A Study of the Maximum Oxygen Consumption (VO_{2max}) of the Students Majoring Physical Education and Health Education at Thaksin University

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Abstract: The purpose of this research was to study and compare the maximum oxygen consumption (VO_2 max) of the students majoring Physical Education and Health Education at Thaksin University. The subjects of the research were 123 students. The instrument used in this research was 2.4 km. Running Test. The data were analyzed by Mean (μ), Standard deviation (σ) and comparison of the maximum oxygen consumption. The results showed that the VO_2max of male students (μ = 42.20 ml/kg/min, $\sigma = \pm 5.50$) was better than that of female students (μ = 35.04 ml/kg/min, $\sigma = \pm$ 3.54). When comparing the data of each class, it is found that the mean of the maximum oxygen consumption of the male and female students was significantly different (P>.05). Therefore, the significance of this research can be applied and developed in a specific training program in order to improve the maximum oxygen consumption of the students majoring Physical Education and Health Education at Thaksin University in the future.

1 INTRODUCTION

Physical fitness refers to the ability to express physical aspects for movement and practice skills in playing sports for maximum efficiency and consistency throughout the competition (Thavorn, 2017). Physical fitness means the state of the body that is in good condition to help people to work. It can be effectively divided into 2 types, namely health-related physical fitness that is related to health, and skill-related physical fitness, that is related to skills (Suphit et al., 2017). Wilmore et al. (1994) said that in an exercise, muscles consume energy derived from the substance Adenosine Triphosphate (ATP); an energy source for muscles. People have small amount of this energy source. It is only enough to be used about 3 to 15 seconds. Therefore, if the muscles are needed to run continuously, it is needed to produce this ATP by the energy and other reactions. (McArdle, and Katch, 2011)

1.1 Energy System

***ATP-PC System*,** in this ATP-PC system, energy comes from ATP, which is caused by the breakdown of PC (Phosphocreatine). The output is in the form of inorganic Phosphate (Pi) and creatine (Cr) providing instant energy which will be used to synthesize ATP. This process can be seen from the following equation:

$$\text{PC Pi} + \text{Cr} + \text{energy} \Longrightarrow \text{energy} + \text{ADP} + \text{Pi} \Longrightarrow \text{ATP8} \quad (1)$$

Lactic acid system, this system is also known as "Anaerobic glycolysis". In this case, the process includes breaking down glucose without oxygen, which is an incomplete glucose metabolism by one molecule of glucose (six carbon atoms) which will be transformed into 2 pyruvic molecules (three carbon atoms)

$$\underset{\text{(glucose)}}{C_6H_{12}O_6} + 2ADP + 2Pi2 \Rightarrow \underset{\text{(pyruvic)}}{C_3H_4O_3} + 2ATP + \text{energy}$$

***Aerobic system*,** This system is also known as "Aerobic glycolysis". The process consists of breaking down glucose by using oxygen. The system is divided into 4 consecutive steps as follows: 1) The glucose process of breaking down using oxygen; 3) Synthesizing process of acetylene coenzyme A; 4) Krebs cycle; 5) Electron transport system.

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1.2 Maximum Oxygen Consumption

The maximum oxygen consumption (VO_2 max) is the body's oxygen consumption, which is considered the standard of exercise measurement. If the heart rate is an indicator of the physical fitness, then the use of oxygen is the amount of gas that the body uses to work. In general, Physical fitness depends on the body's ability to use oxygen. Large amounts of oxygen are transmitted to the working muscles. Most of researches show that the maximum oxygen consumption is an important determinant of respiratory and circulatory endurance components which are important and essential.

Health and athletic skills, in which an oxygen-based energy system will be used, play an important role as backup energy to pull the muscles into power. The force of contraction has continued to be active in sports or movement for the maximum efficiency (Thavorn: 2017). On average, when resting in a sitting position, the rate of oxygen consumption is approximately 200-300 ml./min. or 3.5 ml./kg./min. (1 MET) (McArdle et al., 2000).

VO_{2max} test can be conducted both using direct method and indirect method. The direct method of measurement includes the gas analyzing method from a tool which consists of a Treadmill, Bicycle-ergometer, Gasometer, Gas-analyzer, Metronome and Stopwatch. The test taker is required to exercise and breathe in-out into the analyzer. Then, his ratio of oxygen and carbon dioxide is analyzed, and finally the oxygen value in his body in one minute is calculated.

In indirect method of measurement, the test taker is required to work at the highest level for approximately 5-10 minutes, to estimate the maximum value of the body´s oxygen consumption ability. Books et al. (1996) said that method for measuring the VO_{2max} was conducted using a Treadmill, Bicycle-ergometer, Bench step and field test. For example, the Balke Protocol is tested using a speed of 3.3 miles per hour (mph) and the slope of the treadmill increases by 1% every minute. The test ends when HR = 180 repetition per minute (rpm). A stand-Ryaning Test is a test by bicycle (a fixed-weight bike) to pedal the bike for about 6 minutes using the average pulse in the 5 and 6 minutes, which is a steady stage. Added to this, 2.4 km. Running Test is also conducted by recording time at the end. (Sports Authority of Thailand, 2000)

From the underlying background above, this research was conducted to study the maximum oxygen consumption the students majoring Physical Education and Health Education at Thaksin University while exercising and to compare the maximum oxygen consumption ability of each class.

2 RESEARCH METHOD

2.1 Research Type

The study is an experiment aimed at studying the maximum oxygen consumption of the students majoring Physical Education and Health Education at Thaksin University and comparing the maximum oxygen consumption ability of each class by gender.

2.2 Research Target/Subject

The population used in this research was 1st - 4th level students majoring Physical Education and Health Education, Faculty of Education, Thaksin University. 123 chosen participants consisted of 30 of the first year students, 26 of the second year students, 33 of the third year students and 34 of the fourth year students. That classification is according to information obtained from the students' registration and education services, as of September 7, 2017.

2.3 Data, Instrument, Data Collection Technique

The instrument used in this research was 2.4 km. Running Test. The use of the instrument was also supported by a standard field with a distance of 400 meters, a stopwatch, cones and maximum oxygen test results recording sheets. The data were collected by:

1. studying the details of the use of research instrument and equipment
2. making an appointment with the sample group to inform the objectives and request cooperation in conducting research
3. preparing tools, equipment, and facilities to collect information, appointment, date, and time for collecting data
4. providing assistants in collecting data as well as explaining and demonstrating various methods for collecting data for the sample group and the assistant to understand well about the research
5. Conducting the test for the sample group to measure the maximum oxygen consumption ability by 2.4 km. Running Test method.
6. Recording the time that each sample spent and taking the value from the test to measure the maximum oxygen consumption to analyze the data compared with statistical methods.

Data analysis: The research data were analyzed using SPSS computer program for Windows as shown in the following steps:

1. Analyzing the data by finding the mean (μ) and Standard deviation (σ) for basic information of the students majoring Physical Education and Health Education at Thaksin University.
2. Analyzing the mean (μ) and Standard deviation (σ) of maximum oxygen consumption ability of the students majoring Physical Education and Health Education at Thaksin University by gender and grade level in the academic year.
3. Comparing the average oxygen consumption ability of the students majoring Physical Education and Health Education at Thaksin University between the males and females.
4. Comparing the average maximum oxygen consumption ability of the students majoring Physical Education and Health Education at Thaksin University between each level or year.

3 RESEARCH RESULT AND DISCUSSION

Table 1 shows that the male students majoring Physical Education and Health Education at Thaksin University consisted of 94 people, with an average body weight of 69.20 kilograms (Standard deviation of 12.40), and the average height of 174.20 centimeters (Standard deviation of 6.13).

Meanwhile, the female students majoring Physical Education and Health Education at Thaksin University consisted of 29 people, with an average body weight of 55.20 kilograms (Standard deviation of 8.70), and the average height of 161.48 centimeters (Standard deviation of 6.35).

Table 1: The comparison of average body weight and height of the students majoring Physical Education and Health Education at Thaksin University by gender

Gender	N	Body weight (kg.)		Height (cm.)	
		μ	σ	μ	σ
Male	97	69.20	12.40	174.20	6.13
Female	26	55.02	8.70	161.48	6.35

Table 2 shows the body weight and height data of students majoring Physical Education and Health Education at Thaksin University based on their level. Put in order, the 1st, 2nd, 3rd and 4th year students have an average body weight of 65.02, 63.43, 67.87 and 66.88kg, while the height of 171.17, 168.54, 172.97 and 171.76 cm.

Table 2: The comparison of average body weight and height of the students majoring Physical Education and Health Education at Thaksin University by level/year

Grade level	N	Body weight (kg.)		Height (cm.)	
		μ	Σ	μ	σ
1st	30	65.02	7.81	171.17	6.92
2nd	26	63.43	14.04	168.54	9.01
3rd	33	67.87	16.24	172.97	7.44
4th	34	66.88	13.07	171.76	8.97

Table 3 below shows the comparison of the average oxygen consumption ability of the students majoring Physical Education and Health Education at Thaksin University by gender between males and females. Male students have an average of 42.20 ml./kg./min, while the female ones have an average of 35.04 ml./kg./min.

Table 3: The comparison of the average oxygen consumption ability of the students majoring Physical Education and Health Education at Thaksin University by gender between males and females

Gender	Male (n = 97)		Female(n = 26)	
	μ	Σ	M	σ
VO_2 max	42.20	5.50	35.04	3.54

Table 4 below shows the comparison of the average oxygen consumption ability of the students majoring Physical Education and Health Education at Thaksin University by gender between males and females and by their levels of study. The first to the fourth year male students have an average of 42.25, 42.89, 42.33 and 41.59ml./kg./min. Meanwhile, the first to the fourth year female students have an average of 36.25, 36.00, 33.29 and 35.43ml./kg./min.

Table 4: the comparison of the average oxygen consumption ability of the students majoring Physical Education and Health Education at Thaksin University by gender between males and females and by their levels of study

Grade level		VO_2 max	
Male	N	μ	σ
1st	24	42.25	5.24
2 nd	18	42.89	5.17
3 rd	28	42.33	6.18
4 th	27	41.59	5.55
Total	**97**	-	-
Grade level		VO_2 max	
Female	N	μ	σ
1st	6	36.25	5.56
2 nd	8	36.00	2.24
3 rd	5	33.29	3.30
4 th	7	35.43	3.82
Total	**26**	-	-

3.1 Research Result

1) The maximum oxygen consumption of the students majoring Physical Education and Health Education at Thaksin University has an average 42.89 ml./kg./min; 2) The comparison of the maximum oxygen consumption shows that males had the highest oxygen consumption ability than that of females. Here, the VO_{2max} average of male students was 42.20ml./kg./min, and the average of the females was 35.04 ml./kg./min.

3.2 Discussion

Based on the study of the maximum oxygen consumption conducted toward the students majoring Physical Education and Health Education at Thaksin University, the findings showed that the average oxygen consumption of male students was at an average of 42.20ml./kg./min and the average of the female students was 35.04 ml./kg./min. It can be said that male students have higher oxygen consumption ability than that of female students because most male students are athletes representing Thaksin University, and they have got trainings and joined many competitions all the time, so that they have very good physical fitness. These findings are consistent with Nareerat's (2012) research conducted toward the students of the Institute of Physical Education, Chonburi. By the method of estimating the maximum oxygen consumption at the same age, the males have an average value of 48.89ml./kg./min. On the other hand, the females have an average of 51.05 ml./kg./min.

This is also in line with Thawatchai (1998) who stated that prolonged physical activity, people with physical fitness, heart function and good breathing can transport oxygen and nutrients that are useful to the body tissues in the amount that the body needs effectively and sufficiently. Thus, the activities to promote the performance of the heart must be related to aerobic exercise. Chusak (1993) said the maximum oxygen consumption will vary according to the gender, size and shape. For females, the highest value is at the age of 20-25 years. On the contrary, males have the highest value at the age of 25-30 years, then gradually decreases. Heyward (1997) said that the oxygen consumption of males aged 18-25 years is the lowest in the range of 20-29 ml./kg./min, and the highest in the range of 63-80 ml./kg./min.

The results of research also indicated that the differences of the maximum oxygen consumption in each level of study is not too significant, because the Physical Education field has a structured course curriculum for practical skills sports in accordance with every level of the year. The students majoring Physical Education and Health Education at Thaksin University must regularly maintain their physical fitness and also have a physical fitness test program to evaluate their strength, strengthen their personality. It is expected that will graduate as professional educators. In addition, the department also has a fitness room that is equipped with a variety of sport fields for students. There are activities and projects that need to be trained, thus making all students interested and must develop them always.

4 CONCLUSIONS

The purpose of this research was to study and compare the maximum oxygen consumption (VO_2 max) of the students majoring Physical Education and Health Education at Thaksin University. The findings of this research should be presented to the Thaksin University in order to compare the results obtained by conducting physical fitness test as a guideline for the instructor to use to design the program. Practice in developing sports is potential for the development of the university in the future.

REFERENCES

Bootboonpun Nareerat. 2012. *Level of maximum oxygen consumption of students from Institule of Physical Education Chonburi campus.* Master thesis, Graduate School, Srinakharinwirot University, Thailand.

Kamutsi Thavorn. 2017 *Physical fitness conditioning*, Bangkok Media Press LTD.

Kanjanawattikun Thawatchai. 1998. *The effect of exercise training in the type of resistance to structural and functional changes of the heart.*Master thesis, Graduate School, Kasetsart University, Bangkok, Thailand.

McArdle D. William, Katch I. Frank, and Katch L. Victor. 2000**.** *Essentials of Exercisephysiology. 2nd ed.* Philadelphia.

Samahito Suphit. 2013. *Test and norms for the elderly 60-89 years,* Department of Physical Education, Ministry of Tourism and Sports.

Sports Science Department. 2000. *Physical fitness norms for Thai people*, Sports Authority of Thailand.

Vejchapad Chusak and Palawiwat Kanya. 1993. *Physiology of exercise. 4 th edition*.

Wilmore, J. H., &Costill, D. L. 1994. *Physiology of Sport and Exercise.* USA: Human Kinetics.