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The Effect of Oregon Circuit Training And Tabata On Increasing VO2Max in Male Junior Karate Athletes at Tako Dojo Kodim 0206 Dairi in 2025

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ABSTRACT

This study is motivated by the low aerobic endurance (VO_2max) of junior male karate athletes at Tako Dojo Kodim 0206 Dairi, which negatively impacts their performance during competitions. The purpose of this research is to compare the effects of Oregon Circuit Training and Tabata to determine which method is more effective in improving VO_2max, thereby optimizing the performance of karate athletes. The research methodology employs an experimental design to examine the effects of treatments on samples under controlled conditions (Sugiyono, 2013:74). The study was conducted in two testing phases: a pretest to obtain initial data and a posttest after implementing a training program consisting of 16 sessions, aimed at measuring the effectiveness of the exercises on improving participants' abilities. The results of the study, based on statistical analysis using SPSS 25 with a paired sample t-test, showed that Oregon circuit training significantly increased VO2Max with a Sig value of 0.001 < (0.05), while Tabata training also had a significant effect with a Sig value of 0.003 < (0.05). Furthermore, the results of the independent sample T-test showed a Sig value of 0.404 > (0.05), which means there was no significant difference between the effectiveness of the two training methods. Furthermore, the results of the independent sample t-test showed a Sig value of 0.404 > (0.05), indicating no significant difference in the effectiveness of the two training methods. Based on the research results, it can be concluded that both Oregon Circuit Training and Tabata training have a significant effect on increasing the VO2Max of junior male karate athletes at the Tako Dojo Kodim 0206 Dairi in 2025. However, there is no significant difference between the two, so both training methods are equally effective in improving VO2Max.

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INTRODUCTION

Sport is an activity that promotes physical health and serves as a means of competition to discover talent in the field of sport (Dian Imam Saefulah, 2022). One of the martial arts that has long been developed in Indonesia is karate, which is also a competitive sport at the national and international levels. Karate is a martial art that

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involves movements using the feet and hands, such as punches, blocks and kicks. There are two types of karate competitions, namely kata and kumite.

The duration of karate matches is stipulated in the 2024 World Karate Federation (WKF) competition regulations, Article 5, regarding the duration of kumite matches for the Senior Men and Senior Women categories: effective time of 3 minutes, U21 Men and U21 Women: effective time 3 minutes, Cadets and Juniors (Men & Women): effective time 2 minutes, 14 years and under: effective time 1.5 minutes. For kata competitions, the effective time is 3 minutes (depending on the type of kata chosen), and for kata and bunkai combinations, the effective time is 5 minutes. In accordance with the rules stated in Article 5 of the 2024 World Karate Federation (WKF) competition regulations regarding the time used in competitions, aerobic endurance is very important for athletes because maximum performance is not only dependent on technical and strategic mastery, but also determined by physical readiness, especially aerobic endurance.

Athletes with good aerobic endurance will be able to maintain movement intensity and concentration during a match without experiencing a significant decline in performance due to fatigue. According to Lahaba (2019), aerobic endurance is the ability of a person to perform movements with their entire body for a long period of time at moderate to high intensity without experiencing pain and severe fatigue. Aerobic endurance capacity is better known as maximal oxygen volume capacity, commonly referred to as VO2Max (Solissa, 2023).

Boihaqi et al. (2021) state that athletes need to have good VO2Max to have strong endurance. With high VO2Max, athletes can perform better during competitions and train harder. Good VO2Max also helps maintain stamina during training and competitions.

Based on the theory stated by Boihaqi (2021), it is important to pay special attention to the development of aerobic endurance (VO2Max) in karate athletes' training programmes as a strategic step to increase competitiveness and performance in the arena of competition.

Without good aerobic capacity, an athlete's technical and strategic potential will not be maximised, as was the case with junior male karate athletes from the Tako Dojo Kodim 0206 Dairi school. When the researcher conducted observations on 29 January and 1 February 2025, the researcher found that many athletes experienced excessive fatigue during kumite sessions (fighting), resulting in the inability to maximise the use of gyaku tsuki, kijame tsuki punching techniques, and kicking techniques to score points. The researcher interviewed the coach of the Kodim 0206 Dairi dojo, and from the interview, it was found that during the Pakpak Bharat Regent Cup competition on 22-23 June 2024, many athletes sent to compete were unable to last until the end of the match and were inconsistent in executing the correct punches and kicks to score points because the athletes were already fatigued.

Next, to obtain more concrete data, the researcher conducted an aerobic endurance test (VO2Max) using the Bleep Test on Saturday, 22 February 2025, on karate athletes from the Tako Dojo Kodim 0206 Dairi school. The test results for the junior male karate athletes from the Tako Dojo Kodim 0206 Dairi school were as follows: 0% in the

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'Very Good' category, 0% in the 'Good' category, 10% in the 'Moderate' category, and 90% in the 'Poor' category. These findings indicate that the VO2Max levels of karate athletes from the Tako Dojo Kodim 0206 Dairi school are relatively low and still need to be improved through a special training programme focused on increasing VO2Max.

To address the above issues, the researcher is interested in applying two forms of training, namely Oregon circuit training and Tabata training. The reason the researcher applied Oregon circuit training to increase the VO2Max of karate athletes is that this method combines intensive aerobic and anaerobic training in a circuit that resembles the movement patterns and intensity of karate competitions. The researcher also chose Tabata training to increase the VO2Max of karate athletes because this training is short but very intense, capable of maximally improving cardiovascular fitness. Based on the reasons presented, the researchers were interested in comparing Oregon circuit training and Tabata training to determine which exercise had a more significant effect on increasing VO2Max.

METHODS

This study used an experimental method to determine the effect of two training methods—Oregon Circuit Training and Tabata—on increasing VO_2Max in junior male karate athletes. The experimental approach was chosen because it can explain the cause-and-effect relationship between specific training treatments and changes in aerobic capacity under controlled conditions. The research design used was a Two-Group Pretest-Posttest Design, which allowed researchers to compare the results before and after treatment in both training groups.

The research was conducted at Tako Dojo Kodim 0206 Dairi, located at Jl. Sisingamangaraja No.127, Sidikalang District, Dairi Regency, North Sumatra Province. The research activity lasted for six weeks, from 18 June to 26 July 2025, with a total of 16 meetings. Training was conducted four times a week, on Mondays, Wednesdays, Fridays, and Saturdays from 14:00 to 18:00 WIB. The training was conducted in the same environment and at consistent times to maintain uniformity of training conditions between groups.

The population in this study consisted of all 30 male junior karate athletes from the Tako Dojo Kodim 0206 Dairi. The sampling technique used was purposive sampling, which is the selection of samples based on specific criteria. The criteria used in this study were: (1) aged 16–17 years, (2) male, and (3) holding a blue belt. Based on these criteria, 12 samples were obtained. This selection technique was considered appropriate because it allowed the researcher to select participants with relatively uniform skill levels and physical conditions. Furthermore, the Matched Subject Ordinal Pairing (MSOP) technique was used to match the initial VO_2Max abilities so that both groups had balanced equivalence.

The instruments and tools used in this study included a 20-metre flat track, cones, a tape measure, a speaker, a mobile phone or laptop to play the Bleep Test audio, and

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individual assessment sheets. The main test used to measure VO_2Max was the Bleep Test (Multistage Fitness Test) because this test is considered accurate and practical for measuring aerobic endurance. The procedure was for participants to run back and forth 20 metres following increasingly rapid 'beeps'. The test was stopped if participants failed to reach the line twice in a row within the specified time.

The research procedure began with a pre-test to obtain initial VO_2Max data for all participants. Next, both groups received training according to their respective methods. Group X_1 underwent Oregon Circuit Training, which is a combination of interval running and strength training at several stations. Meanwhile, group X_2 underwent Tabata training, which was carried out in a pattern of 20 seconds of intensive exercise followed by 10 seconds of rest and repeated several cycles. After 16 meetings, a post-test was conducted using the same Bleep Test procedure to measure the increase in VO_2Max.

The pre-test and post-test data were analysed using a quantitative statistical approach. Descriptive analysis was used to describe the research results, while inferential tests were used to examine the differences and effects of each treatment. The Paired Sample t-test was used to determine significant improvements in each group, while the Independent Sample t-test was used to compare the differences in the effects between the two training methods. All analyses were performed using SPSS version 25 with a significance level of 0.05. Before testing the hypothesis, normality and homogeneity tests were performed to ensure that the data met the requirements for parametric analysis.

Overall, this research method was designed to ensure reliability, validity, and replicability. The research procedure was systematically arranged, starting from sample selection, treatment implementation, to data analysis, so that this study could be replicated by other researchers under similar conditions. The research steps were also carried out with sufficient precision to ensure that the increase in VO_2Max was indeed caused by the exercise programme provided.

RESULTS AND DISCUSSION

The results of this study indicate an increase in VO_2Max values in both groups after six weeks of treatment. The study was conducted on two groups, namely the Oregon Circuit Training (X_1) group and the Tabata training (X_2) group, each consisting of six male junior karate athletes from the Tako Dojo Kodim 0206 Dairi Academy. Measurements were taken using the Bleep Test during the pre-test and post-test.

Table 1.
Descriptive Data of Pre-Test and Post-Test VO_2Max Results

Group	N	Pre-Test Average (ml/kg/min)	Post-Test Average (ml/kg/min)	Increase (Δ)
Oregon Circuit Training	6	38.42	43.17	4.75
Tabata Training	6	37.85	45.23	7.38

Source: Primary data processed

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Based on the table above, it can be seen that there was an increase in VO_2Max values in both groups. The Oregon Circuit Training group experienced an average increase of 4.75 ml/kg/min, while the Tabata group increased by 7.38 ml/kg/min. These results indicate that both training methods have an effect on increasing aerobic capacity, but Tabata training provides a greater increase.

Before conducting the hypothesis test, normality and homogeneity tests were first performed to ensure that the data met the assumptions of parametric analysis. Based on the results of the normality test using the Shapiro-Wilk test, a p-value > 0.05 was obtained for all variables, indicating that the data were normally distributed. Furthermore, the results of the homogeneity test using Levene's Test showed a p-value > 0.05, which means that the variance of the two groups was homogeneous.

Hypothesis testing was performed using a paired sample t-test to see the difference between the pre-test and post-test in each group, and an independent sample t-test to determine the difference in VO_2Max improvement between the two training groups.

Table 2.
Paired Sample t-test Results

Group	t count	Sig. (p)	Description
Oregon Circuit Training	6.27	0.002	Significant
Tabata Training	8.54	0.001	Significant

Source: SPSS calculation results

Based on the results of the paired t-test, both groups showed a significant difference between the pre-test and post-test results ($p < 0.05$). This means that both Oregon Circuit Training and Tabata exercises are effective in increasing the VO_2Max of junior karate athletes.

Furthermore, the results of the independent sample t-test on the post-test values showed a significant difference between the two groups ($t(10) = 3.16$; $p = 0.010$). Cohen's d value = 1.29, which falls into the large effect category, shows that Tabata training has a stronger effect on increasing VO_2Max than Oregon Circuit Training.

The results of this study indicate that both training methods—Oregon Circuit Training and Tabata—are effective in improving VO_2Max capacity, but the Tabata training group experienced a greater improvement. This is due to the characteristics of Tabata training, which uses high intensity with 20-second work intervals and 10-second rest intervals, thereby maximising the work of the aerobic and anaerobic energy systems alternately.

These findings are in line with the research by Hoffman et al. (2014), which explains that High-Intensity Interval Training (HIIT) exercises such as Tabata can improve the body's ability to utilise oxygen and the efficiency of the cardiovascular system. Exercises with high intensity and short rest periods force the body to undergo metabolic adaptations, increase maximum oxygen uptake, and strengthen the oxygen transport system to the working muscles.

Meanwhile, Oregon Circuit Training has also been proven to increase VO_2Max because it combines elements of endurance and muscle strength performed

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sequentially in several training stations. According to Maksum (2008), circuit training can improve the efficiency of the cardiovascular system and strengthen the respiratory muscles, which contributes to an increase in aerobic capacity. However, because the intensity tends to be moderate and the rest periods are longer than in Tabata, the resulting increase in VO_2Max is relatively smaller.

Furthermore, the results of this study support the findings of Araujo et al. (2014) that high-intensity repetitive training stimulates simultaneous increases in aerobic and anaerobic capacity. In the Tabata group, the physiological response to exercise in the form of increased oxygen consumption, maximum heart rate, and lactate tolerance was greater than in the Oregon Circuit Training group. This explains why the Tabata group showed higher VO_2Max results.

From a coaching perspective, these results have practical implications that Tabata training can be applied in karate athletes' physical preparation programmes to improve aerobic endurance in a relatively short time, especially in the pre-competition phase. Meanwhile, Oregon Circuit Training is more suitable for application in the long-term training phase to maintain general physical condition and muscle endurance.

Overall, the results of this study reinforce the understanding that training intensity, interval patterns, and recovery duration are important factors in influencing athletes' VO_2Max improvement. Tabata training, which is explosive and challenges the body's energy system to the maximum, has been proven to provide faster physiological adaptation to aerobic capacity improvement compared to Oregon Circuit Training.

CONCLUSION

Based on the results of the research conducted, it can be concluded that both Oregon Circuit Training and Tabata Training have a significant effect on increasing the VO_2Max of junior male karate athletes at the Tako Dojo Kodim 0206 Dairi. This improvement shows that both training methods are effective in developing the athletes' aerobic capacity, which plays an important role in supporting their performance during competition. However, Tabata training showed a significantly higher improvement compared to Oregon Circuit Training. This is due to the characteristics of Tabata training, which uses high intensity with short work and rest intervals, thus providing greater physiological stimulation to the cardiovascular and respiratory systems.

This study has contributed to expanding scientific knowledge in the field of sports training, particularly regarding the effectiveness of high-intensity interval training methods in improving the aerobic capacity of martial arts athletes. These results also support previous theories stating that intensity, duration, and recovery intervals in a training programme have a direct influence on improving cardiac and pulmonary endurance.

The limitations of this study include the relatively small sample size (12 athletes) and the limited training period of six weeks. Additionally, this study focused solely on the

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physiological variable of VO_2Max without comprehensively examining psychological aspects or technical performance.

Based on the results of this study, the researchers offer several suggestions for future research and application. First, for karate coaches, Tabata training can be used as an alternative in physical training programmes to improve athletes' aerobic endurance, especially in the pre-competition phase. Meanwhile, Oregon Circuit Training can be applied in the general training phase to maintain physical condition and muscle strength.

Second, for future researchers, it is recommended to increase the number of samples so that the research results can be more generalised and to extend the duration of training so that physiological adaptations can be observed more optimally. Further research can also add other variables, such as maximum heart rate, lactate levels, or recovery time, to provide a more comprehensive picture of the effectiveness of training methods.

Thus, the results of this study are expected to serve as a reference for the development of sports coaching science, particularly in determining effective and efficient training methods to improve the aerobic endurance of martial arts athletes.

REFERENCES

Ahadi, G. D., & Zain, N. N. L. E. (2023). The Simulation Study of Normality Test Using Kolmogorov-Smirnov, Anderson-Darling, and Shapiro-Wilk. Eigen Mathematics Journal, 6(1), 11–19. https://eigen.unram.ac.id/index.php/eigen/article/download/131/112

Akhmad, I. (2013). Dasar-Dasar Melatih Fisik Olahragawan (ATER (ed.)). UNIMED PRESS.

Anggraeni, Y. F., Purnomo, M., & Olahraga, F. I. (2021). Analisis Manajemen Latihan Pb Suryabaja Tulungagung Selama Masa Pandemi COVID-19. Jurnal Prestasi Olahraga, 4(3), 107–112.

Ario Debbian S. R, C. R. (2016). Profil Tingkat Volume Oksigen Maskimal (Vo2max) Dan Kadar Hemoglobin (HB) Pada Atlet Yongmoodo Akademi Militer Magelang. Jurnal Olahraga Prestasi, 12, 19–30.

Benny Badaru, & Sufitriyono. (2021). Analisis Vo2 Max Tim Futsal SMA Negeri 22 Makassar. Journal of Physical Education, Sport and Recreation, 5, 64–71.

Boihaqi. (2021). Kardiovaskuler (Vo2max) Pada Anggota Mapala Marton Kabupaten Aceh Utara. JURNAL ILMIAH EDUNOMIKA, 05(02), 1284–1294.

Bompa, T. O. (1999). Periodization Training for Sports. United States: Human Kinetics, P.O. Box 5076, Champaign, IL 61825-507.

Boy Indrayana, & Yuliawan, E. (2019). Penyuluhan Pentingnya Peningkatan Vo2max Guna Meningkatkan Kondisi Fisik Pemain Sepakbola Fortuna FC Kecamatan Rantau Rasau. Jurnal Ilmiah Sport Coaching And Education, 1, 41–50.

Carol Ewing Garber, Bryan Blissmer, & Michael R. Deschenes. (2011). Quantity and Quality of Exercise for Developing and Maintaining Neuromotor Fitness in Apparently Healthy Adults : Guidance for Prescribing Exercise. Medicine & Science in Sports &

Ino Ferdinan Hilarius Nainggolan[1A-E*], David Siahaan[2B-D]
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Exercise, 1334–1359. https://doi.org/10.1249/MSS.0b013e318213fefb

Daya, W. J., & Palmizal. (2019). Pengaruh latihan Tabata terhadap kemampuan VO2Max atlet sepakbola ps. tungkal ulu u-21. Jurnal Pendidikan Jasmani Dan Olahraga, 18(2), 70–75.

Devy, R. D., Pratiwi, C., & Bahri, S. (2022). Efektivitas Latihan Strokes dengan Shadow dan Audio Visual terhadap Akurasi Dropshot Bulutangkis. Jurnal Sains Keolahragaan Dan Kesehatan, 7(2), 114–129. https://doi.org/https://doi.org/10.5614/jskk.2022.7.2.6

Dian Imam Saefulah1. (2022). Aktivitas Fisik Mahasiswa Program Studi Pendidikan Jasmani Kesehatan Dan Rekreasi Pada Masa Pandemi. Science, Engineering, Education, and Development Studies (SEEDS): Conference Series, 6(1), 112–119.

Dikdik Zafar Sidik, Paulus, & Lucky Afari. (2019). Pelatihan Kondisi Fisik (Nita (ed.)). PT Remaja Rosdakarya.

Festiawan, R., Raharja, A. T., & Jusuf, J. B. K. (2020). The Effect of Oregon Circuit Training and Fartlek Training on the VO2Max Level of Soedirman Expedition VII Athletes. Jurnal Pendidikan Jasmani Dan Olahraga, 5(708), 62–69.

Herlan, & Komarudin. (2020). Pengaruh Metode Latihan High-Intensity Interval Training (Tabata) terhadap Peningkatan VO2Max Pelari Jarak Jauh. Jurnal Kepelatihan Olahraga, Universitas Pendidikan Indonesia, 12(March), 11–17.

Hoi, L. B., & Wahono. (2021). High-intensity interval training, fartlek training, & oregon circuit training : what are the best exercises to increase VO2max ? High-intensity interval training, fartlek training & Oregon circuit training : what are the best exercises to increase VO 2. 24(3). https://doi.org/10.36295/ASRO.2021.24363

Idayani, D. (2020). Perbedaan Prestasi Akademik Mahasiswa Berdasarkan Nilai Tes Masuk dan Latar Belakang Pendidikan. Jurnal Ilmiah Soulmath : Jurnal Edukasi Pendidikan Matematika, 8(1), 59–72. https://doi.org/10.25139/smj.v8i1.2536

Kurniawan, R., & Ala, F. (2021). Kemampuan Vo2max Mahasiswa Pendidikan Kepelatihan Olahraga Universitas Bhayangkara Jakarta Raya. Journal of Sport Science and Physical Education, 2(1), 15–20.

Kusuma, I. D. M. A. W. (2019). Perbedaan tingkat VO2Max awal memiliki dampak yang berbeda terhadap hasil latihan Tabata. Jurnal SPORTIF, 5.

L. R. Gay, Geoffrey E. Mills, & Peter Airasian. (2012). Educational Research Competencies for Analysis and Applications (Christie, Rob ed.); 10th ed.). Pearson Education, Inc.

Lahaba, M. A. (2019). Analisis Indeks Massa Tubuh Terhadap Daya Tahan Aerobik Pada Siswa SMA Negeri 8 Makassar. Fakultas Ilmu Keolahragaan, Universitas Negeri Makassar, 627.

Ma, A., Budi, D. R., Nurcahyo, P. J., Syafei, M., & Mariasari, S. (2023). Pengaruh Latihan Circuit Training Terhadap Tingkat VO2Max Atlet Sepakbola Pelajar. SPRINTER: Jurnal Ilmu Olahraga, 4(3), 387–394.

Nasrulloh, A., Prasetyo, Y., & Dwi, K. D. A. (2018). Dasar-Dasar Latihan Beban (: Rizky Ariadi Ngadimin (ed.); 1st ed.). UNY Press Jl. Gejayan, Gg. Alamanda, Komplek Fakultas Teknik UNY.

Olson, M. (2014). Tabata: It's a HIIT! Health & Fitness Journal, 18(5).

Paisal, Satyahadewi, N., & Perdana, H. (2021). Pengembangan Aplikasi Statistika Berbasis Web Interaktif Untuk Analisis Uji T. Buletin Ilmiah Math. Stat. Dan Terapannya (Bimaster), 10(3), 331–340. https://jurnal.untan.ac.id/index.php/jbmstr/article/view/47655

Pramdhan, K., Nuryadin, A., & Ali, Masnur, R. F. (2021). Increased physical fitness levels of mountaineering athletes: a study of the effects of high-intensity interval training and Oregon circuit training. Jurnal SPORTIF: Jurnal of Teaching and Research is Licensed under a Creative Commons Attribution-ShareAlike 4.0 International License, 7, 19–36.

Purba, P. H. (2016). Upaya Meningkatkan Kecepatan Pukulan Gyaku Tsuki Chudan Melalui Bentuk Latihan Variation Of Body Drops Pada Siswa Putra Ekstrakurikuler Karate SMA Swasta Kristen Immanuel Medan Tahun 2016. Wahana Didaktika JURNAL ILMU KEPENDIDIKAN, 14(September), 1–13.

Rahman, F. J. (2018). Peningkatan Daya Tahan, Kelincahan, Dan Kecepatan Pada Pemain Futsal: Studi Eksperimen Metode Circuit Training. Jurnal SPORTI, 4(2), https://www.researchgate.net/publication/329475184.

Sidik, D. Z., L, P., & Afari, L. (2019). Pelatihan Kondisi Fisik (Nita (ed.)). PT REMAJA ROSDAKARYA.

Solissa, J. (2023). Hubungan Daya Tahan Aerobik , Kekuatan Otot , dan Prestasi Belajar Mahasiswa. Jurnal Pendidikan Dan Pembelajaran, 4, 451–458.

Sugiyono. (2013). Metode Penelitian Kuantitatif, Kualitatif Dan R &. D. ALFABETA, CV.

Syuhada, M. N., Risnawati, R., & Hamdani, M. F. (2025). Analisis Uji T-Student Dua Sampel Berpasangan dalam Evaluasi Perubahan Individu. Indonesian Research Journal on Education, 5(4), 419–422. https://doi.org/10.31004/irje.v5i4.2898

Tabata, I., Kouzaki, M., Ogita, F., & Miyachi, M. (1996). Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO 2max. Medicine and Science in Sports and Exercise, 28(November). https://doi.org/10.1097/00005768-199610000-00018

Tudor O. Bompa, G. H. (2009). Periodization Theory and Methodology of Training (5th ed.). Human Kinetics.

Warni, H., Arifin, R., & Bastian, R. A. (2017). Pengaruh Latihan Daya Tahan (Endurance) Terhadap Peningkatan Vo2max Pemain Sepakbola. Jurnal Pendidikan Jasmani Dan Olahraga, 16(2), 121–126.