Effects of Complex sap Training on Body Fat and Physical Performance among Young Male Basketball Players

Satian Laoprasert(Ph.D)1,2, Kacha Udomtaku(M.Sc.)1,2, Kurusart Konharn (Ph.D,PT.)2,3*

1Exercise and Sport sciences program, Graduate school, KhonKaen University, KhonKaen, Thailand
2Research Center in Back, Neck, Other Joint Pain and Human Performance (BNOJPH) KhonKaen University, KhonKaen, Thailand
3School of Physical Therapy, Faculty of Associated Medical Sciences, KhonKaen University, KhonKaen, Thailand

*Corresponding Author: Kurusart Konharn, Research Center in Back, Neck, Other Joint Pain and Human Performance (BNOJPH) KhonKaen University, KhonKaen, Thailand, and School of Physical Therapy, Faculty of Associated Medical Sciences, KhonKaen University, KhonKaen, Thailand

Abstract: Basketball is ranked in the top three team sports, it requires movements in multiple planes. Moreover the body fat in young basketball players might be limited to physical performance. There are many training programs that focus on improving the physical performance but only a specific training, while complex training is combining multiple training components. Sixty young male basketball players have divided into 2 groups; 1) the experimental group (n=30) performed the SAP training for 3 days/week (60 mins/day) and regular training for 8 weeks consecutively, 2) the control group (n=30) performed in regular training. Independent sample t-test used in the analysis. After 8-weeks of SAP training, participants had likely 2.82 kg decreased in body fat mass (p<0.05) which had greater decreased than the control group. Moreover they had a vertical jump, agility significantly differed from the counterpart. Body fat mass was negative correlated (r=-0.503; p<0.01) with agility and vertical jump (r=-0.789; p<0.01). The SAP training can decrease body fat mass in young male basketball players, Moreover, show the greater improving the skill-related physical performance in young male basketball players, it can be one of exercise program to promote level the decrease body fat mass relate with physical fitness.

Keywords: Body composition, Adolescence, SAP training

Abbreviations: SAP: Speed, Agility and Plyometric training

1. INTRODUCTION

Sport and exercise promotes physical activity and overweight/obese prevention[1]. While, exercise intensity has a strong association with weight control in young adults[2]. Basketball is a popular team sport [3] that requires multiple planes of movement as well as rapid transitions from jogging to sprinting, and to jumping. Moreover, it requires a movement changes in every 2 seconds that associated to speed, agility, and power. The importance of developing a suitable conditioning programs based on specific physiological demands is considered as a key factor to success in sport[4,5]. In particular with weight control, the excessive weight in basketball players might be limited to physical fitness [6]. While the rate of childhood overweight and obesity in Asia has increased rapidly[7].

Percent of body fat is the proportion of fat compared to body weight, and used a criterion for overweight and obesity [8]. Influence to decline of physical fitness and fat free mass (muscle mass) represents the metabolic active tissue and can provide the physical performance[9]. Moreover, body fat constitutes a valid measurement for define obesity in athletes[10].

There has 3 components to improve physical performance in basketball players are speed, agility and power. Speed is the ability of the muscle tension in the composition of motor units to move the body or body part along the longer distance in the shortest possible time [11]. Agility is defined as a physical skill that enables individuals to rapidly and efficiently decelerate, change direction, and accelerate in an effort to react appropriately to task-relevant cues [12]. Power is a specialized, high-
Effects of Complex sap Training on Body Fat and Physical Performance among Young Male Basketball Players

intensity training technique that enables an athlete muscles to deliver as much strength as possible in the shortest period so that power development can take place [13]. The previous literatures have confirmed that all of the mentioned training can increase strength and agility for athletes [14, 16, 17] as well as effective in reducing body fat [18].

Complex training is a combination of training in difference activities with various goals. There is an alternating training difference of intensity [19]. Combining multiple training times together makes it interesting to practice and may give better results than only specific training [20].

To the best of knowledge, there has no study investigate on the effect of SAP training on reducing of body fat with associated physical fitness among young male basketball players. The purpose of the study was therefore to determine the correlation of body fat and physical performance after “SAP training” among young male basketball players.

2. MATERIALS AND METHODS

Sixty young-male basketball players (n=60) from public secondary schools who agreed to participated in the study. Participants were systematic randomly assigned into 2 groups: the SAP group (n=30); and the control group (n=30) (Table 2). Participants provided written informed consent. This study protocol has approved by KhonKaen University Ethics Committee in Human Research (Reference No#HE582280).

The following tests were performed before training, after 4-weeks training and after 8-weeks conducted:

2.1. Body Weight, Height

Subjects wearing light clothes and no shoes or socks to measured using a digital scale. (Omron Body Composition Monitor HBF-375, Japan) and height was measured using a portable stadiometer (SECA 242; Hamburg, Germany). Body mass index (BMI) was calculated by using a weight-to-height ratio (kg/m²) and is used to classify adults who are underweight, overweight or obese [21].

2.2. Body Fat Mass (Percent)

Body fat mass was evaluated by body composition monitor using a digital scale (Omron Body Composition Monitor HBF-375, Japan). Participant stand and back straight and look straight ahead. The arms are horizontally raised, and the elbows are extended straight. Extend your arms straight at a 90° angle to your body. [22]

2.3. Vertical Jump

Reach height was measured on all participants prior to vertical jump testing. Subjects stood flatfooted and reached as high as possible with one arm. The highest point reached on the vertical jump pole (Swift Yardstick, Australia) was considered reach height (cm.). Individuals were allowed an arm swing down and up while jumping off both feet and reaching as high as possible with one arm to displace the highest possible vane. Vertical jump was calculated as the distance from the initial reach and the highest point reached during the jump. Participants performed 3 maximal vertical jump, with approximately 2 minutes recovery between them [23].

2.4. Agility

Agility test is set up with four cones forming the agility area (10 meters long x 5 meters wide). Cone at point A marking the start. Cone at B & C to mark the turning spots. Cone at point D to mark the finish. Place four cones in the center of the testing area 3.3 meters apart. Start lying face down with the hands at shoulder level. On the “go” command, athlete begins and time starts when they cross the photocells. Get up and run the course in the set path (left to right or right to left). On the turn spots B and C, be sure to touch the cones with your hand. Trial is complete when you cross the finish line and when no cones are knocked over (sec.) [24].

The participants in SAP group trained 60 mins/day, 3 days/week with 8 consecutive weeks. There was consisted of 15-mins warm-up (7-mins jogging after which static stretching). Moreover, all training in
Effects of Complex sap Training on Body Fat and Physical Performance among Young Male Basketball Players

maximum effort and allowed a 2-mins rest between set [25] and 3-mins rest between sessions (Arazi et al., 2012). The SAP group training, it consisted of speed, agility, plyometric training. The protocol of the SAP training has presented in Table 1. While, the control group received a regular training.

Table1. SAP training program

| Week | SAP training | Times/set | Set/day |
|------|--------------|-----------|---------|
| 1-4  | Speed (S)     | 10        | 3       |
|      | Run-Through   |           |         |
|      | Run throughalternatingfast legs | | |
| Agility (A) | Z-Pattern Run | | |
|      | Four-Point Pop-up To 20-yard Shuttle | | |
| Plyometric (P) | Split Cycle Squat Jump (L,R) | | |
|      | Pike Jump     |           |         |
|      | Run throughalternatingfast legs | | |
|      | Partner-Resisted Start | | |
|      | A-Form Runs   |           |         |
| Agility (A) | Sprawl-to-Stand | | |
|      | PopUp to Squirm | | |
|      | Forward Roll over Shoulder (Speed & Cartwheel (Speed & Agility) | | |
| Plyometric (P) | Squat Jump, | | |
|      | Pike Jump     |           |         |
|      | Single leg Vertical Power Jump (L,R) | | |
|      | Single Leg Tuck Jump (L,R) | | |
|      | Double Leg Vertical Power Jump | | |
| 4-8  | Speed (S)     | 10        | 3       |
|      | Run throughalternatingfast legs | | |
|      | Partner-Resisted Start | | |
|      | A-Form Runs   |           |         |
| Agility (A) | Sprawl-to-Stand | | |
|      | PopUp to Squirm | | |
|      | Forward Roll over Shoulder (Speed & Cartwheel (Speed & Agility) | | |
| Plyometric (P) | Squat Jump, | | |
|      | Pike Jump     |           |         |
|      | Single leg Vertical Power Jump (L,R) | | |
|      | Single Leg Tuck Jump (L,R) | | |
|      | Double Leg Vertical Power Jump | | |

Adapted from [27]

2.5. Statistical Analysis

Descriptive statistics are presented in baseline characteristics. Independent sample t-test was used to compare of dependent variables (body weight, body fat mass, vertical jump and agility) between the experiment and the control groups in time periods. Pearson correlations were used to analyze the relationship between body weight, BMI, body fat mass and physical performance. Level of statistical significant was set at p<0.05. All data analysis was performed using the Statistic Package for the Social Sciences program (SPSS) version 17.0 (Chicago, Illinois).

3. RESULTS AND DISCUSSION

Descriptive characteristics of the participants are presented in Table 2. All participants were young male basketball players.

Table2. Demographic characteristic of the participants

|                      | Total (n=60) | SAP group (n=30) | Control group (n=30) | p-value |
|----------------------|-------------|------------------|----------------------|---------|
| Mean                 | SD          | Mean             | SD                   | Mean    | SD       |         |         |
| Age (year)           | 16.53       | 1.01             | 16.50                | 1.00    | 16.56    | 1.04    | 0.802   |
| Weight (kg.)         | 62.64       | 9.1              | 63.77                | 9.44    | 61.51    | 8.86    | 0.343   |
| Height (cm.)         | 172.56      | 3.93             | 172.73               | 3.75    | 172.40   | 4.17    | 0.746   |
| BMI (kg/m^2)         | 21.04       | 3.02             | 21.36                | 3.01    | 20.72    | 3.05    | 0.89    |

Note: There was no significant difference between SAP group and control group was performed by Independent sample t-test (p>0.05); BMI: Body mass index

The result between the pre-test, after 4 weeks and after 8 weeks test in both groups after training program presented in Table 3. The means differences, SD between the 2 groups for body weight, body fat mass, vertical jump and agility. After 8-weeks of SAP training, body fat mass in SAP group had likely decreased 2.82 kg (p>0.05); whereas vertical jump, agility significantly differed control group.
Effects of Complex sap Training on Body Fat and Physical Performance among Young Male Basketball Players

Table 3. Comparison of body weight, body fat mass and physical performance between the 2 groups in pre-test, after 4 weeks and after 8 weeks test.

| Variable/Week | 4 weeks | 8 weeks |
|---------------|---------|---------|
|               | SAP     | Control | p-value | SAP    | Control | p-value |
| Body weight (kg) | 63.77   | 9.44    | 61.51   | 8.86   | 62.83   | 9.31    | 60.90 | 8.7 | 0.41 | 61.74 | 9.12 | 60.56 | 8.73 | 0.61 |
| Body fat mass (%) | 15.15  | 2.28    | 15.31   | 1.98   | 14.10   | 2.02    | 14.92 | 1.95 | 0.11 | 12.33 | 1.76 | 14.10 | 1.84 | 0.00** |
| Vertical jump (cm) | 54.40  | 9.20    | 53.97   | 2.26   | 56.98   | 2.90    | 54.90 | 2.28 | 0.01 | 59.23 | 2.90 | 55.91 | 2.30 | 0.00** |
| Agility (sec) | 18.94   | 1.45    | 18.50   | 1.48   | 17.79   | 1.49    | 18.25 | 1.48 | 0.24 | 16.93 | 1.48 | 17.94 | 1.48 | 0.01** |

Note: ** Significantly different between the experiment and the control group by Independent sample t-test (p<0.05); SAP: SAP group, Control: Control group

After 8 weeks of training, it was shown that the percentage of body fat mass in SAP group decreased significantly, resulting in improved physical fitness in the vertical jump agility of young male basketball players. The Pearson’s correlation presented in Table 4 indicated that body weight and body fat mass has positive correlation (r=0.77; p<0.01) while body fat mass was negatively correlated (r=-0.789; p<0.01) with vertical jump. Moreover, body fat mass was positive correlated (r=-0.503; p<0.01) with agility.

Table 4. Correlations among body weight, body fat mass and physical performance after 8 weeks of intervention

| Variable/Week | Body Weight | Body Fat mass | Vertical Jump | Body Weight | Body Fat mass | Vertical Jump |
|---------------|-------------|---------------|---------------|-------------|---------------|---------------|
| Body Weight   | 0.83**      | 0.77*         |               | 0.83**      | 0.77*         |               |
| Body Fat mass | -0.849**    | -0.729**      | -0.67**       | -0.849**    | -0.729**      | -0.67**       |
| Agility       | 0.779**     | 0.892**       | -0.704**      | 0.779**     | 0.892**       | -0.704**      |

* Correlation was significant at p < 0.05  
** Correlation was significant at p < 0.01

The correlation between body weight, body fat mass decreased and physical performance in both groups was show the significance positive correlation but in the SAP group, physical performance tended to be better.

The main findings from this study showed the 8-weeks of SAP training was significant decreased in body weight and body fat mass. Correlate in accordance with previous studies in Greek young basketball players elite has 11.4 ± 0.5% of body fat[28]. While body fat mass of European elite young basketball players were 13.23 [29]. On the other hand, there has an increase in the height of the vertical jump and agility. Many factors may contribute to the reduction of weight and body fat including physical fitness that could improve in the skill’s performance.

The SAP training was designed to develop muscle strength by focusing on changing the speed and direction of movement combined with the plyometric training that allows coach to save time, allowing athletes to practice multiple purposes at the same time. Plyometric training can improve the production of testosterone [30] and decreasing the concentrations of cortisol in long term [31]. However, the increase of vertical jump and agility in SAP training may involve the effect of training program rather than hormone effects.

The intensity of the SAP training in this study may also contribute to the results, which decreased the body fat mass and body weight and increased the physical performance. The continuous of training and the time each station in day affect to body metabolism of fat. Although in the control group there is a lower of decreased body fat mass rate less than experimental, regular basketball training can help
reduce body fat mass of young male basketball players as well [32] involves the physiological adaptation of athletes [33] in regular exercise. Table 4 shows that the decrease in body weight and body fat mass in the experimental group and the control group having a positive correlation in the physical performance such as vertical jump and agility. This results has a better effects in the SAP group, compared to the control. This enhancement may related to some adaptive change in neuromuscular function and improved in nerve-based command to muscles of agonist group, intermuscular coordination, modification of muscle size and changes in mechanism of single-fiber. The interventional program has a positive influence to the overall outcome of leg strength that linked with the results of previous studies.

Future studies recruiting populations should be young male overweight or obese for significant effect of SAP training and control food intake in participants to the benefit of SAP training.

4. CONCLUSION

Body fat mass is one of important variable that linked to basketball’s player performances. While SAP training can decrease body fat mass in young male basketball player and, there has a great correlation with their physical performance.

ACKNOWLEDGEMENT

This research was supported by Research Center in Back, Neck, Other Joint Pain and Human Performance (BNOJPH) KhonKaen University, KhonKaen, Thailand.

REFERENCES

[1] Lee et al. The Role of Youth Sports in Promoting Children’s Physical Activity and Preventing Pediatric Obesity: A Systematic Review. Behav Med. 2018; 44(1): 62–76.
[2] Donnelly JE, Hill JO, Jacobsen DI, Potteiger J, Sullivan DK, Johnson SL, et al. Effects of a 16-Month Randomized Controlled Exercise Trial on Body Weight and Composition in Young, Overweight Men and Women: The Midwest Exercise Trial. Arch Intern Med. 2003 Jun 9; 163(11): 1343–50.
[3] Hoffman, Maresh. Exercise and sport science. Philadelphia; 2000. 733–744 p.
[4] Gillam GM. Basketball Bioenergetics: Physiological basis. Natl Strength Cond Assoc J. 1984 Dec 1; 6(6): 44–44.
[5] Taylor J. Basketball: Applying Time Motion Data to Conditioning. Strength Cond J. 2003 Apr 1; 25: 57–64.
[6] Nikolaidis PT, Asadi A, Santos EJAM, Calleja-González J, Padulo J, Chtourov H, et al. Relationship of body mass status with running and jumping performances in young basketball players. Muscles Ligaments Tendons J. 2015 Oct 20; 5(3): 187–94.
[7] Ramachandran A, Wan Ma RC, Snehalatha C. Diabetes in Asia. The Lancet. 2010 Jan 30; 375(9712): 408–18.
[8] Heymsfield SB, Sherzer R, Pietrobelli A, Lewis CE, Grunfeld C. Body Mass Index as a Phenotypic Expression of Adiposity: Quantitative Contribution of Muscularity in a Population-Based Sample. Int J Obes 2005, 2009 Dec; 33(12): 1363–73.
[9] Oliveira L, Oliveira S, Guimarães F, Costa M. Contributions of body fat, fat free mass and arm muscle area in athletic performance of wheelchair basketball players. Motricidade [online]. 2017 [cited 2018 May 28]; 13(2). Available from: http://www.redalyc.org/resumen.oa?id=273053385006
[10] Provencher MT, Chahla J, Sanchez G, Cinque ME, Kennedy NI, Whalen J, et al. Body Mass Index Versus Body Fat Percentage in Prospective National Football League Athletes: Overestimation of Obesity Rate in Athletes at the National Football League Scouting Combine. J Strength Cond Res. 2018 Apr; 32(4): 1013–9.
[11] Corbin Charles B. Pangrazi Robert P. Definitions: Health, Fitness, and Physical Activity. Department of Education, America; 2000.
[12] Foran B. High-performance sports conditioning. Champaign, IL: Human Kinetics; 2001. 139–165 p.
[13] Arazi H, Coetzee B, Asadi A. Comparative effect of land- and aquatic-based plyometric training on jumping ability and agility of young basketball players. South Afr J Res Sport Phys Educ Recreat. 2012 Jan 1; 34.
[14] Hazell et al. Running sprint interval training induces fat loss in women. Appl Physiol Nutr Metab. 2014 Aug; 39(8): 944–50.
[15] Chaouachi et al. Lower Limb Maximal Dynamic Strength and Agility Determinants in Elite Basketball Players. J Strength Cond Res. 2009 Aug; 23(5): 1570.
Effects of Complex SAP Model Training on Body Fat and Physical Performance among Young Male Basketball Players

[16] Sharma et al. Effects of Addition of Sprint, Strength and Agility Training On Cardiovascular System in Young Male Field Hockey Players: An Echocardiography Based Study. IOSR J Sports Phys Educ. 2014 Apr 1; 1: 25–9.

[17] Seo and Myong-Won et al. Effect of 8 weeks of pre-season training on body composition, physical fitness, anaerobic capacity, and isokinetic muscle strength in male and female collegiate taekwondo athletes. J Exerc Rehabil. 2015 Apr 24; 11(2): 101–7.

[18] Silva VFN da, Aguiar S da S, Sousa CV, Sotero R da C, Filho JMS, Oliveira I, et al. Effects of short-term plyometric training on physical fitness parameters in female futsal athletes. J Phys Ther Sci. 2017; 29(5): 783–8.

[19] Stilger VG. Explosive Power and Strength: Complex Training for Maximum Results. J Athl Train. 1997; 32(1): 79.

[20] Santos EJAM, Janeira MAAS. Effects of Complex Training on Explosive Strength in Adolescent Male Basketball Players: J Strength Cond Res. 2008 May; 22(3): 903–9.

[21] McConnell-Nzunga J, Naylor P j., Macdonald H, Rhodes RE, Hofer SM, McKay H. Classification of obesity varies between body mass index and direct measures of body fat in boys and girls of Asian and European ancestry. Meas Phys Educ Exerc Sci. 2018 Apr 3; 22(2): 154–66.

[22] Solanki JD, Makwana AH, Mehta HB, Gokhale PA, Shah CJ. Body Composition in Type 2 Diabetes: Change in Quality and not Just Quantity that Matters. Int J Prev Med [online]. 2015 [cited 2019 Jan 23]; 6. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4736063/

[23] Bosco C, Belli A, Astrua M, Tihaný J, Pozzo R, Kellis S, et al. A dynamometer for evaluation of dynamic muscle work. Eur J Appl Physiol. 1995; 70(5): 379–86.

[24] Amiri-Khorasani M, Sahebozamani M, Tabrizi KG, Yusof AB. Acute effect of different stretching methods on Illinois agility test in soccer players. J Strength Cond Res. 2010 Oct; 24(10): 2698–704.

[25] Ramirez-Campillo R, Andrade DC, Álvarez C, Henríquez-Olguín C, Martínez C, Báez-SanMartín E, et al. The Effects of Interset Rest on Adaptation to 7 Weeks of Explosive Training in Young Soccer Players. J Sports Sci Med. 2014 May 1; 13(2): 287–96.

[26] Arazzi H, Coetzee B, Asadi A. Comparative effect of land- and Aquatic-based plyometric training on jumping ability and Agility of young basketball players. South Afr J Res Sport Phys Educ Recreat. 2012; 34(2): 1–14.

[27] Laoprasert S, Konharn K et al. Effects of Complex SAP Model Training on Lay-Up Shot Ability in Young Male Basketball Players. J Health Phys Educ Recreat. 2016; 42(2): 1–13.

[28] Apostolidis N, Nassis G, Bolatoglou T, Geladas N. Physiological and technical characteristics of elite young basketball players. J Sports Med Phys Fitness. 2004 Jun 1; 44: 157–63.

[29] Jelčić M, Sekulić D, Marinović M. Anthropometric characteristics of high level European junior basketball players. Coll Antropol. 2002 Dec; 26 Suppl: 69–76.

[30] Staron RS, Karapondo DL, Kraemer WJ, Fry AC, Gordon SE, Falkel JE, et al. Skeletal muscle adaptations during early phase of heavy-resistance training in men and women. J Appl Physiol Bethesda Md 1985. 1994 Mar; 76(3): 1247–55.

[31] Kraemer WJ, Patton JF, Gordon SE, Harman EA, Deschenes MR, Reynolds K, et al. Compatibility of high-intensity strength and endurance training on hormonal and skeletal muscle adaptations. J Appl Physiol Bethesda Md 1985. 1995 Mar; 78(3): 976–89.

[32] Vamvakoudis E, Vrabis I, Galazoulas C, Stefanidis P, Metaxas T, Mandroukas K. Effects of Basketball Training on Maximal Oxygen Uptake, Muscle Strength, and Joint Mobility in Young Basketball Players. J Strength Cond Res Natl Strength Cond Assoc. 2007 Aug 1; 21: 930–6.

[33] Djordjevic D, Cubrilò D, Macura M, Barudzic N, Djuric D, Jakovljevic V. The influence of training status on oxidative stress in young male handball players. Mol Cell Biochem. 2011 May 1; 351(1): 251–9.