
RELATIONSHIP BETWEEN THE FACTORS AFFECTING EXERCISE BEHAVIOR AND PHYSICAL FITNESS AMONG UNIVERSITY STUDENTS**RELAÇÃO ENTRE OS FATORES QUE AFETAM O COMPORTAMENTO DO EXERCÍCIO E A APTIDÃO FÍSICA ENTRE ALUNOS UNIVERSITÁRIOS**Aungkana Boonsem¹, Anan Malarat² and Sathin Prachanban²¹King Mongkut's University of Technology Thonburi, Bangkok, Thailand.²Srinakharinwirot University, Bangkok, Thailand.**RESUMO**

Esta pesquisa usou um projeto de pesquisa causal para estudar a relação dos vários fatores e comportamentos de exercício que afetam a aptidão física de estudantes universitários com base no QUADRO PRECEDE. Os objetivos incluíam o seguinte: (1) comparar os fatores pessoais que influenciam o comportamento de exercício; (2) estudar a relação entre os fatores predisponentes, habilitadores e reforçadores; e comportamentos de exercício; e (3) comparar o nível de comportamento do exercício que afeta a aptidão física. O grupo de amostra foi amostragem aleatória simples. Esta pesquisa consistiu na aplicação de questionário e teste de aptidão física de cinco itens sobre Índice de Massa Corporal, Sentar e Alcançar, Força de prensão manual, 60 segundos de pé na cadeira e 3 minutos de subida e descida. Os dados foram analisados por meio de um teste t independente, One-Way ANOVA, One-Way ANCOVA e Multiple Regression Analysis, com um nível estatisticamente significativo de 0,05. Os resultados mostraram que o gênero afetou a prática de exercícios de estudantes universitários, sem impacto no conhecimento e nas atitudes, enquanto a idade afetou a prática de exercícios por gênero controlado. Os fatores predisponentes, capacitadores e reforçadores do conceito PRECEDE FRAMEWORK tiveram um efeito positivo no comportamento de exercícios, promovendo os comportamentos de exercícios de estudantes universitários que têm sido implementados continuamente e fizeram com que os alunos mudassem sua aptidão física e melhorassem todos os seus aspectos. Além disso, o comportamento de exercício de conhecimento e atitudes ao exercício não teve efeito sobre a aptidão física, enquanto o comportamento de exercício de atitude e os fatores de predisposição, habilitação e reforço afetaram o comportamento de prática dos alunos do sexo masculino.

Palavras-chave: Comportamento de exercícios. Aptidão física. Estudantes universitários. Precede framework. Fator.**ABSTRACT**

This research used causal research design to study the relationship of the various factors and exercise behaviors affecting the physical fitness of university students based on the PRECEDE FRAMEWORK. The objectives included the following: (1) to compare the personal factors that influenced exercise behavior; (2) to study the relationship between the predisposing, enabling and reinforcing factors; and exercise behaviors; and (3) to compare the level of exercise behavior affecting physical fitness. The sample group were simple random sampling. This research consisted of the questionnaire and physical fitness test of five items on the Body Mass Index, Sit and Reach, Hand Grip Strength, 60 Second Chair Stand and 3-Minute Step Up and Down. The data were analyzed using an independent t-test, One-Way ANOVA, One-Way ANCOVA and Multiple Regression Analysis, with a statistically significant level of 0.05. The results showed that gender affected exercise practices of university students, and with no impact on knowledge and attitudes, while age affected exercise practice by controlled gender. The predisposing, enabling and reinforcing factors in the PRECEDE FRAMEWORK concept had a positive effect on exercise behavior by promoting the exercise behaviors of university students that have been continuously implemented and caused students to change their physical fitness and improve all aspects of its. In addition, exercise behavior of knowledge and attitudes to exercise had no effect on physical fitness, while exercise behavior of attitude and the factors of predisposing, enabling and reinforcing affected the practice behavior of male students.

Keywords: Exercise behavior. Physical fitness. University students. Precede framework. Factor.**Introduction**

Health has an important place in the perception of life quality and that health-related quality of life encompasses factors of mental, physical, and social well-being^{1,2}. The satisfaction of leisure activities in social life, psychological status, functional ability, the



emotional and spiritual, gender well-being along with the satisfaction in relationships with family and friends plays a large role in determining the health quality of life in individuals^{3,4}. At any age, physical activity is valuable to health with increasing in healthy growth throughout life⁵. The research indicates the physical activity being mainly related to life quality, along with all the other variables. At this point, it is possible to add the life skills of teenager by guiding the interest and curiosity to sports activities. Regular physical activity encourages quality of life by reinforcement the psychological healthiness and physical functioning⁵⁻⁷. Moreover, researchers indicated the health risks increased during adolescence and continued into adulthood^{8,9}. Therefore, in teenager period, it is significantly dangerous for obesity development, making early interventions critical in preventing chronic diseases. Therefore, in between 18-24 years old, a large portion of adult population are enrolled in university with growing the numbers. Due to this rising enrollments, the number of unhealthy behaviors are notable. Therefore, several studies showed the courses related to health-related fitness knowledge, and the skills to help students adopt healthy lifestyles^{10,11}.

College students today face various stressors in their daily lives, which could potentially impact their overall health^{12,13}. The decline in physical activity was evident during young adults' transition from young adulthood to early adulthood, with the steepest decline occurring after university entrance¹⁴⁻¹⁶. It has been reported that in a survey that college students reported symptoms of depression were felt by over half of the group¹⁷. In addition, the female students were less active and exercised less than males¹⁸. The fact that students do not recognize the importance of exercise, consistent with the research of Aungkana Boonsem, who claimed that university students in Thailand had exercise behavior phases, according to the theory of behavioral change procedures in step two or contemplation, including awareness of the problem and considered modifying health behavior according to the Stage of Change theory, without motivation and correct exercise behavior^{19,20}. With regard to emotional behavior, it was found that when adolescents change from children to adolescents, it may lead to anxiety and emotional stress that affects the behavior of teenagers and their physical and mental health. Therefore, exercise behavior is another important health problem for university students. The study showed that exercise is an integral part of healthy behavior, but there are still other factors that are important variables for behavior based on the concepts of Green and colleagues²¹. They proposed the Precede framework about the process leading to the predisposing, enabling and reinforcing factors used in the evaluation of behavioral health. In addition, personal factors are still an important aspect and these factors were the basis for directly promoting exercise behavior. Therefore, studying the factors impacted the exercise behaviors and the relations between exercise behavior and the physical fitness of university students are also important. In addition, there has never been a study of university students to promote the identification of factors affecting exercise behaviors and contributing to be adjustment plan for the purpose of good health and physical fitness in society.

For the reasons mentioned above, the purpose of this study is to determine the physical activity level and life quality of university students in terms of social, psychological, environmental and health fields. In addition, the relations of various factors on exercise behaviors affecting the physical fitness were studied.

Research objectives

1. To compare personal factors that influenced the exercise behavior of university students.

2. To study the relationship between the predisposing, enabling and reinforcing factors and the exercise behaviors of university students.

3. To compare the level of exercise behavior affecting the physical fitness university students.

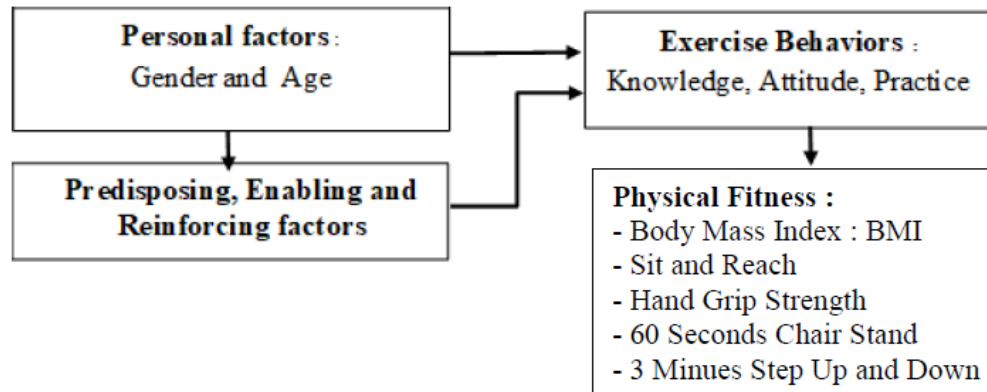


Figure 1. Research framework

Source: The authors

Methods

This research has been reviewed and has been approved for research ethics in compliance with the rules and standards of the Faculty of Liberal Arts Ethics Committee of King Mongkut's University of Technology Thonburi. This research is quantitative research design in causal research design. This is a study of the relationships between various factors and exercise behaviors affecting the physical fitness of students, based on the Precede Framework²¹.

Sample

The sample of this research is calculated by using Taro Yamane²². After calculated the sample size by substituting the numbers into the Yamane formula, with a sample of 370 students. In order to obtain reliable data, the researcher increased the sample size to 400 students out of 5,514 students in the Faculty of Engineering at King Mongkut's University of Technology Thonburi with simple random sampling. All of the healthy students who met the inclusion criteria and voluntarily agreed to participate in the study were recruited. However, 30 students refuse to participate in term of non-participating throughout the program.

Variables studied

1. Independent variables: gender and age;
2. Transmission variables: exercise behavior (knowledge, attitudes and practices) and the exercise factors: predisposing factors (knowledge, beliefs and values of exercise), enabling factors (educational support and fitness facilities) and reinforcing factors (environment, family and friends in terms of exercising);
3. Dependent variables: Physical fitness (body mass index, sit and reach, hand grip strength, 60 second chair stand and three-minute step up and down).

Research tools

The tools used in this research consists of two sections. The first survey measured the exercise behaviors and factors related to quality of life, and the second looked at levels of physical fitness among students in the Faculty of Engineering at King Mongkut's University of Technology, Thonburi, Thailand.

Section 1: A questionnaire²³ on exercise behaviors and factors were determined and reviewed by five experts of behavioral science and sports science in terms of accuracy, suitability, usefulness and possibility. The questionnaire format consisted of the following aspects.

Part 1: General information of students : gender and age.

Part 2: Student's exercise behaviors :

1. Knowledge: A scale was used in the questionnaire to specify the level of the knowledge based on the following criteria; high (66.68-100%), medium (33.34-66.67%), and low (0-33.33%).
2. Attitudes: A scale was used in the questionnaire to specify the level of the agreement or disagreement based on the following criteria; very high agreement (3.51-4.00), high agreement (2.51-3.50), moderate agreement (1.51-2.50) and low agreement (1.00-1.50).
3. Exercise practice: A scale was used in the questionnaire to specify the level of the exercise frequency based on the following criteria; very high frequency (3.51-4.00), high frequency (2.51-3.50), moderate frequency (1.51-2.50) and low frequency (1.00-1.50).

Part 3: Exercise factors on the predisposing factors (knowledge, beliefs, and the values of exercise), and the enabling factor (educational support and fitness facilities) and the reinforcing factor (environment, family and friends in terms of exercising). Such scale was used in the questionnaire to specify the level of the agreement or disagreement based on the following criteria; very high agreement (3.51-4.00), high agreement (2.51-3.50), moderate agreement (1.51-2.50) and low agreement (1.00-1.50).

Section 2: The tools used in measuring physical fitness and based on the Standards of Physical Fitness for the People, as used by the Bureau of Sports Science, the Department of Physical Education and the Ministry of Tourism and Sports, 2019, and consisting of the following five items²⁴:

1. Body Mass Index (BMI) is used to evaluate body proportion by using body weight and height measurements.
2. Sit and Reach is used to assess weakness in the lower back and rear thighs by bending the knees and body to extend arms forward as far as possible and record the distance.
3. Hand grip strength is used to evaluate the muscle strength and lower arms by the hand grip dynamometer and recording the force in kilograms.
4. 60 second chair stand is used to evaluate the strength and endurance of the leg muscles by participants stand up repeatedly from a chair for 60 seconds.
5. Three-minute step up and down is used to assess the endurance of the heart and circulatory system by step up and down on a twelve inch step in three minutes.

Data analysis

The data obtained from the questionnaires were analyzed and divided into:

1. The data concerning the general background of the subjects were calculated and presented in terms of frequency distribution (n), percentage (%), mean (\bar{X}) and standard deviation (SD).
2. The statistical methods were used in the study of factors affected exercise behavior that influenced the performance of the body (physical fitness) as an independent t-test, One-Way ANOVA, One-Way ANCOVA and Multiple Regression Analysis. The statistical significance was at a level of $p < 0.05$.

Results

1. General information

A total of 370 participants consisted of 265 males (71.6%) and 105 females (28.4%). The mean and standard deviation of age were 19.81 ± 0.76 and 20.12 ± 0.9 for males and females, respectively.

2. Comparison of personal factors affecting exercise behaviors

The behavioral level of exercise in terms of knowledge, attitudes and exercise practice are shown at the degree of a high level of knowledge, a very high agreement of attitude and high frequency in exercise practice as shown in Table 1. The data were analyzed in terms of gender affecting the exercise behaviors of university students, with a statistical significance at a level of .05, based on an independent t-test in exercise practices with no effect on exercise behavior in terms of knowledge and attitudes. In addition, male and female students had different levels of knowledge, attitudes to exercise and actual exercise practices.

Table 1. Gender affecting the exercise behaviors of students

Behavior	Male		Female		t	sig
	\bar{X}	SD	\bar{X}	SD		
Percentage of knowledge	82.68	11.04	84.95	11.02	1.79	.08
Attitude	3.54	.36	3.59	.33	1.25	.21
Practice	3.01	.52	2.84	.51	2.75	<.01*

Note: SD, Standard deviation * $p \leq .05$

Source: The authors

The one-way ANOVA analysis showed that age had effects on the physical exercise behavior of university students, as shown in Table 2, with a statistical significance of .05. In addition, when analyzing data to compare relationships of exercise behavior with age when controlled by gender, Practice using Multiple Comparison. The results found that students with 25 years old having the practice behavior significantly decreased compared to 19,20,21 and 22 years old at a level of .05

Table 2. Age affecting the exercise behavior of students

Variable	Source of variance	SS	Ms	DF	F	Sig
Percentage of knowledge	Intercept	76198.35	1	76198.35	626.95*	<.01*
	Gender(Covariate)	431.94	1	431.94	3.55	.06
	Between groups	826.02	6	137.67	1.13	.34
	Within group	43996.48	362	121.54		
	Total	2614100.00	370			
R Squared = .67 (Adjusted R Squared = .52)						
Attitude	Intercept	144.40	1	144.40	1144.52*	<.01*
	Gender(Covariate)	.21	1	.21	1.64	.20
	Between groups	.60	6	.10	.79	.57
	Within group	45.67	362	.13		
	Total	4731.26	370			
R Squared = .72 (Adjusted R Squared = .68)						
Practice	Intercept	100.19	1	100.19	383.97	<.01*
	Gender(Covariate)	1.57	1	1.57	6.01	.01*
	Between groups	4.24	6	.71	2.71	.01*
	Within group	94.46	362	.26		
	Total	3346.08	370			

R Squared = .82 (Adjusted R Squared = .64)

Note: SS = Sum of Square, MS = Mean Squares, DF, Degree of Freedom, F, F-Statistic and *p≤ .05

Source: The authors

3. Correlation between the predisposing, enabling and reinforcing factors to exercise behavior

The correlation between predisposing, enabling and reinforcing factors to exercise behavior using Pearson's correlation is presented in Table 3. The analysis showed that all of predisposing, enabling and reinforcing factors had a positive correlation with exercise behavior. Therefore, the increase in the level of predisposing, enabling and reinforcing factors increased the level of exercise behavior among university students in terms of knowledge, attitude and exercise practices, and with a statistical significance of .05.

Table 3. Correlation between predisposing, enabling and reinforcing factors to exercise behaviors

Factors	Knowledge		Attitude		Practice	
	Pearson Correlation	sig	Pearson Correlation	sig	Pearson Correlation	sig
Predisposing	0.18	<.01*	0.38	<.01*	0.45	<.01*
Enabling	0.15	<.01*	0.24	<.01*	0.30	<.01*
Reinforcing	0.12	.03*	0.20	<.01*	0.38	<.01*

Note: *p≤ .05

Source: The authors

4. Comparison of exercise behavior affecting physical fitness

The analysis of covariance was computed and the result is presented in Table 4. A comparison of the level of exercise behavior in knowledge and attitude affected the physical fitness of the students indicated exercise behavior in terms of knowledge and attitudes to exercise had no effect on physical fitness and measured by both body mass index, sit and reach,

hand grip strength, a 60 second chair stand, three-minute step up and down, with a statistical significance of .05.

Table 4. Comparison between exercise behaviors on physical fitness

Physical fitness	Knowledge			Attitude		
	BMI	Between group	Within group	Total	Between group	Within group
SS	23,849.49	13,359,560.60	13,383,410.09	50,294.73	13,333,115.36	13,383,410.09
DF	2	367	369	1	368	369
Ms	11,924.75	36,402.08		50294.73		
F	33			1.39		
sig	.72			.24		
Sit & Reach	Between group	Within group	Total	Between group	Within group	Total
SS	46.23	36,976.91	37,023.14	189,873	36,833.27	37,023.14
DF	2	367	369	1	368	369
Ms	23.12	100.76		189.87	100.09	
F	.23			1.90		
sig	.79			.17		
Hand grip strength	Between group	Within group	Total	Between group	Within group	Total
SS	.05	13.75	13.79	.08	13.72	13.79
DF	2	367	369	1	368	369
Ms	.02	.04		.08	.04	
F	.63			.15		
sig	.54			.16		
60 second chair stand	Between group	Within group	Total	Between group	Within group	Total
SS	790.49	104,270.29	105,060.78	1,048.43	104,012.35	105,060.78
DF	2	367	369	1	368	369
Ms	395.25	284.12		1048.43	282.64	
F	1.39			3.71		
sig	.26			.06		
3-minute step up&down	Between group	Within group	Total	Between group	Within group	Total
SS	4019.601	899,844.855	903864.457	206.27	903,658.19	903,864.48
DF	2	367	369	1	368	369
Ms	2009.801	2451.893		206.26	2,455.59	
F	.820			.08		
sig	.441			.77		

Note: SS = Sum of Square, MS = Mean Squares, DF, Degree of Freedom, F, F-Statistic and * $p \leq .05$

Source: The authors

When analyzing data to compare relationships of exercise behaviors in practice affecting physical fitness when controlled with gender. The result found that exercise practice affected the sit and reach, hand grip strength, 60 second chair stand and the three-minute step up and down, and with a statistical significance of .05 as shown in Table 5.

Table 5. Comparison of exercise behaviors in practice affecting physical fitness when controlled with gender

Physical fitness	SS	Df	Ms	F	Sig.
Behavior of Practice					
Body mass index					
Intercept	55531.79	1	55531.79	1.53	.22
Gender(Covariate)	794.95	1	794.95	.02	.88
Between groups	66659.39	2	33329.69	.92	.40
Within group	13312383.29	366	36372.63		
Total	13883671.21	370			
R Squared = .75 (Adjusted R Squared = .63)					
Sit and reach					
Intercept	152.15	1	152.15	1.54	.22
Gender(Covariate)	527.56	1	527.56	5.32	.02*
Between groups	350.35	2	175.17	1.77	.17
Within group	36271.83	366	99.10		
Total	48818.65	370			
R Squared = .82 (Adjusted R Squared = .74)					
Hand grip strength					
Intercept	93006.55	1	93006.55	2083.58	<.01*
Gender(Covariate)	12636.67	1	12636.67	283.09	<.01*
Between groups	206.71	2	103.36	2.32	.10
Within group	16337.47	366	44.64		
Total	466841.78	370			
R Squared = .86 (Adjusted R Squared = .85)					
60 second chair stand					
Intercept	140192.77	1	140192.77	516.23	<.01*
Gender(Covariate)	4392.20	1	4392.20	16.17	<.01*
Between groups	629.62	2	314.81	1.16	.31
Within group	99394.46	366	271.57		
Total	1183009.00	370			
R Squared = .54 (Adjusted R Squared = .46)					
Three-minute step up and down					
Intercept	4526243.38	1	4526243.38	2050.85	<.01*
Gender(Covariate)	72667.02	1	72667.02	32.93	<.01*
Between groups	10266.80	2	5133.40	2.33	.10
Within group	807765.28	366	2207.01		
Total	37876501.00	370			
R Squared = .76 (Adjusted R Squared = .69)					

Note: SS = Sum of Square, MS = Mean Squares, DF, Degree of Freedom, F, F-Statistic and *p≤ .05

Source: The authors

When analyzing data of multiple regression analysis on practice behavior of male students. The results found that exercise behaviors of attitude and the factors of predisposing, enabling and reinforcing affected the practice behavior of university students, and with a statistical significance of .05, as shown in Table 6.

Table 6. Result of multiple regression analysis on practice behavior of students

Variables	B	Std. Error	Beta	t	Sig.
(Constant)	.73	.70		1.05	.29
Male	.12	.05	.11	2.31	.02*
Age	-.01	.03	-.02	-.48	.63
Percent of Knowledge	.00	.00	.02	.43	.66
Attitude	.17	.07	.12	2.34	.02*
Predisposing factors	.29	.06	.26	4.54	<.01*
Enabling factors	.12	.06	.10	2.07	.04*
Reinforcing factors	.17	.05	.18	3.35	<.01*

Multiple R = .98, R Square = .89 Adjusted R Square = .78 Std. Error = .45

Note: *p ≤ .05

Source: The authors

Discussion

The purpose of this study was to examine the relationship between exercise and behavioral regulations in terms of physical fitness in a sample of college-aged individuals. In addition, the comparison of personal factors affecting student exercise behavior, including the relationships studied between the predisposing, enabling and reinforcing factors with the exercise behaviors of students were determined. The results showed that gender influenced exercise behavior of university students in exercise practice, without any effect on the knowledge and attitudes, because university students of all genders had similar knowledge and attitudes. Male students effectively demonstrated exercise practices at higher levels than female students, in relation to exercise frequency and the physical differences. The structural features of muscle, skeletal and body system, including the performance of all systems of the body were different in nature²⁵. The personal factors, such as age, had effects on exercise behaviors in practice when controlled by gender. They researched the information and perceived benefits of exercise as well as other activities, causing irregular exercise routines. In addition, older people performed more physical activities and exercise when they are urged to campaign and encourage regular physical activity²⁶. A relationship based on the concept of Precede Framework with behavioral exercises showed that the predisposing, enabling and reinforcing factors were positively correlated with exercise behavior by the predisposing factors of knowledge, beliefs and values depending on the benefits of received or the results of actions or beliefs. The enabling factors in educational support, fitness facilities and the reinforcing factors in the environment, such as family and friends have a direct effect on exercise behavior and provided students with higher levels of exercise behaviors^{27,28}. In terms of the relationship between exercise behaviors and physical fitness, a high level of exercise behavior in terms of knowledge and attitudes of the students had no effect on physical fitness in the body mass index, sit and reach, hand grip strength, 60 second chair stand and the three-minute step up and down. Moreover, because of gender affecting in exercise practice, the data were analyzed in multiple regression analysis on practice behavior of male students that exercise behaviors of attitude and the factors of predisposing, enabling and reinforcing affected the practice behavior of university students without age affecting. Therefore, it could be argued that gender can most accurately predict exercise behavior.

In addition, factors of diet, regular exercise and exercise activities had also effect on physical fitness. The exercise behavior of univesity students were stimulated and encouraged

to develop strong muscles, flexibility, and endurance of the circulatory system to adjust the exercise behavior of university students with the aim of developing a healthy body^{29,30}. This was also in accordance with the research of Aungkana Boonsem, who claimed that a holistic health promotion program was effective for the development of the physical fitness of students, resulting in good physical fitness and with a longer duration of exercise³¹. Therefore, regular exercise practices lead to physical development in university students. For BMI, the fat reducing affecting body mass index³² after exercise routines and regarding consumption behavior, a balanced diet, controlled portions and the amount of food is also an important factor in determining BMI^{33,34}. In addition, the flexibility, strength and endurance of the leg muscles in sit and reach need to develop physically continuous support of a body motion on a continuous basis and causing physiological adaptations tends to increase muscle strength³⁵ and results in smoother movements^{36,37}. For increasing in hand grip strength, the training requires to increase the strength and endurance of arm muscles, but the development in machine exercise focused on gross motor skills and the improvement of arm muscle abilities³⁸.

Therefore, the data indicated that exercise behaviors were related to physical fitness, such as gender and age, as well as the ability to manage the environment, mental states, perception and influence in determining the abilities of the individuals. The habit of exercise routines in behavioral practice increase the knowledge and attitude of fitness being the importance of practicing on a daily basis^{39,40}. The concept of Precede Framework was coupled with exercise behaviors in the development of the students physical fitness is important because adolescent university students have decreased their exercise behavior. According to the pattern of physical activity, in all countries, there are a very low percentage of students that perform vigorous exercise regularly. The continuous environmental adjustments promotes the appropriate exercise habits resulting in higher levels of physical fitness among students. However, there are other important factors, such as behavior patterns in food consumption, exercise frequency, etc.

The studying of factors impact on the exercise behaviors and the relationships between exercise behavior and the physical fitness of university students are important. There has never been a study of university students to promote the identification of factors affecting exercise behaviors and contributing to be adjustment plan for the purpose of good health and physical fitness in society. Therefore, the data revealed the relations between the behaviors of university students that influence their physical fitness at university that can be used to adjust the behavior of physical activity and promote healthier students.

Conclusion

The gender affected the exercise behavior of university students with no influence in terms of age. Moreover, the predisposing, enabling and reinforcing factors in the Precede Framework concept had a positive relationship with the exercise behaviors of university students by promoting exercise, which has been continuously implemented and helped university students to improve all aspects of physical fitness.

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