International Journal of Physical Education, Sports and Health 2016; 3(2): 193-199

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 4.69
IJPESH 2016; 3(2): 193-199

www.kheljournal.com
Received: 24-01-2016
Accepted: 25-02-2016

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The effect of bamboo dance on motor fitness in Chinese college students

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Abstract
Background/Purpose: Physical education (PE) is considered the primary tool to increase physical fitness (PF) of students. In fact, students are not very physically active during traditional school PE classes. Considering the low physical activity level will lead to a poor motor performance in Chinese college students, more physical activity interventions are needed to increase motor fitness of students. Therefore, the purpose of the study was to assess the preliminary effects of an 8-week school-based Bamboo Dance intervention on motor performance among college students in China.
Method: Thirty (male = 18, female = 12) college students (BMI = 22.45±2.61; age = 20.8±2.07) were recruited from the northwest region of China and randomly assigned into experiment and control group. Subjects in the training group were required to participate in Bamboo Dance exercise in regular physical education class. The intervention underwent 8 weeks of training session (90 min per week). Agility, balance, speed, and power were measured before and after the training session for each group.
Results: The results of the study indicated that participants in the intervention program showed significantly promotions in balance (102% vs. 3.6%), agility (6.1% vs. .18%), strength (9.6% vs. .33%), and explosive power (8.4% vs. .42%) than students in control group.
Conclusions: performing Bamboo Dance provides the health benefits to college students in terms of developing lower extremity-related motor abilities. The study demonstrated that a school-based Bamboo Dance programme is able to initiate changes in college students and could be implemented to other colleges throughout China.

Keywords: Bamboo Dance, motor fitness, college students, China

Introduction

Motor fitness are critical for people to reach their maximum potentials in a variety of sports, including power, speed, agility, balance, coordination, and reaction time (Caspersen, Powell, Christenson, 1985; Corbin, Pangrazi, & Franks, 2000; Pangrazi & Beighle, 2013) [5, 7, 27]. The key components of motor fitness will rapidly facilitate learning motor skills so that people are able to achieve their proficient athletic performance (Gísladóttir, Haga, & Sigmundsson, 2013) [11]. Although a shift on assessing physical fitness level from motor fitness to health-related components that has taken place in the past five decades (Mood, Jackson, & Morrow, 2007) [26]. Additionally, school curriculum construction following accreditation criteria has prioritized health-related components (Sawyer, 2006), but people who excel at motor fitness will tend to participate in daily physical activities (Fu *et al*., 2013; Gísladóttir *et al*., 2013; Rink & Hall, 2008; Stodden *et al*., 2008) [10, 11, 34, 39]. It will be associated with improved health-related fitness (Clark & Metcalfe, 2002; Crobin *et al*., 2000; Stodden, True, Langendorfer, & Gao, 2013; Seefeldt, 1980; Vlahov, Baghurst, & Mwavita, 2014) [6, 7, 40, 36, 42], lower risk of motor function-related (Crobin *et al*., 2000) [7] and cardiovascular disease (Zelaznik & Harper, 2007) [46] that significantly improve quality of life (Boreham & Riddoch, 2001; Poulsen, Ziviani, Johnson, & Cuskelly, 2008) [2, 32].

Understanding the influence of variables on motor fitness which could also provide people better atmosphere to develop each individual component of motor fitness. Gísladóttir, Haga and Sigmundsson (2013) [11] had studied if differences in components of motor fitness existed between two different levels of motor competence (The Movement Assessment Battery for Children-2) among teenagers. However, only two components of motor fitness were measured, including standing broad jump (power) and speed (20 meters). The findings indicated that high motor competence group had performed better both in the sum scores and individual components of physical fitness than those in low competence group, suggesting that assisting the lower motor competence teenagers to strengthen their motor fitness which would contribute to positive attitudes toward physical activity and increase participation frequency of physical activity for a long-term goal. According to Spaniol, Jarett, Ocker, Bonnette, and Melrose (2013) [38] a study had focused on investigating two variables (academic major and gender) contributing to differences in motor fitness in college students; measures of motor fitness included the vertical jump (power), T-test (agility), 50-yd dash (speed), and stork stand (balance) tests. The findings indicated that students specialized in kinesiology did not perform significantly better in motor fitness components than those with other majors, as well no significant differences existed between different sexes. In addition to academic major, gender, and motor competence level, Keogh, Weber and Dalton, (2003) [19] utilized motor fitness tests as a talent identification tool to distinguish different levels of female field hockey players. The findings indicated that sprinting speed, agility, muscular power should be used as assessment parameters for female field hockey players.

There have been four studies investigating the relationships of motor fitness components with functional movement screening tasks (Parchmann & McBride, 2011) [28], anthropometric parameters (Brocherie *et al*., 2014) [3], physical activity rate (Tanaka, Hikihara, Ohkawara, & Tanaka, 2012) [41], and body composition (Houwen, Hartman, & Visscher, 2010) [16]. For instance, Parchmann and McBride (2011) [28] addressed a question if function movement screen (FMS) as an injury prediction tool was also predictive of motor fitness. FMS is a process-oriented assessment toward movement patterns (deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, trunk stability push up, and rotary stability) through a 4-point scale. Vertical jump, 10 and 20-m sprint times, and agility T-test were used in the study measuring components of motor fitness. According to Parchmann and McBride (2011) [28] no significant correlation existed between FMS and the components of motor fitness, suggesting that FMS is not a good predictor for motor fitness. However, the findings of three other studies indicated that some components of motor fitness were significantly associated with anthropometric measures (muscle-to bone ratio, skinfolds and adiposex mass) (Brocherie *et al*., 2014) [3], moderate to high physical activity rate (Tanaka, Hikihara, Ohkawara, & Tanaka, 2012) [41], and body composition (body mass and body fat) (Houwen, Hartman, & Visscher, 2010) [16].

Intervention at school setting improving motor fitness for positively influencing health is popular because the school could provide a sufficient participation resources in which participants could participate in various types of physical activities. Studies have focused investigating if different school-based physical activities were effective for motor fitness development (Ardoy *et al*., 2011; Jurak, Cooper, Leskosek, & Kovac, 2013; Jarani *et al*., 2015; Rexen *et al*., 2014) [1, 18, 17, 33]. For instance, researchers had utilized different instruments of measuring components of motor fitness while mainly taking into account reliability, validity, and convenience of using measurements. The similar findings indicated that the following intervention had a positive influence on some components of motor fitness development among school students ranging from seven to fourteen, involving exercise- and games-based physical education classes (Jarani *et al*., 2015) [17], doubling an intensity of physical education classes (Ardoy *et al*., 2011; Rexen *et al*., 2014) [1, 33], and the quality of a lengthy physical activity intervention (Jurak, Cooper, Leskosek, & Kovac, 2013) [18].

In addition to the school-based physical activity intervention, Faigenbaum *et al*. (2014) [8] had studied the effect of an integrative neuromuscular training on selected components of both health- and motor-related fitness among children aged seven. The integrative neuromuscular intervention included major exercises involving an improvement of muscular power, lower extremity strength, and core strength, as well as minor exercises to facilitate fundamental movement skills. Motor fitness measures consisted of stork stand test (balance), standing horizontal jump and single-legged hop (power), and shuttle run (speed and agility). The findings indicated an improvement of the selected motor fitness components, which was attributed to an integrative neuromuscular training intervention. In particular, female participants had a significant increase of 4.9 cm in standing horizontal jump and 7.1 cm in single-legged-hop, whereas male participants only had a significant increase of 8.4 cm in single-legged-hop. The researchers suggested that incorporating integrative neuromuscular training into physical education as a cost-effective and time-efficient method is meaningful to enhance motor competence and promote physical activity in children.

Creating an enjoyable learning environment is essential for participants to be more active in activities so that they are able to improve motor fitness for a lifelong health (Fu *et al*., 2013; Rink & Hall, 2008) [10, 34]. An English literature of Mitchell (2001) [25] addressed that bamboo dance (also called Tinikling) is originated from Philippines as a popular physical activity taught in the physical education setting in the United States, whereas Bamboo dance studies in Chinese version derived its origin from Hainan of China (Li, Song, & Li, 2010; Zhu, Liu, & Long, 2008) [22, 47]. Each two people for a group are first required to hold each side of the ends of two long and small bamboo poles and perpendicularly stand between other two big and long bamboo poles. There are three or four groups required while performing bamboo dance. They would manipulate bouncing against the big bamboo poles, then bringing them together based on their own consistent rhythm predetermined while holding the ends of the poles. For dancers, in order to avoid getting clipped by the poles when jumping through bamboo poles, they need to establish a jump rhythm. The dancer (s) could perform bamboo dance individually or by a pair or with objects if difficulty should be increased (Figure)

Some anecdotal evidences addressed the benefits of bamboo dance on motor fitness, which may be attributed to bamboo dance involving practice with ball of feet for mainly strengthening ground force generation and with single-leg base of support for improving dynamic postural stability (Li, Song, & Li, 2010; Long, Zhang, Lin, Yin, & Chen, 2009; Mitchell, 2001; Zhu, Liu, & Long, 2008) [22, 24, 25, 47]. A large number studies have been conducted to focus on physical activity participation among Chinese college students and reported that Chinese college students had spent less than 80 minutes (Liang, Housner, Wall, & Yan, 2012; Yan, Berger, Tobar, & Cardinal, 2013; Yan, Cardinal, & Acock, 2013; Yan & Cardinal, 2013) [23, 44, 45, 43], which does not meet the most recent recommendation of participating in moderate intensity physical activity with a minimum 150 minutes per week for health benefits (Haskell *et al*, 2007) [14]. At this situation, bamboo dance is a fun complemental physical activity that could be implemented to improve motor fitness among college students in which they may maintain health. In addition to provision of a relaxing and interesting (diversity) learning environment within Bamboo Dance, it also provides a chance to socialize with each other because of a requirement of cooperative learning for successfully carrying out Bamboo Dance; when compared with other traditional sports or physical activities, it requires inexpensive equipment and simple and convenient facility for curriculum implementation. Therefore, based on a comprehensive consideration, investigating the effect of Bamboo Dance on motor fitness is needed within school setting for college students to maintain lifelong health.

Individuals who are assigned into an intervention group are expected to have higher performance in four components of motor fitness (agility, balance, speed, and power) during the posttest session than those who are in the control group.

Methods

Participants

Participants in the study included thirty healthy college students (female =12 and male =18; BMI=22.45±2.61; age = 20.8±2.07,) recruiting from the northwest region of China. The investigation was approved by the University Institutional Review Board and written informed consent was obtained prior to this study. After a successful participation in the study, the participants had received membership cards with free charge for one month as an incentive while entering into a local fitness club. Any student who had musculoskeletal injuries or is currently experiencing pain in ankles or joints was excluded from the study.

Testing Instruments and Tools

Skill-related Fitness Tests

The present study consisted of four tests for motor fitness, including Agility T-Test (Pauole, Madole, Garhammer, LaCourse, & Rozenek, 2000; Sassi *et al*., 2009; Seminick, 1990) [31, 35, 37], Vertical Jump Test (Patterson & Peterson, 2004) [30], 50-yd dash run (Hoffman, 2006; Kirby, 1991) [15, 20], Stork Balance Stand Test (Hoffman, 2006; Kirby, 1991) [15, 20]. The four components (agility, power, speed, and balance) of motor fitness were assessed with the use of two stopwatches, a ruler, and erase marks.

Agility T- test and 50-yard dash run

T-Test was used to measure agility. The participant starts at cone A, sprints forward 10 yards (9.14 m), and touches cone B. He or she then shuffles 5 yards (4.57 m) and touches cone C. After that, he or she shuffles 10 yards (9.14 m) and touches D and then shuffles back to cone B. Upon touching cone B, the participant runs backward 10 yards (9.14 m) and passes the finish line at cone A. Time duration (seconds) for completing the T-test was recorded. The standardized 50-yd dash run was used for measuring speed. The participant ran from cone A to cone B in the 50-yd dash distance. Time duration was recorded by stopwatch.

Standing long jump

Leg explosive power was measured using standing long jump test. Participant stands behind a green line marked on the ground with feet slightly apart. Once the participant is ready, he or she can start taking off, and then jumping forward with swinging of the arms and keeping his or her knees bent. The participant completes a jump on his or her own pace as far as possible, landing on both feet without falling backwards. The distance was measured from the take-off point to where the participant lands.

Stork stand test

Stork stand test was used for measuring balance. The participant was asked to remove the shoes and place the hands on the hips, then position the non-supporting foot against the inside knee of the supporting leg. The participant raised the heel to balance on the ball of the foot. The stopwatch was started as the heel was raised from the floor. The stopwatch was stopped if any of the follow occur: 1) the hand (s) come off the hips, 2) the supporting foot swivels or move (hops) in any direction, 3) the non-supporting foot loses contact with the knee, 4) the heel of the supporting foot touches the floor. The total time in seconds was recorded.

Bamboo Dance

Prior to the beginning of Bamboo Dance, participants are required to setup bamboos, including two bamboos (as two bases) with the diameter of 5 cm for 5 meters above and four or five pairs of small bamboos with the diameter of around 2 cm for 3 meters. The small sizes of bamboos should be perpendicularly placed on the two big size of bamboo which forms a net structure. Each two people for a group who move their two small bamboo poles in rhythmic beats (sound forms the rhythm of the dance for the dancers to get ready for stepping in or out) on the two perpendicularly big bamboo while standing in opposite direction. The dancer could be individual or team who perform by stepping in and out of the bamboo blocks. The dancer is required to have a sensitive perception of coincident timing and a strong single balance to successfully perform a graceful dance from one side to another side. In order to be more interesting, the female and male dancers could demonstrate their movements predetermined without touching the bamboo poles while wearing traditional customs.

Procedure

Thirty healthy college students were randomly assigned to either an 8-week experimental group (n =15) or control group (n=15). The study included three phases: a pretest, 8-week intervention phase, and a posttest. Prior to the beginning of the bamboo dance intervention program, all participants were asked to perform motor fitness tests on balance (Stork Stand test), agility (agility T-test), leg strength (50-yard dash), and explosive power (standing broad jump). During the 8-week intervention phase, participants in the experimental group had experienced two bamboo dance classes per week for 90 minutes, which was instructed by a certified bamboo dance assistant professor. Participants in the control group, however, were not involved in bamboo dance during the same time period. At the end of the 8-week intervention, a posttest with similar testing procedures to those of the pretest was administrated to all participants.

An informed consent form was approved by Institutional Review Board of University for each participant to complete prior to the beginning of the study. All tests were conducted at the indoor track. Each participant was asked to perform a 10-minute individual warm-up which included light jogging and stretching exercises followed by specific instructions and demonstration of the tests. Two trials for motor fitness tests were administered to each participant by a well-trained research assistant. A 3-minute break between the trials were implemented to ensure adequate recovery. The best result of the two trials were used for data analysis.

Statistical analysis

The study included four dependent variables (agility, balance, power, and speed) of the motor fitness. Two independent variables included both group (intervention and control) and test phase (pre-test and posttest). Therefore, A 2 x 2 (group x test) mixed MANOVA was used to examine differences in the motor fitness tests between the two groups. Before data analysis, the preliminary data screening was conducted for the main basic assumptions of A 2 x 2 (group x test) MANOVA. It was involved in checking Levene's test for homogeneity of variance for each dependent variable, correlations of the dependent variables using Pearson Product Moment Correlation Coefficient Analysis (PPMCC), the Box M test for homogeneity of the variance/covariance matrices of the dependent variables across both groups and test sessions, Bartllett's Test for intercorrelations of the dependent variabels. Follow-up analyses were employed to determine any significant main or interaction effect. Demographic information was analyzed using descriptive statistic. All statistical analysis were carried out with SPSS version of 21.0 (SPSS Inc., Chicago, IL, USA). The level of significance for the present study was set at .05.

Results

Within the preliminary data screening, the Levene's statistcis indicated that all *p* values for the pretest in four motor fitness components were greater than .05. It indicated that at the pretest, no significant mean differences on four motor fitness components existed between the intervention group and the control group (Figure 1). Correlation table (PPMCCA) indicated that agility T- test was highly significant correlated with standing broad jump (r = -.91), 50-yard dash (r = .787) and moderately significant correlated with Stork Stand test (r=-.453). The Box M statistic was not significant which indicated the assumption of homogeneity of variance/covariance matrices had been met across the two groups. The Bartlett's test of Sphercity verified significant intercorrelations of the four motor fitness components (Table 1). A significant interaction effect between test and group was observed across four motor fitness tests, Wilks' λ=.127, F (1, 28) = 42.987, p<0.001, $\eta_p^2 = .873$. Participants of the Bamboo dance intervention group had significantly performed better (2.43±9.80 meter) on standing broad jump (power) than their control group counterparts (2.38±2.43 meter), p<.0001. Additionally, Bamboo Dance group had demonstrated significantly (p<.0001) shorter time (5.83±.41 second) on 50-yard dash than those in the control group, whereas significantly slower speed (p<.0001) on agility T-test (11.31±.90 second) than those in the control group (10.725±.989 second). With respect to Stork Stand test, participants in the Bamboo Dance had performed significantly (p<.0001) longer time (6.65±3.28 second) than their control group counterparts (3.73±1.38 seconds). In particular, participants of the Bamboo Dance had greater improvement between the two test periods on agility T-test (6.1% vs. .18%), Stork Stand test (102% vs. 3.6%), 50-yard dash (9.6% vs. .33%), and Standing broad jump (8.4% vs. .42%) than those in the control group. All average performance scores and standard deviation for the four motor fitness tests for the two test periods between the pre- and posttest are displayed in Table 2, as well as the overall improvement percentage for each individual test of the motor fitness between the two tests periods.

Table 1: Basic Assumptions for the 2 x 2 (group x test) Mixed MANOVA In the pretest's characteristic

Variables	Levene's Test	
	F ratio	*p*
Agility	0.26	.87
Power	.803	.378
Speed	3.137	.087
Balance	1.775	.194

Box M F ratio = 1.632, p = .091
Bartlett Test of Sphericity = 348.468, p=.000

Table 2: Descriptive Statistic on the Pre- and Posttest for both the Bamboo Dance group and control groups

Motor fitness components/change	Pretest	Posttest	% improved
Bamboo Dance			
Agility T-test	11.99 ± 1.07	11.31 ± .90	6.1
Stork Stand test	3.28 ± 1.12	6.64 ± 3.28	102
50-yard dash	6.39 ± .41	5.83 ± .41	9.6
Standing Broad Jump	2.24 ± 10.92	2.43 ± 9.80	8.4
Control			
Agility T-test	10.75 ± .98	10.73 ± 1.0	.18
Stork Stand test	3.60 ± .86	3.73 ± 1.38	3.6
50-yard dash	6.08 ± .59	6.1 ± .59	.33
Standing Broad Jump	2.39 ± 11.66	2.38 ± 10.56	.42

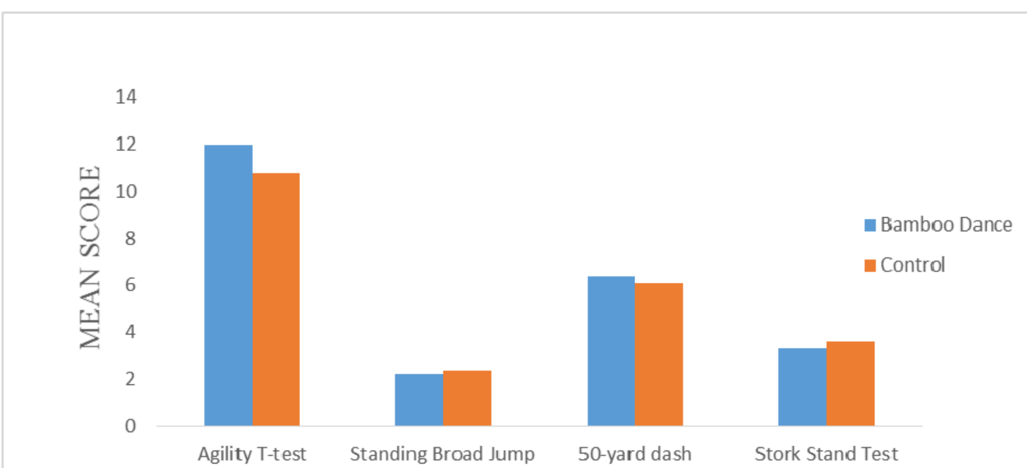

Fig 1: Mean performance scores in the four motor fitness tests at the pretest for the two groups.

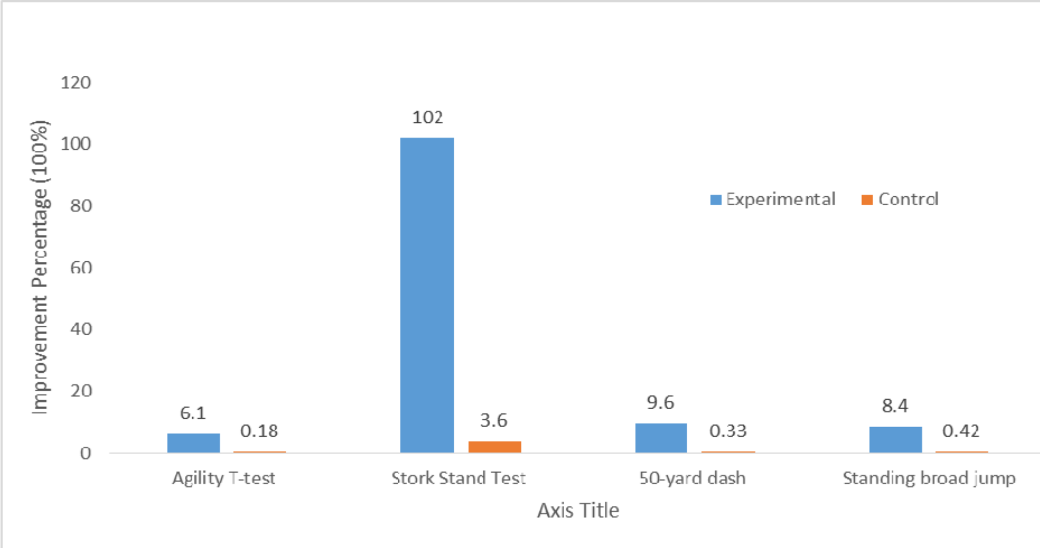

Fig 2: Improvement percentage in each component of the motor fitness between pre- and posttest in two groups.

Discussion

Physical education (PE) is considered the primary tool to increase motor fitness of students. In fact, students are not very physically active during traditional school PE classes (Carlson *et al*., 2013; Ha, Lonsdale, Ng, & Lubans, 2014; Partavi, 2013) [4, 13, 29]. Considering the low physical activity level in many PE lessons, more interventions are needed to enhance physical and motor fitness level of students. To address such issue, researchers designed a school-based physical activity intervention based on Chinese Bamboo Dance. We examined the effectiveness of the Bamboo Dance intervention in enhancing college students' lower extremity-related motor abilities. The intervention is an activity of low to moderate intensity, but requires a small space to participate in. These characteristics of the activity may be of relevance to the typical school environments (Ha, Burnett, Sum, Medic, & Ng, 2015) [12].

There is limited information in relation to whether Bamboo Dance training can be used as training method to improve physical fitness in college students. The aim of the present study, therefore, was to assess whether the 8-week physical activity intervention could be used to improve balance, power, speed, and agility in youth (college students). The main findings of the study showed that the motor abilities of college students are able to be promoted by offering them a Bamboo Dance training in PE class.

The results of the study indicated that participants in the intervention program showed significantly promotions in balance (102% vs. 3.6%), agility (6.1% vs. .18%), strength (9.6% vs. .33%), and explosive power (8.4% vs. .42%) than students in control group. The findings provide evidence that Bamboo Dance exercise could be used as an effective physical activity in college physical education class to improve lower extremity-related motor performance of students. The observation is unique since it produces empirical evidence for our hypotheses. It also appears that the Bamboo Dance may be critical in improving physical fitness level of college students. Currently, most of physical activity intervention studies focused on using traditional PE classes or sports to develop and advance individual motor abilities. Based on our knowledge, the study is the first intervention that designed specifically according to Chinese ethnicity group sports to promote motor performance of students in PE lessons. Thus, the study contributes knowledge on the effect of ethnic minority sports on motor fitness and provides a potential strategy to improve physical fitness level of students. Meanwhile, the study supplies an effective data to the literature and provides substantial information for researchers to utilize Chinese ethnicity group sports as a physical activity intervention to enhance motor performance of college students.

Apart from measurement issues, the intervention designed was aimed at increasing students' motor abilities through a school-based physical activity. External factors that might affect our experiment could be verified. For instance, individual difference (e.g., interest motivation, and enjoyment towards physical activity) factors were not specifically enhanced or measured in the present study even though researchers have previously found that these factors predicted physical fitness and motor performance (Fairclough, 2013). Further, the current protocol allows researchers to explore further whether the intervention effect is homogeneous across gender. This is important because males and females may have different preferences towards the type of activity or game played (Ha *et al*., 2014) [13]. As such, examining the interaction effect on males and females separately may assist in future interventions aimed at increasing students' activity levels and motor abilities. Additionally, future intervention studies may also aim to incorporate more diverse types of Bamboo Dance activities in order to make the activity more interesting and attractive to students, and hence might facilitate their engagement in Bamboo Dance or more generally in physical activity.

Another limitation of the current study is that motor performance was measured only during school hours, and it is unclear how much students engage in PA after they leave school. Research has shown that school-based interventions may also increase students' physical and motor fitness levels out of school (Kriemler *et al*., 2011) [21]. Thus, the future studies should examine students' PA levels after school time rely on larger sample size and analyze the role of components of the intervention in promoting motor performance. In conclusion, the study demonstrated that performing Bamboo Dance provides the benefits to college students in terms of developing lower extremity-related motor abilities. In addition, a school-based Bamboo Dance programme is able to initiate changes in college students and could be implemented to other colleges throughout China.

Acknowledgment
This study is partially supported by Hunan Province Department of Higher Education.

Disclosure Statement
No competing financial interests exist.

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