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The Effectiveness of Occupational Functional Exercises in Improving Professional Physical Fitness for Cadets at the University of Fire Prevention and Fighting

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ABSTRACT: This study evaluates the effectiveness of occupational functional exercises in extracurricular activities for improving professional physical fitness among cadets at the University of Fire Prevention and Fighting. Based on the occupational characteristics of the Fire Prevention, Firefighting and Rescue Police force, the study approaches professional physical fitness as a component of occupational task performance capacity associated with activities such as rapid movement, carrying equipment, overcoming obstacles, climbing, and transporting victims under complex conditions. The study employed the following methods: pedagogical experimental method with an experimental group and a control group; combined with document analysis, expert interviews; pedagogical testing and statistical processing. The assessment system consisted of general physical fitness tests and three professional physical fitness tests: carrying a dummy for 60m, carrying a fire extinguisher for 60m, and carrying two fire hoses for 50m. The results showed that the experimental group achieved better performance than the control group in all three professional physical fitness tests after the experiment; all differences were statistically significant at the probability level of $p < 0.05$. The research results confirm that incorporating occupational functional exercises into extracurricular activities is an appropriate solution for professionalizing physical education, enhancing occupational readiness, and contributing to the improvement of cadet training quality at the University of Fire Prevention and Fighting.

KEYWORDS: Occupational functional exercises; general physical fitness; professional physical fitness; extracurricular activities; task-oriented training; specialized physical education.

1. INTRODUCTION

Fire prevention, firefighting, and rescue operations are a specialized field of activity with high movement intensity, great danger, and strict requirements for physical, technical, psychological, and tactical coordination capacities. In practice, officers and soldiers often have to access incident scenes under conditions of smoke, high temperatures, obstructed visibility, many obstacles, risks of structural collapse, short handling time, and very high pressure to rescue people. Such situations require the personnel performing the mission to have a good foundation of general physical fitness and professional physical fitness; cardiovascular endurance, muscular strength, carrying capacity, climbing ability, flexibility, balance, and the capacity to maintain precise operations in a fatigued state. Therefore, physical fitness is not merely a supporting condition but a direct component constituting occupational task performance capacity.

The practical context in 2025 continues to show the urgent requirement to improve the quality of training and preparation for the fire prevention, firefighting, and rescue force. According to the Fire Prevention, Firefighting and Rescue Police Department, in 2025 the whole country recorded 3,060 fires, causing 90 deaths and 93 injuries; estimated property losses were approximately VND 786.78 billion and 251.35 hectares of forest. In the same year, there were 28 explosions nationwide, causing 19 deaths and 36 injuries; the Fire Prevention, Firefighting and Rescue Police force directly participated in 1,349 rescue and emergency response incidents, mobilized forces and vehicles to fight more than 2,000 fires, guided evacuation, and saved 2,760 people. These figures show that the duties of the Fire Prevention, Firefighting and Rescue Police force are large in scale, highly complex, and require sustainable and professional combat readiness capacity.

At the University of Fire Prevention and Fighting, physical education and extracurricular sports activities play an important role in forming a foundation of health, willpower, adaptability, and specialized movement capacity for cadets. However, if extracurricular sports activities mainly stop at common sports such as football, volleyball, badminton, or general physical development exercises such as pull-ups, standing long jump, and endurance running, their transfer effectiveness to specialized occupational capacity will not reach an optimal level. The training characteristics of the university show that cadets not only study general subjects but also have to study many specialized subjects with high movement requirements, such as individual firefighting techniques, high-rise building firefighting tactics, industrial zone firefighting, forest firefighting, and rescue of victims trapped in fires or on high-rise buildings. Therefore, the requirements for general physical fitness and professional physical fitness in the process of study and professional service are very high.

International studies on firefighters show that physical fitness has a close relationship with task performance. Rhea, Alvar and Gray (2004) indicated that physical fitness indicators are related to firefighters' job performance. Michaelides et al. (2011) showed that strength,

endurance, aerobic capacity, body composition, and functional movement capacity are all related to performance in simulated occupational tasks. Xu et al. (2020) further confirmed that components of physical fitness can predict performance in specialized tasks such as rope climbing, loaded running, ladder carrying, stair climbing, and deployment of firefighting equipment. These pieces of evidence reinforce the requirement to shift from a general physical conditioning model to an occupational task-oriented physical training model.

On that basis, this study focuses on evaluating the effectiveness of occupational functional exercises in extracurricular sports activities for improving professional physical fitness among cadets at the University of Fire Prevention and Fighting. The approach of the article is to standardize the research content in the form of a scientific paper: clarifying the research problem, describing the experimental design, presenting results through core data tables, discussing findings on the basis of comparison with international studies, and providing application implications for training work.

2. RESEARCH METHODS

The study used a pedagogical experimental method with an experimental group and a control group, appropriate to the objective of assessing the impact of an occupational functional exercise program on the development of professional physical fitness. Experimental data were synthesized, processed, and presented from survey results, pedagogical testing, and pedagogical experimentation in the study on the application of occupational functional exercises in extracurricular sports activities for cadets at the University of Fire Prevention and Fighting. The experimental sample consisted of 40 male cadets, divided into two groups: an experimental group and a control group, with 20 participants in each group. The two groups were tested before the experiment to ensure relative similarity in initial physical fitness levels.

The experimental group was organized to train according to the system of occupational functional exercises in extracurricular sports activities. The control group trained according to the usual extracurricular form. Before and after the experimental process, both groups were tested using the same system of tests to assess the degree of change in physical fitness. This design allowed comparison of changes within each group and comparison of differences between the two groups after the intervention, thereby determining the relative effectiveness of the occupational functional exercise system.

The research methods used included document analysis and synthesis, expert interviews, pedagogical testing, pedagogical experimentation, and mathematical statistics. Document analysis was used to identify the theoretical basis of occupational functional exercises, the physical requirements of the fire prevention, firefighting, and rescue force, and at the same time to compare with international studies on physical training for firefighters. Expert interviews were conducted to determine the necessity of introducing occupational functional exercises into extracurricular activities and to select exercises appropriate to the training characteristics of the University of Fire Prevention and Fighting. Pedagogical testing was used to assess general physical fitness and professional physical fitness before and after the experiment. The data were processed using mean values and standard deviations. The level of statistical significance was set at $p < 0.05$.

The test system consisted of two groups. The general physical fitness group included: pull-ups, shuttle run 4 x 10m, standing long jump, sit-ups in 30 seconds, and 1500m run. The professional physical fitness group included: carrying a dummy for 60m, carrying a fire extinguisher for 60m, and carrying two fire hoses for 50m. These three professional tests directly reflect movement ability under load, rapid movement, motor coordination, and task handling with occupational simulation. In the training context of fire prevention, firefighting, and rescue, these are capacities directly linked to the ability to rescue people, approach fire scenes, and deploy firefighting equipment.

Table 1. System of tests for assessing professional physical fitness

Test	Capacity assessed	Occupational meaning
Carrying a dummy for 60m	Speed, load-bearing strength, motor coordination	Simulates victim transportation
Carrying a fire extinguisher for 60m	Movement speed while carrying equipment	Simulates approaching the fire location
Carrying two fire hoses for 50m	Speed-strength, coordination while carrying loads	Simulates deployment of firefighting equipment

Source: *Synthesized from pedagogical testing results and standardized according to the professional physical fitness assessment requirements for cadets at the University of Fire Prevention and Fighting.*

The intervention program was organized in extracurricular activities, focusing on exercises that simulated occupational tasks. The selected exercises included 30m zigzag running, 50m uphill and downhill running, carrying a fire extinguisher for 60m, 60m obstacle running, parallel-bar push-ups, hanging and moving on a horizontal ladder, rope climbing, carrying a dummy for 60m, carrying weights of 25-30 kg, stair running, pull-ups, hand-walking on parallel bars, running across a balance beam, carrying a person up and down stairs, and 1500m running. This exercise system ensured a combination between the development of foundational physical fitness and the development of professional movement capacity, while also meeting the principles of appropriateness, progression, safety, and connection with occupational practice.

3. RESEARCH RESULTS

The results of the expert opinion survey showed that introducing occupational functional exercises into extracurricular activities is necessary and appropriate to the training characteristics of the University of Fire Prevention and Fighting. Specifically, 18 out of 20 experts,

equivalent to 90%, agreed that occupational functional exercises should be introduced into extracurricular activities; only 10% stated that the form of training in sports should be maintained as before. This result reflects the high consensus of lecturers, coaches, and specialized staff regarding the need to renovate extracurricular content toward occupational linkage.

The selected exercises had a direct relationship with fire prevention, firefighting, and rescue duties. Carrying a dummy for 60m simulated the task of transporting victims out of dangerous areas. Carrying a fire extinguisher for 60m simulated the task of approaching a fire with initial firefighting equipment. Carrying two fire hoses for 50m simulated the task of deploying equipment in a firefighting formation. Stair running, hill running, rope climbing, hanging on a horizontal ladder, and overcoming obstacles helped develop capacities that are frequently mobilized when operating in high-rise buildings, complex terrain, or confined spaces.

After the experimental period, the experimental group achieved better performance than the control group in the professional physical fitness tests. Because these tests were calculated by completion time, lower values reflected better movement capacity. The specific results are presented in Table 2.

Table 2. Results of professional physical fitness tests after the experiment

Professional physical fitness test	Experimental group	$\bar{X}$ ±	Control group	$\bar{X}$ ±	t / p
Carrying a dummy for 60m	13.38 ± 0.34 seconds		13.78 ± 0.36 seconds		t = 3.55; p < 0.05
Carrying a fire extinguisher for 60m	12.11 ± 0.37 seconds		12.41 ± 0.52 seconds		t = 2.081; p < 0.05
Carrying two fire hoses for 50m	9.32 ± 0.33 seconds		9.56 ± 0.39 seconds		t = 2.046; p < 0.05

Source: *Results of processing pedagogical experimental data; the tests were calculated by completion time, and lower values reflect better performance.*

In the test of carrying a dummy for 60m, the experimental group achieved 13.38 ± 0.34 seconds, while the control group achieved 13.78 ± 0.36 seconds; the difference was statistically significant with t = 3.55 and p < 0.05. This is a result of clear practical significance because this test simulates victim transportation, an important task in rescue and emergency response. In real conditions, the ability to shorten victim transportation time can contribute to improving rescue effectiveness and reducing risks for participating forces.

In the test of carrying a fire extinguisher for 60m, the experimental group achieved 12.11 ± 0.37 seconds, better than the control group with 12.41 ± 0.52 seconds; the difference was statistically significant with t = 2.081 and p < 0.05. This test reflects the ability to move quickly while carrying firefighting equipment, a task commonly encountered in initial fire handling or approaching fire locations in areas where motorized vehicles have difficulty accessing. The results show that loaded exercises, short-distance speed running, and hand-foot coordination in the intervention program had a positive impact on this capacity.

In the test of carrying two fire hoses for 50m, the experimental group achieved 9.32 ± 0.33 seconds, better than the control group with 9.56 ± 0.39 seconds; the difference was statistically significant with t = 2.046 and p < 0.05. This test reflects speed-strength and coordination ability when deploying firefighting equipment. In firefighting formations, quickly, accurately, and stably deploying hose lines is important for effective access to and control of fires.

In general, the experimental results show that occupational functional exercises had a positive impact on the professional physical fitness of cadets. All three professional physical fitness tests showed differences, and all were statistically significant between the experimental group and the control group. This indicates that the intervention program not only improved pure movement performance but also created transfer effectiveness to occupational simulation tasks. This is the core value of occupational functional exercises in the specialized training environment of fire prevention, firefighting, and rescue.

4. DISCUSSION

The research results confirm the necessity of organizing extracurricular activities with occupational orientation in training cadets at the University of Fire Prevention and Fighting. Compared with general physical development exercises, occupational functional exercises have an advantage in their ability to simulate real movement conditions. When cadets perform exercises such as carrying dummies, carrying fire extinguishers, carrying hose rolls, rope climbing, stair running, or overcoming obstacles, the body is trained not only in speed, strength, and endurance but also forms movement sensations close to occupational tasks. It is this simulation factor that helps increase the transferability between training and professional practice.

In theoretical terms, the study contributes to transforming the approach to physical education in specialized training institutions. The physical fitness of cadets in the field of fire prevention, firefighting, and rescue should not be viewed as an independent objective separated from the professional curriculum, but should be placed within the structure of integrated occupational competence. This structure includes physical fitness, techniques, tactics, psychology, coordination ability, and decision-making capacity under dangerous conditions. Therefore, extracurricular activities are not only a place to train health but can also become an environment for developing occupational competence.

The research results are consistent with international trends in firefighter training. Studies on firefighters all emphasize the relationship between physical fitness and task performance. Rhea et al. (2004) showed that physical fitness is related to job performance, especially in the components of strength and endurance. Michaelides et al. (2008, 2011) pointed out the predictive capacity of physical fitness indicators for performance in firefighting ability tests. Williams-Bell et al. (2009), together with Sheaff et al. (2010), showed that Candidate Physical Ability Test-type assessments have high physiological requirements, demanding the coordination of the cardiovascular, respiratory, and musculoskeletal systems. These pieces of evidence indicate that physical training programs for cadets at the University of Fire Prevention and Fighting need to be designed in a functional direction, simulating tasks, and having clear professional evaluation criteria.

One notable point is that tasks in fire prevention, firefighting, and rescue often place the body under high exertion in short or medium durations, with load carrying and under the impact of adverse environments. Smith, DeBlois, Kales and Horn (2016) emphasized cardiovascular strain in firefighting activities and the risk of sudden cardiac events; Kales and Smith (2017) also noted that firefighting activities can greatly increase cardiovascular burden. Therefore, physical training for this force cannot focus only on movement performance but must combine physiological safety, recovery capacity, and injury prevention.

Extracurricular activities are a suitable environment for implementing occupational functional exercises because they are highly flexible, can be organized repeatedly, can adjust movement intensity and time, and can integrate many forms of training. However, to achieve effectiveness, extracurricular activities should not be managed only by the number of participation sessions or training duration. It is necessary to shift to management by competency objectives, in which each exercise group must be associated with a specific occupational capacity group: rapid movement, carrying equipment, climbing, overcoming obstacles, transporting victims, deploying fire hoses, or maintaining operations under fatigue. Competency-based management will help extracurricular programs become more oriented, measurable, and more consistent with training output standards.

From the research results, some application implications can be proposed. First, it is necessary to assess the initial physical fitness of cadets in order to group training appropriately and avoid applying the same load to all subjects. Second, extracurricular programs should be designed according to progressive cycles, combining general physical development exercises and specialized exercises. Third, physical exercises should be integrated with firefighting technical operations; for example, after running while carrying a fire extinguisher, cadets continue to perform the operations of placing the extinguisher, pulling the pin, directing the nozzle, and handling a simulated situation. Fourth, it is necessary to build a periodic testing system using professional tests to monitor progress. Fifth, professional physical fitness results should be regarded as an important indicator in evaluating the occupational readiness of cadets before internships or graduation.

The above solutions should be understood as a synchronized intervention package, not as separate recommendations. First of all, assessment of initial physical fitness has foundational significance because it helps lecturers identify differences among groups of cadets in speed, strength, endurance, carrying ability, and the level of adaptation to high-intensity movement. When initial data are available, training grouping will become more scientific, reducing the risk of overload for cadets with low physical fitness foundations while at the same time creating conditions to increase requirements for groups with good capacity. This is an important condition for individualizing training in a specialized training environment.

Second, extracurricular programs need to be organized according to training cycles with clear objectives. The initial stage should prioritize strengthening foundational physical fitness and basic movement techniques; the next stage should gradually increase loaded exercises, overcoming obstacles, climbing, stair running, and transporting dummies. The final stage should integrate exercises into continuous situations, in which cadets must perform multiple successive operations such as running to approach, carrying equipment, deploying hoses, overcoming obstacles, and transporting victims. Such a cyclical structure helps the training process be progressive, ensuring both physical development and the formation of occupational movement capacity.

Third, integrating physical exercises with technical operations should be considered a central solution. If physical exercises are organized completely separately from specialized techniques, the transfer effectiveness to occupational capacity will not reach an optimal level. Conversely, when cadets perform exercises in a simulated task context, for example running while carrying a fire extinguisher and then operating the extinguisher, carrying hose rolls and then deploying hose lines, or carrying a dummy after overcoming obstacles, physical qualities will be linked with situation-handling skills. This approach is consistent with the requirement to train fire prevention, firefighting, and rescue forces in a practical, combat-oriented manner and to assess them through task performance capacity.

Fourth, the periodic testing system needs to be standardized to manage training quality. The tests of carrying a dummy for 60m, carrying a fire extinguisher for 60m, and carrying two fire hoses for 50m can be used as core indicators to monitor the progress of professional physical fitness. In addition to completion time, it is necessary to observe technical quality, movement stability, coordination ability, and safety level during performance. Test results should not only be used for classification but also serve as a basis for adjusting lesson plans, movement volume, and the complexity of exercises in subsequent cycles.

Fifth, for the solutions to be sustainable, the university needs to link the renewal of extracurricular activities with ensuring conditions for training grounds, equipment, safety procedures, and the organizational capacity of lecturers. Training models should be designed by stations, teams, squads, or continuous situations in order to develop both individual physical fitness and group coordination. At the same time, it is necessary to build progress tracking records for each cadet, recording test results, growth rates, injury status, and the ability to complete simulated tasks. When training data are accumulated regularly, extracurricular activities will shift from a movement-style training form to a measurable component in the process of training occupational competence.

Thus, the value of the occupational functional exercise system lies not only in improving some performance indicators after the experiment, but also in its ability to create a model of professional physical fitness management and training that can be applied in the long term. If implemented regularly, with periodic assessment and coordination between physical education lecturers and specialized lecturers,

this program can contribute to improving the quality of physical preparation, movement skills, and occupational readiness of cadets at the University of Fire Prevention and Fighting.

5. CONCLUSION

The study shows that occupational functional exercises have a positive effect on improving professional physical fitness among cadets at the University of Fire Prevention and Fighting. After the experiment, the group of cadets trained according to the occupational functional exercise program achieved better performance than the control group in the tests of carrying a dummy for 60m, carrying a fire extinguisher for 60m, and carrying two fire hoses for 50m; all differences were statistically significant at the probability level of $p < 0.05$.

The research results confirm that extracurricular activities at the University of Fire Prevention and Fighting need to be organized in a specialized direction, linking physical education with the specific occupational requirements of the fire prevention, firefighting, and rescue force. The occupational functional exercise system not only helps develop speed, strength, endurance, and coordination ability, but also contributes to preparing cadets with the necessary movement capacity for firefighting and rescue tasks.

From these results, it is possible to propose that occupational functional exercises be introduced as regular content in extracurricular activities; at the same time, a system of standards for assessing professional physical fitness should be developed according to each training stage. This is a practical solution for improving the quality of training human resources for fire prevention, firefighting, and rescue in the context of increasingly complex, diverse, and dangerous task requirements.

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