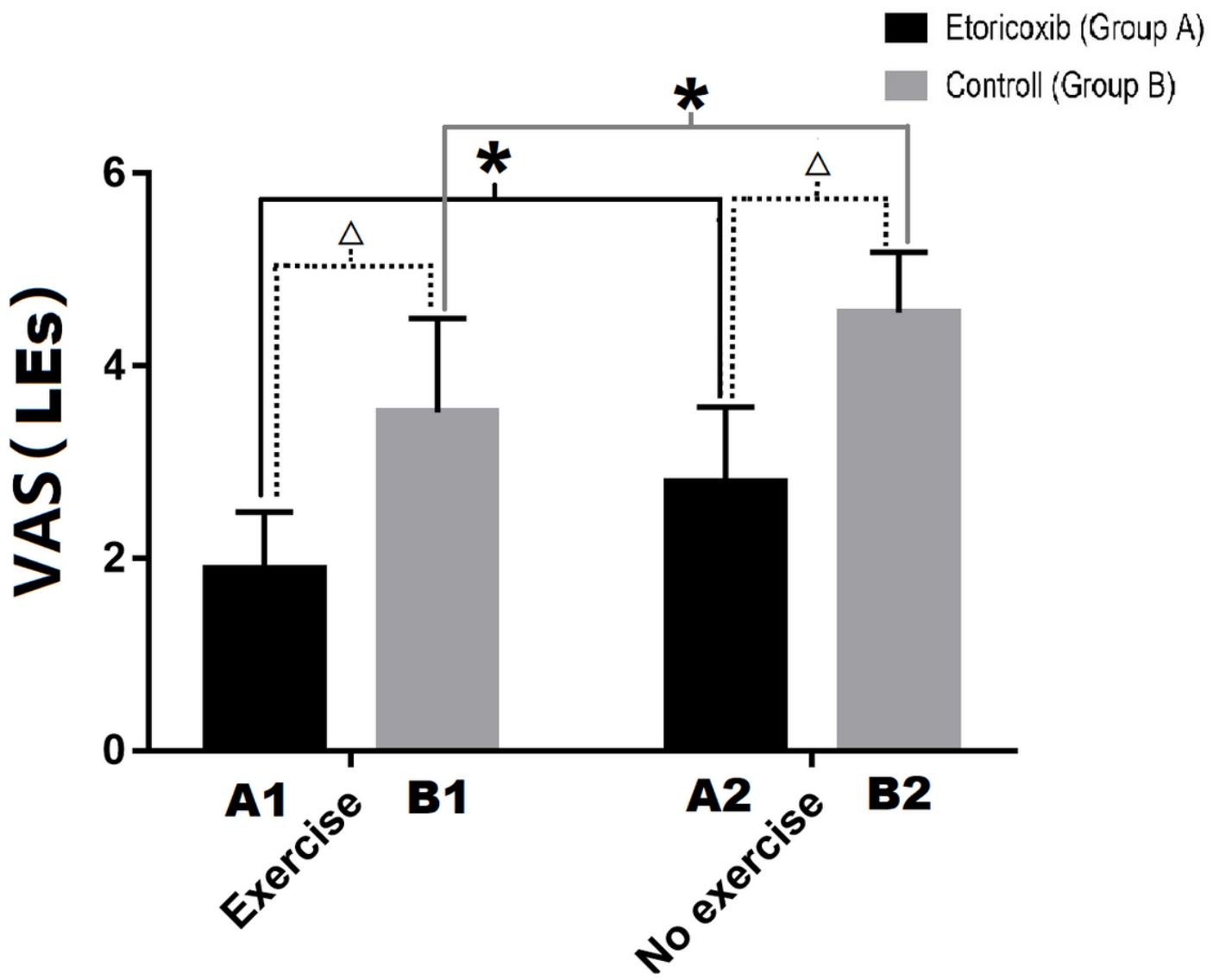


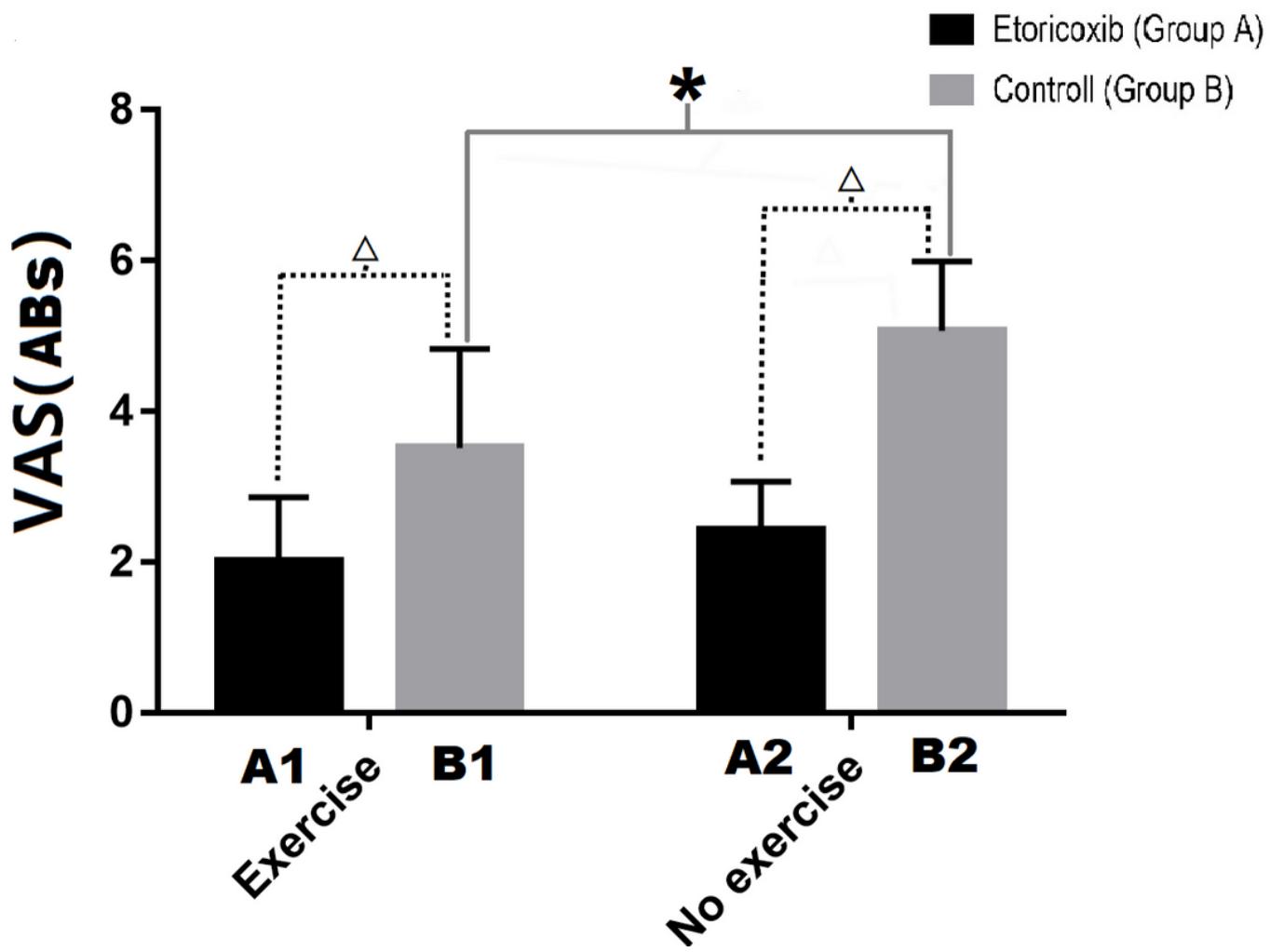
Figure 2

Comparison of sit-ups test scores. Figure 2 is histogram of sit-ups score. The results showed that NSAID can improve the test results in the group without "continuous exercise" ( $\Delta P < 0.05$ ), but in the people with "persistent exercise", whether taking drugs or not has no obvious effect. Meanwhile, in those who did not take NSAID that "keep exercising" had a significant effect on improving performance (\*:  $P < 0.05$ ).



**Figure 3**

Comparison of VAS of lower extremities. Figure 3 is a histogram of pain's visual analogue score for lower extremities. It can be seen that the influencing factors, whether taking NSAID or persisting in exercise, have independent influence on the results respectively (\*,  $\Delta$ :  $P < 0.05$ ). There may be a superposition effect between the two influencing factors on this observation index.



**Figure 4**

Comparison of VAS of abdominals. Figure 4 is a histogram of VAS score of abdominals. The pain score of regular exercisers was lower than that of non exercisers when didn't take NSAID (\*:  $P < 0.05$ ). However, this observation was significantly more correlated with NSAID. In any case, NSAID could significantly alleviate PEM in each subgroups ( $\Delta P < 0.05$ ).