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Joana L Yasol-Vicente
Department of Human Kinetics,
University of the Philippines Los
Baños Laguna, Philippines

Improving strength, flexibility and balance using Taijiquan exercises

Joana L Yasol-Vicente

Abstract

The purpose of this study was to assess the effect of Taijiquan exercises on flexibility, balance, and leg strength among college students. The study used seventy-six students from three random sections of Physical Education 2 taking up Taijiquan, namely: BMMA, BSA 191C and BSA 191D. A 15-week Taijiquan Training Program was employed among the subjects, conducted two times a week for 80 min per session. Everyone was subjected to pre-test and post-test using wall squat, sit-and-reach, and one-leg-standing balance as fitness parameters. After the intervention, a significant increase was observed between the respondents' performance in three fitness parameters. This study has confirmed that the practice of Taijiquan has improved the muscle strength, flexibility, and balance.

Keywords: balance, taichi, taijiquan, muscle strength, flexibility, wushu

Introduction

Taijiquan or Tai Chi Chuan is an ancient Chinese exercise for health improvement, spiritual growth, disease prevention, healing assistance and self-defense [1, 2, 3]. It is an exercise that works on internal energy and manifests externally involving slow, circular movements, mental concentration, breath control relaxation and meditation [4]. The integration of mind and body is the significant ideology of all traditional Chinese martial arts. As it is not only focused in addressing physical pains but deals more on the improvement of the entire body making it more balance with its surrounding nature and in oneself. The slow moving but powerful characteristics of Taijiquan is intended to strengthen and stretch the body, develops balance and being aware of the body's movement in space. It involves focused and controlled breathing which improve the flow of blood and other fluids and relaxation. Taijiquan training may vary from an individual or group level, thus, making it suitable for all ages and population groups in the society [5]. The practice of Taiji has been acknowledged as good physical activity in improving functional capability and health for people with varied health conditions, such as older adults, patients with chronic diseases, and even children with intellectual disability [6]. Studies also have shown evidence of excellent general health and fitness benefits in practicing Taijiquan such as improved balance and aerobic capacity in those with poor fitness, increased strength in the lower limbs, and increased well-being and improved sleep [7]. The characteristics and benefits of taijiquan in improving health and fitness among its practitioners' paved way to the offering of the art in physical education program in the academe. This is augmenting the academic routine of the students by teaching them ways on improving their fitness using Taiji. Taijiquan or Tai Chi Chuan is now being offered as one of the Physical Education course offerings in Higher Educational Institutions in the Philippines. It is deemed to improve all the aspects of human life such as physical, social, mental, and emotional. In this study, the author examined the effect of Tai Chi on lower extremity muscle strength, flexibility, and functional balance control. This study aimed to examine whether Taiji program is effective in improving both health and skill related physical fitness in in the school-based physical education curricula. The results of the study will help in providing alternative fitness programs in promoting health and fitness among students.

Materials and methods

A clustered random sampling was used to identify the population in this study. A total of 76

Corresponding Author:
Joana L Yasol-Vicente
Department of Human Kinetics,
University of the Philippines Los
Baños Laguna, Philippines

College students coming from the three randomized sections (i.e., BMMA, BSA 191A and BSA 191D) of Physical Education 2 2nd Term SY2019-2020 of National University Calamba Campus in Calamba, Laguna, Philippines was tested for strength, flexibility, and balance. All respondents agreed with an informed consent before the implementation of the study. The research was described, and voluntary participation were sought to the respondents. Further, risks and discomforts, potential benefits, utilization of the result, confidentiality and the researchers contact information were explained to the participants.

A 15-week Tai Chi Intervention Program were employed among the respondents. Each session lasted for 60 minutes, twice every week with warm up and cool down exercises. The program includes basic Tai Chi, breathing and relaxation exercises and Yang Tai Chi (16 and 24 forms). A pre and post fitness test were employed to compare if the procedure influences the respondents. Three physical variables were measured, namely: sit-and-reach flexibility, static balance, and wall squat leg strength.

Frequency and percent distribution were used to show the

actual number of observations in both categorical (gender) and numeric (weight and height) variables. T-test was used to determine the significant difference between the respondent's pre-test and post-test in different fitness parameters. One-way ANOVA was utilized to determine the significant difference among the means of the respondent's pre-test and post-test for different fitness parameters.

Results and Discussion

Population Description

To The study utilized three (3) random class sections of PE 2 Taijiquan (Figure 1). Using a stratified random sampling, 35% of the respondents were randomly picked from Bachelor in Multimedia Arts (BMMA), 33% respondents from Bachelor of Science in Accountancy 191C (BSA191C) and 32% of the respondents came from Bachelor of Science in Accountancy 191D (BSA191D). The data further reveal that the respondents are dominated by male (70%) students with height and weight of 146-155 centimeters (cm) (49%) and 121-130 pounds (lbs) (55%), respectively.

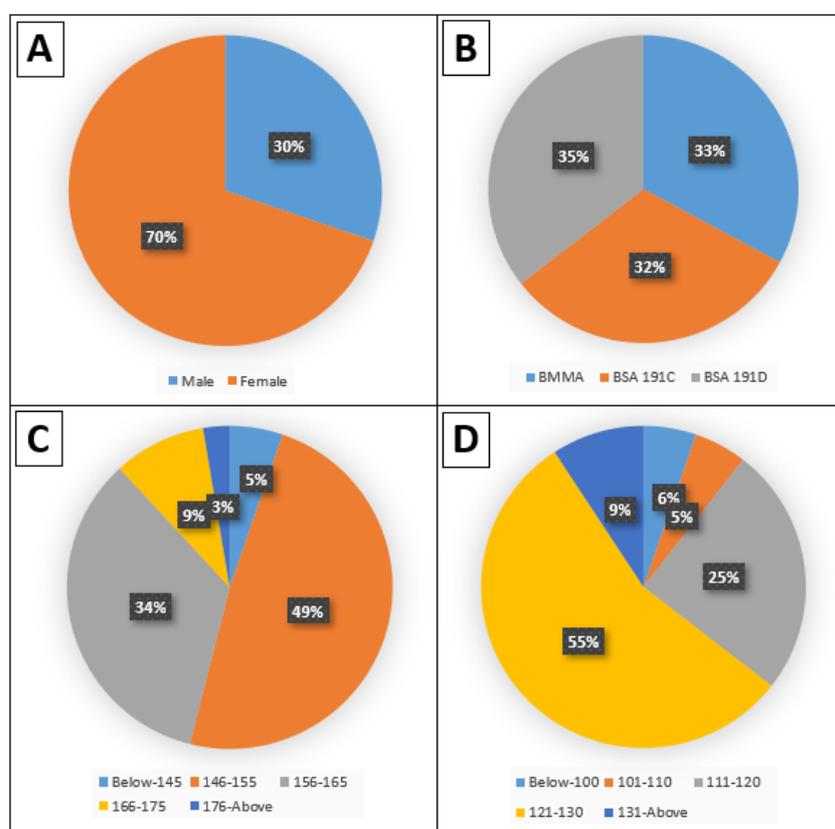


Fig 1: The respondents' demographic profile as to gender (A), section (B), height (C) and weight (D)

Muscle strength

Muscle strength is measured using the fitness parameter wall squat. Respondents' test results on wall squat across different variables is presented in Table 1. Pre-test results of the population reveals that males ($\mu = 131.52$ sec) performed better than females ($\mu = 81.7$ sec). The section from BMMA did excel in wall squat with a mean of 148.4 seconds. Meanwhile, respondents with the height above 176 cm and weight between 111-120 lbs has the highest mean wall squat of 235.5 seconds and 103.58 seconds, respectively.

Analysis of pre-test performance within clusters reveals no significant correlation in wall squat except in terms of gender (p -value = 0.01). This is expected as males are often more exposed to rigorous activities such as sports. Similarly, a

significant difference was also observed between sections with p -value = 0.00.

After the 15-weeks Tai Chi Training Program, it was observed that all respondents improved and performed between 57 to 627 seconds of wall squat. A significant difference was observed between the respondents' pre-test and post-test with a p -value of 0.00 at 0.05 level of significance (Table 4). However, no significant difference was observed in some classes such as of those height below 145cm, above 176cm, and weight between 101 to 110 lbs.

Improvement on the performance can be attributed to the strengthening of the muscles in the pelvis, lower back, hips, legs, glutes, and abdomen. Despite tai chi involves slow bodily movement and not using any equipment during

execution, it can give comparable result like strength training or weightlifting which uses your body weight and gravity as resistance only. Similarly, the studies conducted by Penn *et al* [8], Zhou *et al* [9], Su *et al* [10] and Xu *et al* [11] among Tai Chi practicing elderlies revealed an enhanced muscle strength of the lower limbs.

Flexibility

The “sit and reach exercise” was used to measure the flexibility of the respondents. Their reached while sitting on the floor with their back flat on the wall and legs stretched out forward were compared before and after the Tai Chi Intervention Program. Pre-test results (Table 2) showed that respondents can reach between 19-79 centimeters. Post-test results revealed that they performed between 17-89 centimeters. Despite some of the respondents exhibited

reduced flexibility, as implied by the lower reached during the post-test, all class means improved after the intervention. Statistical analysis further verified that there is a significant difference between the respondent’s performance during pre-test and post-test, with a p-value of 0.00 at 0.05 level of significance (Table 4).

The practice of Tai Chi has been investigated by many researchers leading to the discovery that it was beneficial to improve flexibility among older adults [3, 6, 12]. The gentle and slow movement causes the maximum joint and muscle extension without causing injury. The involvement and coordination of all parts of the body, complimented by deep breathing scatters the stress brought about by the movement from one specific muscle group and distribute it to the entire body.

Table 1: Respondents’ pre-test and post-test results on wall squat (in seconds) across different variables and their correlations within classes

Variable	N	Pre-Test					Post-Test				
		Min	Max	Mean	F-value	p-value	Min	Max	Mean	F-value	p-value
Gender											
Male	23	34	420	131.5	7.18	0.01*	60	349	239.0	1.98	0.16
Female	53	12	305	81.7			57	627	204.8		
Program											
BSMMA 191A	25	48	420	148.4	10.40	0.00*	60	627	297.7	22.10	0.00*
BSA 1C	24	20	195	66.2			57	310	154.0		
BSA 1D	27	12	204	76.2			66	259	193.1		
Height (cm)											
Below-145	4	18	267	157.5	2.72	0.04*	181	338	282.5	0.92	0.46
146-155	37	18	305	95.2			57	627	214.1		
156-165	26	12	230	82.6			66	330	212.9		
166-175	7	37	196	83.1			60	315	175.0		
176-Above	2	51	420	235.5			201	340	270.5		
Weight (lbs)											
Below-100	4	20	50	41.3	0.89	0.48	57	92	76.5	2.37	0.06
101-110	4	38	75	56.0			77	310	207.3		
111-120	19	18	420	103.6			62	340	215.5		
121-130	42	18	267	100.8			60	627	227.3		
131-Above	7	12	193	97.3			66	349	223.3		
Total	76	12	420	96.7			57	627	215.2		

*marked correlations are significant at p<0.05

Table 2: Respondents’ pre-test and post-test results on sit and reach (in centimeters) across different variables and their correlations within classes

Variable	N	Pre-Test					Post-Test				
		Min	Max	Mean	F-value	p-value	Min	Max	Mean	F-value	p-value
Gender											
Male	23	20	79	45.6	1.14	0.29	27	73	48.0	0.27	0.60
Female	53	19	66	42.4			17	89	49.8		
Program											
BSMMA 191A	25	19	79	42.8	0.05	0.95	17	89	43.4	4.02	0.02*
BSA 1C	24	25	63	43.9			27	73	51.2		
BSA 1D	27	23	68	43.4			27	73	51.9		
Height (cm)											
Below-145	4	34	62	46.0	0.71	0.59	43	71	51.8	1.08	0.38
146-155	37	19	68	42.0			23	65	46.5		
156-165	26	23	79	43.5			17	89	51.9		
166-175	7	30	58	45.5			34	73	49.6		
176-Above	2	52	58	55.0			60	61	60.5		
Weight (lbs)											
Below-100	4	36	60	44.3	0.12	0.98	41	65	50.8	0.34	0.85
101-110	4	27	56	43.0			35	73	56.3		
111-120	19	23	63	43.2			23	69	48.4		
121-130	42	19	79	44.0			17	89	49.1		
131-Above	7	20	68	46.5			39	64	50.3		
Total	76	19	79	43.4			17	89	49.3		

*marked correlations are significant at p<0.05

Balance

Balance is the ability of the person not to fall, or in the case of objects, it is the state when the resultant force acting on it is zero [13]. In this study, balance is determined by the fitness parameter one leg standing balance exercise. Respondents' pre-test and post-test results across different variables is shown in Table 3. Pre-test results reveal that respondents can do the exercise between 5 to 213 seconds, with a total average mean of 75.0 seconds. The highest were observed in the classes of males (79.6 sec), BMMA (85.8 sec), 146-155 cm height (83.8 sec) and 111-120 lbs weight (94.6 sec). After the 15-weeks Tai Chi Intervention Program were employed among the respondents, it was observed that their performance improved almost twice as much before the intervention was employed with the total mean of 132.0 seconds (range: 21-335seconds). Statistical analysis further

revealed a significant difference in total mean (p value of 0.00) despite no difference in some classes of height (below 145 cm, above 176 cm) and weight (below 100 lbs, 101-110 lbs, above 131 lbs).

Numerous studies have been conducted on the effect of Tai Chi on older individuals [14, 15, 16] and patients with mobility problems [4, 17, 18] showed a positive influence on balance control. Wong and Lan [19] emphasized that the synchronization of visual, proprioceptive, vestibular, and musculoskeletal system is essential in keeping one's balance. He further stated that Tai Chi improves static and dynamic balance, especially in more challenging sensory perturbed condition. Tai Chi improves leg strength, flexibility, range of motion and reflexes which are all bodily mechanisms required to stay upright [19].

Table 3: Respondents' pre-test and post-test results on one leg standing balance (in seconds) across different variables and their correlations within classes.

Variable	N	Pre-Test					Post-Test				
		Min	Max	Mean	F-value	p-value	Min	Max	Mean	F-value	p-value
Gender											
Male	23	16	172	79.6	0.31	0.58	38	285	143.2	0.59	0.45
Female	53	5	213	73.1			21	335	128.4		
Program											
BSMMA 191A	25	16	213	85.8	1.72	0.18	57	335	208.6	37.64	0.00*
BSA 1C	24	5	158	78.2			37	180	111.5		
BSA 1D	27	9	172	62.3			21	190	81.8		
Height (cm)											
Below-145	4	45	76	63.0	1.31	0.28	90	265	181.3	0.79	0.54
146-155	37	9	213	83.8			37	303	141.0		
156-165	26	17	172	73.9			21	335	119.4		
166-175	7	5	158	53.6			47	198	116.0		
176-Above	2	14	39	26.5			62	180	121.0		
Weight (lbs)											
Below-100	4	18	82	43.3	1.18	0.33	37	119	71.5	1.69	0.16
101-110	4	22	100	66.3			74	180	132.8		
111-120	19	28	213	94.6			51	237	133.8		
121-130	42	5	172	74.5			38	335	129.0		
131-Above	7	23	102	66.5			21	328	194.8		
Total	76	5	213	75.0			21	335	132.9		

*marked correlations are significant at p<0.05

Table 4: Difference in the respondents' pre-test and post-test on various fitness parameters across different variables

Variable	Fitness Parameter					
	Wall Squat (sec)		Sit and Reach (cm)		One Leg Standing Balance (sec)	
	t-test	p-value	t-test	p-value	t-test	p-value
Gender						
Male	5.33	0.00*	1.13	0.27	3.39	0.00*
Female	10.85	0.00*	4.81	0.00*	5.13	0.00*
Program						
BSMMA 191A	2.01	0.00*	2.00	0.01*	2.05	0.04*
BSA 1C	2.05	0.00*	2.01	0.00*	2.01	0.01*
BSA 1D	2.15	0.00*	2.01	0.00*	2.01	0.00*
Height (cm)						
Below-145	3.01	0.06	1.36	0.28	3.27	0.05
146-155	7.45	0.00*	12.92	0.00*	4.61	0.00*
156-165	8.23	0.00*	3.00	0.00*	2.40	0.02*
166-175	4.45	0.00*	1.1	0.31	2.81	0.03*
176-Above	0.30	0.81	1.57	0.36	2.03	0.29
Weight (lbs)						
Below-100	5.59	0.01*	6.79	0.00*	1.22	0.31
101-110	2.56	0.08	6.89	0.00*	2.49	0.09
111-120	4.52	0.00*	1.8	0.09	3.18	0.01*
121-130	10.42	0.00*	2.97	0.00*	4.23	0.00*
131-Above	3.61	0.02*	0.58	0.58	2.24	0.08
Total	11.90	0.00*	4.61	0.00*	6.18	0.00*

*marked correlations are significant at p<0.05

Conclusions and Recommendations

The practice of Tai Chi has improved the muscle strength, flexibility, and balance. Further investigation on the effects of Tai Chi exercise in a bigger population is also recommended. Testing is also suggested to younger population such the grade school students.

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