

Meningkatkan kapasitas anaerob atlet bola basket menggunakan 3x3 small-sided game

Improving anaerobic capacity of basketball athletes using 3x3 small-sided game

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Abstrak

Penelitian ini bertujuan untuk meningkatkan kapasitas anaerob dan *self-esteem* para atlet Klub Bola Basket Canton menggunakan permainan 3x3. Penelitian ini menggunakan model penelitian Kemmis & Taggart dan dilakukan di Palembang, Indonesia pada bulan Maret 2018. Dalam penelitian ini, lima belas atlet pria telah mengajukan diri secara sukarela untuk enam belas pertemuan pelatihan yang dibagi menjadi dua siklus dan telah melakukan permainan 3x3 dengan beberapa modifikasi dalam setiap pertemuan. *The Running-based Anaerobic Sprint Test* (RAST) dan wawancara diterapkan untuk memeriksa peningkatan kapasitas anaerob dan *self-esteem* atlet yang melakukan 3x3 pertandingan sebelum dan sesudah setiap siklus. Perbedaan yang signifikan dari indeks kelelahan diamati. Dalam *pre-test*, rata-rata adalah 5,35 W / s dengan nilai minimum 3,83 W / s dan nilai maksimum 6,77 W / s, sedangkan pada *post-test* siklus II adalah 3,60 W / s dengan minimum dan maksimum nilai masing-masing 2,07 W / s dan 5,39 W / s. Hasil penelitian ini mengungkapkan bahwa peningkatan kapasitas anaerob bervariasi tergantung pada modifikasi yang digunakan. Selain itu, permainan 3x3 bermanfaat untuk meningkatkan kapasitas anaerob. Oleh karena itu, disarankan agar penelitian yang akan datang mengeksplorasi suasana hati atlet dan berbagai jenis *small-sided game* serta modifikasinya untuk peningkatan kinerja atlet.

Kata kunci: kapasitas anaerob, permainan 3x3, RAST.

Abstract

This research aims to improve the anaerobic capacity and self-esteem of Canton Basketball Club athletes using 3x3 game. This study employs Kemmis and Taggart research model and was conducted in Palembang, Indonesia on March 2018. In this study, fifteen male athletes have volunteered for sixteen training meetings divided into two cycles and have performed 3x3 game with some modifications in each meeting. *The Running-based Anaerobic Sprint Test* (RAST)

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and interview are applied to examine the improvement of anaerobic capacity and self-esteem of athletes who perform 3x3 games before and after each cycle. A significant difference of fatigue index is observed. In pretest, the average is 5,35 W/s with a minimum value of 3,83 W/s and maximum value of 6,77 W/s, while in post cycle II is 3,60 W/s with minimum and maximum value of 2,07 W/s and 5,39 W/s respectively. The result of this study reveals that the improvement of anaerobic capacity is various depend on the used modifications. Furthermore, 3x3 game is advantageous to improve anaerobic capacity. Hence, it is suggested that the upcoming studies explore the athletes' mood and different type of small-sided games as well as its modifications for the improvement of athletes' performance.

Keywords: anaerobic capacity, 3x3 game, RAST.

INTRODUCTION

Basketball is an intermittent, anaerobic-dominant, team sport that is played by athletes across a range of levels (Leicht, Gómez, & Woods, 2017; Scanlan, Dascombe, Reaburn, & Dalbo, 2012). It is known that the anaerobic contribution in basketball is important for tactical moves (i.e., defensive/offensive transitions) and technical actions such as shooting, jumping, blocking, passing, lay-ups and other technical movements (Araujo, Gobatto, Papoti, Camargo, & Gobatto, 2014; Castagna et al., 2010; Delextrat & Cohen, 2008; Hoffman, Epstein, Einbinder, & Weinstein, 1999). Anaerobic capacity is defined as the maximum amount of adenosine triphosphate that can be resynthesized via anaerobic metabolism during maximal exercise (Minahan, Chia, & Inbar, 2007; Pavlović, Idrizović, & Pupiš, 2015).

Improving athletes' physical qualities, especially anaerobic capacity, is important so that they are able to reach the status of elite basketball athletes. However, the excitement of playing the game is hardly found in the physical training which leads the laziness of athletes to join the practices either individually or in a group. While exercise can improve mood (Bonet, Parrado, & Capdevila, 2017), increased training load may cause mood disturbances (Halsen, Lancaster, Jeukendrup, & Gleeson, 2003; Kellmann, 2010; Maria et al., 2016; Morgan, Brown, Raglin, O'Connor, & Ellickson, 1987). However, participation in competitive sports such as basketball may also impact psychological measures, such as mood and performance anxiety, which in turn may affect aspects like

enjoyment, continued participation, self-efficacy, and so on (Hoover et al., 2017).

A study reveals that 3x3 basketball game with high speed inertial movements within limited distance creating a relatively high physiological response (Montgomery & Maloney, 2018b). Furthermore, another study shows that, most notably, general fitness and development of aerobic and anaerobic capacities are lacking at this point in the 3x3 athletes (Montgomery & Maloney, 2018a). Considering that 3x3 game in basketball is relatively new, the available information is still rare. To the best of our knowledge, only a few studies have investigated the physical and physiological demands of 3x3 basketball (Koh, Wang, & Mallett, 2011, 2012, Montgomery & Maloney, 2018c, 2018b).

In this study, 3x3 game is applied as a small-sided practice. As a popular urban team sport, 3x3 game rules are simple designed to be fast, spectacular and exciting. Applying this game as a small-sided practice is expected to improve the athletes' anaerobic capacity as well increase their interest in physical training.

Small-sided games are usually used by coaches to develop technical-tactical skills (Gracia, García, Cañadas, & Ibáñez, 2014; Jones & Drust, 2007; Reilly, 2005), but some initial studies show that small-sided games can be used to improve physical performance. Hoffmann, Reed, Leiting, Chiang, & Stone (2014) suggest that with proper planning and implementation, sport coaches can enhance their athletes' performance through small sided games and Marcelino et al., (2016) show that a reduced number of athletes in the same court area induced higher cardiovascular and perceptual responses. Small-sided games push athletes to work harder, compete at game speed and learn to succeed against competition (Willett, 2003). Thus, the small-sided game can be implemented as a training practice to improve anaerobic capacity of basketball athletes.

The small-sided 3x3 game rules are employed in this study to raise the training intensity. The implemented rules increase intensity and

interest in the training which triggers the athletes training harder and performing maximum skill without mental disturbance.

METHODS

Research Design

This study is designed to improve anaerobic capacity and self-esteem of Canton Basketball Club athletes using 3x3 game. This study employs Kemmis and Taggart research model which consists of four stages: 1) planning, 2) action, 3) observation and 4) reflection. This study is conducted in sixteen training meetings divided into two cycles and 3x3 game is performed with some modifications in each meeting. The subjects are divided into teams of three athletes with equal technical level. RAST is applied to examine the improvement of athletes' anaerobic capacity using 3on3 game before and after each cycle.

Research Sample

Fifteen male basketball athletes (between 18 – 27 years old) volunteer in this study. They are amateur athletes of Canton Basketball Club which play in division 1 Palembang basketball league. This study has been conducted before 2018 season. To be subjects of the research, the player should be the member of the assessed basketball team and meet the requirement of following criteria: 1) the athletes are required to participate fully in all 3x3 game, 2) they have to fully contribute in RAST (pre and post-test) and interview. Prior to the study, they are informed on 3x3 game rules and they practice the game to get accustomed. The research procedures are approved by State University of Jakarta.

3x3 Game

3x3 game is arranged in twelve minutes and performed under rules which has no stoppage in each field goal made. The modifications such as less or no dribbling, no lay-up (the athletes are only allowed jumping to shoot), less shot clock (12 second of shot clock is reduced to 8 second of shot clock), are organized to renew the game and increase the intensity. In the last meeting of each cycle, a real 3x3 game is played for fifteen minutes per game without rules modification. The winning team is awarded

by a trophy. Free throw is forbidden to be performed in the game except in the end of cycle to increase the game intensity.

Research Instruments and Procedure

The Running-based Anaerobic Sprint Test (RAST) is performed before and after each cycle. RAST is developed at University of Wolverhampton (United Kingdom) to test the athlete's anaerobic performance (Mackenzie, 2005). Prior to the commencement of the test, the athletes will be weighed and do ten-minutes-warming up with three to five minutes recovery. The athletes complete six sprints over 35 meters at maximum pace with a ten seconds recovery between each sprint. These sprint times along with body mass, are used to calculate anaerobic capacity and power outputs. Maximum power (MaxP), minimum power (MinP) and total time (TT) are registered to calculate fatigue index (FI). FI is calculated by the following equation: $FI = \frac{MaxP - MinP}{TT}$; where $power = \frac{Weight \times Distance^2}{Time^3}$; and $TT = \text{sum of six runs}$. This procedure is reliable and valid, and can be used to measure running anaerobic power and predict short-distance performances (Pavlović et al., 2015). RAST has also been validated as an evaluation protocol for sports that use locomotion.

Interviews are taken after each cycle to identify the athletes' sentiment and the athletes' standards of the stimulating game. RAST result and the interview become the material to reflect whether the game is performed well or not as well as to identify whether the intensity and modifications should be increased or changed. The reflection results are used to plan the strategy for the next cycle.

Data Analysis

RAST is applied to examine the improvement of athletes using 3x3 game before and after each cycle. Meanwhile, the interview is applied to scrutinize the improvement of athletes' self-esteem after each meeting.

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RESULTS

Table 1. Basic statistical parameters athletes' fatigue index

| Test | Mean | Min. | Max. | Range | SD | Skew. | Kurt. |
|---------------|------|------|------|-------|------|-------|-------|
| Pre-cycle | 5,35 | 3,83 | 6,77 | 2,94 | 0,87 | -,43 | -,20 |
| Post cycle I | 4,48 | 3,15 | 5,90 | 2,75 | 0,85 | -,16 | -,59 |
| Post cycle II | 3,60 | 2,07 | 5,39 | 3,32 | 0,86 | ,34 | ,84 |

Legend: Mean (average value); Min (minimal result); Max (maximal result); Range (range result); SD (standard deviation); Skew. (skewness), Kurt. (kurtosis)

Table 1 defines the basic statistical parameters fatigue index (FI) of Canton Basketball Club athletes. Twelve athletes complete all activities and tests while three athletes fail to perform some activities due to injury, accident, and family matter. The FI average of athletes in pre-test is 5,35 W/s with a minimum value of 3,83 W/s and maximum value of 6,77 W/s. In post cycle I, the FI average decreases to 4,48 W/s with minimum value of 3,15 W/s and maximum value of 5,90 W/s. The results is greater in post cycle II which is 3,60 W/s FI average with minimum and maximum value of 2,07 W/s and 5,39 W/s respectively.

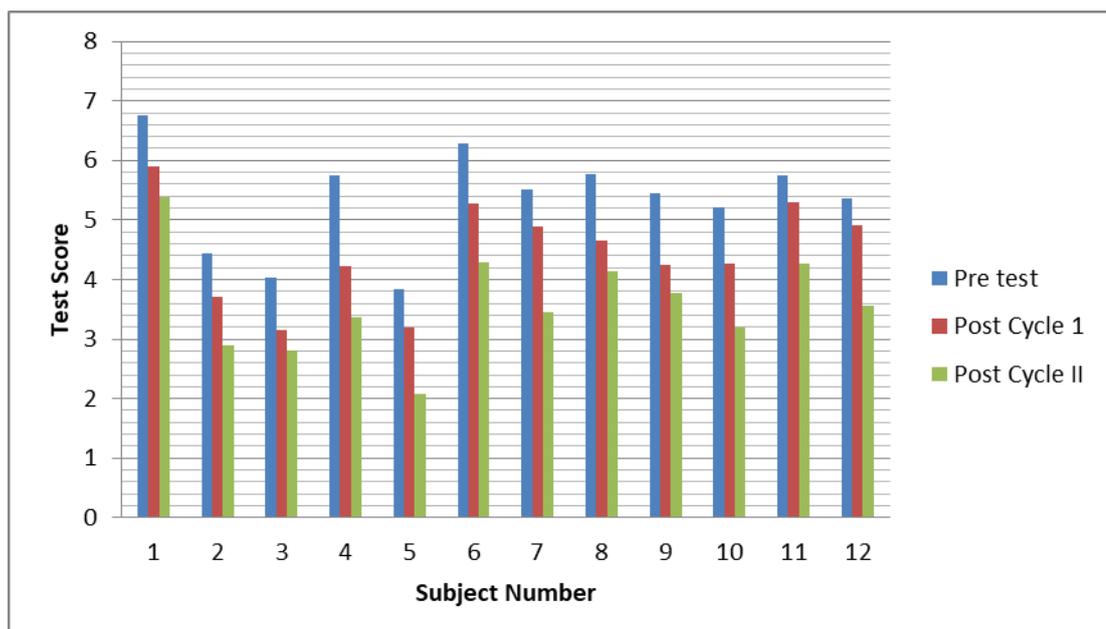


Figure1. Athletes' fatigue index

The fatigue index at post cycle I and II is significantly declined from the pre-test ($p>0,00$), though the improvements are varies because of the modifications of 3x3 games in each cycle. Furthermore, the interviews in the end each cycle show athletes' self-esteem is high and they are genuinely satisfied with 3x3 game.

DISCUSSION

The general objectives of this study are to improve anaerobic capacity and to increase physical training interest of Canton Basketball Club athletes using 3x3 game. The results show impressive improvements in athletes' anaerobic capacity, self-esteem and interest toward physical trainings. Furthermore, the main finding is that 3x3 game improves athlete's anaerobic capacity significantly though the improvements are varies. This is because of the game characteristics; in this case, the training is carried out with high intensity. Such activities will break down glucose into energy without using oxygen. The body will produce more energy and use energy sources stored in the muscles, physical activity of very short duration, fuelled by the energy sources within the contracting muscles and independent of the use of inhaled oxygen as an energy source (Patel et al., 2017).

The modifications used in the first cycle, such as three pass finishing and inside shooting, tend to provide greater opportunities for people with big built body or post athletes to reduce the fatigue index. As for the smaller athletes, the anaerobic capacity is not impressively developed because the bigger athletes hold the ball mostly.

Reflecting such finding, the higher intensive modifications is arranged in the second cycle to create more ball movements so that all athletes have equal opportunities to move with or without the ball. The modifications with higher intensity used in second cycle are less dribble, no dribble, less shot clock and real competition. As for the combination, the shot clock is combined with higher intensity modifications. For example, in a training meeting, 3x3 game is played with no dribble and less shot clock in order to make the game faster and more intense. The

result of this study is in accordance with previous studies which state that training with very high intensity significantly increase anaerobic abilities (Tabata et al., 1996). As the result, smaller athletes' capacity in second cycle is improved than in the first cycle. Meanwhile, post athletes' anaerobic capacity is improved, but not as good as in the first cycle. The unique value of this study compared to the previous studies is the increase of anaerobic capacity is obtained by performing 3x3 game, so that athletes are able to enjoy the presented high intensity training in the form of a game.

As previously stated, with proper planning and implementation, sport coaches can enhance their athletes' performance through small-sided games (Hoffmann et al., 2014). Modified small-sided games inflict noteworthy basketball athletes' performance and self-esteem improvements. Other similar study shows that small sided games influence physical performance (Marcelino, Aoki, Arruda, Freitas, Mendez-Villanueva, et al., 2016). The result indicates that the lactate concentration of athletes is significantly elevated after small-sided game. It can be concluded that small-sided games can be used to train the lactate tolerance of athletes.

However, the key of the improvements in 3x3 game is in the rules of no stoppage in each field goal made and the usage of the same space used for 5 on 5 game; fewer athletes inflicted more movement. The total movement of the athletes in 3x3 game is greater than in 5 on 5 game, considering greater players load and distance covered per minute. The results of this study are similar to Sampaio, Abrantes, & Leite's (2009) which indicate that smaller number of athletes in the same space provokes an increase in player participation, which would increase physical effort.

CONCLUSION AND RECOMMENDATION

This study shows that 3x3 game with some modifications significantly improves the athletes' anaerobic capacity as well as enhances athletes' participation interest in the practice. The results of this study propose that the improvement of anaerobic capacity is varies depend on

the utilized modifications in the game. Hence, it is suggested that the upcoming studies explore the athletes' attitude (which has not been analyzed further in this study) and different type of small-sided games and modifications for the improvement of athletes' performance.

REFERENCES

- Araujo, G. De, Gobatto, F. M.-, Papoti, M., Camargo, B., & Gobatto, C. (2014). Anaerobic and Aerobic Performances in Elite Basketball Players. *Journal of Human Kinetics*, 42, 137–147. <https://doi.org/10.2478/hukin-2014-0068>
- Bonet, J., Parrado, E., & Capdevila, L. (2017). Efectos agudos del ejercicio físico sobre el estado de ánimo y la HRV / Acute Effects of Exercise on Mood and HRV. *Revista Internacional de Medicina y Ciencias de La Actividad Física y Del Deporte*, 65(2017), 85–100. <https://doi.org/10.15366/rimcafd2017.65.006>
- Castagna, C., Manzi, V., Impellizzeri, F., Chaouachi, A., Abdelkrim, N., & Ditroilo, M. (2010). Validity of an On-Court Lactate Threshold Test in Young Basketball Players. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association*, 24, 2434–2439. <https://doi.org/10.1519/JSC.0b013e3181e2e1bf>
- Delextrat, A., & Cohen, D. (2008). Physiological Testing of Basketball Players: Toward a Standard Evaluation of Anaerobic Fitness. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association*, 22, 1066–1072. <https://doi.org/10.1519/JSC.0b013e3181739d9b>
- Gracia, García, Cañadas, & Ibáñez. (2014). Heart rate differences in small sided games in formative basketball. *E-Balonmano.Com Revista de Ciencias Del Deporte*, 10(1), 23–30.
- Halson, S. L., Lancaster, G. I., Jeukendrup, A. E., & Gleeson, M. (2003). Immunological responses to overreaching in cyclists. *Medicine and Science in Sports and Exercise*, 35(5), 854–861. <https://doi.org/10.1249/01.MSS.0000064964.80040.E9>
- Hoffman, J. R., Epstein, S., Einbinder, M., & Weinstein, Y. (1999). The Influence of Aerobic Capacity on Anaerobic Performance and Recovery Indices in Basketball Players. *Journal of Strength and Conditioning Research*, 13(4), 407–411.
- Hoffmann, J. J., Reed, J. P., Leiting, K., Chiang, C. Y., & Stone, M. H. (2014). Repeated sprints, high-intensity interval training, small-sided games: Theory and application to field sports. *International Journal of Sports Physiology and Performance*, 9(2), 352–357. <https://doi.org/10.1123/IJSP.2013-0189>
- Hoover, S. J., Winner, R. K., McCutchan, H., Beaudoin, C. C., Judge, L.

- W., Jones, L. M., Hoover, D. L. (2017). Mood and Performance Anxiety in High School Basketball Players: A Pilot Study. *International Journal of Exercise Science*, 10(4), 604–618. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/28674604><http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC5466400>
- Jones, S., & Drust, B. (2007). Physiological and technical demands of 4 v 4 and 8 v 8 games in elite youth soccer players. *Kinesiology*, 39(2), 150–156.
- Kellmann, M. (2010). Preventing overtraining in athletes in high-intensity sports and stress/recovery monitoring. *Scandinavian Journal of Medicine and Science in Sports*, 20(SUPPL. 2), 95–102. <https://doi.org/10.1111/j.1600-0838.2010.01192.x>
- Koh, K., Wang, J., & Mallett, C. (2011). Discriminating Factors between Successful and Unsuccessful Teams: A Case Study in Elite Youth Olympic Basketball Games. *Journal of Quantitative Analysis in Sports*, 7, 21. <https://doi.org/10.2202/1559-0410.1346>
- Koh, K., Wang, J., & Mallett, C. (2012). Discriminating Factors between Successful and Unsuccessful Elite Youth Olympic Female Basketball Teams. *International Journal of Performance Analysis in Sport*, 12. <https://doi.org/10.1080/24748668.2012.11868588>
- Leicht, A. S., Gómez, M. A., & Woods, C. T. (2017). Explaining match outcome during the men's basketball tournament at the olympic games. *Journal of Sports Science and Medicine*, 16(4), 468–473.
- Mackenzie, B. (2005). *101 Performance Evaluation Tests*. London: Electric World plc.
- Marcelino, P. R., Aoki, M. S., Arruda, A. F. S., Freitas, C. G., Mendez-Villanueva, A., & Moreira, A. (2016). Does small-sided-games' court area influence metabolic, perceptual, and physical performance parameters of young elite basketball players? *Biology of Sport*, 33(1), 37–42. <https://doi.org/10.5604/20831862.1180174>
- Maria, F. P., Witard, O. C., Tonoli, C., Jackman, S. R., Turner, J. E., Kies, A. K., Meeusen, R. (2016). Effect of intensive training on mood with no effect on brain-derived neurotrophic factor. *International Journal of Sports Physiology and Performance*, 11(6), 824–830. <https://doi.org/10.1123/ijspp.2015-0279>
- Minahan, C., Chia, M., & Inbar, O. (2007). Does power indicate capacity? 30-S wingate anaerobic test vs. maximal accumulated O₂ deficit. *International Journal of Sports Medicine*, 28(10), 836–843. <https://doi.org/10.1055/s-2007-964976>
- Montgomery, P. G., & Maloney, B. D. (2018a). 3x3 Basketball Competition: Physical and Physiological Characteristics of Elite Players. *Journal of Physical Fitness, Medicine & Treatment in Sports*, 5(3), 1–7. <https://doi.org/10.19080/jpfmts.2018.05.555664>

- Montgomery, P. G., & Maloney, B. D. (2018b). Three-by-Three basketball: Inertial movement and physiological demands during elite games. *International Journal of Sports Physiology and Performance*, 13(9), 1169–1174. <https://doi.org/10.1123/ijsp.2018-0031>
- Montgomery, P. G., & Maloney, B. D. (2018c). Three-by-Three Basketball: Inertial Movement and Physiological Demands During Elite Games. *International Journal of Sports Physiology and Performance*, 13(9), 1169–1174. <https://doi.org/10.1123/ijsp.2018-0031>
- Morgan, W. P., Brown, D. R., Raglin, J. S., O'Connor, P. J., & Ellickson, K. A. (1987). Psychological monitoring of overtraining and staleness. *British Journal of Sports Medicine*, 21(3), 107–114. <https://doi.org/10.1136/bjbm.21.3.107>
- Patel, H., Alkhawam, H., Madanieh, R., Shah, N., Kosmas, C. E., & Vittorio, T. J. (2017). Aerobic vs anaerobic exercise training effects on the cardiovascular system. *World Journal of Cardiology*, 9(2), 134. <https://doi.org/10.4330/wjc.v9.i2.134>
- Pavlović, R., Idrizović, K., & Pupiš, M. (2015). Evaluation of anaerobic abilities of students applying the running anaerobic sprint test. *Sport Scientific and Practical Aspects*, 12(2), 23–31.
- Reilly, T. (2005). An ergonomics model of the soccer training process. *Journal of Sports Sciences*, 23(6), 561–572. <https://doi.org/10.1080/02640410400021245>
- Sampaio, J., Abrantes, C., & Leite, N. (2009). Power, heart rate and perceived exertion responses to 3X3 and 4X4 basketball small-sided games. *Revista de Psicologia Del Deporte*, 18(SUPPL.), 463–467.
- Scanlan, A., Dascombe, B., Reaburn, P., & Dalbo, V. (2012). The physiological and activity demands experienced by Australian female basketball players during competition. *Journal of Science and Medicine in Sport / Sports Medicine Australia*, 15, 341–347. <https://doi.org/10.1016/j.jsams.2011.12.008>
- Tabata, I., Nishimura, K., Kouzaki, M., Hirai, Y., Ogita, F., Miyachi, M., & Yamamoto, K. (1996). Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO₂max. *Medicine and Science in Sports and Exercise*, 28(10), 1327–1330. <https://doi.org/10.1097/00005768-199610000-00018>
- Willett, P. (2003). The hockey coach's guide to small-area games. *Paul Willett International, LLC*.