

The Effect of Using HIIT Training On the skill level of judo players**Professor Dr. Mohsen Ali Ali Abu Al-Nour****Emeritus Professor of Wrestling in the Department of Wrestling and Individual Sports and former Dean of the Faculty of Physical Education, Minya University****Assistant Dr. Hamada Khalaf Sahrah****Assistant Professor in the Department of Competitions and Individual Sports, Faculty of Physical Education, Minya University****Mr. Tarek Abdel Halim Fathy Abdel Halim****Assistant lecturer in the Department of Competitions and Individual Sports, * Faculty of Physical Education, Minya University****Abstract**

Background: The research aims to know the use of HIIT training by designing a proposed training program and knowing its impact on the following: Skill level of judo players. The research population included judo players from the Judo Division of the Department of Wrestling and Individual Sports at the Faculty of Physical Education, Minya University, who were registered with the Egyptian Judo Federation 2023/2024. The research sample was chosen intentionally, consisting of (20) judo players, The control group: which uses the traditional training program and consists of (10) players during the sports season (2023/2024). The experimental group: It is the one that uses the proposed training program using Heat training and consists of (10) players during the sports season (2022/2023). **Conclusions:** Using HIIT training has a positive effect in skill level (Ippon Seo Nagi skill - Tai Otoshi skill - Oguchi skill - Ostogari skill) of the judo players under study. HIIT training contributed to developing the physical elements among members of the experimental group, with improvement rates ranging between (6.56%: 69.74%).

KEYWORDS: skill level, Judo, HIIT**Introduction**

Sports training is considered one of the basic sciences in the fields of physical education and sports, as it has methods, methods, and tools that distinguish it from other sciences. At the same time, it uses many contributing sciences, such as: biological and physiological science, biomechanics, nutrition, and psychology. From here it is clearly clear to us that Sports training is an educational process based on sound scientific foundations and principles. Its goal

is to raise the athlete to the highest sporting levels in the type of sporting activity he practices. To ensure that the individual reaches the highest level, the training process is given responsibility for fulfilling certain duties, including educational and pedagogical duties.

Musa Ali Mahmoud (2017) states that to achieve maximum development from training, exercises must take the form and nature of skill performance for the type of activity practiced in terms of performance time, nature of performance, alternating periods of work and rest, working muscles, motor paths, and the element to be developed. (15:11)

Muhamm Redha Al-Rubi (2005) points out that there must be a link between the time of performance, the form of the performance and the energy required to complete it, the strength and speed with which the performance is performed, the use of muscles with the appropriate ability and timing, and the multiple physical, skill and physiological requirements for the effectiveness of the movement to be studied. (11: 251)

“Mohamed Qri Bakri, Siham Al-Sayed Al-Ghamri” (2011) indicate that for the effect of training to occur, the body’s organs and systems and muscle tissues must be in challenge with the intensity, duration, number of times and intensity of training los, which they are not accustomed to, but over time the tissue, muscular system, organs and systems apt. The body for this training lo. (12: 245)

Researchers believe that HIIT exercises, known as high-intensity interval training, are one of the modern training methods that have spre recently, and which are given to players in the form of regular exercises, but with a different method of implementation, as they are characterized by high intensity and few rest periods, or rest is almost non-existent in relation to the training intensity. used.

The fitness industry is currently witnessing an increase in interest and growth in high-intensity interval training (HIIT), as this training method relies on giving repeated bouts of high-intensity muscular effort for periods ranging from 5 seconds to 8 minutes, followed by rest periods of varying lengths of time (24). :34-36)

Amal Majid Salman (2019) refers to the concept of high-intensity interval training (HIIT) as an improved form of intermittent or intermittent training. It is also an exercise strategy with short alternating periods characterized by intensity, which makes the body need a larger amount of oxygen than usual, followed by periods Very short break (2:17)

Through the researchers' scientific and practical experience in teaching judo at the College of Physical Education, it was found that the field of judo faces the problem of a severe lack of modern devices and tools in training. It is worth noting that in recent times the concept of modern devices and means used during the training process has developed and expanded to include many devices and tools. It has enormous potential, whether for the purpose of training or measurement, and its availability has become one of the reasons for success in achieving training programs' goals, which would help the coach in developing the technical and physical level of the players. Researchers believe that the higher the level of training using modern tools and devices, this leads to the development of the physical level. And the skilled And reaching the highest athletic level, and from here the research problem appeared, and this is what prompted the researchers to conduct this study using HIIT exercises to develop the skill level of the players away from the traditional exercises currently used, as an attempt by the researchers to develop the level of skill performance of the players.

Research aims:

The research aims to know the use of HIIT training by designing a proposed training program and knowing its impact on the following:

1- The skill level of judo players.

Research hypotheses:

1- There are statistically significant differences between the average scores of the pre- and post-measurements of the experimental group in the skill level of the judo players under study in favor of the post-measurement.

2- There are statistically significant differences between the average scores of the pre- and post-measurements of the control group in the skill level of the judo players under study in favor of the post-measurement.

3- There are statistically significant differences between the average scores of the two post-measurements of the experimental and control groups in the skill level of the judo players under study in favor of the post-measurement of the experimental group.

Scientific terms:**1- Sport Training:**

It is a planned educational process based on sound scientific foundations that helps the player reach an ideal performance during matches and competitions. (12:9)

2- Program:

It is a set of exercises included in the training package within the framework of the curriculum established for the training process to achieve the goal set for the physical activity performed by the individual. (18:66)

3- High Intensity Interval Training (HIIT):

It is performing the greatest amount of muscle work at high intensity during one training session and is achieved by alternating periods of high-intensity exercise with periods of low-intensity exercise or rest periods (20:140).

Research procedures:**Research Methodology:**

According to the nature and problem of the research, to achieve its objectives and test its hypotheses, the researchers used the experimental method using pre- and post-measurements for the experimental and control groups due to its suitability to the nature of the study.

research community:

The research community included judo players from the Judo Division of the Department of Wrestling and Individual Sports at the Faculty of Physical Education, Minya University, who were registered with the Egyptian Judo Federation for 2023/2024.

The research sample:

The researchers deliberately selected a research sample consisting of (20) judo players, and they were divided into two equal groups, one experimental and the other control, according to the following:

- The control group: which uses the tritonal training program and consists of (10) players during the sports season (2023/2024).

- The experimental group: It is the one that uses the proposed training program using Heat training and consists of (10) players during the sports season (2022/2023).
- Exploratory sample: (8) players from the research community and from outside the research sample.

Homogeneity of the research sample:

The researchers measure of the moderation of the distribution of the research sample members considering the growth variables and the physical and skill tests under study. The skewness coefficients for the sample under study in the growth variables were limited to between (-3, +3), which indicates the moderation of the values. Thus, the initial measurements in the growth tests under investigation for the research sample as a whole fall within the normal moderate curve. The skewness coefficients for the sample under study in the physical and skill variables were limited to between (-3, +3), which indicates the moderation of the values. Thus, the initial measurements in the physical tests under investigation for the research sample as a whole fall within the natural moderation curve.

Equivalence between the two research groups:

The researchers found equality between the control and experimental groups considering the variables under study. There are no significant differences in the "t" value calculated for the pre-measurement between the experimental and control group in growth variables, which indicates parity between the two research groups before applying the basic research experiment. There are no significant differences in the "t" value calculated for the pre-measurement between the experimental and control group at the skill level, which indicates parity between the two research groups before applying the basic research experiment to the judo players under study.

Third, data collection methods:

In collecting data and information related to the variables under research, researchers relied on the following tools:

A- Reference survey:

B- Preparing registration forms:

C- Measurements and tests for the skill variables under investigation:

- Ippon Seo Nagi's skill
- Tai Otoshi's skill
- O-goshi skill
- Osto-gari skill

Scientific transactions for the tests under investigation:

The researchers conducted scientific procedures for the tests under study on a sample from the same research community and from outside the original sample, which consisted of (10) ten players, in the period from 9/1/2022 until 9/10/2023 , as follows:

Honesty:

The validity of the tests under study was calculated using discriminant validity on a survey sample similar to the research community and from outside the basic research sample, numbering (10) ten players. They were divided into two groups after ranking their scores in the variables under study (a distinct group), numbering (5) players. (Less distinguished group), numbering (5) players. The significance of the differences between the two groups in the tests under study was calculated using the non-barometric Mann-Whitney test. It became clear that there were statistically significant differences between the distinguished and less distinguished groups in the tests under study, and in the direction of the distinguished group, as the error probability values Significant at the level of significance (0.05), which indicates the validity of these tests and their ability to distinguish between groups.

Stability:

The tests under study were applied and re-applied to a sample of (10) players, which is a sample similar to the research sample and other than the original sample, with a time difference of (7) seven days for the effect of the application to disappear. Correlation coefficients were found between the first and second applications, and it became clear that the correlation coefficients between the application and re-application For the skill level tests under investigation, they ranged between (0.82, 0.98), and all of them have statistically significant correlation coefficients, as the calculated (R) values are greater than the tabulated (R) value at the significance level (0.05), which indicates the stability of these tools.

A- Pre-measurement:

The researchers conducted a pre-measurement to determine the level of the players and the measurements of height and weight, age and training age, physical tests, and skill performance tests to place them in two equal groups in the week preceding the actual implementation of the program from Tuesday, 10/26/2023 until Wednesday, 10/27/2023 . The researchers considered the appropriate preparation process before performance.

B- Program implementation:

The program was implemented in the period from (Sunday 10/1/2023) to (Thursday 12/21/2023) on the judo division players at the college. It took (12) twelve training weeks. The experimental group used the proposed training program, while the control group applied the traditional training program with unified training times for both groups. The researchers considered changing the training times in the morning and evening for both groups.

C- Dimensional measurement:

Post-measurements were conducted on the same tests that were done in the pre-measurements, under the same conditions as the pre-measurements, and on all variables under investigation on the experimental and control groups, during the period from Sunday, 12/24/2023 until Monday, 12/25/2023 .

The statistical method used:

Considering the objectives and hypotheses of the research, the researchers used the following statistical methods:

- Median arithmetic mean, standard deviation, skewness coefficient, percentage, "t" test for significance of differences, "t" test for independent samples, Pearson correlation coefficient

The researcher accepted a significant level of (0.05). The researchers also used the Spss program to calculate some statistical coefficients.

Presentation and discussion of results:

Researchers will review the research results in the following order:

1. The significance of the differences between the average scores of the pre- and post-measurements of the experimental group in the skill level of the judo players under investigation.

2. The significance of the differences between the average scores of the pre- and post-measurements of the control group in the skill level of the judo players under investigation.
3. The significance of the differences between the average scores of the two post-measurements for the experimental and control groups in the skill level of the judo players under investigation.

Table (1)

**The significance of the differences between the means of the pre- and post-measurements for the experimental group
Skill level under investigation (n = 10)**

Skill variables	measuring unit	Pre-measurement		Dimensional measurement		Differences between the averages	Improvement rate	Statistical significance	
		Average	St. Deviation	Average	St. Deviation			value (T)	indication
ippon Seo Nagi	degree	٥.٠٦	٠.٦٣٨	٧.٣٥	١.٣٤٨	٢.٢٩-	٤٥.٢٦	٤.٦٣٥	sig
Tai Otooshi	degree	٥.٤٠	٠.٦١٥	٧.٣٠	٠.٩١٩	١.٩٠-	٣٥.١٩	١٥.٢٣٤	sig
O-goshi	degree	٥.٥٠	١.٠٥٤	٧.٥٥	١.١٦٠	٢.٠٥-	٣٧.٢٧	٥.١٩٧	sig
Osto- gari	degree	٥.٤٢	١.٠٢٥	٧.٣٤	١.٣٤٣	١.٩٢-	٣٥.٤٢	٦.١٦٣	sig

The tabular (t) value is at a significance level of $(0.05) = 1.833$

It is clear from Table (1) that:

- There are statistically significant differences between the average scores of the pre-measurements and the post-measurement of the experimental group in the skill variables under study, in favor of the post-measurement, as the calculated (t) value is greater than the tabulated (t) value at the significance level (0.05).

The percentage improvement between the average scores of the pre-measurements and the post-measurements for the experimental group in the skill variables under study ranged between (35.19%: 45.26%).

Table (2)

The significance of the differences between the means of the pre- and post-measurements for the control group
Skill level under investigation (n = 10)

Skill variables	measuring unit	Pre-measurement		Dimensional measurement		Differences between the averages	Improvement rate	Statistical significance	
		Average	St. Deviation	Average	St. Deviation			value (T)	indication
ippon Seo Nagi	degree	٥.١٦	٠.٥٢١	٥.٩٦	٠.٤٠٦	٠.٨٠-	١٥.٥٠	٤.٢٩٧	sig
Tai Otooshi	degree	٥.٥٠	٠.٧٨٢	٦.٢٦	١.٠٤٥	٠.٧٦-	١٣.٨٢	٤.٠٧٩	sig
O-goshi	degree	٥.٧٠	٠.٩١٩	٦.٣٦	١.٠٦٥	٠.٦٦-	١١.٥٨	١.٨٨٤	sig
Osto- gari	degree	٥.١٢	٠.٩٤٧	٦.١٦	١.١١٨	١.٠٤-	٢٠.٣١	٣.١٦٧	sig

The tabular (t) value is at a significance level of (0.05) = 1.833

It is clear from Table (19) that:

- There are statistically significant differences between the average scores of the pre-measurements and the post-measurement of the control group in the skill variables under study and in favor of the post-measurement, as the calculated (t) value is greater than the tabulated (t) value at a significance level (0.05), except for the Ojoshi skill, where differences were found. Not statistically significant in favor of the post measurement.

The percentage improvement between the average scores of the pre- and post-measurements for the control group in the skill variables under study ranged between (11.58%: 20.31%).

Table (13)

The significance of the differences between the means of the two post-measurements for the experimental and control groups in The skill level under investigation (N1 = N2 = 10)

Skill variables	measuring unit	Pre-measurement		Dimensional measurement		Differences between the averages	Improvement rate	Statistical significance	
		Average	St. Deviation	Average	St. Deviation			value (T)	indication
ippon Seo Nagi	degree	٧.٣٥	١.٣٤٨	٥.٩٦	٠.٤٠٦	١.٣٩	١٨.٩١	٣.١٢١	sig
Tai Otoshi	degree	٧.٣٠	٠.٩١٩	٦.٢٦	١.٠٤٥	١.٠٤	١٤.٢٥	٢.٣٦٤	sig
O-goshi	degree	٧.٥٥	١.١٦٠	٦.٣٦	١.٠٦٥	١.١٩	١٥.٧٦	٢.٣٩٠	sig
Ostogari	degree	٧.٣٤	١.٣٤٣	٦.١٦	١.١١٨	١.١٨	١٦.٠٨	٢.١٣٦	sig

The tabular (t) value is at a significance level of (0.05) = 1.833

It is clear from Table (21) that:

- There are statistically significant differences between the means of the two post-measurements for the experimental and control groups in the skill variables under study, in favor of the post-measurement, as the calculated (t) value is greater than the tabulated (t) value at a significance level of (0.05).

The percentage improvement between the averages of the two post-measurements for the experimental and control groups in the skill variables under study ranged between (14.25%: 18.91%).

Discussion of results:

It is clear from Table (1) that there are statistically significant differences between the average scores of the pre-measurements and the post-measurements of the experimental group in the skill variables (Ippon Seo Nagi skill - Tai Otoshi skill - Ojoshi skill - Ostogari skill) and in favor of the measurement. Post-test, the percentage improvement between the average scores of the pre-measurements and the post-measurements for the experimental group in the skill variables under investigation ranged between (35.19%: 45.26%).

The researcher attributes the significance of the differences in favor of the post-measurement in the judo skills under study (Ippon Seo Nagi skill - Tai Otoshi skill - Oguchi skill - Ostogari skill) among the members of the experimental group to the integrated training program and the subject according to scientific foundations in which the various skill training exercises for the skills under study overlapped with training exercises. HIIT, which effectively contributed to

developing the judo skills under study (Ippon Seo Nagi skill - Tai Otoshi skill - Ojoshi skill - Ostogari skill) among members of the experimental group.

In this regard, Abu Al-Ela Abdel Fattah (2003) indicates that in order to ensure the achievement of the goals and objectives of sports training, the coach must organize and plan it well. Therefore, the planning process in training represents the scientific procedures planned and organized in a very precise manner that helps the athlete to achieve high indicators in training. Accordingly, planning is the important tool that the trainer uses in his endeavor to manage organized training programs. An efficient and effective trainer is an organized trainer (1:90)

This is consistent with what Muhann Hussein Al-Bashtawi and Ahmed Ibrahim Al-Khoja (2005) indicated that standardized physical exercises that are planned according to a scientific method can qualify you to perform the basic skills that need those abilities and also contribute to your success in developing those physical abilities. (41:69)

The results reached by the researcher are consistent with the findings of the studies of Mahmoud Ahmed Tawfiq (2020), Amira Abdul Rahman Shaheen (2020), MUTHANA & OTHERS (2019), P ZAENKER et al (2017) on the positive and effective effect of HIIT training.) in improving physical fitness elements and skill variables for the samples being studied, and this is consistent with the current study.

Thus, the first hypothesis has been fulfilled, which states that “there are statistically significant differences between the average scores of the pre- and post-measurements of the experimental group in the skill level of the judo players under study.”

It is clear from Table (2) that there are statistically significant differences between the average scores of the pre-measurements and the post-measurement of the control group in the skill variables (Ippun Seo Nagi skill - Tai Otoshi skill - Ostogari skill) and in favor of the post-measurement, except for Ojoshi skill: statistically non-significant differences were found in favor of the post-measurement. The percentage improvement between the average scores of the pre-measurement and the post-measurement for the control group in the skill variables under study ranged between (11.58%: 20.31%).

The researcher attributes the improvement of the skill variables (Ippon Seo Nagi skill - Tai Otoshi skill - Ojoshi skill - Ostogari skill) among the members of the control group to the commitment to attending all training units in the traditional

training program, which contributed to the clarity of the correct performance method performed by the trainer through explanation and model and using methods. Various training sessions helped to impart a sense of enthusiasm among members of the control group, which made them keener to attend all training units and thus improved their skill variables.

Thus, the second hypothesis has been fulfilled, which states that “there are statistically significant differences between the average scores of the pre- and post-measurements of the control group in the skill level of the judo players under investigation.”

It is clear from Table (3) that: There are statistically significant differences between the means of the two post-measurements for the experimental and control groups in the skill variables (Ippun Seo Nagi skill - Tai Otoshi skill - Ostogari skill) and in favor of the post-measurement for the experimental group, it ranged The percentage improvement between the averages of the two post-measurements for the experimental and control groups in the physical elements under study is between (14.25%: 18.91%).

The researcher attributes the significance of the differences in favor of the experimental group's post-measurement in the judo skills under study (Ippun Seo Nagi skill - Tai Otoshi skill - Ojoshi skill - Ostogari skill) among the members of the experimental group to the use of HIIT exercises in the content of the training program, which contributed to the content of the training program. High-intensity training exercises improve the functional efficiency of the body and thus have a positive impact on the skill performance of the experimental group members in developing the judo skills under study (Ippun Seo Nagi skill - Tai Otoshi skill - Ojoshi skill - Ostogari skill).

The results reached by the researcher are consistent with the findings of the studies of Mahmoud Ahmed Tawfiq (2020), Amira Abdul Rahman Shaheen (2020), MUTHANA & OTHERS (2019), P ZAENKER et al (2017) on the positive and effective effect of HIIT training.) in improving physical fitness elements and skill variables for the samples being studied, and this is consistent with the current study.

Thus, the third hypothesis has been fulfilled, which states that “there are statistically significant differences between the averages of the two post-measurements of the experimental and control groups in the skill level of the judo players under investigation, in favor of the post-measurement of the experimental group.”

Conclusions:

- 1- Using HIIT exercises has a positive effect on the skill level of the judo players under study.
- 2- The traditional training program has a positive impact on the skill level of the judo players in the control group.
- 3- Using HIIT exercises was more effective than the traditional training program on the skill level of judo players.
- 4- HIIT training contributed to developing the skill level (Ippon Seo Nagi skill - Tai Otoshi skill - Ostogari skill) among the experimental group members with improvement rates ranging between (6.56%: 69.74%).
- 5- The traditional training program contributed to developing the skill level (Ippon Seo Nagi skill - Tai Otoshi skill - Ostogari skill) among members of the control group with improvement rates ranging between (2.17%: 37.58%)
- 6- There were statistically significant differences between the averages of the two post-measurements of the experimental and control groups at the skill level (Ippon Seo Nagi skill - Tai Otoshi skill - Ostogari skill) and in favor of the post-measurement of the experimental group with improvement rates that ranged between (2.85%: 17.80%)

Recommendations:

- 1- Applying the training program using HIIT exercises to develop the skill level of judo players.
- 2- Using the training program using HIIT exercises to develop the skill level of judo players.
- 3- Using HIIT training to develop the skill level of judo players at different age levels.
- 4- Conduct further studies to identify the impact of heat training on developing the skill level of players in matches and individual sports.

References**First: Arabic references:**

1. Abu Al-Ela Ahmed Abdel Fattah (2003): Physiology of Training and Sports, Dar Al-Fikr Al-Arabi, Cairo.
2. Amal Majid Salman (2019): Hiit and Fit training and their effect on some components of physical fitness for women aged (30-35), PhD thesis, College of Physical Education and Sports Sciences for Girls, University of Baghd.
3. Amira Abdel Rahman Shaheen (2020): The effect of using Tabata training on the level of physiological efficiency and the level of skill performance in tennis, published research, Scientific Journal of Physical Education and Sports Sciences, Helwan University - Faculty of Physical Education for Boys, No. 88.
4. Iman Faiq Saleh, Ban Jih Imran (2020): The effect of cardio exercises in developing the (explosive) strength of the muscles of the legs and arms of volleyball players, Contemporary Sports Journal, Volume 19, College of Physical Education and Sports Sciences for Girls, University of Baghd.
5. Bilal Morsy and Tut (2022): The effectiveness of high-intensity interval training (HITT) on developing the physical, skillful and physiological training status of wrestlers, scientific production research, Faculty of Physical Education, Sat City University.
6. Rehab Ahmed Hassanein (2021): The effect of cardio training on some physical variables, functional efficiency variables, and the performance level of the 800 m competition, Assiut Journal of Physical Education Sciences and Arts, No. 59.
7. Sarah Muhammm Al-Ashram, Reham Muhammm Al-Ashram (2017): The effect of using intensive training on some physiological and physical variables related to the golden point match according to the amendment to the judo sport law, published research, Scientific Journal of Physical Education and Sports Sciences, Helwan University - Faculty of Physical Education for Boys, No. 81, pp. 1-20.
8. Abeer Dakhel Hatem, Zainab Qahtan Al-Hashemi (2017): The effect of cardio exercises in developing some special abilities, physiological indicators, the skill of forward distancing, and the crushing blow for binton players, research on the physiology of binton training, College of Physical Education and Sports Sciences for Girls, University of Baghd, 2017 .
9. Essam El-Din Abdel-Khaleq (2003): Sports Training, Theories and Applications, 1st edition, Mansha'at Al-Maaref, Alexandria. 2003

10. Fatima Salah Jumaa (2022): The effect of cardio training on some physiological variables and the level of performance of combined attack kicks among female Taekwondo players, Scientific Journal of Sports Sciences and Arts, Faculty of Physical Education for Girls, Helwan University, No. 70.
11. Muhammed Reda Al-Roubi (2005): Principles of Free Wrestling Training, Artistic Performance of Movements, Mahi Computer Services, Alexandria.
12. Muhammed Qri Bakri, Siham Al-Sayed Al-Ghamri (2011): "Physiology of Sports Performance for Athletes and Non-Athletes," Egyptian Library for Publishing and Distribution, Giza.
13. Mahmoud Ahmed Tawfiq (2020): The effect of using high-intensity interval training (HIIT) on improving the level of physical fitness and losing weight for wrestlers, published research, Scientific Journal of Sports Sciences and Arts, Helwan University - Faculty of Physical Education for Girls, vol. 17, pp. 1-28.
14. Musa Ali Mahmoud (2017): Basic Concepts of Sports Training Science, Dar Al-Wafaa for Printing and Publishing, Alexandria.
15. Muhammed Hussein Al-Bashtawi, Ahmed Ibrahim Al-Khoja (2005): Principles of Sports Training, Dar Wael for Printing and Publishing, Jordan.
16. Mai Mohamed Abdel Azim, Heba Sa Mohamed, Jih Ahmed Mohamed (2022): The effect of cardio training on the Grand Gothic skill in rhythmic artistic exercises, Journal of Sports Sciences, Faculty of Physical Education, Minya University.
17. Wagdi Mustafa Al-Fateh, Muhammed Lotfy Al-Sayed (2002): Scientific foundations of sports training for the player and the coach, Dar Al-Huda for Publishing and Distribution, Minya.

Second: Foreign references:

18. Jacob Eisenreich Erickson: high intensity interval training versus supersets training, a comparison of energy expenditure, 2015
19. Leanna M Ross, Ryan R Porter, J Larry durstine (2016): High-intensity interval training (hiit) for patients with chronic diseases, Journal of sport and health science 5(2), 139-144.
20. Mallol M, Bentley DJ, Norton L, Norton K, Mejuto G, Yanci J. Comparison of Reduced-Volume High-Intensity Interval Training and High-Volume Training on Endurance Performance in Triathletes. Int J Sports Physiol Perform. 2019 Feb 1;14(2):239-245. doi: 10.1123/ijsp.2018-0359. Epub 2019 Jan 2. PMID: 30080432.
21. Micah Zuhl, Len Kravitz (2012) :Hiit vs. continuous endurance training of the aerobic titans , IDEA Fitness journal 9(2), 34-40.

22. Muthana & others (2019): Effects of concurrent training on explosive strength and VO2max in prepubescent children. International journal of sports medicine, 34(10), 888-896
23. Robinson Vélez, Paula Hernández, Alejandra Tordecilla, Cristian Álvarez, Rodrigo Ramírez, Mikel Izquierdo, Jorge Correa, Antonio HERMOSO, and Ronald Garcia: Effectiveness of HIIT compared to moderate continuous training in improving vascular parameters in inactive ults, Article number: 42, Vol 18, Journal of Lipids in Health and Disease, 2019.
24. Víctor Arboleda, Elkin Velez, Ruben Gomez and Yuri Feito: Effects of a High-Intensity Interval Training Program Versus a Moderate-Intensity Continuous Training Program on Maximal Oxygen Uptake and Blood Pressure in Healthy ults: Study Protocol for a Randomized Controlled Trial, journal of Biomed Central, Vol 17, Article number: 413, 2016.
25. Zaenker, Pierre & Favret, Fabrice & Lonsdorfer-Wolf, Evelyne & Muff, Guillaume & Seze, Jérôme & Isner-Horobeti, Marie-Eve. (2017). High-intensity interval training combined with resistance training improves physiological capacities, strength and quality of life in multiple sclerosis patients: A pilot study. European journal of physical and rehabilitation medicine. 54. 10.23736/S1973-9087.17.04637-8.

Third, information network references:

26. Courier-journal.com/story/mike/jelt/2015/04/14/exercise-as-stress