p-ISSN : 2788-5070 | e-ISSN : 2788-5089

DOI(Journal): 10.31703/gpessr
DOI(Volume): 10.31703/gpessr/.2024(VII)
DOI(Issue): 10.31703/gpessr.2024(VII.II)

www.gpessrjournal.com

GPESSR
Global Physical Education & Sports Sciences Review

VOL. VII, ISSUE II, SPRING (JUNE-2024)

# GPESSR

## GLOBAL PHYSICAL EDUCATION & SPORTS REVIEW

HEC-RECOGNIZED CATEGORY-Y

HumanityPublications
sharing research
www.humapub.com
US | UK | Pakistan

Double-blind Peer-review Research Journal
www./gpessrjournal.com

Humanity Publications (HumaPub)
www.humapub.com
Doi: https://dx.doi.org/10.31703

## Article Title

# Role of Strength Training on Body Composition and Karate Performance of School Children

**Global Physical Education & Sports Sciences Review**

**p-ISSN:** 2788-5070 **e-ISSN:** 2788-5089
**DOI(journal):** 10.31703/gpessr
**Volume:** VII (2024)
**DOI (volume):** 10.31703/gpessr.2024(VII)
**Issue:** II Spring (June 2024)
**DOI(Issue):** 10.31703/gpessr.2024(VII-II)

**Home Page**
www.gpessrjournal.com

**Volume: VII (2024)**
https://www.gpessrjournal.com/Current-issues

**Issue: II-Spring (June-2024)**
https://www.gpessrjournal.com/Current-issues/9/2/2024

**Scope**
https://www.gpessrjournal.com/about-us/scope

**Submission**
https://humaglobe.com/index.php/gpessr/submissions

**Google Scholar**

**Visit Us**

## Abstract

*This study evaluates the anthropometry, fitness, and karate performance of schoolboys. The sample comprises an experimental group (n = 15) and a control group(n = 15). Eight weeks of strength and karate training were given to the experimental group and only karate training to the control group. The study measures were eight skinfolds, nine girths, body mass, hand grip strength, agility, flexibility, leg strength, balance, speed, sit-ups, push-ups, and half squats. The statistical analysis of the repeated measures ANOVA reveals that the experimental group was significantly higher than the control group after eight weeks of strength training in agility, flexibility, speed, vertical jump, sit-ups, push-ups, and half squats. Finally, it is concluded that strength and karate training are suitable for reducing fats and increasing the physical fitness of school children. It is suggested that the school administration adopt strength and karate training programs to improve physical fitness and body composition.*

**Keywords:** Strength Training, Karate, Fat Reduction, Physical Fitness, School Children

## Authors:

**Alvina Maqbool:** M. Phil Scholar, Department of Physical Education and Sports Sciences, The Islamia University of Bahawalpur, Punjab, Pakistan.

**Samina Jamil:** M. Phil Scholar, Department of Physical Education and Sports Sciences, The Islamia University of Bahawalpur, Punjab, Pakistan.

**Muhammad Zia ul Haq:** (Corresponding Author) Associate Professor, Department of Physical Education and Sports Sciences, The Islamia University of Bahawalpur, Punjab, Pakistan.
(Email: muhammad.zia@iub.edu.pk)

**Pages:** 19-25
**DOI:** 10.31703/gpessr.2024(VII-II).03
**DOI link:** https://dx.doi.org/10.31703/gpessr.2024(VII-II).03
**Article link:** http://www.gpessrjournal.com/article/A-b-c
**Full-text Link:** https://gpessrjournal.com/fulltext/
**Pdf link:** https://www.gpessrjournal.com/jadmin/Auther/31rvIolA2.pdf

Humanity Publications (HumaPub)
www.humapub.com
doi: https://dx.doi.org/10.31703

## Citing this Article

| 03 | Role of Strength Training on Body Composition and Karate Performance of School Children | | | | | | |
|---|---|---|---|---|---|---|---|
| | Author | Alvina Maqbool<br>Samina Jamil<br>Rabia Noreen | | DOI | 10.31703/gpessr.2024(VII-II).02 | | |
| Pages | 19-25 | Year | 2024 | Volume | VII | Issue | II |

| Referencing & Citing Styles | |
|---|---|
| APA 7th | Maqbool, A., Jamil, S., & Noreen, R. (2024). Role of Strength Training on Body Composition and Karate Performance of School Children. *Global Physical Education & Sports Sciences Review*, *VII*(II), 19-25. https://doi.org/10.31703/gpessr.2024(VII-II).03 |
| CHICAGO | Maqbool, Alvina, Samina Jamil, and Rabia Noreen. 2024. "Role of Strength Training on Body Composition and Karate Performance of School Children." *Global Physical Education & Sports Sciences Review* VII (II):19-25. doi: 10.31703/gpessr.2024(VII-II).03. |
| HARVARD | MAQBOOL, A., JAMIL, S. & NOREEN, R. 2024. Role of Strength Training on Body Composition and Karate Performance of School Children. *Global Physical Education & Sports Sciences Review,* VII**,** 19-25. |
| MHRA | Maqbool, Alvina, Samina Jamil, and Rabia Noreen. 2024. 'Role of Strength Training on Body Composition and Karate Performance of School Children', *Global Physical Education & Sports Sciences Review*, VII: 19-25. |
| MLA | Maqbool, Alvina, Samina Jamil, and Rabia Noreen. "Role of Strength Training on Body Composition and Karate Performance of School Children." *Global Physical Education & Sports Sciences Review* VII.II (2024): 19-25. Print. |
| OXFORD | Maqbool, Alvina, Jamil, Samina, and Noreen, Rabia (2024), 'Role of Strength Training on Body Composition and Karate Performance of School Children', *Global Physical Education & Sports Sciences Review,* VII (II), 19-25. |
| TURABIAN | Maqbool, Alvina, Samina Jamil, and Rabia Noreen. "Role of Strength Training on Body Composition and Karate Performance of School Children." *Global Physical Education & Sports Sciences Review* VII, no. II (2024): 19-25. https://dx.doi.org/10.31703/gpessr.2024(VII-II).03. |

**e-ISSN:** 2708-3608 **Volume:** VII (2024) **Issue:** II-Spring (June-2024) **p-ISSN:** 2708-2113

**Global Physical Education & Sports Sciences Review**

www.gpessrjournal.com

DOI: http://dx.doi.org/10.31703/gpessr

**Pages:** 19-25 **URL:** https://doi.org/10.31703/gpessr.2024(VII-II).03 **Doi:** 10.31703/gpessr.2024(VII-II).03

## Title

# Role of Strength Training on Body Composition and Karate Performance of School Children

## Abstract

*This study evaluates the anthropometry, fitness, and karate performance of schoolboys. The sample comprises an experimental group (n = 15) and a control group (n = 15). Eight weeks of strength and karate training were given to the experimental group and only karate training to the control group. The study measures were eight skinfolds, nine girths, body mass, hand grip strength, agility, flexibility, leg strength, balance, speed, sit-ups, push-ups, and half squats. The statistical analysis of the repeated measures ANOVA reveals that the experimental group was significantly higher than the control group after eight weeks of strength training in agility, flexibility, speed, vertical jump, sit-ups, push-ups, and half squats. Finally, it is concluded that strength and karate training are suitable for reducing fats and increasing the physical fitness of school children. It is suggested that the school administration adopt strength and karate training programs to improve physical fitness and body composition.*

## Authors:

**Alvina Maqbool:** M. Phil Scholar, Department of Physical Education and Sports Sciences, The Islamia University of Bahawalpur, Punjab, Pakistan.

**Samina Jamil:** M. Phil Scholar, Department of Physical Education and Sports Sciences, The Islamia University of Bahawalpur, Punjab, Pakistan.

**Muhammad Zia ul Haq:** (Corresponding Author) Associate Professor, Department of Physical Education and Sports Sciences, The Islamia University of Bahawalpur, Punjab, Pakistan. (Email: muhammad.zia@iub.edu.pk)

**Keywords:** Strength Training, Karate, Fat Reduction, Physical Fitness, School Children

## Contents



## Introduction

Karate is a hopping technique that rapidly changes body position to perform the next action of the movement frame function (Andrade et al., 2019). Its competitions comprise the weight categories. A karate match consists of three rounds of three minutes, which require proper time recovery and strength for repetitions of the next action. Therefore, karate performance depends on physical strength, endurance, agility, flexibility, balance, and coordination (Slimani et al., 2017; Stanley, 2020). Physical strength is the most important factor in executing the karate skill along with punching abilities (Zulkarnain, 2021; Zemková & Hamar, 2018). These kinds of exercises improve the transfer of force through the kinetic chain from the lower body to the upper body (Wroble, 2009). An

athlete's primary goal is to maximize his strength for kicking and punching (Jukić et al., 2016). Without proper training, it is not possible to react effectively against an opponent. It is essential to enhance balance through the enhancement of muscular strength of the abdomen, legs, and pelvis which assists in controlling spine position (Isacowitz, 2022). These four muscle groups boost the stability of the trunk during sporting activities as well as prevent injuries (Işık & Başar, 2021). Appropriate training improves stability when hitting and kicking karate athletes (Luo et al., 2022). Strength training increases lean body mass and metabolic rates which decreases the body fat of the athletes (Kerksick et al., 2009).

Cardiorespiratory endurance, muscular endurance, flexibility, and body composition are fitness components that improve the performance of karate players (Hauschild et al., 2016). However, a higher percentage of body fat is not a good attribute to control body mass faster movement of school children (Nikookheslat et al., 2016). Thus, strength training along with faster movement with high intensity are beneficial for the reduction of body fat (Hanson et al., 2009). Therefore, this study is designed to investigate the karate ability of school-going children where karate is not a popular sport.

## Methods and Material:

### Study design and Participants

Purposively, (n = 30) novice schoolboys were recruited for this experimental study. The sample consisted of (n = 15; age = 11.13 ± 01.22 years) experimental group and (n = 15; age = 10.73 ± 01.27 years) control group. The experimental group was strength training with karate training and the control group was given simple karate training for two months. A consent letter was signed by all participants to ensure their willingness as volunteers to participate in the study process. All measurements were compiled at 26 BC Middle School Tehsil Yazman, District Bahawalpur, Pakistan.

### Procedure of Data Collection

The first phase of the study examined anthropometrics, the second phase was physical fitness, and the third phase was a kinematics analysis of the participants' karate actions. The selected variables were skinfolds, girths, lengths, breadths, arm span, stature, sitting height, body mass, and hand grip strength. Nine stations were organized for anthropometric measurements such as body marking, measurement of skinfolds, girths, lengths, breadths, arm span, stature, sitting height, body mass, and handgrip strength. A stadiometer was used for the stature and body mass of the participants. It was instructed the participants keep their heads straight, in an upright position in a relaxed position hanging their hands on both sides (Rima, 2019; Herman, 2011). Both measurements were recorded in stature in centimeters and body mass in kg. A skinfold caliper was used to measure the skinfold at the triceps, biceps, subscapular, iliac crest, abdomen, frontal thigh, and calf as all measurements were recorded in millimeters as guided by (Olutekunbi et al., 2018). The handle of the dynamometer was adjusted to grip properly with the fingers then squeezed by applying maximum force and the reading was recorded in kg as guided by (Hassan, 2018).

The vertical jump is measured to assess leg strength, a stopwatch is used to measure the body balance time, the sit and reach test for flexibility, and the kicking bag for the kick force and frequency. T-runs test was implemented to assess agility. This running was completed in ten 10-meter straight, a five-meter side towards the left, then ten meters to the right side, then return to the center for five meters and finally retune to the starting point after a ten-meter dash. It is believed that there is a substantial variation in agility between karate athletes time was recorded with a stopwatch used for speed for a 30-meter race straight (Pal et al., 2020). Flexibility was obtained through the sit and reach test by using a wooden flex meter. The participants were asked to sit on the floor and place booth feet on the surface of the device that push forward the attached ruler as can possible (Blazevich et al., 2018). Thirty-meter dash was applied to assess speed (Anglos, 2017). Set-ups were recorded in a minute and applied as proposed by (Lawrence, 2019).

**Table 1**

*Strength Training Schedule on Karate Performance*

| Week Number | Procedure and practice | Frequencies |
|---|---|---|
| Week 1-2 | Punching and kicking on pads | 2 to 3 |
| Week 3-4 | Punching and kicking on pads | 3 to 4 |
| Week 5-6 | Drills with gloves for offensive and defensive strategy with partner | 4 to 6 |
| Week 7-8 | Offensive and defensive both together with a partner | 4 to 7 |

| Week Number | Procedure and practice | Frequencies |
|---|---|---|

*Phung and Goldberg (2019)*

## Statistical Analysis

Numerous statistical strategies have been applied to analyze anthropometric and physical fitness measures. To detect differences in skinfolds from anthropometric, repeated measure ANOVA with a second factor was applied to assess the comparison among experimental and control groups before and after the completion of the training program. A comparable statistical technique has been followed for the assessment of corporations in karate (Błaszczyszyn et al., 2019). The Tukey post hoc was used to gauge the distinction among groups. All values were computed using a $p < 0.05$ significance level.

This section of the study provides a statistical analysis of karate schoolboys' skinfold in anthropometric measurement. The total anthropometric measurements included eight skinfolds and two physical strengths. The pre-tested and post-tested anthropometric measurements of 9- to 12-year-old karate players were compared. Figure 01 shows a significant difference between the experimental group at thigh skinfold at pre- and post-tested measurements of schoolboys of karate game as $F$ (3.813) = $P$ (0.05). Results showed that the experimental group had significantly more reduced frontal thigh skinfold than the control group which can be observed in the mean values.

## Result

### Figure 1

*Pre and Skinfold Measures Of Experimental And Control Groups Of The Karate Players*

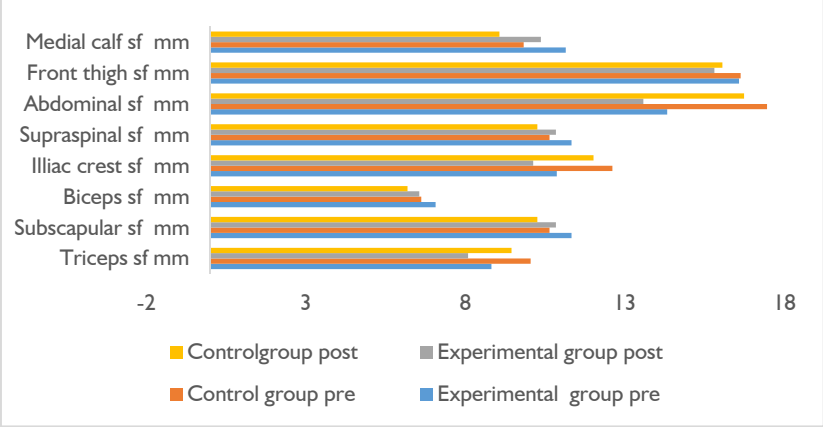



Figure 2 showed that the comparison of pre-and post-tested body mass of schoolboys in karate games was substantially different $F$ (4.156) = $P$ (0.043). The experimental group had reduced considerably body mass compared to the control group.

### Figure 2

*pre and post measure hand grip and body mass of experimental and control groups of the karate players*

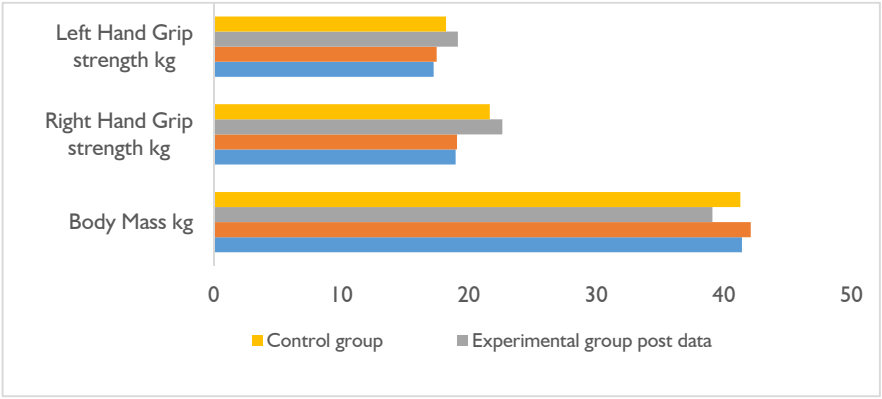
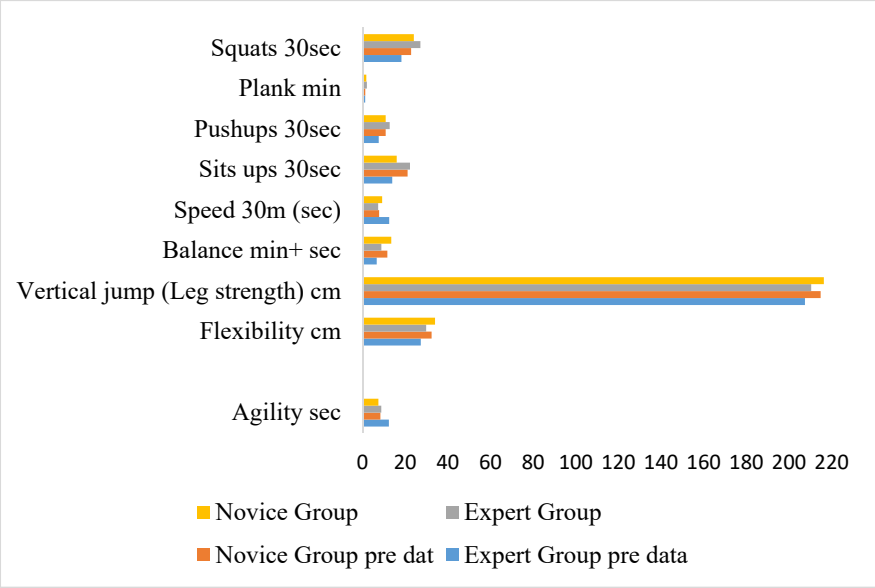


Figure 3 showed that the comparison of pre-and post-tested schoolboys in karate games was significantly different in the following measures as in agility $F$ (5.212) = $P$ (.030), Tukey post hoc depicts that control groups were inferiors than experimental groups in flexibility $F$ (10.706), $p$ (.003). After eight weeks of training the experimental group found a significant increase in flexibility than the counterpart group. In vertical jump for leg strength of schoolboys of karate, players were significantly different as $F$ (9.647), $p$ (.004), in comparison of pre and post-test data. The experimental group has significant improvements in vertical jump capacity. In the speed 30m shuttle race schoolboys in karate games were significantly different $F$ (74.815), $p$ (.000. In the sit-ups of schoolboys of karate games were significantly different, $F$ (10.788), $p$ (.003). The pushups of schoolboys in karate games were significantly different, $F$ (13.064), $p$ (.001). In the plank of schoolboys of karate game were significantly different, $F$ (10.031), $p$ (.004). In the half squats of schoolboys of karate game was significantly different, $F$ (14.235), $p$ (.001).

**Figure 3**

*Pre and Post-Physical Fitness of Experimental and Control Groups of The Karate Players*




## Discussion and Conclusion

This study concludes that combining strength training with karate training reduces obesity and fat in schoolboys. There are significant differences in skinfold triceps thickness between the experimental and novice groups. The total number of skinfolds in the experimental group was reduced after the 12-week strength-training program (Koutedakis & Sharp, 2004). This showed the fat and body mass reduction with strength training with karate training. The handgrip strength increased but not significantly between the group comparison of the experimental group and the control group (Madankumar, 2018). The agility performance was obtained to estimate the ability to rapidly change direction, accelerate, or decelerate. This study concludes that combining strength training with karate training increases the agility performance of schoolboys. This study concludes that combining strength training with karate training increases the agility performance of schoolboys. In a previous study, consistent speed, agility, and quickness training were shown to increase strike speed and agility in karate athletes (Purba 2021; Romanova et al., 2022). This study concludes that karate training increases flexibility as reported, the karate group generates maximum quadriceps flexibility (Franchini & Herrera-Valenzuela, 2021). This study concludes that karate schoolboys' vertical jump increased through strength and karate training. In the previous study, the vertical jump estimated the energy of the lower extremities through the movements of hips, knees, and ankles and confirmed the finding with the present study (Abidin & Adam, 2013; Vanrenterghem et al., 2004).

This study found that combining strength training with karate training improved balance which determines a person's capacity to control their body position (Ansari & Sharma, 2022). This study concludes that the combination of strength training and karate training substantially increased speed over a shorter period as supported by the findings of (Paradisis et al., 2014). The sit-up measurement estimates the strength of the abdominal muscles. This study concludes that the number of sit-ups significantly increased through strength training with karate training and strengthening the abdominal muscles. A previous study was used to assess abdominal power (Ovretveit & Toien 2018). This study concludes that the number of push-ups significantly increased through strength training with karate training and strengthened the upper body and muscle tone. The push-up measurement was taken to estimate muscle tone and strength in the upper body. This shows that the general strength and conditioning schooling (Brudnak et al., 2002). Planking improves stability which has a large effect (Broussal-Derval, 2019). Within the preceding examination plank boosts the metabolic rate and benefits middle energy (Kabadayı, 2023). Leg muscles supporting the leg shrunk (Grgic et al., 2021). This study concludes that Squats significantly increased the core strength of the body through strength training with karate training and increased numbers of Squats in the comparison of pre- and post-tested data.

In conclusion, strength and karate training significantly affect the performance of the experimental group than the control group in physical fitness measurements. Both training courses increased strength in muscles but strength training with karate training has more significant effects. Strength training with karate training reduces fats by minimizing the skinfolds, increasing hand grip strength, and reducing body mass.

## Reference


Abidin, N. Z., & Adam, M. B. (2013). Prediction of vertical jump height from anthropometric factors in male and female martial arts athletes. *PubMed*, *20*(1), 39–45. https://pubmed.ncbi.nlm.nih.gov/23785254
Google Scholar Worldcat Fulltext

Andrade, A., Flores, M. A., Andreato, L. V., & Coimbra, D. R. (2019). Physical and Training Characteristics of Mixed Martial Arts Athletes: Systematic review. *Strength and Conditioning Journal*, *41*(1), 51–63. https://doi.org/10.1519/ssc.0000000000000410
Google Scholar Worldcat Fulltext

Anglos, K. (2017). *Establishing a standardized fitness test battery for karate athletes*. https://dspace.library.uvic.ca/handle/1828/8032
Google Scholar Worldcat Fulltext

Ansari, S., & Sharma, S. (2022). Prevalence and risk factors of chronic low back pain in university athletes: a cross-sectional study. *The Physician and Sportsmedicine*, *51*(4), 361–370. https://doi.org/10.1080/00913847.2022.2108351
Google Scholar Worldcat Fulltext

Błaszczyszyn, M., Szcz□sna, A., Pawlyta, M., Marszałek, M., & Karczmit, D. (2019). Kinematic analysis of Mae-Geri kicks in beginner and advanced Kyokushin karate athletes. *International Journal of Environmental Research and Public Health*, *16*(17), 3155. https://doi.org/10.3390/ijerph16173155
Google Scholar Worldcat Fulltext

Broussal-Derval, A. (2019). Training and conditioning for judo. In *Human Kinetics eBooks*. https://doi.org/10.5040/9781718225732
Google Scholar Worldcat Fulltext

Brudnak, M. (2002). Probiotics as an adjuvant to detoxification protocols. *Medical Hypotheses*, *58*(5), 382–385. https://doi.org/10.1054/mehy.2001.1442
Google Scholar Worldcat Fulltext

Grgic, J. (2021). Effects of caffeine on resistance exercise: A review of recent research. *Sports Medicine*, *51*(11), 2281–2298. https://doi.org/10.1007/s40279-021-01521-x
Google Scholar Worldcat Fulltext

Hanson, E. D., Srivatsan, S. R., Agrawal, S., Menon, K. S., Delmonico, M. J., Wang, M. Q., & Hurley, B. F. (2009). Effects of strength training on physical function: influence of power, strength, and body composition. *The Journal of Strength and Conditioning Research*, *23*(9), 2627–2637. https://doi.org/10.1519/jsc.0b013e3181b2297b
Google Scholar Worldcat Fulltext

Hassan, S. (2018). The effects of Push-Up training on muscular strength and muscular endurance. *International Journal of Academic Research in Business and Social Sciences*, *8*(11). https://doi.org/10.6007/ijarbss/v8-i11/4940
Google Scholar Worldcat Fulltext

Hauschild, V. D., DeGroot, D. W., Hall, S. M., Grier, T. L., Deaver, K. D., Hauret, K. G., & Jones, B. H. (2016). Fitness tests and occupational tasks of military interest: a systematic review of correlations. *Occupational and Environmental Medicine*, *74*(2), 144–153. https://doi.org/10.1136/oemed-2016-103684
Google Scholar Worldcat Fulltext

Herman, I. P. (2011). *Physics of the human body*. https://cds.cern.ch/record/1339364/files/978-3-540-29604-1_BookTOC.pdf
Google Scholar Worldcat Fulltext

Işık, E. İ., & Başar, S. (2021). Pilates training in the elderly. *International Journal of Academic Medicine and Pharmacy*, *Volum: 3, Issue: 3*(Volum: 3, Issue: 3), 277–280. https://doi.org/10.29228/jamp.50599
Google Scholar Worldcat Fulltext

Jukić, I., Milanović, L., Hopvac, A., Filipović, M., Jukić, N., & Krakan, I. (2016). Physical conditioning in mixed martial arts: from evidence to practical experience. *Medicine in Combat Sports.*, 101–124. https://www.bib.irb.hr/944692
Google Scholar Worldcat Fulltext

Koutedakis, Y., & Sharp, N. C. C. (2004). Thigh-Muscles strength training, dance exercise, dynamometry, and anthropometry in professional ballerinas. *The Journal of Strength and Conditioning Research*, *18*(4), 714. https://doi.org/10.1519/13983.1
Google Scholar Worldcat Fulltext

Kerksick, C., Thomas, A., Campbell, B., Taylor, L., Wilborn, C., Marcello, B., Roberts, M., Pfau, E., Grimstvedt, M., Opusunju, J., Magrans-Courtney, T., Rasmussen, C., Wilson, R., & Kreider, R. B. (2009). Effects of a popular exercise and weight loss program on weight loss, body composition, energy expenditure and health in obese women. *Nutrition & Metabolism*, *6*(1). https://doi.org/10.1186/1743-7075-6-23
Google Scholar Worldcat Fulltext

Lawrence, G. (2019). Teaching Power Yoga for sports. In *Human Kinetics eBooks*. https://doi.org/10.5040/9781718225664
Google Scholar Worldcat Fulltext

Luo, S., Soh, K. G., Soh, K. L., Sun, H., Nasiruddin, N. J. M., Du, C., & Zhai, X. (2022). Effect of core training on skill performance among athletes: A Systematic review. *Frontiers in Physiology*, *13*. https://doi.org/10.3389/fphys.2022.915259
Google Scholar Worldcat Fulltext

Madankumar, S. (2018). *Improvement in handgrip strength in normal volunteers following selective sukshma vyayam practices: A Pilot randomized control trial*. http://repository-tnmgrmu.ac.in/10174/
Google Scholar Worldcat Fulltext

Nikookheslat, S. D., Faraji, H., Fatollahi, S., & Alizadeh, M. (2016). Physical and Physiological Profile of Elite Iranian Karate Athletes. *International Journal of Applied Exercise Physiology*, *5*(4),35-44.
Google Scholar Worldcat Fulltext

Olutekunbi, O. A., Solarin, A. U., Senbanjo, I. O., Disu, E. A., & Njokanma, O. F. (2018). Skinfold thickness measurement in term Nigerian neonates: Establishing reference values. *International Journal of Pediatrics*, *2018*, 1–10. https://doi.org/10.1155/2018/3624548
Google Scholar Worldcat Fulltext

Pal, M., Berhanu, G., Desalegn, C., & Kandi, V. (2020). Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-COV-2): An update. *Cureus*. https://doi.org/10.7759/cureus.7423
Google Scholar Worldcat Fulltext

Paradisis, G. P., Zacharogiannis, E., Mandila, D., Smirtiotou, A., Argeitaki, P., & Cooke, C. B. (2014). Multi-Stage 20-m shuttle run fitness test, maximal oxygen uptake and velocity at maximal oxygen uptake. *Journal of Human Kinetics*, *41*(1), 81–87. https://doi.org/10.2478/hukin-2014-0035
Google Scholar Worldcat Fulltext

Phung, J. N., & Goldberg, W. A. (2019). Promoting Executive Functioning in Children with Autism Spectrum Disorder Through Mixed Martial Arts Training. *Journal of Autism and Developmental Disorders*, *49*(9), 3669–3684. https://doi.org/10.1007/s10803-019-04072-3
Google Scholar Worldcat Fulltext

Purba, P. H. (2021). Contribution of Exercise Squat Jump Split and Training Twist Bar on The Improvement of Mae Geri Chudan Kick Speed on Athlete Karate Female of DOJO WADOKAI UNIMED in 2019. In *International Conference on Science, Education, and Technology (7*)1, 434-440.
Google Scholar Worldcat Fulltext

Rima, A. J. (2019). *Measurement of hand grip strength among healthy adults by modified sphygmomanometer: a normative study in BANGLADESH*. http://library.crp-bangladesh.org:8080/xmlui/handle/123456789/525
Google Scholar Worldcat Fulltext

Romanova, E., Kolokoltsev, M., Vorozheikin, A., Purtova, G., Zotin, V., Vrachinskaya, T., ... & Aganov, S. (2022). Speed abilities in Kyokushin karate at the stage of initial training in 9-10-year-old boys. *Journal of Physical Education and Sport*, *22* (10), 2406-2412.
Google Scholar Worldcat Fulltext

Slimani, M., Chaabene, H., Miarka, B., Franchini, E., Chamari, K., & Cheour, F. (2017). Kickboxing review: anthropometric, psychophysiological and activity profiles and injury epidemiology. *Biology of Sport*, *2*, 185–196. https://doi.org/10.5114/biolsport.2017.65338
Google Scholar Worldcat Fulltext

Stanley, E. R. (2020). *Maximal punching performance in amateur boxing: An examination of biomechanical and physical performance-related characteristics*. https://chesterrep.openrepository.com/handle/10034/623170
Google Scholar Worldcat Fulltext

Vanrenterghem, J., Lees, A., Lenoir, M., Aerts, P., & De Clercq, D. (2004). Performing the vertical jump: Movement adaptations for submaximal jumping. *Human Movement Science*, *22*(6), 713–727. https://doi.org/10.1016/j.humov.2003.11.001
Google Scholar Worldcat Fulltext

Wroble, R. R. (2009). Wrestling. *Combat sports medicine*, 215-245.
Google Scholar Worldcat Fulltext

Zulkarnain, A. N., Kristiyanto, A., & Rachma, N. (2021). Effectiveness body weight strength training and plyometrics in the speed and agility taekwondo athletes. *Jurnal SPORTIF Jurnal Penelitian Pembelajaran*, *7*(2), 219–231. https://doi.org/10.29407/js_unpgri.v7i2.15943
Google Scholar Worldcat Fulltext

Zemková, E., & Hamar, D. (2018). Sport-Specific assessment of the effectiveness of neuromuscular training in young athletes. *Frontiers in Physiology*, *9*. https://doi.org/10.3389/fphys.2018.00264
Google Scholar Worldcat Fulltext