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The Effect of Fartlek Running on Energy Expenditure in Four Routes at Mae Fah Luang University, Thailand

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ABSTRACT

Introduction: Fartlek running is used as one of the current life styles in daily exercise with the concept that individuals will exercise based on their ability to increase metabolism and improve their health. The study aimed to examine the differences of physical characteristics by walking and running through the different routes and distances in Mae Fah Luang University among students and faculty.
Methods: An experimental study was used to test the hypothesis of the study. There were 4 study routes in Mae Fah Luang University and 40 participants were recruited into the study. The participants were divided into 4 groups with equal samples: i) ten (10) male students, ii) ten (10) female students, iii) ten (10) male staff, and iv) ten (10) female staff. All participants were assigned on walking and running based on the fartlek style along the specified four routes assigned: route one, it was 5.45 kilometers distance, an accumulated slope of 60 meters, and the longest slope distance of 1,560 meters; route two, it was 5.23 kilometers distance, an accumulated slope of 35 meters, and the longest slope distance of 590 meters; route three, it was 5.32 kilometers distance, an accumulated slope of 15 meters and the longest slope distance 590 meters; and route four, it was 5.0o kilometers distance, an accumulated slope of 10 meters and the longest slope distance of 350 meters. All energy used was examined by using a wrist smart watch and global positioning system (GPS) tracking system. Descriptive statistics and one-way analysis of variance (ANOVA) were used to test the hypotheses at the statistical significance level at a =0.05.
Results: Route four was found as the highest energy expenditure used. Sex was associated with individual energy use significantly.
Conclusion: Individuals who need to exercise in daily life and living in the university areas, route no. four would be the best route to increase their energy use and keep up health.
Keywords: Fartlek running, Energy expenditure, Four routes in Mae Fah Luang University

Introduction

Being healthy is important for everyone, no matter how different in ages, sexes. Keeping in the health stage could lead to a better quality of life [1], reducing medical costs [2] and maintaining productivity in the society [3]. The World Health Organization (WHO) has defined that health means a state of complete physical and mental well-being, including a normal life in society, and not only the absence of disease and infirmity [4]. The WHO also reported one in three women and one in every four men worldwide are at risk of non-communicable diseases such as heart disease, diabetes and cancer if they do not get enough physical activity [5]. Many non-communicable diseases (NCDs) are commonly reported throughout almost all people's ages, sexes, and socioeconomic status [6] while the stress in daily life is one important driving factor to contribute to people's health into the poorer stage [7]. Many other factors are clearly detected as the risk factors of NCDs development such as having a sweet diet, fast-food consumption [8], poor daily physical movement [9]. While many families are having a big economic burden from expenses of their regular medical services costs [10]. Having proper physical moving and activities through daily life by adapting lifestyle or keeping their exercise practices could reduce these burdens eventually [11].

Exercising is the best way to promote individuals' health worldwide and extremely recommended to all citizens [12]. All exercise approaches are presenting positive and efficient support to good health in all

people [13]. Exercise is also strengthening the human immune system then it can protect against infections, and less likelihood to develop a disease finally [14]. Exercise is also clearly known as the best approach to prevent and control all NCDs in humankind [15]. Regular exercise could lead to a healthy stage for people and it works on reducing national health economically [16]. Running is one of the approaches to exercise and is being used as the main method for people who are living in both rural and urban areas. The main advantages of running are easy and cheaper to seek tools for exercise compared to other methods.

Fartlek [17] is a Swedish word that means playing with speed (speed play), which is a running speed that changes according to Terrain with a variety of differences. It's presented in continuous run with an alternating intensity of speed such as running on up and down hill routes [18]. Some sections are flat alternating between each other according to the condition of the running route, the speed will be slow or fast according to the runner who must reach the destination or the distance specified. The result of running is aimed to develop an endurance circulatory system. It is an aerobic and anaerobic use of energy, affecting the increase in the body's energy metabolism and suitable for health. The exercisers can set the difficulty and intensity by themselves [19].

Mae Fah Luang University is located in northern Thailand and is classified as one of the leading universities to produce quality graduates to serve the world society. The university has a variety of academic programs and research works. More than 700 faculty, 2,000 staff are working in the university, while more than 15,000 students are attending different programs in the 2022 academic year. With the geographic location [20] of the university, most people living in the campus are required to use big vehicles or walk safely through their daily life activity. Based on people's style, a large proportion of people living in the campus are suffering from overweight, and office syndromes. They are also detected as having several signs of NCDs. While one-third of people aged 40 years and over are getting trouble regularly seeking medical care from NCDs. Then identifying the best approach for exercise to those people who are living in the campus could help them to start and maintain their daily exercise to reduce NCDs problems. The study aimed to identify the best effective route of exercise by fartlek running in the areas of the university.

Methodology

Research design

An experimental study design was used to examine the most effective route of Fartlek running according to energy expenditure in Mae Fah Luang University.

Samples

A purposive selection with voluntary based was used to recruit the participants into the study. Participants were students who were attending in 2022, and staff who were working at Mae Fah Luang University. Those who had a healthy stage, exercised at least three times a week, and did not have an underlying disease met the inclusion criteria. However, before attending the program, all participants who met the inclusion criteria were assessed their physical health again by the physical activity readiness questionnaire (PAR-Q). However, those who were detected at least one positive item on the PAR-Q were excluded from the study.

The sample size in the study was calculated by the standard formula for an experimental study [21] as following;

$$n_{jk} = \frac{(n' - 1)(df + 1)}{R \times C} + 1$$

Where;

n_{jk} was the sample required in each cell.

n' was the sample needed from the variables put into the ANOVA table with the effect size (SE) at 0.10, 0.25, and 0.40. While the power of the test was set at 80.0%, and α was 0.05.

From the calculation according the formula selected, following is presented the number of participants;

$$n_{jk} = \frac{(21-1)(2+1)}{3 \times 3} + 1$$

$$= 7.66 \text{ and rounding to } 8$$

At least eight (8) participants were required in each group. Considering the loss of follow up, ten (10) participants were needed in each group. Finally, 40 participants were required in four (4) groups in the study. Participants were assigned into four groups: ten (10) male students were assigned into group-one, ten (10) female students were assigned into group-two, ten (10) male staff were assigned into group-three, and ten (10) female staff were assigned into group four.

Research instruments

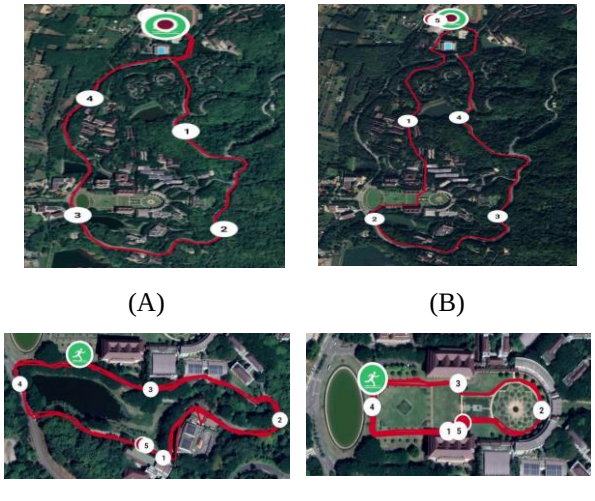
There were four research tools used in the study. First, the polar grit X wrist smart watch was used as the tool to record the indicator required in the study. Basically, it can show the information of running distance, energy used, and heart rate. Second, the body composition analyzer which was used for analyzing body-percentage of fat. Third, watch which was used for determining time for the experiments. Lats, the

questionnaire which was used for collecting personal data of participants.

Step of data collection

All possible routes of running in the Mae Fah Luang University campus were surveyed and considered as the running routes of the study. Afterwards, information of all possible routes of running were displayed by the google map. Participants were selected according to the selection criteria of the study. Those who met the criteria were asked to obtain the consent form based on their voluntary basis before being given the information of the study including the objective of the study. All selected participants were assessed by the PAR-Q again to make sure that all selected participants were ready for the test assigned. The appointments were made for each group to assign to run in each route. During the experiment or running, all participants were monitored their performance by the polar grit X wrist smart, all participants were advised to be falling between zone 1 and zone 3 which was related to heart rate, not too extreme or poorly. The rate of running was set at pace-8 and pace-12, which were 8-12 minutes for one kilometer running. The experiment was set at evening time. Data were cumulatively collected in all four (4) routes. After running in the first route, they were asked to rest for two (2) days or 36-48 hours before starting to run in the next route till to complete all four (4) routes. Afterwards, data were put into the analysis.

Regarding the route of running, there were four (4) routes. Route no. one (1), it was 5.45 km distance, 60 meters of highest slope, and the longest slope was 1,560 meters (Fig No.1). Route no. two (2), it was 5.23 km distance, 35 meters of highest slope, and the longest slope was 590 meters. Route no. three (3), it was 5.32 km distance, 15 meters of highest slope, and the longest slope was 590 meters. Route no. four (4), it was 5.00 km distance, 10 meters of highest slope, and the longest slope was 350 meters (Fig no.1).



(A) (B)

(C) (D)

Fig. 1 The four routes; route no. 1, route no. 2, route no. 3, and route no. 4

Statistical analysis

Descriptive statistics were used to present the general information of the participants in forms of percentages (for categorical data), and means with standard deviation (SD) for continuous data. One-way analysis of variance (ANOVA) was used to detect the differences of calorie expenditures among participants who walked and ran through four different routes and distances at the statistical significance value at $\alpha = 0.05$.

Ethical considerations

This study was approved by the ethical committee of Mae Fah Luang University (EC 22036-18). All subjects were notified of the study procedures before obtaining consent form by voluntary basis.

Results

A total of 40 participants were recruited into the analysis. The average age of participants were 21 years, 22 years, 40 years, and 37 years in male-students, female-students, male-staff and female-staff, respectively. While the average weight of participants were 69 kg (average height = 176 cm), and 61 kg (average height = 158 cm), 65 kg (average height = 167 cm), and 57 kg (average height = 162 cm) among male-students, female-students, male-staff, and female-staff, respectively.

Route no.4 was detected as the most effective route for using energy due to it had the shortest distance but required the highest energy to complete running the route (Table no.1).

Table 1 Comparisons of the distances and average energy expenditure in running time among four (4) groups

Route	**Distance** (km)	**Average energy expenditure** (kcal)	**Average running time** (minutes)
Route no. 1	5.45	356.41	59.84
Route no. 2	5.23	337.28	60.11
Route no. 3	5.32	338.58	59.06
Route no. 4	5.00	367.14	59.53

The comparisons of time and energy expenditure between males and females in running through all four routes, the energy expenditure in males had a greater volume than females significantly, while the time for running was not significant (Table 2).

Table 2 The differences of time and energy expenditure by sex

Factor	Variance source	SS	df	MS	F	p-value
Time	Between groups	6.350	1	6.350	4.29	0.057
	Within the group	20.688	14	1.478		
	Sum	27.038	15			
Energy expenditure (Kcal)	Between groups	11821.126	1	11821.126	10.82	0.005*
	Within the group	15283.679	14	1091.691		
	Sum	27104.805	15			

*Statistically significant difference

Discussion

Based on the specific geographic location of the university, the four routes of running were chosen to find the most effective route in energy expenditure in fartlek running method, and it was found that route no. four was detected as the best route with shortest distance but highest volume of energy expenditure. Moreover, in route no. four, males had a better advantage than females' runners due to releasing more volume of their energy.

While closely observing the characteristic of route no four, it was found that the route was clear and safe which was related to a good ruining platform for fartlek in appropriate steep, uphill, downhill, and flat path [17, 18]. While the other three routes were also found as a good running platform for fartlek which were the physical characteristics, but in terms of energy released, the route no. 1 was observed in the best route.

Under the experiments, the maximum heart rate was controlled at 60%-70%which was always used for the fartlek running form. However, even though the study kept the heart rate at the mentioned level, the energy used was different which was caused by the slope and the length of the slope of the path. The characteristics of the path in route no.4 were related to the good paths for fartlek from various studies [22, 23]. Then it is confirmed that the characteristics of the running path is associated with energy used for the runner.

According to the zoning system, 70-80% or moderate zone was detected as the best zone for fartlek running. Route no. four had the highest cumulative value of the moderate zone, then it was observed as the best route for running. A study conducted by Hottenrott, et al [24] reported that in the moderate zone was found the best zone in use of energy for running.

Our study found that other factors were related to energy expenditure such as sex. Those males had a greater volume of energy used compared to females. This coincides with other studies [23, 25] which were reported that many individuals' characteristics were associated with energy expenditure. The difference might be because of the difference of hormones, physical activities, and type of work.

There were some limitations found in the study. The basic characteristics of four groups might not be completely comparable among groups especially in age. However, the study aimed to investigate the best route for all people living in the campus, then the design of the study was grouped in four categories to cover all people living in the campus. Second, with the understanding of many people in fartlek is still limited, the selecting the participants was not fully completed. Last, some participants presented they're not fully participating in the program after the implementation being launched. However, researchers had kept the procedure of the experiment in the whole course of the intervention to ensure that all the findings were accurate, while the procedure and participation of the participants were kept the standard of the research ethics obtained.

Conclusion

Route no. four (4) which is located on the central area of the campus is detected as the most effective route on highest volume of energy expenditure, but it is the shortest route. The route is appropriate for both male and female, and also all age categories living in the university. The route should be promoted for daily exercise for students and staff. However, there should be investment on some infrastructure to make it safer for general people and also for those who are disabled persons.

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