ผลของโปรแกรมการละเล่นพื้นบ้านต่อความสามารถในการควบคุมกล้ามเนื้อและเวลาตอบสนองของกล้ามเนื้อในนักเรียนหญิงระดับประถมศึกษา
Effects of Thai Traditional Play Program on the Ability to Control Muscle and Reaction Time of Muscle among Female Students in the Primary School

นิพนธ์ต้นฉบับ

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Original Article

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บทคัดย่อ

วัตถุประสงค์: เพื่อเปรียบเทียบผลของโปรแกรมการละเล่นพื้นบ้านไทยที่ให้เพิ่มจากวิชาพลศึกษาต่อความสามารถควบคุมกล้ามเนื้อและเวลาตอบสนองของกล้ามเนื้อในนักเรียนหญิงระดับประถมศึกษา **วิธีการศึกษา:** กลุ่มตัวอย่างเป็นนักเรียนหญิงโรงเรียนชุมชนสามพร้าว จ.อุดรธานี จำนวน 36 คน โดยกลุ่มทดลอง (18 คน) ได้รับการฝึกโปรแกรมการละเล่นพื้นบ้านไทยควบคู่กับชั้นเรียนพลศึกษา และกลุ่มควบคุม (18 คน) ได้เรียนพลศึกษาเพียงอย่างเดียว การฝึกวันละ 60 นาที 3 วันต่อสัปดาห์นาน 8 สัปดาห์ ประเมินความสามารถควบคุมกล้ามเนื้อโดยใช้แบบสอบถามที่ก่อนการฝึกและหลังการฝึก (8 สัปดาห์) วัดเวลาปฏิกิริยาของกล้ามเนื้อโดยชุด WittySEM® ที่ก่อนการฝึก สัปดาห์ที่ 4 และหลังการฝึก (สัปดาห์ 8) ทดสอบความต่างระหว่างกลุ่มโดยใช้ independent t-test ส่วนความต่างภายในกลุ่มใช้ paired t-test หรือ repeated measure ANOVA ตามความเหมาะสม กำหนดระดับนัยสำคัญทางสถิติที่ *P*-value < 0.05 **ผลการศึกษา:** กลุ่มทดลองและกลุ่มควบคุมมีอายุไม่ต่างกัน (8.12 และ 8.43 ปี ตามลำดับ) คะแนนความสามารถในการควบคุมกล้ามเนื้อในกลุ่มทดลองสูงกว่ากลุ่มควบคุมที่ 8 สัปดาห์อย่างมีนัยสำคัญทางสถิติ และเวลาตอบสนองของกล้ามเนื้อก็สั้นกว่าอย่างมีนัยสำคัญทางสถิติด้วย ทั้งการตอบสนองของมือที่สัปดาห์ที่ 8 และของเท้าที่สัปดาห์ที่ 4 และที่ 8 สำหรับการเปลี่ยนแปลงภายในกลุ่ม กลุ่มทดลองมีคะแนนควบคุมกล้ามเนื้อที่สัปดาห์ที่ 8 เพิ่มจากก่อนเริ่มอย่างมีนัยสำคัญทางสถิติ และเวลาตอบสนองของมือและเท้าที่ 4 และ 8 สัปดาห์ต่างก็ลดลงจากก่อนการทดลองอย่างมีนัยสำคัญทางสถิติ **สรุป:** โปรแกรมการละเล่นพื้นบ้านไทยเพิ่มความสามารถในการควบคุมกล้ามเนื้อและลดเวลาตอบสนองของกล้ามเนื้อของนักเรียนหญิงในโรงเรียนประถมศึกษาดีกว่าการเรียนพลศึกษาเพียงอย่างเดียว

คำสำคัญ: การละเล่นพื้นบ้านไทย, ความสามารถในการควบคุมกล้ามเนื้อ, เวลาตอบสนองของกล้ามเนื้อ, นักเรียนหญิง, ประถมศึกษา

Abstract

Objective: To examine the effects of Thai traditional play program on the ability to control muscle and reaction time of muscle in addition to those by the usual physical education in primary school female students. **Method:** The sample consisted of 36 female students of Chumchonsampraw School, Udonthani province. Test group (n = 18) was trained with the Thai traditional plays training with physical education activity; while control group was trained with physical education activity only. The training took 60 minutes per day, 3 days per week, for 8 weeks. The ability to control muscle was measured by a questionnaire at before and after the 8-week training. Reaction time of muscle was measured using WittySEM® at before, at 4 weeks, and 8 weeks of the training. Differences between groups were ested by independent t-test; while within-group differences were tested using paired t-test and repeated measure ANOVA, as appropriate. Statistical significance was set at *P*-value < 0.05. **Results:** No difference in age between test and control groups was found (8.12 and 8.43 years, respectively). Scores of ability to control muscles in test group was significantly higher than that in control group at 8 weeks. Reaction time of the hand in test group was significantly shorter than that in control group at 8 weeks; while reaction time of the foot in test group was significantly shorter than that in control group both at 4 and 8 weeks. For within-group changes, score of ability to control muscle at 8 weeks was significantly increased from that at baseline. Reaction times of the hand and foot were significantly decreased from baseline both at 4 and 8 weeks. **Conclusion:** Thai traditional play program could increase ability to control muscle and improve reaction time of the muscle among the female students in primary school.

Keywords: Thai traditional plays, ability to control muscle, reaction time of muscle, female students, primary school

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Introduction

Movement skill refers to a series of movements performed with accuracy and precision; a movement skill may be fundamental or specialized movement skills.[1] Fundamental motor skills include manipulative, locomotor, and stability movement skills. These skills are commonly considered to be the building blocks to more advanced movement skills and specific sport skills.[1,2] Fundamental skills help children control their body and muscles, and form complex skills and movement patterns involved in sports and other recreational activities such as skills for standing, walking, running, jumping and throwing.[2,3]

Ability to control muscle requires whole body movement and involves the large (core stabilizing) muscles of the body to perform everyday functions, such as standing and walking,

running and jumping, and sitting upright at the table. This ability also includes eye-hand coordination skills such as ball-controlling skills (throwing, catching, and kicking) as well as riding a bike or a scooter and swimming. Gross motor skills are important to enable children to perform everyday functions, such as walking and running, playground skills (e.g. climbing) and sporting skills (e.g. catching, throwing and hitting a ball with a bat).[4]

Individuals' reaction times occur through the central nervous system and muscles as a result of the interaction between appropriate components and various factors.[5] Reaction occurs through a stimulant reaching to a central nervous system via the neurons, and then a decision is created and conveyed subsequently to the muscles via the neurons; finally, the muscles start to move in accordance with the relevant command.[6]

Reaction time is extremely important in our daily lives. The measurements obtained from the simple reaction time tests give information about a person's neurological and cognitive function in a given activity.[7] Reaction time is an important criterion in exercise as a part of sport components which include muscle- nerve performance and hand- eye coordination. It has been determined that reaction time can be developed through regular exercise.[8] Furthermore, reaction time can also be developed through regular training in several exercise branches. By the effect of training, the most significant development in reaction time is mentioned to be noticed between 7 and 12 years old.[9]

Thai Traditional play refers to the social activities that show local identity which is based on the way of life of communities that have inherited practices from the past to the present. There are playing in groups with imagination and simple rules. Some games use materials which are easy to find around them such as banana stems, pebbles, sticks, and cloth. Some simple songs and rhymes are also incorporated. Apart from relieving stress and strain in daily life, Thai traditional plays help build up physical fitness such as balance, muscle power, coordination, strength, speed, and agility. This is due to the fact that Thai folk games incorporate the body and various organs into the movements from running to stopping, dodging, changing the direction of tiptoe, and jumping in various ways, such as playing Kratai ka-deaw or the single-legged rabbit jumping.[10] With its benefits based on local folk wisdom but no systematic examination, the purpose of this study was to examine the effects of Thai traditional play training program on the ability to control muscle and reaction time of the muscle in female student in the primary school.

Methods

In this experimental stude, participants were female students from Chumchon Samprow Primary School, Samprow sub-district, Muang district, Udonthani province. A total of 36 participants aged 7 – 9 years were recruited. This sample size was indicated by Krejcie and Morgan' s[11] sample size estimation from a population of 40 students.

The participants were randomly selected and equally divided into experimental and control groups (18 participants each). In the experimental group, participants were trained in the Thai traditional play training program and physical education activity; while those in control group participared in physical education session only.

To be eligible, the participants had to be healthy female students with no history of cardiovascular disease or injuries of the muscle. This study was approved by the Research Ethics Review Committee for Research Involving Human Research Participants, Health Sciences Group, Chulalongkorn University (approval number: 144.1/61; approval date: August 8, 2018). Each volunteer provided informed consent.

The experimental intervention and procedures

In **experimental group**, participants took part in the Thai traditional play program which consisted of activities divided into 2 phases based on intensity of the activity. In phase 1 of training (week 1 to 4), activities with intensity levels of 61 – 70% of the maximum heart rate including Ngu-gin-hang, Ree-ree- khao- san, Ling- ching- luck, Ma- kan- kluay, Loog- kang, Dern-kala, Ga-fug-kai, and Ai-kae-ai-koang. In phase 2 (week 5 – 6), activities with intesnsity levels of 71 to 80% of the maximum heart rate were used. These included Wing- peaw, Kra-tai-ka-deaw, Reu-bog, Khee-ma-song-muaeng, Ga-dod-chuaek, Tiger-eat-cow, Mon-son-pa, Chag-ka-yer, and Pong-pang. For participants in **control group**, only regular weekly physical education class was provided.

The period of training was 8 weeks with 3 days per week, on alternate days. The training session started with stretching (5 minutes), followed by traditional folk play activities (a total of 50 minutes of 4 activities with 8 minutes per activity and 2 minutes of resting in between), and finally the cool- down session (5 minutes).

The participants' reaction time of muscle was assessed every four weeks throughout the experimental period. The ability to control muscles was assessed before and after the training sessions. The duration of experimental and assessment was from November to December, 2018.

Data collection instruments

Demographic data of the participants including age, body weights and heights were collected. The qestionnaiore of the **ability to control muscles** was used to measure the ability to control muscles. [12] The questionnaire consisted of 40 questions which could be divided into 4 skills namely general, jumping, balance, and running skills with 10 questions for each skill. The scoring was 0 point for being unable to perform the activity and 1 point for being able. Levels of ability to control muscles were divided into good (30 - 40 points), moderate (20 - 29 points), and low (less than 19 points).[13] The ability to control muscles was measured at baseline and at the end of the training (8 weeks).

For **reaction time**, it was measured using Witty SEM®, a commercial training timer system. Reaction time test measured general alertness and motor speed. It was a 3-choice reaction time test, similar to the Simple Reaction Time task; however, stimulus and response uncertainty was introduced by having two possible stimuli and two possible responses. Reaction time was determined at baseline, 4 weeks of training and at the end of training (8 weeks).

Statistical analysis

All data were presented as mean with standard deviation (S.D.). Differences in age, weight and height between the two groups were tested using independent t-test. Reaction times in seconds between the two groups, at baseline, 4 weeks, and 8 weeks were compared by using independent t-test. Scores of ability to control muscle, general skills, jumping skills, balancing skills, and running skills between the two groups at baseline and 8 weeks were compared using independent t-test.

For the changes within each of the two groups, reaction times at baseline, 4 weeks and 8 weeks were compared using repeated measure ANOVA with Scheffe's adjustment method for pairwise comparisons. Scores of ability to control muscle, general skills, jumping skills, balancing skills, and running skills at baseline and 8 weeks were compared paired t-test. Statistical significance was set at a type I error of 5%. Data were analyzed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp. Released 2012.).

Results

There were not significant differences between the experimental and control groups (18 participants each) with respect to age (8.12 and 8.43 years), weight (22.75 and 21.69 kg) and height (127.37 and 129.01 cm), respectively (Table 1).

Table 1 Demographic characteristics of the participants (N = 36).

Characteristics	Mean (± S.D.)		*P*-value
	Experimental group (n = 18)	Control group (n = 18)	
Age (years)	8.12 ± 0.71	8.43 ± 0.72	0.565
Weight (kilogram)	22.75 ± 2.29	21.69 ± 2.77	0.869
Height (centimeter)	127.37 ± 7.58	129.01 ± 8.21	0.156

It was found that, reaction times of the foot in the experimental group were significantly enhanced (i.e., lower) when compared with those in control group at 4 weeks (1.59 and 1.97 seconds, respectively, *P*-value= 0.023), and 8 weeks (1.53 and 1.99 seconds, respectively, *P*-value < 0.001) (Table 2). For hand reaction, participants in the experimental group had a significantly shorter reaction time than the control group at 8 weeks (1.53 and 1.81 seconds, respectively, *P*-value = 0.023), but not at 4 weeks. In terms of the ability to control muscles, the experimental group had a significantly higher score (i.e., better) than the control group (32.34 and 19.50 points, *P*-value < 0.001) at 8 weeks. In addition, all sport skill scores (general, running, balancing and jumping) in the experimental group were higher, i.e., better, than those in the control group (*P*-value < 0.001 for all skills) (Table 2).

In terms of changes with in groups, children trained with the Thai traditional play improved their reaction time significantly (*P*-value < 0.001) where significant decreases from baseline to 4 and 8 weeks and from 4 to 8 weeks were seen (Table 2). On the other hand, no significant change in the control group was observed in the control group.

For each of scores of the ability to control muscles, general skills, jumping skills, balancing skills, and running skills, significant increase (i.e., improvement) at 8 weeks from baseline was observed (*P*-value < 0.001, for all scores) in the experimental group (Table 2). In contrast, no significant change was found in each of all scores in the control group.

Table 2 Reaction time of muscles and ability to control muscles of the participants between two groups (N = 36).

Outcomes	Mean (± S.D.)		*P*-value†
	Experimental group (n =18)	Control group (n = 18)	
Foot reaction time (sec.)			
before	2.55 ± 0.83	2.71 ± 1.24	0.676
at 4 weeks	1.59 ± 0.35[a]	1.97 ± 0.45	0.023
at 8 weeks	1.53 ± 0.32[a,b]	1.99 ± 0.46	< 0.001
P-value‡	< 0.001	0.161	
Hand reaction time (sec.)			
before	2.15 ± 0.80	1.81 ± 0.47	0.156
at 4 weeks	1.83 ± 0.70[a]	1.86 ± 0.57	0.866
at 8 weeks	1.53 ± 0.27[a,b]	1.81 ± 0.38	0.023
P-value‡	0.031	0.937	
Ability to control muscles (score points)			
before	17.26 ± 2.91	19.00 ± 2.94	0.101
at 8 weeks	32.34 ± 2.27	19.50 ± 2.63	< 0.001
P-value#	< 0.001	0.190	
General skills (score points)			
before	4.38 ± 1.38	4.89 ± 0.83	0.196
at 8 weeks	8.17 ± 1.24	4.94 ± 0.87	< 0.001
P-value#	< 0.001	0.331	
Jumping skills (score points)			
before	4.22 ± 1.47	4.94 ± 0.93	0.890
at 8 weeks	8.33 ± 0.97	4.89 ± 0.96	< 0.001
P-value#	< 0.001	0.331	
Balancing skills (score points)			
before	4.33 ± 1.71	4.61 ± 1.50	0.608
at 8 weeks	8.06 ± 0.93	5.00 ± 1.19	< 0.001
P-value#	< 0.001	0.168	
Running skills (score points)			
before	4.33 ± 1.50	4.56 ± 1.33	0.641
at 8 weeks	7.78 ± 1.26	4.67 ± 1.18	< 0.001
P-value#	< 0.001	0.331	

† Independent t-test for comparisons between experimental and control groups.

‡ Repeated measure ANOVA for within-group comparisons at baseline, 4 weeks and 8 weeks.

Paired t-test for within-group comparisons at baseline and 8 weeks.

[a] The measure significantly different from that at baseline by repeated measure ANOVA.

[b] The measure was significantly different from that at 4 weeks by repeated measure ANOVA.

Discussions and Conclusion

In this experimental study, the benefits of the Thai traditional play programs on ability to control muscle and reaction time in primary school female students were examined. We found the Thai traditional plays offered faster hand and foot reaction times. This could be due to the practice, techniques, and duration of activity of the Thai traditional plays which were different from those of the usual physical education training with several possible mechanisms as follows.

People can acquire and improve new motor skills with practice.[14] The practice activities of learning motor skill could influence information processing.[15] With the repetition of motion, a person's conscious effort is decreased and the motion becomes more and more automatic.[16] Motor neural circuits of basal ganglia play a key role in the automatic execution of motor tasks. The practice is an exercise activity related to the nervous system and it can have a direct influence on the memory. This results in the person's improved performance.[17] Our findings were consistent with the study by Çankaya et al where balance was developed and reaction time and body mass index were improved in children participating in 8-week special exercises both in athlete and sedentary groups.[18] The study by Garg et al also demonstrated that exercise decreased, i.e., improved, reaction times.[19] Our and previous studies all indicated that exercise is is beneficial for people in their daily lives because it influences reaction time abilities.

It was worthy noting that when compared with the usual physical education session, the significant improvement of reaction time in the foot was seen as early as week 4 and also at week 8; while that in the hand was found later, i.e., at week 8. The early improvement in the foot is due to the fact that the Thai traditional play program is a physical process that involves moving around the feet repeatedly in order to stimulate the brain or nervous system to achieve a better coordination. With its intensive movement of the feet, the improvement as the reaction time of the feet was achieved earlier.

The improvement in the reaction time is based on the stimulation of the brain or nervous system that acts as a sensory neuron to the central nervous system that analyzes and transforms data.[20] The signal is then sent to the motor neurons to control movement. Repeated practice improves accuracy and speed of the movement. In addition, repeated visual stimulation could also improve response time among children.[21]

The Thai traditional play training program was brain-muscle specific. It is a step-by-step movement pattern that develops the contraction ability of the muscle. Once the muscles contract, a reflex reaction of the muscle could in turn allow the central nervous system to learn and develop. When the brain commands the muscle contraction, the coordination of the alpha- and gamma-motor neurons could lead to the coordination of the extrafusal and infrafusal muscle fibers. Such stimulation in turn makes the muscle spindles to maintain the sensitivity to the stimulation throughout the muscle length. With this consequent better coordination of the musculoskeletal nervous system, motor neurons could mobilize their effects and the neural signals could be

increased that the responses are improved. Based on the basic process of the nervous system, repetitive stimulation and inhibition are better coordinated, and result in a more effective and faster movement.[22] Frequent movement could reduce the decision time by eliminating incorrect decisions, thus makes the right decision more effectively. If the training is sufficient, reflex or the body's ability to respond to stimuli automatically without consciousness.[23] Our findings were consistent with the study of Noyvibool where training using ball and physical education activities in autistic children could significantly develop more hand and foot reflex than the usual physical education activities alone after the 8 week training.[24]

The ability to control the muscle and all skills (general, jumping, balancing, and running) were improved after 8 weeks of training. This could be due to the fact that the Thai traditional play training emphasizes the regular use of large muscles. It encourages children to use every part of their whole body including head, shoulders, arms, trunk/torso and legs. In the play, the dictated various movements of sitting, standing, walking, balancing, running, and jumping help children improve their muscle strength. A study indicated the Thai folk play activities helped children engage in basic body movements such as sitting, standing, walking, running, jumping, and leaping which could result in the development of strong muscles, especially the muscles of the arms, legs, and torso thus promoting physical development.[25] It has been supported that the development of large muscle should be a continuous process.[26]

Massive muscle development can be achieved by organizing activities that aim to develop the ability to control the movement the muscles of the arms, legs, and body. Most movements usually performed by children in various activities could include running, jumping, rolling, skidding, horse riding, and climbing. Based on these movements, therefore, activities that promote the development of large muscles for children at this age could be outdoor activities, plays activities, exercise and rhythmic activities. In a study, a folk play focusing on the movement during outdoor activities in accordance with the principle of play theory that encourages children to develop large muscles resulted in a better physical fitness and improved ability to work in large muscles after the 8-week training.[12]

In conclusion, an 8-week physical training based on the Thai traditional folk plays could improve reaction time in foot and hand, the ability to control the muscle, and all movement skills in primary school female children. This kind of training could be implemented as an alternative to regular physical education training in all primary schools, public and private. The training could also attract policy makers, as well as communities, at all levels. Future studies could emphasize on sustainability of the play continuation, and physical strengths and motor skills. More studies with larger sample size and longer follow-up period are recommended.

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References

1. Gallahue DL, Donnelly FC. Movement skill acquisition. In: Developmental physical education for all children. Champaign, IL. Human Kinetics, 2003: pp.257-275.
2. Payne VG, Isaacs LD. Human motor development: A life span approach. Mountain View, California. Mayfield, 2002: pp. 434-435.
3. Davis WE, Burton AW. Ecological task analysis: Translating movemen t behavior theory into practice. *Adapt Phys Activ Quart* 1991;8(2):154-177.
4. Kanjunda S. A study on gross motor skills of children with severe intellectual disabilities using the motors skills training program of special Olympic, Thailand, incorporated with physical fitness activities. Bangkok, Thailand. Srinakharinwirot University, 2010. (in Thai)
5. Eren E, Müniroglu RS, Özer U. Examination of visual and auditory reaction times of licensed tennis players in different age groups. *Int J Cult Soc Stud* 2017;3(2):343-352.
6. Sevim Y. Training information, 1st ed. Ankara. Nobel Publishers, 2002.
7. Okkesim S, Coskun K. Evaluation of reaction time before and after muscle fatigue. Proceedings of Tıp Teknolojileri Ulusal Kongresi (TIPTEKNO 15). Bodrum, Mugla, Oct. 15-18, 2015.
8. Çolakoglu M, Tiryaki S, Moralı S. The effect of concentration methods on reaction time. *Sport Bilimleri Dergisi* 1993;4(4):32-47.
9. Sevim Y. Training Information, 8th ed. Ankara. Fil Publishers, 2010. ‘
10. Choengklinchan A. Effect of the agility training program with integration of Thai tradition plays on agility development of football players between the age of 10 – 12 years old. Bangkok, Thailand. Chulalongkorn University, 2009. (in Thai)
11. Krejcie RV, Morgan EW. Determining sample size for research activities. *Educ Psych Meas* 1970;30(30):608.

12. Sudmuma, S. A study of ability to control muscles through folk games of students with Mental retardation at primary school level. Maha Sarakham, Thailand. Rajabhat Maha Sarakham University, 2007. (in Thai)
13. Praphan, R. A Study on gross motor using ability of children with mental retardation in grade I through Thai folk play activities. Bangkok, Thailand. Srinakharinwirot University, 1998. (in Thai)
14. Ando S, Kida N, Oda S. Practice effects on reaction time for peripheral and central visual fields. *Percept Mot Skills* 2002;95(3 pt 1):747-751.
15. Rostami HR, Ashayeri H. Effects of motor skill practice on reaction time and learning retention in Parkinson' s disease. *Neurol India* 2009; 57(6):768-771.
16. Breines FB. Therapeutic occupations and modalities. In: Pendleton MH, Schultz-Krohn W (editors). Pedretti's occupational therapy practice skills for physical dysfunction, 6th ed. St. Louis. Mosby, 2008: pp.658-684.
17. Deschaumes- Molinaro C, Dittmar A, Vernet- Maury E. Relationship between mental imagery and sporting performance. *Behav Brain Res* 1991;45(1):29-36.
18. Çankaya, S, Gökmen, B, Musa Ç, TaŞmektepligil, MY. The effect of special balance developer training applications on reaction time and body mass index of eleven year old young males, *J Sport Perform Res* 2014;5(2):59-67.
19. Garg M, Hem L, Lily W, Omesh G. Effect of aerobic exercise on auditory and visual reaction times: A prospective study. *Indian J Physiol Pharmacol* 2013:57(2):138-145.
20. Krabuanrat C. Nine–square with brain development. Bangkok. Sinthana Coppycenter, 2009. (in Thai)
21. Maneechag, W, Witthayakorn, S, Phetaugsorn, M, Chinchai, S. Reference frame in children's treatment activities. Chiang Mai, Thailand. Faculty of Associated Medical Sciences, Chiang Mai University, 2001. (in Thai)
22. Watsapad S, Palawiwat K. Physiology of exercise. Bangkok. Thunkamol Press, 1993.
23. Green M. How long does it take to stop? Methodological analysis of driver perception-brake time. *Transport Hum Fact* 2000;2:195-216.
24. Noyvibool K. Effects of the ball training upon eye and hand reaction time of autistic children. Bangkok, Thailand. Kasetsart University, 2007. (in Thai)
25. Madteh F, Reuchutakul P, Cherngchow C. Effects of traditional games training on early childhood development. *J Educ Prince of Songkla University* 2014;27(2):179-191.
26. Pilwas N. Developing gross motor skills. 2014. (Accessed on Oct. 21, 2018, at http://taamkru.com)