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Submission date: 24-Jun-2025 02:13AM (UTC-0700)
Submission ID: 2705232104
File name: wOVsBob7tm3kCyDaHzP9.docx (279.66K)
Word count: 5089
Character count: 30607

HALAMAN OLAHRAGA NUSANTARA (HON)
Jurnal Ilmu Keolahragaan

Volume 4 no I
Tahun 2021

ISSN 2614-277X (Print)
ISSN 2621-814X (Online)

Combined Aerobic and Resistance Training to Improve of Forced Vital Capacity (FVC) in Young Athletes

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Abstract
The purpose of this study was to assess the effectiveness of an aerobic and resistance training program in improving forced vital capacity (FVC) in young athletes participating in the DBON program (Desain Besar Olahraga Nasional). The study included 19 participants aged 13 to 16, including 7 boys and 12 girls, who underwent a 15-week training program. To ensure measurement accuracy, FVC values were taken before and after the training program with a spirometer. The intervention resulted in a modest increase in FVC values in the male group, from 3.7±0.4 to 3.7±1.3 liters (p=0.509). Females had significantly lower FVC levels (3.4±1.1 liters vs. 3.9±2.7 liters) (p=0.047). Other variables, such as forced expiratory volume in one second (FEV1) and peak expiratory flow (PEF), showed no significant differences between the male and female groups before and after therapy. These findings indicate that both endurance and strength training can improve vital capacity, but the response may vary by gender. This work can be utilized to build individualized training programs for young athletes, taking into account sex-specific physiological characteristics to increase training effects and sports performance.
Keywords: *Forced Vital Capacity; Combined training; Aerobic and Resistance*
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INTRODUCTION

Forced Vital Capacity (FVC) is an important statistic for evaluating lung function and maximum respiratory capacity. It is strongly related to athletic performance, particularly in high-intensity sports. (Fernández-Lázaro et al. 2023; Mahotra et al. 2017; Malik, Malik, and Kumar 2017). FVC is a measurement of respiratory capacity that reveals the maximum volume of air that can be expelled after a complete inhalation. As a result, FVC is commonly used as a surrogate for assessing respiratory function and the physiological changes that occur during exercise. (Daw and Saha 2019; Durmic et al. 2017; Hasan, Taha, and Tawfeeq 2021). The importance of respiratory function is particularly important for young athletes because their respiratory systems are still developing. As a result, proper training may have long-term implications for ventilatory efficiency and oxygen diffusion capacity. (KAHRAMAN et al. 2023; Munadi et al. 2024; Şengür and Yaka 2024).

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Exercise in general, both aerobic and resistance-based, has been shown to improve numerous elements of lung function, including FVC (Brandao-Rangel et al. 2025; D, D, and D 2018; Silva-Reis, Rodrigues Brandao-Rangel, Moraes-Ferreira, Gonçalves-Alves, Souza-Palmeira, Aquino-Santos, Bachi, Oliveira, Lopes-Martins, Oliveira-Silva, Albertini, Frison, and Rodolfo P. Vieira 2022). Aerobic training induces changes in respiratory dynamics, such as an increase in tidal volume and a drop in ventilation frequency per minute at submaximal intensity. On the other hand, resistance training improves respiratory muscles, including the diaphragm and intercostal muscles (Chlif, Chaouachi, and Ahmaidi 2017; Koike and Ogawa 2025; Langer et al. 2018). However, studies examining the combined effects of both techniques remain limited, despite the fact that adaptive exercise physiology theory suggests that a multimodal strategy has the potential to improve adaptation results synergistically (Barha et al. 2017; BOLDT et al. 2021) In this context, it is possible to hypothesize that combined training has two effects: an increase in lung capacity due to cardiovascular exercise and an increase in maximum inspiratory and expiratory pressure as a result of strengthening respiratory muscles (Fan et al. 2024a; Hermes et al. 2015; dos Santos et al. 2019).

Nevertheless, the majority of literature discussing the relationship between combined training and respiratory function is more focused on adults or patients under medical supervision (e.g., individuals with COPD or cardiovascular conditions) (Francisco de Lima et al. 2024; Kourek et al. 2024; Tian et al. 2024), Only a few research have looked at its effect on groups of young athletes, notably those enrolled in Indonesia's National Sports Grand Design (DBON) program (Fitriani and Pangestika 2022; Masaji Dirgantara et al. 2024; Putriningtyas et al. 2024). The DBON approach emphasizes evidence-based training treatments to maximize athletes' physiological capabilities beginning at a young age. However, more study is needed to build complete respiratory training regimens. As a result, longitudinal research concentrating on individualized mixed training approaches for DBON athletes is required to close this gap.

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In this setting, the current research aims to assess the efficacy of integrated aerobic and resistance exercise in increasing FVC, which is a key metric for assessing athletes' respiratory capacity. It is expected that the findings of this research will make a substantial contribution to the creation of evidence-based training programs for Indonesian adolescent sportsmen. In practice, such a protocol would serve as the basis for creating training programs that not only improve overall physical performance but also concentrate on strengthening the respiratory system, which is essential for long-term athletic performance (Fan et al. 2024b; Silva-Reis, Rodrigues Brandao-Rangel, Moraes-Ferreira, Gonçalves-Alves, Souza-Palmeira, Aquino-Santos, Bachi, Oliveira, Lopes-Martins, Oliveira-Silva, Albertini, Frison, and Rodolfo P. Vieira 2022; Xu et al. 2023). As a result, this study is important both theoretically, in improving our knowledge of physiological responses to various training styles, and practically, in developing more appropriate training strategies to enable national sports success.

METOD

This study employs a quasi-experimental technique with a one-group pretestposttest design (Stratton 2019), The purpose of this study is to assess the efficacy of a combined aerobic and resistance training program in improving and changing Forced Vital Capacity (FVC) among adolescent athletes participating in the National Sports Grand Design (DBON) program.

Research Subject

The trial included 19 young athletes, aged 13 to 16, who were actively engaged in the DBON development program. The sample included seven men and twelve women representing four sporting disciplines: sport climbing, athletics, archery, and weightlifting. The sample was purposefully chosen based on inclusion criteria, which included being a registered DBON athlete, falling within the age range, having no history of chronic respiratory problems or medical conditions that would preclude participation, and agreeing to participate in the entire training and measurement procedure.

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Research Instrument

To ensure uniformity, spirometry-trained medical personnel took the readings. The surgery was carried out under standard conditions: participants sat straight, wearing a nasal clip to prevent air leakage, and were advised to exhale as hard and as long as possible after a maximum inhalation. Each person was measured three times, with the highest value serving as the primary data if the results were consistent. Demographic data and anthropometric measures such as Body Mass Index (BMI) were obtained for correlation analysis to confirm the instrument's validity. The study was organized into three main phases: preliminary testing, training intervention, and final testing.

Research Procedure

The initial testing occurred in January 2024, with all individuals obtaining their first FVC evaluation using standard spirometry techniques to determine baseline lung capacity. Following that, individuals took part in a 15-week mixed aerobic and resistance training program that included five training sessions each week. Each session included a warm-up, core exercises (circuit training, core strength, and resistance training), and a cool-down. The workouts were designed to gradually and periodically increase respiratory muscle strength and lung capacity, and they utilized equipment such as resistance bands, gym balls, body weight, and light weights. To preserve measurement consistency and reduce variance across time points, the last testing was carried out at the end of the training phase in April 2024, with the same methodology and settings as the first.

Data Analysis

The data was quantitatively evaluated using JASP software (Han and Dawson 2020). Prior to doing additional research, descriptive statistics were used to determine the sample characteristics and FVC distribution, which comprised participant averages, standard deviations, age ranges, and BMI. Before hypothesis testing, the Shapiro-Wilk normality test was used to investigate data distribution. To assess the efficiency of the training, a paired sample t-test was used to compare FVC values from the pretest and posttest within the same group. Furthermore,

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gender differences in intervention effects were examined using independent sample t-tests or Mann-Whitney tests. Pearson and Spearman correlation studies were utilized to look into the links between physiological variables like BMI, FVC, FEV1, and PEF. This investigation provides empirical data for assessing training efficacy and the effect of gender on physiological responses to the intervention.

RESULT AND DISCUSSION

The research included 19 people, 12 of them were female and 7 were male. Data on sample features such as age, height, weight, and Body Mass Index (BMI) were gathered. Table 1 present the mean and standard deviation (SD) for each variable assessed in this trial.

Tabel 1. Data characteristics sample

Variable	Male n= 7 mean ± sd	Female n = 12 mean ± sd
Age (years)	14.6 ±0.8	14.3 ± 0.9
Height (cm)	165.1 ± 3.9	161.3 ± 6.1
Berat (kg)	58.2 ± 9.0	55.9 ± 10.1
BMI (kg/m2)	21.5 ± 4.2	21.4 ± 3.1

Tabel 2. Respiratory responses

Variable	Male n = 7 mean ± sd		Female n = 12 mean ± sd	
	Pre	Post	Pre	Post
FVC (Liter/minutes)	3.7 ± 0.4	3.7 ± 1.3	3.9 ± 2.7*	3.4 ± 1.1
FEV1 (L)	3.0 ± 0.8	3.0 ± 1.5	2.5 ± 0.4	2.7 ± 0.7

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PEF (liter/minute)	6.1 ± 2.1	5.6 ± 2.7	5.3 ± 1.8	5.1 ± 1.5
BMI (kg)	21.5 ± 4.2	21.7 ± 4.1	21.4 ± 3.1	21.5 ± 2.8

*) Shows a significant difference in pre-training FVC between males and females ($p < 0.05$, $p = 0.047$, $t = 66.000$, with mann-whitney test)

According to the research, there were variations in post-intervention respiratory responses between male and female groups, with some being statistically significant. Concerning the FVC variable, which represents the total volume of air exhaled following deep inhalation, normality testing using the Shapiro-Wilk test revealed that FVC data for males both before (p = 0. 126) and after (p = 0. 509) the intervention were normally distributed, as p-values were greater than 0. 05. In contrast, postintervention FVC data for females showed a statistically significant result (p = 0. 002), implying a nonnormal distribution, but preintervention data showed normality (p = 0. 743). Nonetheless, a t-test comparing FVC values for males before and after the intervention revealed no statistically significant difference (t = 0. 191, p = 0. 851, with p > 0. 05), suggesting that the intervention had no effect on Forced Vital Capacity in males. Similarly, while females saw a decrease in FVC values (from 3. 908 to 3. 360), the t-test revealed that this change was not statistically significant (t = 0. 675, p = 0. 509, p > 0. 05), indicating that the difference was insufficient to be considered a significant effect of the intervention.

According to normality analysis, the FEV1 statistics for men both before and after the intervention were normally distributed (p = 0. 297 and p = 0. 622, p > 0. 05). In contrast, preintervention FEV1 data for females were normally distributed (p = 0. 122), but postintervention data were not (p = 0. 002). The t-test comparing FEV1 values in males revealed a modest, yet statistically insignificant increase (t = 1. 856, p = 0. 081, p > 0. 05). A modest reduction was observed in females, but this conclusion was again non-significant (t = 0. 492, p = 0. 629, p > 0. 05).

Regarding the PEF variable, which represents the maximum airflow rate during exhalation, normality testing revealed that both pre- and post-intervention

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PEF data in males (p = 0. 369 and p = 0. 618) and females (p = 0. 193 and p = 0. 714) were normally distributed (p > 0. 05). Despite a recorded fall in PEF values following the intervention in both groups (men from 6. 1 to 5. 6, females from 5. 27 to 5. 13), t-tests comparing PEF before and after the intervention revealed no significant changes in either men (t = 0. 924, p = 0. 369) or females (t = 0. 508, p = 0. 618), implying that the intervention had no substantial impact on PEF values in either group.

BMI (Body Mass Index) measurements were also performed to evaluate participants' physical health. BMI statistics for both males and females before and after the intervention were nonnormally distributed, with p values less than 0. 05, indicating that BMI data prior to the intervention were not normally distributed for both men (p = 0. 017) and females (p = 0. 032), while postintervention data were also nonnormally distributed (males p = 0. 006, females p = 0. 032). Nonetheless, ttests comparing BMI before and after the intervention in males (t = 0. 030, p = 0. 977) and females (t = 0. 161, p = 0. 874) found no statistically significant differences between groups, implying that the intervention had no major effect on weight changes

In general, there were no statistically significant changes in the evaluated variables associated with respiratory function or body mass status, with minor variations. The t-test analysis revealed no significant variations to be regarded as intervention effects on these variables. As a result, despite the fact that the statistics revealed minor differences, the intervention had no significant influence on the respiratory response or body mass status of the research group.

Table 3. Correlation

Variable		BMI	FVC	FEV1	PEF
1. BMI	Pearson's r (n)	—			
	p-value	—			
	Spearman's rho (tn)	—			

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Variable		BMI	FVC	FEV1	PEF
	p-value	—			
2. FVC	Pearson's r	0.575*	—		
	p-value	0.010	—		
	Spearman's rho	0.459*	—		
	p-value	0.048	—		
3. FEV1	Pearson's r	0.129	-0.025	—	
	p-value	0.599	0.918	—	
	Spearman's rho	0.076	0.286	—	
	p-value	0.759	0.235	—	
4. PEF	Pearson's r	-0.224	-0.534*	0.614**	
	p-value	0.356	0.019	0.005	
	Spearman's rho	-0.220	-0.270	0.523*	
	p-value	0.364	0.263	0.023	

* p < .05, ** p < .01, *** p < .001

According to the findings based on the Pearson and Spearman methods, there is a substantial positive link between BMI and FVC. This suggests that as BMI rises, so does functional lung capacity (FVC). This might indicate that, up to a point, an increase in body weight has an influence on the greatest volume of air that can be expelled from the lungs. However, it is critical to highlight that this does not prove causation; additional variables may be implicated.

A large negative correlation was also identified between PEF and FVC, meaning that as vital lung capacity increases, peak expiratory flow falls. This relationship could represent the difference between lung volume and airflow speed.

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Another significant relationship was identified between PEF and FEV1, demonstrating the link between expiratory volume in one second and an individual's ability to expel air quickly. Physiologically, this is possible because both are closely related to airway patency.

In contrast, no significant association was discovered between FEV1 or PEF and BMI. This shows that body mass index has no direct effect on quick expiratory capacity or the volume of air ejected in a single second, which may be affected by other factors such as airway condition and respiratory muscle strength.

Overall, these findings highlight the importance of examining many aspects of lung function while assessing how factors such as BMI affect respiratory health. The discovered relationships could serve as a platform for further research, such as evaluating causal links or the impact of influencing variables through regression approaches.

Discussion

1. General Interpretation

The goal of this study was to see how a mixed aerobic and weight training program improved Forced Vital Capacity (FVC) in young DBON participants. The data show that there was no statistically significant change in FVC in either the male or female groups during the 15-week treatment period. Although females had a lower FVC ($p = 0.047$), this has to be reevaluated because the t-test results were not statistically significant ($p = 0.509$), indicating uncertain physiological alterations. These data indicate that integrated training does not necessarily instantly improve lung capacity, especially in teenagers.

2. Comparison with Previous Research

Aerobic and strength training, in theory, benefit respiratory function. Aerobic activity improves breathing efficiency and oxygen usage, while strength training strengthens the muscles engaged in breathing, such as the diaphragm and intercostal muscles (Polla 2004; Silva-Reis, Rodrigues Brandao-Rangel, Moraes-Ferreira, Gonçalves-Alves, Souza-Palmeira, Aquino-Santos, Bachi, Oliveira,

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Lopes-Martins, Oliveira-Silva, Albertini, Frison, and Rodolfo P Vieira 2022) The combination of the two is thought to synergistically improve FVC, (C. Cheshier et al. 2022; Kuriakose and Mathew 2022; Moradians et al. 2016). However, the majority of these researches focused on adults or clinical patients rather than adolescent athletes, as in this trial. Regular exercise has been demonstrated to raise FVC in adolescents who play football; however, a more prolonged and focused intervention is required, according to research by (Rwitusmita, Horshajyoti, and Reeta 2014). Similarly, trials on individuals with pulmonary issues revealed that multitype training significantly improved lung function (Baek et al. 1991). These mixed results imply that combined training may need to be prolonged or intensified in order to produce substantial benefits in healthy adolescents with developing physical problems.

3. Analysis by Gender

The investigation found variances in replies between men and females. The female group showed a drop in FVC values, although the reduction was not statistically significant. Some studies suggest that estrogen influences lung tissue elasticity and airway resistance, resulting in distinct adaptive responses in females and males (HARMS and ROSENKRANZ 2008; Harms, Smith, and Kurti 2016). Furthermore, variations in the developmental stages of respiratory muscles may account for the different outcomes between the two groups (Hulzebos et al. 2018).

4. Correlation of Physiological Variables

Correlation analysis showed a significant positive correlation between FVC and BMI, suggesting that greater body weight (within normal limits) is associated with greater lung capacity. This suggests that a healthy BMI promotes lung morphology and respiratory muscle strength (Bekkers et al. 2015; Prado Peralta et al. 2017). However, the negative link between FVC and PEF indicates that an increase in lung capacity does not always correspond to an increase in peak airflow rate. This study highlights the need for a more complete understanding of airway efficiency and respiratory muscle coordination. In contrast, the positive relationship between FEV1 and PEF demonstrates that these two parameters suggest airway

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patency and quick respiratory performance (Da Silva et al. 2016). However, the lack of a significant relationship between BMI and both FEV1 and PEF suggests that BMI alone is not a reliable predictor of overall lung function. Aerobic ability, muscle fitness, and nutrition are also important factors (Zhou et al. 2024).

5. Practical and Theoretical Implications

This research emphasizes the necessity of a personalized strategy to respiratory training for adolescent athletes. Since there was no substantial increase in FVC, coaches and sports professionals should reconsider the intensity, duration, and advancement of training methods. In Indonesia, the creation of evidence-based respiratory training programs is still limited, making this research a first step toward developing more successful training protocols. Theoretically, these findings pave the path for further research into the efficacy of multimodal approaches in youth populations, taking into account hormones, physical maturity, and gender differences in training response. Furthermore, longitudinal studies with stringent control over external variables are required to reduce bias and increase result validity.

6. Research Limitations

This study had various limitations, including a small sample size, a gender imbalance, and no control group for comparison. The 15-week period of physical activity may not have been long enough to cause major changes, especially in physiological systems like breathing that require long-term adaptation. Furthermore, variations in the types of sports played by participants may have influenced baseline skills and training responses.

CONCLUSION

This study examined the usefulness of combining aerobic and resistance training in improving lung function, specifically Forced Vital Capacity (FVC), in young athletes participating in the DBON program. After 15 weeks, the intervention did not result in significant increases in FVC, FEV1, or Peak Expiratory Flow (PEF) in either male or female athletes. Despite not being clinically meaningful, female

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athletes demonstrated a statistically significant drop in FVC. The study discovered a strong positive association between Body Mass Index (BMI) and FVC, but no significant relationships between BMI and FEV1 or PEF. Meanwhile, the negative association between FVC and PEF suggests the presence of complex physiological processes that are not fully understood and require additional research. Overall, the data indicate that combination training does not usually improve pulmonary function in adolescent athletes. Adaptive responses may vary according to gender and anthropometric status. As a result, when developing training programs based on the DBON idea, individual aspects such as gender and body composition must be considered, and the multimodal training technique must be reassessed to increase accuracy and efficacy in increasing young athletes' respiratory capacity.

REFERENCES

Baek, H., Kyungeun Kim, B. C. Lee, Choong Ki Lee, D. Choi, Hi-Myung Park, Y. Kim, and Jong Suk Kim. 1991. "Effect of Intensive Training on Ventilatory Functions in Soccer Players." *Tuberculosis and Respiratory Diseases*.

Barha, Cindy K., Jennifer C. Davis, Ryan S. Falck, Lindsay S. Nagamatsu, and Teresa Liu-Ambrose. 2017. "Sex Differences in Exercise Efficacy to Improve Cognition: A Systematic Review and Meta-Analysis of Randomized Controlled Trials in Older Humans." *Frontiers in Neuroendocrinology* 46:71–85. doi: 10.1016/j.yfrne.2017.04.002.

Bekkers, Marga B., Alet H. Wijga, Ulrike Gehring, Gerard H. Koppelman, Johan C. de Jongste, Henriette A. Smit, and Bert Brunekreef. 2015. "BMI, Waist Circumference at 8 and 12 Years of Age and FVC and FEV1 at 12 Years of Age; the PIAMA Birth Cohort Study." *BMC Pulmonary Medicine* 15(1):39. doi: 10.1186/s12890-015-0032-0.

BOLDT, KEVIN, VENUS JOUMAA, JEANNINE TURNBULL, PAUL W. M. FEDAK, and WALTER HERZOG. 2021. "Mechanical and Structural Remodeling of Cardiac Muscle after Aerobic and Resistance Exercise Training in Rats." *Medicine & Science in Sports & Exercise* 53(8):1583–94. doi: 10.1249/MSS.0000000000002625.

Brandao-Rangel, Maysa Alves Rodrigues, Boris Brill, Guilherme Eustáquio Furtado, Catharine Cássia Lanna Freitas-Rolim, Anamei Silva-Reis, Victor

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Hugo Souza-Palmeira, Renilson Moraes-Ferreira, Vanessa Lopes-Silva, Regiane Albertini, Wendel Simões Fernandes, Sérgio César Ferreira, Ricardo César Alves Ferreira, Jose Roberto Mateus-Silva, Carlos Rocha Oliveira, Claudio Ricardo Frison, and Rodolfo P. Vieira. 2025. "Exercise-Driven Comprehensive Recovery: Pulmonary Rehabilitation's Impact on Lung Function, Mechanics, and Immune Response in Post-COVID-19 Patients." *Infectious Disease Reports* 17(1):1–16. doi: 10.3390/idr17010001.

C. Cheshier, Brandie, Bert H. Jacobson, Carlos A. Estrada, Masoud Moghaddam, and Carter J. Stewart. 2022. "Effects of a Respiratory Resistance Mask on Forced Expiratory Volume at 1s (FEV1), Forced Vital Capacity (FVC) and the Ratio of FEV1/FVC Lung Function Following High Intensity Training (HIT)." *International Journal of Physical Education, Fitness and Sports* 11(2):28–34. doi: 10.34256/ijpefs2224.

Chlif, Mehdi, Anis Chaouachi, and Said Ahmaidi. 2017. "Effect of Aerobic Exercise Training on Ventilatory Efficiency and Respiratory Drive in Obese Subjects." *Respiratory Care* 62(7):936–46. doi: 10.4187/respcare.04923.

D, Masoud Moeini Ph, Mojtaba Eizadi Ph D, and Shahram Sohaily Ph D. 2018. "Effect of Aerobic Training on Total Antioxidant Capacity and Pulmonary Function in Asmatic Men." 20(2):2018.

Daw, Sumanta, and Gopal Chandra Saha. 2019. "A Comparative Study of Cardio Respiratory Efficiency between Aquatic and Track and Field Performers." *World Academy of Science, Engineering and Technology International Journal of Sport and Health Sciences* 13(10):450–53.

Durmic, Tijana, Biljana Lazovic Popovic, Mirjana Zlatkovic Svenda, Marina Djelic, Vladimir Zugic, Tamara Gavrilovic, Zoran Mihailovic, Marija Zdravkovic, and Roman Leischik. 2017. "The Training Type Influence on Male Elite Athletes' Ventilatory Function." *BMJ Open Sport and Exercise Medicine* 3(1):1–5. doi: 10.1136/bmjsem-2017-000240.

Fan, Yuncai, Yucheng Duan, Zhiqing Gao, and Yong Liu. 2024a. "Inspiratory Muscle Resistance Combined with Strength Training: Effects on Aerobic Capacity in Artistic Swimmers." *Frontiers in Sports and Active Living* 6(December):1–7. doi: 10.3389/fspor.2024.1476344.

Fan, Yuncai, Yucheng Duan, Zhiqing Gao, and Yong Liu. 2024b. "Inspiratory Muscle Resistance Combined with Strength Training: Effects on Aerobic Capacity in Artistic Swimmers." *Frontiers in Sports and Active Living* 6. doi: 10.3389/fspor.2024.1476344.

Fernández-Lázaro, Diego, Luis A. Corchete, Juan F. García, David Jerves Donoso,

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situs web: http://www.univpgri-palembang.ac.id

Eva Lantarón-Caeiro, Raúl Cobreros Mielgo, Juan Mielgo-Ayuso, David Gallego-Gallego, and Jesús Seco-Calvo. 2023. "Effects on Respiratory Pressures, Spirometry Biomarkers, and Sports Performance after Inspiratory Muscle Training in a Physically Active Population by Powerbreath®: A Systematic Review and Meta-Analysis." *Biology* 12(1). doi: 10.3390/biology12010056.

Fitriani, Anna, and Rismawati Pangestika. 2022. "PENDAMPINGAN PENILAIAN STATUS HIDRASI MENINGKATKAN PENGETAHUAN DAN ASUPAN CAIRAN ATLET SEPAKBOLA U13-18." *JMM (Jurnal Masyarakat Mandiri)* 6(5). doi: 10.31764/jmm.v6i5.10157.

Francisco de Lima, Fabiano, Carlos Augusto Marçal Camillo, Isis Grigoletto, Juliana Uzeloto, Franciele Marques Vanderlei, Dionei Ramos, Chris Burtin, and Ercy Mara Cipulo Ramos. 2024. "Combining Functional Exercises with Exercise Training in COPD: A Randomized Controlled Trial." *Physiotherapy Theory and Practice* 40(5):952–61. doi: 10.1080/09593985.2022.2148146.

Han, Hyemin, and Kelsie J. Dawson. 2020. "JASP (Software)."

HARMS, CRAIG A., and SARA ROSENKRANZ. 2008. "Sex Differences in Pulmonary Function during Exercise." *Medicine & Science in Sports & Exercise* 40(4):664–68. doi: 10.1249/MSS.0b013e3181621325.

Harms, Craig A., Joshua R. Smith, and Stephanie P. Kurti. 2016. "Sex Differences in Normal Pulmonary Structure and Function at Rest and During Exercise." Pp. 1–26 in.

Hasan, Mazin Sami, Ahmed Abdulgani Taha, and Rebaz Baiz Tawfeeq. 2021. "Effects of Two Types of Warm-up Exercises on Vital Capacity and Forced Vital Capacity Values." *Sport Mont* 19(3):59–64. doi: 10.26773/smj.211015.

Hermes, Bárbara Maria, Dannuey Machado Cardoso, Tiago José Nardi Gomes, Tamires Daros dos Santos, Marília Severo Vicente, Sérgio Nunes Pereira, Viviane Acunha Barbosa, and Isabella Martins de Albuquerque. 2015. "Short-Term Inspiratory Muscle Training Associated with Combined Aerobic and Resistance Training Is Benefic in Patients Undergoing CABG Surgery in Phase II Cardiac Rehabilitation Program." *Revista Brasileira de Cirurgia Cardiovascular*. doi: 10.5935/1678-9741.20150043.

Hulzebos, Erik, Tim Takken, Elja A. Reijneveld, Mark M. G. Mulder, and Bart C. Bongers. 2018. "Reference Values for Respiratory Muscle Strength in Children and Adolescents." *Respiration* 95(4):235–43. doi: 10.1159/000485464.

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KAHRAMAN, Muhammed Zahit, Sedat OKUT, Cengizhan SARI, Ömer Faruk BİLİCİ, and Fatih BİLİCİ. 2023. "The Effect of Athletics and Football Training Characteristics on Some Respiratory Parameters in Female Athletes." *Turkish Journal of Kinesiology* 9(1):52–58. doi: 10.31459/turkjkin.1258836.

Koike, Jun, and Takeshi Ogawa. 2025. "Effect of Inspiratory Muscle-Loaded Exercise Training on Ventilatory Response and Intercostal Muscle Deoxygenation During Incremental Cycling Exercise." *Research Quarterly for Exercise and Sport* 96(1):62–74. doi: 10.1080/02701367.2024.2365291.

Kourek, Christos, Antonia Zachariou, Eleftherios Karatzanos, Michalis Antonopoulos, Theodora Soulele, Andreas Karabinis, Serafim Nanas, and Stavros Dimopoulos. 2024. "Effects of Combined Aerobic, Resistance and Inspiratory Training in Patients with Pulmonary Hypertension: A Systematic Review." *World Journal of Critical Care Medicine* 13(2). doi: 10.5492/wjccm.v13.i2.92585.

Kuriakose, Anu, and Princy Mathew. 2022. "Effectiveness of Aerobic Exercise Versus Resistance Training on Lung Function among Female Physiotherapy Undergraduate Students." *International Journal of Science and Research (IJSR)* 11(3):1256–60. doi: 10.21275/SR22214154043.

Langer, Daniel, Casey Ciavaglia, Azmy Faisal, Katherine A. Webb, J. Alberto Neder, Rik Gosselink, Sauwaluk Dacha, Marko Topalovic, Anna Ivanova, and Denis E. O'Donnell. 2018. "Inspiratory Muscle Training Reduces Diaphragm Activation and Dyspnea during Exercise in COPD." *Journal of Applied Physiology* 125(2):381–92. doi: 10.1152/japplphysiol.01078.2017.

Mahotra, N. B., T. M. Amatya, B. SJB Rana, and D. Banstola. 2017. "Effects of Exercise on Pulmonary Function Tests: A Comparative Study between Athletes and Non-Athletes in Nepalese Settings." *Journal of Chitwan Medical College* 6(1):21–23. doi: 10.3126/jcmc.v6i1.16575.

Malik, Dr. Arvind, Dr. Sonia Malik, and Satender Kumar. 2017. "Sports Specific Influence on Force Vital Capacity in University Players." *IOSR Journal of Sports and Physical Education* 04(02):06–09. doi: 10.9790/6737-04020609.

Masaji Dirgantara, Hijrin Fithroni, Heri Wahyudi, and Abdul Aziz Hakim. 2024. "Evaluasi Program Sentra Latihan Olahragawan Muda Potensial Nasional Universitas Negeri Surabaya." *Jurnal Kajian Dan Penelitian Umum* 2(1):98–110. doi: 10.47861/jkpu-nalanda.v2i1.846.

Moradians, Vahan, Alireza Rahimi, Seyed Ali Javad Moosavi, Fateme Sadat Sahebkar Khorasani, Ali Mazaherinejad, Masoud Mortezazade, and Hanieh Raji. 2016. "Effect of Eight-Week Aerobic, Resistive, and Interval Exercise

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Routines on Respiratory Parameters in Non-Athlete Women." *Tanaffos* 15(2):96–100.

Munadi, Munadi, Rachmad Suhanda, Zulkarnain Zulkarnain, Mulkan Azhari, and Winda Yulia. 2024. "Optimization of Lung Vital Capacity to Improve Athlete Fitness." *Journal of Social Research* 3(4):1010–17. doi: 10.55324/josr.v3i4.1988.

Polla, B. 2004. "Respiratory Muscle Fibres: Specialisation and Plasticity." *Thorax* 59(9):808–17. doi: 10.1136/thx.2003.009894.

Prado Peralta, Gabriela, Elaine Fuertes, Judith Garcia-Aymerich, John Henderson, and Debbie Jarvis. 2017. "Lean Body Mass Is Positively Associated with Lung Function at Age 15." P. OA501 in *Paediatric Respiratory Epidemiology*. European Respiratory Society.

Putriningtyas, Natalia Desy, Widya Hary Cahyati, Tandiyo Rahayu, and Latifah Rachmawati. 2024. "Sosialisasi Gizi Bagi Atlet Angkat Besi Di Sentra Latihan Olahragawan Muda Potensial Nasional Semarang." *Jurnal Kreativitas Pengabdian Kepada Masyarakat (PKM)* 7(6):2639–50. doi: 10.33024/jkpm.v7i6.14861.

Rwitusmita, Bharali, Chutia Horshajyoti, and B. Reeta. 2014. "Chronic Aerobic Exercise-a Boon to Pulmonary Functions."

dos Santos, Tamires Daros, Sergio Nunes Pereira, Luiz Osório Cruz Portela, Dannuey Machado Cardoso, Pedro Dal Lago, Naiara dos Santos Guarda, Rafael Noal Moresco, Marisa Bastos Pereira, and Isabella Martins de Albuquerque. 2019. "Moderate-to-High Intensity Inspiratory Muscle Training Improves the Effects of Combined Training on Exercise Capacity in Patients after Coronary Artery Bypass Graft Surgery: A Randomized Clinical Trial." *International Journal of Cardiology* 279:40–46. doi: 10.1016/j.ijcard.2018.12.013.

Şengür, Emrah, and Zehra Yaka. 2024. "Investigation of the Effect of Core Exercises Applied to Football Players on Respiratory Parameters." 01027.

Silva-Reis, Anamei, Maysa Alves Rodrigues Brandao-Rangel, Renilson Moraes-Ferreira, Thiago Gibson Gonçalves-Alves, Victor Hugo Souza-Palmeira, Helida Cristina Aquino-Santos, Andre Luis Lacerda Bachi, Luis Vicente Franco de Oliveira, Rodrigo Álvaro Brandão Lopes-Martins, Iranse Oliveira-Silva, Regiane Albertini, Claudio Ricardo Frison, and Rodolfo P. Vieira. 2022. "Combined Resistance and Aerobic Training Improves Lung Function and Mechanics and Fibrotic Biomarkers in Overweight and Obese Women." *Frontiers in Physiology* 13(September):1–14. doi:

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10.3389/fphys.2022.946402.

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Da Silva, Bruna Gonçalves Cordeiro, Fernando César Wehrmeister, Philip H. Quanjer, Rogelio Pérez-Padilla, Helen Gonçalves, Bernardo Lessa Horta, Pedro Curi Hallal, Fernando Barros, and Ana Maria Baptista Menezes. 2016. "Physical Activity in Early Adolescence and Pulmonary Function Gain from 15 to 18 Years of Age in a Birth Cohort in Brazil." *Journal of Physical Activity and Health* 13(11):1164–73. doi: 10.1123/jpah.2016-0056.

Stratton, Samuel J. 2019. "Quasi-Experimental Design (Pre-Test and Post-Test Studies) in Prehospital and Disaster Research." *Prehospital and Disaster Medicine* 34(6):573–74. doi: 10.1017/S1049023X19005053.

Tian, Xu, Fangrong Liu, Feili Li, Yi Ren, and Hongcai Shang. 2024. "A Network Meta-Analysis of Aerobic , Resistance , Endurance , and High-Intensity Interval Training to Prioritize Exercise for Stable COPD." *International Journal of Chronic Obstructive Pulmonary Disease* (September).

Xu, Yiming, Donghong Yang, Beibei Lu, Yin Zhang, Lei Ren, and Honghua Shen. 2023. "Efficacy of Aerobic Training and Resistance Training Combined with External Diaphragm Pacing in Patients with Chronic Obstructive Pulmonary Disease: A Randomized Controlled Study." *Clinical Rehabilitation* 37(11):1479–91. doi: 10.1177/02692155231172005.

Zhou, Jiacai, Linlin You, Xin Zhou, and Yuying Li. 2024. "Associations between Metabolic Score for Visceral Fat and Adult Lung Functions from NHANES 2007–2012." *Frontiers in Nutrition* 11. doi: 10.3389/fnut.2024.1436652.

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