The Effect of the Arm Swing on the Heart Rate of Non-Athletes

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Background: *The Arm Swing Exercise (ASE) is a style of alternative medicine. The ASE normally follows the pattern of swing forward 30 degrees and then swing backward 60 degrees for each swing. It is thought that practicing the ASE can improve musculoskeletal performance.*

Objective: *The purposes of this study were: 1) to compare the difference in mean number of arm swings, heart rates and energy expenditures between the groups, 2) To examine the effect of basic characteristics and number of arm swing on heart rates and energy expenditures in Thai people.*

Material and Method: *This practice attracted researchers to study the benefits of the ASE in various groups. The ASE pattern was modified to swing forward 90 degrees and swing backward 60 degrees in this research study. The ASE was performed in three age groups of Thai people without diseases: 1) 18-25 years old, n = 25 2) 26-35 years old, n = 25 and 3) 36-55 years old, n = 25 sample of all cases were drawn from volunteers. The instrument utilized was heart rate monitor. Data was analyzed using descriptive statistics, t-test, ANOVA, correlation and multiple regression.*

Results: *The findings revealed that Thai people's mean heart rates, number of arm swings and energy expenditures were significantly different in each group at p-value = 0.05 (F = 5.757, 5.250 and 3.196, p-value = 0.005, 0.007 and 0.47, respectively) with statistical significance at p-value = 0.05 in each group. The basic characteristics in the population groups found that body weight, age and number of arm swings affected heart rate (t = 2.575, 2.341 and 2.058, p-value = 0.012, 0.022 and 0.043, respectively).*

Conclusion: *Although ASE is a light intensity exercise, if done 30 minutes every day, ASE will improve efficacy of the cardiovascular system.*

Keywords: *Arm swing exercise, Thai people*

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The Arm Swing Exercise (ASE) is a style of alternative medicine. ASE normally follows the pattern of swing forward 30 degrees and then swing backward 60 degrees for each swing[1,2]. This practice attracted researchers to study the benefits of the ASE in various groups, especially in elderly groups. They monitored in different benefit. However, the ASE pattern was modified to swing forward 90 degrees and swing backward 60 degrees in this research study, which this modified ASE was no performed, in previous study. The authors focused on the healthy working people. ASE is not difficult to do and no need for sports skill. This research explored by sport science principle for proved to be evidence-based medicine. In addition, the aims of research would encourage working people attend to ASE for good health in anywhere.

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Material and Method

This research selected 75 healthy working people who were non-athletes (exercise less than 3 times per week). We separated in 3 groups 25 persons per each group; 18-25-year old, 26-35-year old and 35-55-year old[3]. The selected groups were drawn from volunteers who received information through workshops and individual contact. The target groups were in good health i.e. have never experienced any heart diseases, asthma, brain problems, balance problems, hypertension, or rotator cuff injuries. but may currently be taking medicines such as Viagra, beta-blockers, an bronchodilators. An electrocardiogram was performed on volunteers 45 years of age or older before ASE. The data recorder demonstrated the ASE pattern for this research: stand straight, width between feet

equal to shoulders width, arms straight before swinging forward 90 degrees and then swinging backward 60 degrees like a pendulum. The heart rate monitor SiGMA@ ONYXBalance/Classic[4] recorded heart rate in beats per minute (bpm) and energy expenditure in kilocalories unit (kcal). The counter machine recorded to the number of swings. Both instruments recorded every 3 minutes; therefore, 10 times for the 30 minute test.

The objectives of this research were: 1) to compare the difference in mean number of arm swings, heart rates and energy expenditures between the groups, and 2) to examine factors of basic characteristics and number of arm swings and their effect on heart rates and energy expenditures in Thai people. Percentage, mean, and standard deviation were applied in descriptive statistics and t-test, ANOVA, Correlation and Multiple regression in analytical statistics.

Results

Show basic characteristics in each group

Show basic characteristics by sex, occupation and age in each group. 75 people were divided into 3 groups; 25 (33.33%); 18-25 years old, 25 (33.33%); 26-35 years old and 25 (33.33%); 36-55 years old. There were 30 (45%) males and 45 (55%) females in all groups. There were 32 (42.67%) government/company officers, 14 (18.67%) students, 11 (14.67%) shopkeepers, 9 (12.00%) Service industry workers 2 (2.67%) business owners, 1 (1.33%) nurse, lawyer, hairdresser, musician, technician and farmer in each group (Table 1.1).

Basic characteristics in each group were defined in health status. Basic characteristic of health status was define by age, body weight (BW), height (Ht), body mass index (BMI) and resting heart rate (Table 1.2).

Comparison of analytical results

This mean of difference comparisons was heart rates, number of arm swings and energy expenditures in each sample group. This part was shown result of mean of different in heart rates before and heart rates after the arm swing exercise (Table 2.1). Results of mean of difference in heart rates, number of arm swings and energy expenditures between sexes in each group was shown in t-test (viz. Table 2.2) and analysis of variance (ANOVA) (Table 2.3).

This result was analyzed by t-test and found a statistically significant difference ($p<0.01$) between the mean of heart rates before and heart rates after arm

Table 1.1. Basic characteristics by sex, occupation and age in each group

Basic characteristic	Age group (years old)						Summary	
	18-25		26-35		36-55			
	n	%	n	%	n	%	n	%
Sex								
Male	10	40.00	10	40.00	10	40.00	30	45.00
Female	15	60.00	15	60.00	15	60.00	45	55.00
Sum	25	100.00	25	100.00	25	100.00	75	100.00
Occupation								
Government/company officer	5	20.00	16	64.00	11	44.00	32	42.67
Student	13	52.00	1	4.00	-	-	14	18.67
Shopkeeper	1	4.00	2	8.00	8	32.00	11	14.67
Service industry workers	3	12.00	4	16.00	2	8.00	9	12.00
Technician	1	4.00	-	-	1	4.00	2	2.67
Business owner	-	-	2	8.00	-	-	2	2.67
Nurse	-	-	-	-	1	4.00	1	1.33
Musician	1	4.00	-	-	-	-	1	1.33
Lawyer	-	-	-	-	1	4.00	1	1.33
Farmer	-	-	-	-	1	4.00	1	1.33
Hairdresser	-	-	-	-	1	4.00	1	1.33
Sum	25	100.00	25	100.00	25	100.00	75	100.00

Table 1.2. Basic characteristic defined by age, body weight (BW), height (Ht), body mass index (BMI) and resting heart rate

Basic characteristic in health status	Age group								
	18-25 years old (n = 25)			26-35 years old (n = 25)			36-55 years old (n = 25)		
	Min	Max	Mean ± SD	Min	Max	Mean ± SD	Min	Max	Mean ± SD
Male									
Age (years old)	18.00	25.00	20.90±2.56	26.00	35.00	28.80±2.62	37.00	51.00	43.80±5.31
Body weight (kilogram)	50.00	83.00	61.50±11.11	32.00	89.00	60.00±15.45	46.00	65.00	58.40±6.48
Height (centimeters)	165.00	175.00	170.10±4.15	160.00	180.00	169.60±6.83	158.00	172.00	164.70±4.30
Body mass index (kg/m^2)	17.30	27.10	21.20±3.35	12.50	27.47	20.85±4.35	18.43	23.88	21.50±1.97
Resting heart rate (beat per minute)	55.00	71.00	67.60±4.84	60.00	71.00	68.70±3.20	63.00	85.00	71.10±7.00
Female									
Age (years old)	18.00	24.00	20.60±1.88	26.00	35.00	30.07±3.39	36.00	50.00	43.40±5.49
Body weight (kilogram)	38.00	84.00	52.27±14.71	40.00	90.00	55.33±12.16	42.00	92.00	62.27±12.30
Height (centimeters)	150.00	170.00	157.00±5.41	145.00	165.00	156.73±5.62	150.00	170.00	157.47±6.15
Body mass index (kg/m^2)	15.82	37.33	21.19±5.96	17.78	33.06	22.42±4.05	18.42	33.79	24.98±3.86
Resting heart rate (beat per minute)	62.00	71.00	68.87±2.33	62.00	98.00	71.07±8.20	60.00	95.00	73.40±9.22
Both									
Age (years old)	18.00	25.00	20.72±2.13	26.00	35.00	29.56±3.11	36.00	51.00	43.56±5.31
Body weight (kilogram)	38.00	84.00	55.96±13.92	32.00	90.00	57.20±13.46	42.00	92.00	61.72±10.38
Height (centimeters)	150.00	175.00	162.24±8.15	145.00	180.00	161.88±8.80	150.00	172.00	160.36±6.49
Body mass index (kg/m^2)	15.82	37.33	21.20±4.99	12.50	33.06	21.79±4.16	18.42	33.79	23.59±3.63
Resting heart rate (beat per minute)	55.00	71.00	68.36±3.51	60.00	98.00	70.12±6.67	60.00	95.00	72.48±8.32

Table 2.1. Result of mean of difference in heart rates before and after arm swing exercise in general population

Arm swing exercise	Before	After	Mean differences	t	Sig.
	Mean ± SD (beat/minute)	Mean ± SD (beat/minute)			
18-25 years old (n = 25)	68.36±3.51	89.32±10.30	20.960±13.07	8.020**	0.000
26-35 years old (n = 25)	70.12±6.67	90.84±8.37	20.720±8.31	12.461**	0.000
36-55 years old (n = 25)	72.48±8.32	98.20±10.85	25.720±12.70	10.123**	0.000
All groups 18-55 years old (n = 75)	70.32±6.66	92.79±10.51	22.467±11.64	16.713**	0.000

**$p<0.01$

Table 2.2. Result of comparison in mean of difference in heart rates, number of arm swings and energy expenditures between male and female in each group

Groups	Male	Female	t	Sig
	Mean ± SD	Mean ± SD		
18-25 years old (n = 25)	(n = 10)	(n = 15)		
Heart rate (bpm)	91.70±16.38	87.73±1.67	0.763	0.465
Number of arm swing (times)	1,474.10±139.83	1,363.33±29.26	3.001**	0.006
Energy expenditure (kcal)	119.20±68.54	143.13±33.87	-1.164	0.256
26-35 years old (n = 25)	(n = 10)	(n = 15)		
Heart rate (bpm)	88.10±2.47	92.67±10.36	-1.639	0.120
Number of arm swing (times)	1,465.60±7.35	1,554.27±32.76	-10.107**	0.000
Energy expenditure (kcal)	108.50±76.52	90.00±62.14	0.665	0.513
36-55 years old (n = 25)	(n = 10)	(n = 15)		
Heart rate (bpm)	96.10±7.09	99.60±12.81	-0.748	0.462
Number of arm swing (times)	1,378.40±209.55	1,515.27±127.64	-2.045	0.052
Energy expenditure (kcal)	113.90±95.07	73.93±56.82	1.320	0.200
All groups 18-55 years old (n = 75)	(n = 30)	(n = 45)		
Heart rate (bpm)	91.97±10.58	93.33±10.58	-0.549	0.585
Number of arm swing (times)	1,439.37±147.13	1,477.62±112.858	-1.272	0.207
Energy expenditure (kcal)	113.87±78.10	102.36±59.29	0.725	0.471

**$p<0.01$

Table 2.3. Result of analysis of variance (ANOVA) in mean of different in heart rates, number of arm swings and energy expenditures between groups

Factors	18-25 years old (n = 25)	26-35 years old (n = 25)	36-55 years old (n = 25)	F	Sig
	Mean ± SD	Mean ± SD	Mean ± SD		
Heart rate (bpm)	89.32±10.30	90.84±8.37	98.20±10.85	5.757*	0.005
Number of arm swing (times)	1,407.64±104.40	1,518.80±51.11	1,460.52±175.08	5.250*	0.007
Energy expenditure (kcal)	133.56±50.73	97.40±67.34	89.92±75.31	3.196*	0.047

*$p<0.05$

swing exercise.

This result was analyzed by t-test found a statistically significant difference ($p<0.01$) in the mean of number of arm swings between sexes in 18-25 years old and 36-55 years old groups after arm swing exercise. Nevertheless, in all groups 18-55 years old there was no statistically significant difference ($p<0.01$) in heart rates, number of arm swings and energy expenditures.

When ANOVA was used for this data, it was found that there was a statistically significant difference in the mean of difference in heart rates, number of arm swings and energy expenditures in each group ($p<0.05$).

Therefore, LSD (Least Significant Difference) was applied for deep comparison by each group as follows:

Heart rate

36-55 years old group had mean of heart rates higher than 26-35 years old group and 18-25 years old differences were statistically significant ($p<0.05$).

Number of arm swing

26-35 years old group had mean of number of arm swings higher than 18-25 years old were differenced statistically significant ($p<0.05$).

Energy expenditure

18-25 years old group had mean of energy expenditures higher than 36-55 years old were differenced statistically significant ($p<0.05$).

Show the basic characteristics and number of arms swings affecting the heart rate and energy expenditure

Basic characteristics were defined by sex, age, occupation, body weight, height, body mass index, resting heart rate and number of arm swing. Univariate analysis was used in all factors and found that age, body weight and number of arm swings were significantly related to heart rate. Multiple regression with the Stepwise regression method (Table 3.1). Therefore, we set the related equation from these factors affecting the heart rate.

However, after correlation was applied. We found that sex, occupation, body weight, height, body mass index, resting heart rate and number of arm swings were not significantly related to energy expenditure ($p<0.05$).

Discussion

The sample groups were represented by non-athletes and were drawn from various occupations. Most people were government/company officers, students and shopkeepers. 45 (60%) females, 30 (40%) males found that body weight, height, body mass index and resting heart rate increased by age groups (18-25, 26-35 and 36-55 years old). These results revealed a statistically significant difference between heart rate means before and after arm swing exercise ($p<0.01$). Human physiology changed after 30 minutes of ASE. After reviewing related articles, we found different sample groups, various methods of ASE and different measurements of physiological change. However, this research focused on working age and modified patterns to swing forward 90 degrees and swing backward 30 degrees which are different from previous researches. The authors found that body weight, age, number of arm swings were related to heart rate with a statistically significant difference. The effect during exercise improves cardiorespiratory systems for compliance to keep blood pressure constant. Cardiac output increased

Table 3.1. The results of basic characteristics and number of arm swings affecting the heart rate and energy expenditure were analyzed by multiple regression with stepwise method

Factors to effected	Unstandardized coefficients		Standardized coefficients	t	Sig.	95% confidence interval for B	
	B	Std. Error	Beta			Lower bound	Upper bound
(constant)	45.491	13.596		3.346	0.001*	18.381	72.602
Body weight	0.226	0.088	0.273	2.575	0.012*	0.051	0.401
Age	0.258	0.110	0.249	2.341	0.022*	0.038	0.477
Number of arm swing	0.018	0.009	0.218	2.058	0.043*	0.001	0.035

*$p<0.05$

by demand for oxygen transportation under vasodilatation affecting systemic vascular resistance decreased during exercise, but heart rate and stroke volume were also increased[5].

However, increasing number of arm swings cannot reach the target heart rate because ASE is a light aerobic exercise with constant arm swing speed. Heart rate increases constantly too. ASE in this research increase degree of swing forward which the benefit had more flexibility[6,7] and strengthening to muscle around shoulder[8], arms[9,10], and trunks balancing[11].

There was a statistically significant difference ($p<0.05$) when comparing mean of difference of heart rates, number of arm swings and energy expenditures in all age groups. 36-55 years old group had mean of heart rates higher but mean of energy expenditures lower than 26-35 years old group and there was a statistically significant difference ($p<0.05$) in the 18-25 years old group after LSD (Least significant difference) was applied for deep comparison. Basal metabolic rate (BMR) decreased by chronological age but increased by body weight[12]. So, obese people had more BMR than thin people. Moreover, BMR depends on fat mass, fat-free mass and physical activity for human adaptation. Someone with a lot of fat-free body mass will increase energy expenditures due to BMR rising, 18% of all organs for resting metabolic rate is muscle metabolism. In addition, there was a statistically significant difference ($p<0.01$) in the mean of number of arm swings between sexes in years old group and 18-25 years old group. It depends on their rhythm of number of arm swings and the length of arms. But there was no statistically significant difference in the mean of heart rates and energy expenditures between sexes in all groups due to the energy expenditure formula is the same for males and females but variation by body weight, period of time and metabolic equivalent of task in physical activity[13].

Elderly hypertension patients doing ASE with family members can be encouraged to do a greater number of arm swings than those doing ASE without family support[14]. Therefore, ASE with group support can be applied to working people especially in the office or factory. The resulting physiology will be changed and related with the plan of Thailand healthy lifestyle strategic 2011-2020, focusing on prevention[15]. Health promotion and prevention are the best things to do.

Conclusion

Which age, body weight and number of arm swing affected heart rate after ASE 30 minutes. Although ASE is a light exercise, if people do ASE 30 minutes every day, it will improved efficacy of the cardiovascular system and have good health effects. Public health officials and volunteers should inform the general public of the benefits of ASE. Although those suffering from office syndrome can apply ASE anywhere, the head of organization should define the policy for exercise time, ASE can also increase flexibility of muscle to release myalgia. In addition, body composition should be considered for ASE research in the future when searching for evidence-based medicine even if the physical environment is difficult to control. The sample groups did not represent all working ages but came from volunteers and were selected from various occupations.

What is already known on this topic?

Most previous researches involving ASE chose elderly and/or hypertension, diabetic mellitus for sample groups. Health background, body weight, resting heart rate, blood pressure, blood sugar, muscle flexibility and physical/physiological changes were indicators for measurement after ASE studies, including pattern based ASE programs. In addition, the ASE pattern in previous research used ordinary ASE or modified ordinary ASE to 150 degrees swing forward. Most international research was interested in biomechanics and studied arm swing while walking or running.

What this study adds?

This research modified ASE patterns to 90 degree swing forward and studied healthy people, working-aged groups (18-55-year old). The objectives studied different outcomes in each group: 18-25-year old, 26-35-year old and 36-55-year old. The results focused on health promotion and prevention formed from evidence-based medicine and sport sciences application in ASE 30 minutes, and is easy and simple to do. Heart rate and energy expenditure were considered. Which age, body weight and number of arm swing affecting heart rate after ASE 30 minutes? Although ASE is a light exercise, if people do ASE 30 minutes every day, it will improve efficacy of the cardiovascular system and have good health effects.

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Expenditures were considered. Which age, body weight and number of arm swings affect heart rate after ASE 30 minutes? Although ASE is light exercise but if people do ASE on ground, 30 minutes every day will improve efficacy of cardiovascular system and have a good health.

Potential conflicts of interest

None.

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ผลการแกว่งแขนบนบกที่มีต่ออัตราการเต้นของหัวใจในบุคคลทั่วไป

สีขาว เชื้อปรุง, บุรทิน ขำภิรัฐ, ปารัช รัตนไชยพันธ์, พูลลาภ ทัตตะทองคำ

ภูมิหลัง: *การแกว่งแขนเป็นศาสตร์แพทย์ทางเลือก มีรูปแบบที่ชัดเจนคือ แกว่งแขนไปข้างหน้า 30 องศาและแกว่งไปด้านหลัง 60 องศา ทั้งมีการทดลองปฏิบัติจนมีคำว่า "แกว่งแขนบำบัดโรค" ทำให้นักวิจัยในประเทศไทยสนใจศึกษาคุณประโยชน์ของการแกว่งแขนในหลากหลายกลุ่ม*

วัตถุประสงค์: *1) เพื่อเปรียบเทียบความแตกต่างของค่าเฉลี่ยจำนวนครั้งในการแกว่งแขน อัตราการเต้นของหัวใจและการเผาผลาญพลังงานในแต่ละกลุ่มทดลองและ 2) เพื่อศึกษาปัจจัย ข้อมูลพื้นฐาน และจำนวนครั้งในการแกว่งแขน ที่ส่งผลต่ออัตราการเต้นของหัวใจและการเผาผลาญพลังงาน*

วัสดุและวิธีการ: *วิจัยครั้งนี้ปรับท่าแกว่งแขนเป็นแกว่งไปข้างหน้า 90 องศาและแกว่งไปด้านหลัง 60 องศา กับกลุ่มบุคคลทั่วไปจำนวน 75 คน (18-25 ปี 25 คน, 26-35 ปี 25 คน และ 36-55 ปี 25 คน) เปรียบเทียบความแตกต่างของค่าเฉลี่ยจำนวนครั้งในการแกว่งแขน อัตราการเต้นของหัวใจและการเผาผลาญพลังงานในแต่ละกลุ่มทดลองและศึกษาปัจจัย ข้อมูลพื้นฐาน และจำนวนครั้งในการแกว่งแขน ที่ส่งผลต่ออัตราการเต้นของหัวใจและการเผาผลาญพลังงาน โดยใช้เครื่องวัดอัตราการเต้นของหัวใจและพลังงานเป็นเครื่องมือในการติดตามขณะแกว่งแขน 30 นาที และทำเสนอผลทางสถิติแบบค่าเฉลี่ย, t-test, ANOVA, correlation และ Multiple regression*

ผลการศึกษา: *ค่าเฉลี่ยจำนวนครั้งในแกว่งแขน มีความหลากหลายแล้วแต่บุคคลซึ่งสัมพันธ์กับอายุ โดยค่าเฉลี่ยอัตราการเต้นของหัวใจ จำนวนครั้งในการแกว่งแขนและการเผาผลาญพลังงาน ($F = 5.614, 5.250$ and 3.196, p-value $= 0.005, 0.007$ and 0.47 ตามลำดับ) มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติที่ระดับ 0.05 ในทุกช่วงอายุของกลุ่มบุคคลทั่วไป และปัจจัยพื้นฐานในกลุ่มบุคคลทั่วไปพบว่า อายุ น้ำหนัก และจำนวนครั้งในการแกว่งแขนบนบก มีผลต่ออัตราการเต้นของหัวใจขณะแกว่งแขน ($t = 2.575, 2.341$ และ 2.058, p-value $= 0.012, 0.022$ และ 0.043 ตามลำดับ)*

สรุป: *แม้ว่าการแกว่งแขนบนบกถูกจัดเป็นการออกแรงระดับเบา แต่หากกลุ่มบุคคลทั่วไปปฏิบัติอย่างสม่ำเสมอและต่อเนื่องจะสามารถช่วยทำให้การทำงานระบบการไหลเวียนของหลอดเลือดดีขึ้น*