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# EFFECT OF 6 WEEKS OF SELECTIVE CARDIORESPIRATORY ENDURANCE AND PLYOMETRICS TRAINING ON 800 METER COLLEGIATE ATHLETES

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## ABSTRACT

**Background:** The 800 meter race is a form of middle-distance running and requires significant contributions from both the anaerobic and aerobic energy system. The present study would help to find the effect of selective plyometric training with cardiorespiratory endurance training on 800 meter collegiate runners. The purpose of present study is to compare this training approach with conventional training to evaluate 800 meter performances. **Methods:** 100 healthy voluntary rural collegiate 800 meter athletes from different colleges of Rahata Talluka of Ahmednagar were randomly selected based on inclusion and exclusion criteria and divided into two groups. Group A was control group which received only conventional training including cardio-respiratory endurance training (CON), and Group B received plyometric training with conventional training including cardiorespiratory endurance training (PLYO). Mean±SD age (years), weight (kg), height (cms), BMI (kg/m2) and pulse (b/min) of group A were 19.22 (±1.53), 60.68 (±10.47), 170.4 (±6.55), 20.88 (±3.48) & 83.78 (±9.74) respectively, and group B were 19.48 (±1.18), 63.16 (±9.31), 171.8 (±5.16), 21.37 (±2.80) & 86.22 (±11.69) respectively VO2 max (ml/kg/min), anaerobic power (watt), sprint test (sec) and 800 meter running time (min.sec) were recorded. Student's t test was applied between all the parameters within group and between the groups ($p<0.005$). **Results:** In CON group only sprint test has shown statistically significant improvement after 6 weeks of regular training, where as in PLYO group statistically significant improvement can be seen in anaerobic power, sprint test and 800 meter time after 6 weeks of plyometric training along with their regular training. **Conclusion:** The findings of the present study suggest that PLYO group has only significant improvement in anaerobic power of the athletes as compared to CON group.

**KEYWORDS :** 800 Meter Running, VO2 max, Anaerobic Power, Sprint Test, Plyometric

## INTRODUCTION:

The 800 meter running requires both aerobic and anaerobic energy system contribution and thus influenced by several physiological variables (Blumkaitis et al. 2016; Kumar & Badwe 2022). The intensity requires to perform 800 meter running is higher than long distance running and lower than sprint as it is a form of middle distance running (Brandon 1995; Kumar & Badwe 2023). There are various factors responsible for the performance of 800 meter running as it is characterized by maintaining economy while running at high velocity makes it little different from other types of sports (Thompson 2017). Both strength and endurance are needed to perform 800 meter running and they are achieved by activation of fast twitch and slow twitch muscle fibers respectively (Katch et al. 2011).

The most important parameter for any individual's fitness is their cardio-respiratory endurance which is also known as VO2max (Kumar et al. 2015; Kumar et al. 2017). It is the ability to perform moderate to high intensity exercise for a prolonged period of time by an individual (Kumar & Laroiya 2017). The cardio-respiratory endurance or VO2 max training can performed by various methods such as running, cycling, jogging, swimming, brisk walking etc. The measurement of VO2 max can be done by various field test such as beep test, step test etc (Thompson et al. 2009; Kumar & Sharma 2011; Kumar & Goswami 2020).

Plyometric exercise is a determinant of anaerobic exercise where there is eccentric contraction followed by concentric contraction of muscles which. There is stretch shortening cycle which helps in activating myotatic stretch reflex of muscles (Davies et al. 2015; Saez de Villarreal et al. 2010; Parab & Kumar 2024). The reactive ability of neuromuscular system is improved with the help of plyometric exercises as it improve the excitability of the nervous system (Shah 2012). The common Plyometric exercises are hoping, jumping, throws and various box drills etc. (Lephart et al. 2005).

The present study would help to find the effect of 6 weeks of cardiorespiratory endurance training with selective plyometric training on 800 meter collegiate runners. The purpose of present study is to compare this training approach with conventional training to evaluate 800 meter performances. The effect of endurance training has been seen on many endurance sports as well as the effect of plyometric training has been seen on many sports which require sudden explosive or agile activity (Fletcher & Hartwell 2004; Adams et al. 1992; Davies et al. 2015), effect of intermittent sprint and plyometric have been seen on endurance running performance (Lum et al. 2019), but there is a paucity of research work on these training effects on middle distance performances in college athletes.

800 meter running performances are basically performed by cardio respiratory endurance, muscular strength and power. If the VO2 max, muscular strength and power increase then the 800 meter running performance may also improve. Similarly, if the selective Plyometric training have any significant role in improving 800 meter running performance then there will be a broader scope to athletes, coaches, athletic trainer, sports physiotherapists, managers etc to enhance athletic performance.

## METHODS:

A total of 150 voluntary participants were target and identified for this study, in which 40 were excluded due to various reasons (22 were not meeting the inclusion criteria, 15 participants were declined to participate, and 3 participants Schedule did not allow them to participate) . A total of 110 healthy voluntary rural collegiate 800 meter athletes from PIMS-DU, Rahata Talluka of Ahmednagar district aged between 18 to 25 years were randomly selected based on inclusion and exclusion criteria. The participants with any recent injury and any medical and/or psychological conditions which may affect their performances were excluded from this study. The minimum eligibility of

participants was to qualify PAR-Q to rule out any cardiac condition of subjects which may triggered by intervention protocol, and they all submitted their written informed consent. The ethical committee approval has been taken from Institutional Ethical Committee of Pravara Institute of Medical Sciences (Deemed to be University), Loni.

All these 110 participants divided randomly in to two equal groups (N= 55). Control group (CON) received only conventional training including cardio-respiratory endurance training, and Plyometric training group (PLYO) received conventional training including cardio-respiratory endurance training with plyometric training. Total 10 participants, 5 from each group, expressed their unavailability and requested to withdraw voluntarily during follow-up. Hence, total 100 participants, with 50 in group A and 50 in group B, completed the intervention

All the participants have done 6 weeks of their group specific training, eg., participants of group A received only conventional training as per their schedule of 6 weeks, and participants of group B received conventional plus plyometric training as per the designed schedule (table 1) for 6 weeks. Before and after 6 weeks of their regular group specific training, their anaerobic power, sprint test, VO2 max and 800 m running time were recorded.

**The following variables were taken:**
**Height (cm)** measured by Stadiometer; and **weight (kg)** measured by digital weighing machine

**Vo2 max (Beep test, Mackenzie 2001):**
This test involved continuous running between two lines 20m apart in time to recorded beeps. The test subjects stood behind one of the lines facing the second line, and began running when instructed by the tape. The speed at the start was quite slow. The subject continued running between the two lines, turning when signaled by the recorded beeps. After one minute, a sound beep indicated an increase in speed, and the beeps were closer together. This was continued for each minute (level). If the line was not reached in time for each beep, the subject must rerun to the line turn and try to complete the task within 2 more 'beeps'. Also, if the line is reached before the beep sounds, the subject must wait until the beep sounds. The test was stopped if the subject failed to reach the line (within 2 meters) for two consecutive ends. The athletes score was considered as the level and number of shuttles (20m) reached before they were unable to keep up with the recording. This score was converted to a VO2max equivalent score using mobile app.

**Anaerobic power (RAST- Running Based Anaerobic Sprint test, Mackenzie 1998):**
Initially, body mass of each participant measured with the same clothes to be used in the RAST Test. Two lines taped to the floor marked a sprinting trace of 35 meters and cones placed at the end of each of the line. Participants instructed to complete six 35-meter sprints at maximum pace and to be sure to cross each line. Participants verbally encouraged to run as fast as possible during each run to ensure a maximal effort. Between each run, participants are allowed to rest for 10 seconds before turning around, in order to allow them to prepare for the subsequent sprint. Each 10-second interval between the sprints has also been timed manually.

For the first sprint, the instruction was "ready, 3, 2, 1, go". For the other five sprints, a countdown from 6 to 1 and the start signal "go" proved to be sufficient. Power, expressed in watts (W), and be calculated by the formula power = (Body Mass/*Distance2)/Time.3, 21 Peak power (PP) is defined as the highest calculated power and minimum power (MNP) as the lowest, while mean power (MP) is defined as the average power over the six sprints.

**F30 sprint test (Mackenzie 1999):**
This test assessed the sprinting ability over a short distance, which is of particular importance for many sportsand has been associated with the performance of different activities. F30 has been performed on a straight track marked with cones and lines at 30 and 60 m after the starting point. The participants waited for the signal at the starting point and then ran at maximum speed. Participants performed two trials separated by 5 minutes and the best time has been used in the analysis.

**800 meter running time:**
After a warm-up of self-selected velocity and 5 minutes of rest, participants were asked to perform 800 meter run in a minimal time possible

**Interventions:**
Group A (CON) received only their regular conventional training including cardio-respiratory endurance training which they were doing as their daily regular training program. Group B (PLYO) received plyometric training with their regular conventional training including cardio-respiratory endurance training (Table 1).

**Selective plyometric training:**
This program lasts for 6 weeks as shown in Table 1. Plyometric training was performed two times a week in nonconsecutive days (Tuesdays and Thursdays) under strict supervision and control. Every session began with a 10 minutes warm-up that included jogging at a self-selected pace and type. The plyometric sessions took ~25 minutes and followed by 5 minutes of cool down. (Assuncao et al. 2018)

Table 1.— Plyometric training program

| Exercise | Sets | Repetitions | Total |
|---|---|---|---|
| (Two times in a week) | | | |
| Bilateral horizontal jumps | 2 | 15 | 30 |
| Unilateral zig-zag jumps | 2 | 8 | 16 |
| Bilateral vertical jumps | 2 | 15 | 30 |
| Unilateral horizontal jumps | 2 | 6 | 12 |
| Depth jumps | 2 | 10 | 20 |

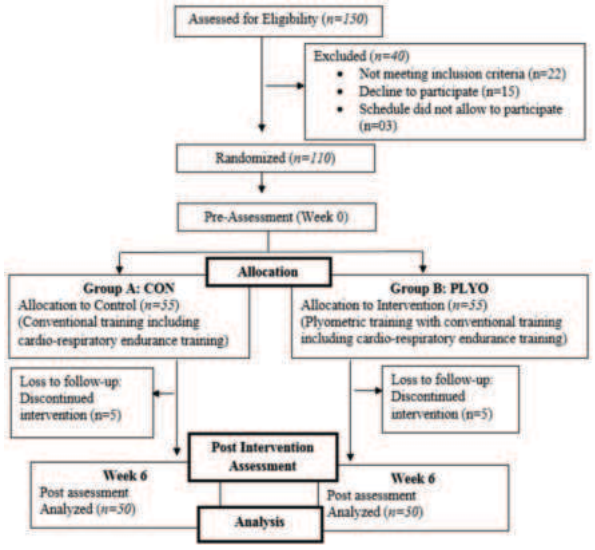


**Fig. 1: CONSORT diagram of flow of participants through the trial**

**Data Analysis:**
The descriptive statistics for all outcome measures expressed as mean±SD. The effect of CON & PLYO training in their group analyzed by paired sample T- test. An independent sample T- test used to compare post training values between CON & PLYO. The confidence interval was set at 95%. The analysis was done using SPSS version 20.

## RESULTS:

Mean±SD age (years), weight (kg), height (cms), BMI (kg/m2) and pulse (b/min) of CON and PLYO groups are shown in table 2.

**Table 2. — Descriptive data of both groups**

| Variables | Age (years) | Weight (kg) | Height (cm) | BMI (kg/m2) | Pulse (b/min) |
|---|---|---|---|---|---|
| CON (mean ±SD) | 19.22 ±1.53 | 60.68 ±10.47 | 170.4 ±6.55 | 20.88 ±3.48 | 83.78 ±9.74 |
| PLYO (mean ±SD) | 19.48 ±1.18 | 63.16 ±9.31 | 171.8 ±5.16 | 21.37 ±2.80 | 86.22 ±11.69 |

The Mean±SD of all the variables of CON and PLYO groups are shown in table 3.

**Table 3. — Descriptive data of the variables of both groups**

| | | Vo2max (ml/kg/min) | Anaerobic power (watt) | Sprint test (sec) | 800 meter time (min.sec) |
|---|---|---|---|---|---|
| CON | Pre | 35.39 ±4.49 | 321.29 ±106.47 | 5.45 ±0.26 | 3.43 ±0.20 |
| | Post | 35.39 ±3.96 | 321.7 ±105.6 | 5.31 ±0.23 | 3.38 ±0.18 |
| PLYO | Pre | 36.26 ±3.54 | 347.04 ±122.42 | 5.44 ±0.27 | 3.44 ±0.26 |
| | Post | 36.41 ±3.57 | 416.84 ±112.98 | 5.30 ±0.14 | 3.37 ±0.21 |

Student's t test was applied between all the parameters within group and between the groups, there finding is shown in table 4.

**Table 4. — Comparison within group and between groups (p values)**

| p value | Vo2max (ml/kg/min) | Anaerobic power (watt) | Sprint test (sec) | 800 meter time (min.sec) |
|---|---|---|---|---|
| CON (pre & post) | 0.5 | 0.15 | 0.0001* | 0.11 |
| PLYO (pre & post) | 0.12 | 0.0001* | 0.0001* | 0.0001* |
| Between Groups (pre CON & PLYO) | 0.14 | 0.13 | 0.39 | 0.36 |
| (post CON & PLYO) | 0.10 | 0.0001* | 0.37 | 0.38 |

*- Statistically significant

In CON group only sprint test has shown statistically significant improvement after 6 weeks of regular training, where as in PLYO group statistically significant improvement can be seen in anaerobic power, sprint test and 800 meter time after 6 weeks of plyometric training along with their regular training. But if post intervention values of both groups are compared then only anaerobic power showed statistically significant improvement.

## DISCUSSION:

The purpose of the present study was to find the effect of 6 weeks of selective Cardiorespiratory Endurance and Plyometric training on 800 meter Collegiate Athletes.

The average VO2 max (ml/kg/min) of CON and PLYO group was 35.39 ±4.49 and 36.26 ±3.54 respectively, which is below than standard (www.physio-pedia.com; Buttar et al. 2022; Nitin et al. 2013). There might have many factors for that which needs to be studied in future. The aerobic capacity of these athletes is required to be improved by proper aerobic training. In a study conducted by Støren et al (2021), the middle distance running time is related with athletes' aerobic capacity. The difference between pre values of VO2 max between CON and PLYO was statistically insignificant. In CON the difference between pre and post values of VO2 max was also statistically insignificant. In PLYO the difference between pre and post VO2 max was again statistically insignificant. The comparison between post values of VO2 max between CON and PLYO was statistically insignificant. With these findings, it can be suggested that VO2 max of these athletes have not improved in 6 weeks of either their regular exercises or by selective plyometric exercises. Since these athletes have not gone for any intensive aerobic exercises, they have either done their regular exercises (in CON) or plyometric exercises (in PLYO), it can be understood that these exercises of 6 weeks was not helpful for improving VO2 max. it is also imperative to mention that plyometric exercise are type of anaerobic exercise and it has limited evidence in improving VO2 max (Egan-Shuttler et al. 2017 & Saunders et al. 2006).

The average anaerobic power (watt) of group A (CON) and group B (PLYO) was 321.29 ±106.47 and 347.04 ±122.42 respectively, which is well below standard values (Abichandani & Hule 2017; Zupan et al. 2009). The anaerobic power is required to be improved with the help of well guided strength training program and to prevent them to indulge in drug abuse substances (Kumar et al. 2011). Støren et al (2021) suggested in a study that anaerobic power is an important component for middle distance running and they are correlated. The difference between pre values of anaerobic power between CON and PLYO was 0.13 which was statistically insignificant. In CON the difference between pre and post values of anaerobic power was 0.15, which is also statistically insignificant. In PLYO the difference between pre and post anaerobic power was 0.001, which is statistically significant. The comparison between post values of anaerobic power between CON and PLYO was 0.001 which is again statistically significant. With these findings, it can be suggested that in group A (CON), where only regular exercises have been done there is no improvement of aerobic power seen. Whereas in group B (PLYO), where plyometric exercises have been done, a significant improvement in anaerobic power can be seen and hence there is a significant difference between both groups can also be seen. Since, plyometric exercises are a type of anaerobic exercise, the finding of the present study is in line with the findings of Assuncao et al. 2018 which suggested plyometric exercises helps in improving anaerobic power.

The average sprint test time (sec) of group A (CON) and group B (PLYO) was 5.45 ±0.26 and 5.44 ±0.27 respectively. In a study conducted by Haugen et al (2021), it was suggested that shorter distance running training particularly 30 m and 60 m is effective in middle distance running. The difference between pre values of sprint test between CON and PLYO was 0.39 which was statistically insignificant. In CON the difference between pre and post values of sprint test was 0.001, which is statistically significant. In PLYO the difference between pre and post sprint test was 0.001, which is also statistically significant. The comparison between post values of sprint test between CON and PLYO was 0.37 which is statistically insignificant. With these findings, it can be suggested that sprint test time can be improved by 6 weeks either regular exercises (CON) or selective plyometric exercises (PLYO). Further, it can also be suggested that there is no significant difference between both aerobic as well as anaerobic exercises in improving sprint test time.

The average 800 meter running time (min.sec) of group A (CON) and group B (PLYO) was 3.43 ±0.20 and 3.44 ±0.26 respectively, which is well below the national and international records (https://indianathletics.in; https://www.worldathletics.org). There may be certain factors for this low level performance which need to be further studied. The difference between pre values of 800 meter running time between CON and PLYO was 0.36 which was statistically insignificant. In CON the difference between pre and post values was 0.11, which was statistically insignificant. In PLYO the difference between pre and post values was 0.001, which is statistically significant. The comparison between post values

of 800 meter running time between CON and PLYO was 0.38 which is statistically insignificant. With these findings, it can be suggested that 6 weeks of regular exercises in CON does not helps in improving 800 meter running time whereas 6 weeks of plyometric exercises in PLYO has significant improvement. Further, it can also be suggested that both aerobic and anaerobic exercises are equally important as there is insignificant differences shown on post intervention values of 800 meter running time between both groups. The finding of the present study is quite consistent with the findings of (Blumkaitis et al. 2016 and Rami´rez-Campillo et al. 2014), which suggested that middle distance running can be improved by aerobic and anaerobic exercises.

## COCLUSION:

The findings of the present study suggest that VO2 max, anaerobic power and 800 meter running time of rural collegiate athletes are well below standard norms and need to be improved with the help of proper training and guidance. The 6 weeks of selective plyometric training found significant in improving anaerobic power of the athletes as compared to those without such training but has insignificant role in VO2 max. The sprint test time was seen to improved by either 6 weeks of regular exercises or plyometric training. Further, it can also be suggested that 6 weeks of plyometric training has significant role in improving 800 meter running time of rural collegiate athletes.

## REFERENCES:


1. Abichandani, D., & Hule V. (2017). Assessment of anaerobic power and balance among elite Indian under-19 football players. International Journal of Science and Research. 6, 9, ART20176597, 521-527
2. Adams, K., O'Shea, J. P., O'Shea, K. L., & Climstein, M. (1992). The effect of six weeks of squat, plyometric and squat-plyometric training on power production. *J of appl spo sci res*. 6(1), 36-41.
3. Assuncao, A. R., Bottaro, M., Cardoso, E. A., Dantas daSilva, D. P., Ferraz, M., Vieira, C. A., et al. (2018). Effects of low volume plyometric training in anaerobic performance of adolescent athletes. J. Sports Med. Phys. Fitness. 58, 570–575. 10.23736/S0022-4707.17.07173-0.
4. Blumkaitis, J. C., Sandefur, C.L., Fahs, C. A., & Rossow, L. M. (2016). Anaerobic and aerobic contributions to 800 m and 8 km season bests. *Journal of Trainology*. 5: 28-42.
5. Brandon, L. J. (1995). Physiological factors associated with middle distance running performance. *Sports Med*. 19 (4): 268-277.
6. Buttar, K. K., Kacker, S., & Saboo, N. (2022). Normative data of maximal oxygen consumption (VO2 max) among healthy young adults: A cross-sectional study. Journal of clinical and diagnostic research. 16:7, CC31-CC34
7. Davies, G., Riemann, B. L., & Manske, R. (2015). Current concepts of plyometric exercise. *Int J of spo phys the*. 10(6), 760-786.
8. Egan-Shuttler, J. D., Edmonds, R., Eddy, C., O'Neill, V., Ives, S. J. (2017). The Effect of Concurrent Plyometric Training Versus Submaximal Aerobic Cycling on Rowing Economy, Peak Power, and Performance in Male High School Rowers. Sports Medicine-Open. 3:7. DOI 10.1186/s40798-017-0075-2
9. Fletcher, I. M., & Hartwell, M. (2004). Effect of an 8 week combined weights and plyometrics training program on golf drive performance. *J of stre and cond res*. 18(1), 59-62.
10. Haugen, T., Sandbakk, Ø., Enoksen, E., Seiler, S., & Tønnessen, E. (2021). Crossing the Golden training divide: The science and practice of training world class 800 and 1500 meter runners. Sports medicine. 51, 1835-1854
11. https://indianathletics.in/wp-content/uploads/2022/02/National-Records-updated-as-on-1-Feb-2022.pdf
12. https://www.physio-pedia.com/VO2_Max#cite_note-:2-2
13. https://www.worldathletics.org/world-rankings/800m/men?regionType=world&page=1&rankDate=2022-03-01&limitByCountry=0
14. Katch, V. L., McArdle, W. D., & Katch, F. L. (2011). Essentials of exercise physiology. 3rd ed. *Lippincott Williams & Wilkins*.
15. Kumar, N., Archana., & Singh, P. (2015). To determine the association of cardiorespiratory fitness with anthropometric characteristics in collegiate athletes. *Serb J of Spo Sci*. 9(1), 27-30.
16. Kumar, N., Badwe, A. N. (2022). A study to determine basic values of Aerobic, Anaerobic and running time performances of 800 meter rural collegiate athletes. *YMER*. 21:10, 274-279.
17. Kumar, N., Badwe, A. N. (2023). Association of rural collegiate 800 m athletes' running time with their cardiorespiratory endurance, power, and F30 time. *Saudi Journal of Sports Medicine*. 23 (01), 17-21.
18. Kumar, N., Goswami, S. (2020). Comparison of Rockport one-mile walk test and McArdle step test for the prediction of VO2 max. *Saudi Journal of Sports Medicine*. 19, 82-85.
19. Kumar, N., & Laroiya, N. (2017). Association of VO2 max, agility and BMI among collegiate athletes. *Annals of Spo med & res*. 4(5), 1121.
20. Kumar, N., Paul, M., & Sandhu, J. S. (2011). Why players engage in drug abuse substances? A survey study. The Doping Journal 8 (1). Available at: http://dopingjournal.org/content/8/1/
21. Kumar, N., Sharma, S. (2011). Effect of Tobacco Chewing on VO2 max. Medicina Sportiva. VII, 3, 1680-1684.
22. Kumar, N., Srivastava, D., Tiwari, N. N., & Dwivedi, S. (2017). Effective time for consumption of preexercise energy drink to enhance cardiorespiratory fitness. *Saudi J of Spo Med*. 17: 79-81.
23. Lephart, S. M., Abt, J. P, Ferris, C. M., Sell, T. C., Nagai, T., Mayers, J. B., et al. (2005). Neuromuscular and biomechanical characteristic changes in high school athletes: a plyometric versus basic resistance program. *Br J Sports Med*. 39: 932-938.
24. Lum, D., Tan, F., Pang, J., & Barbosa, T. M. (2019). Effects of intermittent sprint and plyometric training on endurance running performance. *J of sports and heallth sci*. doi: 10.1016/j.jshs.2016.08.005.
25. Mackenzie, B. (1998). *RAST* [WWW] Available from: https://www.brianmac.co.uk/rast.htm [Accessed 7/3/2022]
26. Mackenzie, B. (1999). *Flying 30 metre Test* [WWW] Available from: https://www.brianmac.co.uk/flying30.htm [Accessed 7/3/2022]
27. Mackenzie, B. (2001). *VO2 max* [WWW] Available from: https://www.brianmac.co.uk/VO2max.htm [Accessed 7/3/2022]
28. Nitin, Y. M., Suchitra, S., Madhura, M., Thomas, T., & Sandhya, T. A. (2013). VO2 max in an Indian Population: A study to understand the role of factors determining VO2 max. Indian J Physio Pharmacol. 57:2, 87-94
29. Parab, S., Kumar, N. (2024). Effect of low-moderate plyometric exercise in post anterior cruciate ligament reconstruction: A case study. *International Journal of Physical Education, Sports and Health* .11 (2), 293-297.
30. Rami´rez-Campillo, R., A´lvarez, C., Henri´quez-Olgui´n, C., Baez, E. B., Marti´nez, C., Andrade, D. C., Izqierdo, M. (2014). Effects Of Plyometric Training On Endurance And Explosive Strength Performance in Competitive Middle- and Long-Distance Runners. Journal of Strength and Conditioning Research. 28(1)/97–104
31. Saez de Villarreal, E. S., Requena, B., & Newton, R. U. (2010). Does plyometric training improve strength performance? A meta-analysis. *J of sci & med in sports*. 13:5, 513-522.
32. Saunders, P. U., Telford, R. D., Pyne, D. B., Peltola, E. M., Cunningham, R. B., Gore, C. J., Hawley, J. A. (2006). Short term plyometric training improves Running economy in highly trained middle and long distance runners. Journal of Strength and Conditioning Research, 20(4), 947–954
33. Shah, S. (2012). Plyometric exercises. *Int J of health sci & res*. 2(1), 115-126.
34. Støren, Ø., Helgerud, J., Johansen, J. M., Gjerløw, L. E., Aamlid, A., Støa, E. M. (2021). Aerobic and Anaerobic Speed Predicts 800-m Running Performance in Young Recreational Runners. Front Physiol. 12:672141. doi: 10.3389/fphys.2021.672141. PMID: 34093233; PMCID: PMC8176219
35. Thompson, M. A. (2017). Physiological and biomechanical mechanisms of distance specific human running performance. *Integrative and Comparative biology*. 57(2): 293-300.
36. Thompson, W. R., Gordon, N. F., & Pescatello, L.S. (2009). ACSM's guidelines for exercise testing and prescription. *Lippincott Williams & Wilkins*. 54.
37. Zupan, M. F., Arata, A. W., Dawson, L. H., Wile, A. L., Payn, T. L., & Hannon, M. E. (2009). Wingate anaerobic test peak power and anaerobic capacity classifications for men and women intercollegiate athletes. Journal of strength and conditioning research. 23:9, 2598-2604