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Rapid weight loss (RWL) method on game performance of martial art athletes

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Abstract: Martial athletes use the rapid weight loss (RWL) method as a strategy to lose weight quickly before competing. This study was conducted to examine the prevalence of the magnitude of the impact of the RWL method used as a way to lose weight by running using a sauna suit on the physical, physiological, psychological, and performance conditions of martial athletes. The population in this study were martial arts athletes throughout Indonesia. This study uses a descriptive method by collecting data through a questionnaire instrument on google Forms which is distributed to martial athletes, especially in the fighting class. The results of the identification through the instrument were then analyzed using descriptive statistics. The results n this study were 88 martial arts athletes using the weight loss method by running using a sauna suit. The impact that occurred on athletes all experienced more than one impact of RWL on the athlete's physical condition, physiological, psychological, and performance of martial athletes which included athletes experiencing 19% of martial arts athletes experiencing muscle cramps, 26% of athletes' body temperature increasing, 7% increasing heart rate, 1% athletes experience dyspnea, 3% athletes experience injuries, 8% athletes feel irritable/increased temperament, 49% athletes experience increased fatigue, 16% athletes experience decreased performance, 9% athletes experience stress, and 17% athletes feel their sports interest is reduced.
Keywords: rapid weight loss, game performance, martial art

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INTRODUCTION

The character of the martial arts sport usually uses high intensity, most of the movements are carried out explosively and change positions quickly. A professional athlete will try to show the best performance for his abilities (Maulana et al., 2017). In addition to performance, body weight is a major factor in martial arts competitions. These two things have become an important part that must be maintained before the competition. Athletes compete with the lightest weight, believing it will provide a competitive advantage over their smaller and less powerful opponents (Figlioli et al., 2021; Khodaee et al., 2015). This is a strategy used by athletes in regulating their body weight, one of which is rapid weight loss.

Martial athletes usually use a rapid weight loss strategy which is carried out as a rapid weight loss (Todorović et al., 2021). The weight loss period used is usually 7 days before the match (Joseph et al., 2018). Rapid weight loss characterized by a significant reduction in body weight (usually 2–5%, although larger reductions are often seen between 5–10%) in the days before weighing (mostly in the last 2-3 days) is achieved by a combination of methods. which include reducing fluid consumption and caloric intake (mainly from carbohydrates and fats), increasing fluid loss (training in the heat, using saunas, plastic clothing, etc.), or even using pharmacological aids (laxatives, diuretics, thyroid hormones) (Guilherme G. Artioli et al., 2016; Daniele et al., 2016; Dugonjić et al., 2019; Yarar, 2022).

Rapid weight loss is common in fighting class martial arts athletes. Athletes usually lose weight 2-5 times a year, although many athletes lose weight 6-10 times a year (Giannini Artioli et al., 2010). Athletes assume that weight loss is minimal based on the belief that they gain an advantage over their competitors (Rahayusari Ramadhani, 2021). After that, the athlete will attempt to quickly regain some

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of that weight and when the competition becomes heavier than the allocated class. However, rapid weight loss is considered an extreme dietary factor (Sundgot-Borgen et al., 2013). Studies of US high school and university wrestling athletes show that 3–4% dehydration due to rapid weight loss will inevitably impair muscle endurance during high training and result in decreased muscle performance (Lambert & Jones, 2010). From 52 studies Web of Science and Pubmed were in 14 criteria according to the subject 1103 judo athletes showed data that contradicted physiological parameters and biomarkers as well as feelings of tension, anger, and fatigue significantly, as well as decreased strength (Lakicevic et al., 2020).

Many health risks are the impact of the rapid weight loss strategy. Short-term weight loss may have a marked effect on body composition, blood chemistry, and hormonal parameters (A M Karila et al., 2008). In addition, it has the potential to cause significant health risks including impaired nutritional status, reduced physical performance, and impaired growth and development (Berkovich et al., 2016). Any fatal risk from the RWL strategy, most likely to occur at an extreme level indicates a gradual reduction in body mass in the weeks before competition due to glycogen depletion, dehydration, and other greater risks (Guilherme G Artioli et al., n.d.). On the other hand, losing weight quickly will benefit athletes over their opponents because more and more competition in martial arts competitions will increase the rapid weight loss strategy as an effort to create opportunities.

Based on the problems above, this study was conducted to determine the prevalence of the effect of the RWL strategy using a sauna suit in fighting class martial arts athletes, and to describe the symptoms that arise related to the use of this method related to athlete performance. These symptoms are seen from the physiological parameters, biomarkers, and psychological well-being of martial athletes. This study was conducted to provide an overview to martial arts athletes regarding the impact of the RWL strategy using a sauna suit. In addition, there is no research in Indonesia related to rapid weight loss strategies in fighting class martial arts athletes.

METHODS

The research was a quantitative descriptive study, in which to study the effects of the RWL method using a sauna suit. The test instrument used was a questionnaire. Data collection in this study was carried out for 2 weeks by distributing questionnaires in various martial arts clubs throughout Indonesia. The subjects in this study amounted to 88 martial arts athletes who had participated in fighting class martial arts competitions. The sample in this study includes martial arts that are popular in Indonesia with systematic random sampling. The categories of martial arts consist of: wrestling, mixed martial arts, karate, kempo, muaythai, pencak silat, taekwondo, tarung derajat , and wushu.

Data collection technique used was to distribute a questionnaire/questionnaire in the form of a google form to martial arts clubs throughout Indonesia. Filling in the instrument was done by means of the subject answering questions about personal data, the athlete's residence, the athlete's martial arts sport, the class of competition that was followed, body weight, weight problems that had been experienced (over/under), weight loss models that were often done, and the after effects of weight loss. The data analysis technique used is descriptive statistics aimed at collecting data, presenting data, and determining data results. The data obtained from each answer to the questionnaire is the data that is analyzed.

RESULTS AND DISCUSSION

The results of distributing questionnaires to martial athletes the average weight loss used using the Rapid Weight Loss (RWL) method with a decrease in running fluid using a sauna suit with a total of 88 martial arts athletes as a subject. Figure 1 shows the results of measuring the impact of the RWL method on the physical, physiological, psychological, and performance conditions used by athletes for the male and female groups.

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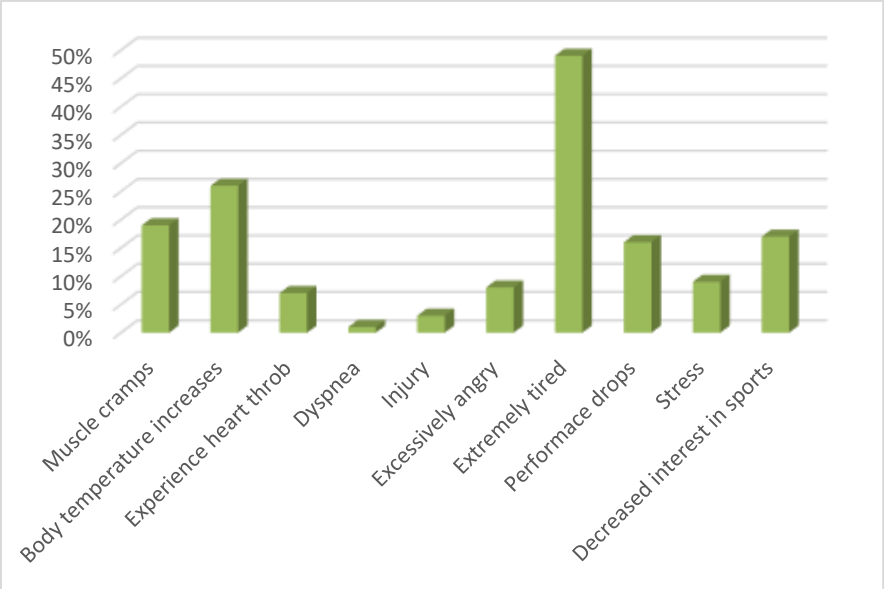

Figure 1. Percentage of Martial Athletes with The Liquid Dropping Method by Running Using Sauna Suit

Based on Figure 1, regarding rapid weight loss using the fluid reduction method by running using a sauna suit, the impact on the athlete's physical condition, physiological, psychological, and performance of martial arts athletes which includes athletes experiencing 19% of martial arts athletes experiencing muscle cramps, 26% of athletes' body temperature increases, 7% increased heart rate, 1% athletes experienced dyspnea (shortness of breath), 3% athletes experienced injuries, 8% athletes felt irritability/increased temperament, 49% athletes experienced increased fatigue, 16% athletes experienced decreased performance, 9% athletes experienced increased stress, and 17% of athletes feel that their interest in sports is reduced. Based on these percentages, it can be seen that the greatest impact on the physiology of athletes is increased fatigue in athletes.

Table 1. Analysis of Effects Using a Sauna Suit as an Effort to Reduce Fluid Quickly

Effect	Statistic Analysis								
	N	Mean	df	Variance	Min	Max	Odds.R		95%±CI
							Coch	M.H	
Muscle cramps	17	0.1932	0.3971	0.1577	0.000	1.000	0.157	1.000	0.0841
Body temperature increases	23	0.2614	0.4419	0.1953	0.000	1.000	0.157	1.000	0.0936
Experience heart throb	6	0.0682	0.2535	0.0643	0.000	1.000	0.157	1.000	0.0537
Dyspnea	1	0.0000	0.0000	0.0000	0.000	1.000	0.157	1.000	0.0000
Injury	3	0.0341	0.1825	0.0333	0.000	1.000	0.157	1.000	0.0387
Excessively angry	7	0.0795	0.2721	0.0741	0.000	1.000	0.157	1.000	0.0577
Extremely tired	43	0.4886	0.5027	0.2527	0.000	1.000	0.157	1.000	0.1065
Performance drops	14	0.1591	0.3679	0.1353	0.000	1.000	0.157	1.000	0.0779
Stress	8	0.1591	0.2891	0.0836	0.000	1.000	0.157	1.000	0.0613
Decreased interest in sports	15	0.1705	0.3782	0.1430	0.000	1.000	0.157	1.000	0.0801

The minimum data for athletes can be obtained, athletes experiencing dyspnea as much as 1 athlete. While the maximum data and data that often appear (mode) are athletes experiencing fatigue as many as 43 martial arts athletes. Judging from the total number of martial arts athletes as many as 88 athletes, almost all martial arts athletes experienced more than one impact from the rapid weight loss strategy, the method of reducing running fluid using a sauna suit. Previous research also showed the

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same results, feelings of tension, anger, and fatigue were significantly increased by the impact of rapid weight loss behavior (Lakicevic et al., 2020). Similar research also states that male and female athletes most often choose the diet method as a fast weight loss method and 21.5% of athletes who use the weight loss method with fluid loss prefer to run with a sauna suit (Seyhan, 2018). The use of a sauna suit for weight loss has quickly become a method that is often used by martial arts athletes, especially when approaching competitions at the city, provincial level, and not a few also do this at national level matches. The results of this study describe that athletes who experience dyspnea have the least amount, in this case dyspnea is a state of shortness of breath characterized by obstruction of blood flow, this condition is very closely related to heart or respiratory disease (Global Initiative for Chronic Obstructive Lung Disease, 2017) so that dyspnea is more common. in chronic obstructive pulmonary disease (COPD). In this study, the RWL method is closely related to fatigue conditions because it is associated with very drastic body fluid expenditure, so that the impact that occurs on the subjects of this study is more on these factors outside of the athlete's congenital disease or condition.

The use of a sauna suit as a method for weight loss shows that the highest effect of extreme weight loss is the high fatigue felt by athletes before the match, this greatly affects the athlete's performance and the athlete's unpreparedness in running the match. Decreased fluid in the body causes dehydration and acute kidney damage because the values of creatinine, blood urea nitrogen, and urine specific gravity increase significantly after RWL (Lakicevic et al., 2021). The process of body movement during exercise can cause an increase in energy and material consumption due to large energy losses, increased lactic acid, and decreased glycogen will cause central fatigue (Yu, 2020). Lactic acid is the result of carbohydrate metabolism without the use of oxygen (anaerobic metabolism). Meanwhile, to increase aerobic capacity and endurance capacity during extended exercise time, it can be effective by compensating for the decrease in carbohydrates and causing lipids to be used efficiently as energy (Rhyu & Cho, 2014). In addition to macronutrients, minerals are also no less important role. Water in the body makes up about 50-60% of total body weight, if a deficiency of 2% of the body's hydration needs is found to inhibit work performance (Rismayanthi, 2012). There is still a need for new research related to the results of this study with several related studies, fluid reduction through the sauna suit method has an impact on athlete fatigue, but previous studies have stated that fatigue is caused by lack of nutrition. In this case, during pre-match athletes who lose weight using the RWL method by reducing food portions and doing exercises using a sauna suit with reduced meal portions, the nutritional needs needed by the body are not fulfilled properly, so in this study the athletes stated not only fatigue. the excess is felt, but they feel more than one impact that occurs in the body. Almost all of the subjects felt at least two to three or more of the effects that occurred on them when losing weight by using a sauna suit.

Physiological aspects caused by a decrease in fluid are increased body temperature, muscle cramps, increased heart rate, and decreased performance. Increased body temperature due to hypohydration. Sweat expenditure often exceeds water intake resulting in a lack of water (hypohydration) and loss of electrolytes will increase body temperature and potentially reduce performance. When exercising in the heat, core body temperature increases by 0.22°C for every additional 1% loss of body mass (Adams et al., 2014). While muscle cramps that occur during exercise are caused because the production of lactic acid lowers the pH value of the muscles, at the same time, the production of ammonia in the blood and tissues affects the ability of the muscles to work, and muscle spasms occur when the production of ammonia increases in brain tissue (Yu, 2020). Increased heart rate occurs during training or competition. An increase in heart rate of about 6-10 b min during exercise if they are 2-3% dehydrated can exacerbate cardiovascular irregularities and perceived fatigue levels and decrease exercise performance, especially during resistance training and in hot weather (Adams et al., 2014). All physiological effects (rise body temperature, muscle cramps, increased heart rate) of the RWL method of decreasing fluid can affect the performance of athletes.

Psychologically, the impact of the RWL method of reducing fluid using the sauna suit method includes stress, reduced sports interest, and increased anger. One of the stresses in athletes occurs due to injury caused by an increase in the portion of exercise (Adetya, 2020). In addition to stress, the fear of failure in competition is influenced by high fatigue (Gustafsson et al., 2017). Before the competition, the percentage of conflict/pressure and depression increased by 40% and 100%, respectively (Costa et al., 2018). Another study also stated that the psychological effect for athletes with a percentage of 87.1% was exposed to stress, and 90.0% experienced a decrease in performance (Yagmur et al., 2019). However, there are studies that disagree with the authors' opinion, the research states that weight

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management is considered important mentally as part of pre-competition preparation, serves as a coping strategy by creating an increased feeling of focus and commitment. In addition, the mental advantage against the opponent (Pettersson et al., 2013).

Judging from the table, the least impact felt by athletes was injury and dyspnea (shortness of breath). Other studies have also obtained similar results, with lower percentages of injury and athlete's dyspnea. Low incidence of physiological disorders such as muscle cramps (7%), increased body temperature (6.3%), palpitations (4.3%), dyspnea (4.3%) and injury (4%) after weight loss (Seyhan, 2018). Of the several impacts on the athlete's physiology, injury and dyspnea have a lower percentage. However, there are other studies that get the results that the percentage is the same between injuries and muscle cramps, with a value of 72.9% (Yagmur et al., 2019). In this study with this study found differences, namely in addition to reducing fluid, the study also reduced the portion of food in athletes.

The results of research data regarding the effect of rapid weight loss are supported by previous studies of four university-level wrestling athletes with the results that the effect of rapid weight loss of 8% over a four-day period with a reduction in food and fluid intake can significantly reduce muscle glycogen concentrations and reduce muscle glycogen concentration. dynamic strength, accompanied by weight loss. There is a similar study of 107 female taekwondo athletes and 195 male taekwondo athletes who used weight loss methods and had physiological side effects (muscle cramps, increased body temperature, palpitations, dyspnea, injury) and psychological (excessive nervousness, low performance due to high fatigue, stress) of rapid weight loss with very low results due to the method used in the 3-4 week period before the competition (Seyhan, 2018).

It can be said that rapid weight loss has a negative impact on martial arts athletes. The process of rapid weight loss is not a good strategy for optimizing the performance of martial arts athletes and is harmful to health (Fortes et al., 2017; Kons et al., 2017). Athletes reported using dangerous dehydration-based RWL strategies, including saunas (43%) and training in plastic clothing (43%) resulted in 57% of athletes being dehydrated and 43% experiencing extreme dehydration (Matthews & Nicholas, 2017). Another study with a total subject of 12 male judo athletes and at least 18 years of age used the RWL method by reducing body weight ± 4.0 kg, the day before a special competition, food and fluid restrictions were the most frequently carried out by judo athletes so that this study has warned staff professionals (coaches and other staff) involved with combat athletes to ensure appropriate and gradual weight loss strategies during the competition period to determine the relationship between athlete diet and exercise volume/intensity in specific and nonspecific tasks (Kons et al., 2017). In fact 90% of judo and taekwondo coaches reported that the recommended pre-competition weight loss duration was 16.2±8.2 days and an average reduction of 1.5±0.7 kg (Ben-El Berkovich et al., 2019) . Considering the harmful effects of RWL outlined in the existing literature, it is important to determine and monitor the athlete's minimum competitive weight to prioritize athlete health and safety, emphasize fairness, and ultimately benefit the sport even though RWL is not officially prohibited (Guilherme Giannini Artioli et al., 2017; Lakicevic et al., 2020). The NCAA has created a weight management program that appears to be more effective at reducing weight loss behavior than rapid weight loss and several studies have demonstrated the positive impact of the NCAA program on athletes' weight management behavior (Giannini Artioli et al., 2010; RA et al., 2006). There are several things that can be done besides using the RWL method, namely by adjusting the diet by considering food nutrition and carrying out a diet program that is regulated long before the match day (Irianto, 2005; Kurnia et al., 2020). When the athlete's daily weight is in accordance with the class weight in the competition, it will have a very good impact on the athlete, self-confidence will appear higher compared to losing weight first (Nisa & Jannah, 2021), so that better game performance given will also be maximized.

CONCLUSIONS

This survey provides a comprehensive picture of the prevalence of the effect of weight loss methods on martial arts athletes using a sauna suit against martial arts athletes. Weight loss used Rapid Weight Loss (RWL) with a fluid reduction approach carried out through the running method using a sauna suit had a major impact on increasing athlete fatigue with the highest percentage of 49%. The general impact of using a suana suit as a result in this study was 19% muscle cramps, 26% increase in body temperature, 7% heart palpitations, 1% dyspnea/shortness of breath, and 3% easier injury. These aspects are physiological impacts experienced by many athletes. Meanwhile, on the psychological

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aspect, athletes experience excessive nervousness, 8% of athletes feel irritable/increased temperament, 17% of athletes feel their sports interest is reduced, low performance due to high fatigue 49%, and 9% stress during matches and a few days before the match so that the performance given by athletes when in the field less than a maximum of 16%. Many previous studies have revealed that the process of rapid weight loss is not a good strategy for optimizing the performance of martial arts athletes and is harmful to health.

REFERENCES

A M Karila, A. T., Sarkkinen, P., Marttinen, M., Seppälä, T., Mero, A., & Tallroth, K. (2008). Rapid Weight Loss Decreases Serum Testosterone Physiology & Biochemistry. *Int J Sports Med*, *29*, 872–877. https://doi.org/10.1055/s-2008-1038604

Adams, W. M., Ferraro, E. M., Huggins, R. A., & Casa, D. J. (2014). Influence of body mass loss on changes in heart rate during exercise in the heat: A systematic review. *Journal of Strength and Conditioning Research*, *28*(8), 2380–2389. https://doi.org/10.1519/JSC.0000000000000501

Adetya, M. F. (2020). *Psikoedukasi Manajement Stres Pada Atlet Pra-PON yang Mengalami Cedera Fisik (Studi Kasus pada Atlet Cabang Olahraga Shorinji Kempo di Jawa Timur)*.

Artioli, Guilherme G., Saunders, B., Iglesias, R. T., & Franchini, E. (2016). It is Time to Ban Rapid Weight Loss from Combat Sports. *Sports Medicine 2016 46:11*, *46*(11), 1579–1584. https://doi.org/10.1007/S40279-016-0541-X

Artioli, Guilherme G, Saunders, B., Iglesias, R. T., & Franchini, • Emerson. (n.d.). It is Time to Ban Rapid Weight Loss from Combat Sports. *Sports Medicine*. https://doi.org/10.1007/s40279-016-0541-x

Artioli, Guilherme Giannini, Saunders, B., Iglesias, R. T., & Franchini, E. (2017). Authors' Reply to Davis: "It is Time to Ban Rapid Weight Loss from Combat Sports." *Sports Medicine*, *47*(8), 1677–1681. https://doi.org/10.1007/s40279-017-0715-1

Ben-El Berkovich, Aliza Hannah, Stark Alon Eliakim, Dan Nemet, & Tali Sinai. (2019). Rapid Weight Loss in Competitive Judo and Kaekwondo Athletes: Attitudes and Practices of Coaches and Trainers. *International Journal of Sport Nutrition and Exercise Metabolism*.

Berkovich, B.-E., Eliakim, A., Nemet, D., Stark, A. H., & Sinai, T. (2016). Rapid Weight Loss Among Adolescents Participating In Competitive Judo. *International Journal of Sport Nutrition and Exercise Metabolism*, *26*(3), 276–284. https://doi.org/10.1123/IJSNEM.2015-0196

Costa, D. de O., Oliveira, L. dos S., de Sena, E. A., de Lima, F. F., & Silva, A. S. (2018). Pre-Competition Physical, Physiological and Phycosocial States of Taekwondo Athletes. *Journal of Physical Education*, *29*(1). https://doi.org/10.4025/JPHYSEDUC.V29I1.2913

Daniele, G., Weinstein, R. N., Wallace, P. W., Palmieri, V., & Bianco, M. (2016). Rapid weight gain in professional boxing and correlation with fight decisions: analysis from 71 title fights. *Physician and Sportsmedicine*, *44*(4), 349–354. https://doi.org/10.1080/00913847.2016.1228421

Dugonjić, B., Krstulović, S., & Kuvačić, G. (2019). Rapid Weight Loss Practices in Elite Kickboxers. *International Journal of Sport Nutrition and Exercise Metabolism*, *29*(6), 583–588. https://doi.org/10.1123/ijsnem.2018-0400

Figlioli, F., Bianco, A., Thomas, E., Stajer, V., Korovljev, D., Trivic, T., Maksimovic, N., & Drid, P. (2021). Rapid weight loss habits before a competition in sambo athletes. *Nutrients*, *13*(4), 1–8. https://doi.org/10.3390/nu13041063

Fortes, L. S., Costa, B. D. V., Paes, P. P., Cyrino, E. S., Vianna, J. M., & Franchini, E. (2017). Effect of rapid weight loss on physical performance in judo athletes: is rapid weight loss a help for judokas with weight problems?*. *Http://Dx.Doi.Org/10.1080/24748668.2017.1399323*, *17*(5), 763–773. https://doi.org/10.1080/24748668.2017.1399323

Copyright © 2022, Jurnal Keolahragaan, ISSN 2339-0662 (print), ISSN 2461-0259 (online)

Giannini Artioli, G., Gualano, B., Franchini, E., Scagliusi, F. B., Takesian, M., Fuchs, M., & Lancha Jr, A. H. (2010). Prevalence, Magnitude, and Methods of Rapid Weight Loss among Judo Competitors. *Judo Competitors. Med. Sci. Sports Exerc*, *42*(3), 436–442. https://doi.org/10.1249/MSS.0b013e3181ba80

Global Initiative for Chronic Obstructive Lung Disease. (2017). Global Initiative for Chronic Obstructive. *GOLD, Global Obstructive Lung Disease*, 1–44.

Gustafsson, H., Sagar, S. S., & Stenling, A. (2017). Fear of failure, psychological stress, and burnout among adolescent athletes competing in high level sport. *Scandinavian Journal of Medicine & Science in Sports*, *27*(12), 2091–2102. https://doi.org/10.1111/SMS.12797

Irianto, D. (2005). Program Diet Untuk Mengendalikan Berat Badan Olahragawan Menuju Puncak Prestasi. *Jurnal Olahraga Prestasi*, *1*(2), 115991.

Joseph, Matthews, Stanhope, E. N., Godwin, M. S., J, M. E., Holmes2, & Artioli3, G. G. (2018). *The Magnitude of Rapid Weight Loss and Rapid Weight Gain in Combat Sport Athletes Preparing for Competition: A Systematic Review*.

Khodaee, M., Olewinski, L., Shadgan, B., & Kiningham, R. R. (2015). Rapid weight loss in sports with weight classes. *Current Sports Medicine Reports*, *14*(6), 435–441. https://doi.org/10.1249/JSR.0000000000000206

Kons, R. L., Da Silva Athayde, M. S., Follmer, B., & Detanico, D. (2017). Methods and Magnitudes of Rapid Weight Loss in Judo Athletes over Pre-Competition Periods. *Human Movement*, *18*(2), 49–55. https://doi.org/10.1515/humo-2017-0014

Kurnia, D. I., Kasmiyetti, & Dwiyanti, D. (2020). PENGETAHUAN PENGATURAN MAKAN ATLET DAN PERSEN LEMAK TUBUH TERHADAP KEBUGARAN JASMANI ATLET. *Soins Aides - Soignantes*, *11*(56), 26–27. https://doi.org/10.1016/j.sasoi.2013.12.010

Lakicevic, N., Paoli, A., Roklicer, R., Trivic, T., Korovljev, D., Ostojic, S. M., Proia, P., Bianco, A., & Drid, P. (2021). Effects of rapid weight loss on kidney function in combat sport athletes. *Medicina (Lithuania)*, *57*(6), 1–9. https://doi.org/10.3390/medicina57060551

Lakicevic, N., Roklicer, R., Bianco, A., Mani, D., Paoli, A., Trivic, T., Ostojic, S. M., Milovancev, A., Maksimovic, N., & Drid, P. (2020). Effects of Rapid Weight Loss on Judo Athletes: A Systematic Review. *Nutrients 2020, Vol. 12, Page 1220*, *12*(5), 1220. https://doi.org/10.3390/NU12051220

Lambert, C., & Jones, B. (2010). Alternatives to rapid weight loss in US wrestling. *International Journal of Sports Medicine*, *31*(8), 523–528. https://doi.org/10.1055/S-0030-1254177/ID/37

Matthews, J. J., & Nicholas, C. (2017). Extreme rapid weight loss and rapid weight gain observed in UK mixed martial arts athletes preparing for competition. *International Journal of Sport Nutrition and Exercise Metabolism*, *27*(2), 122–129. https://doi.org/10.1123/ijsnem.2016-0174

Maulana, Muhammad Yudistira Arya and, & Achmad Dwityanto. (2017). *Hubungan Antara Kestabilan Emosi Dengan Kontrol Diri Pada Atlet Beladiri Kota Surakarta - UMS ETD-db*.

Nisa, K., & Jannah, M. (2021). Pengaruh kepercayaan diri terhadap ketangguhan mental atlet bela diri. *Character: Jurnal Penelitian Psikologi*, *8*(3), 36–45.

Pettersson, S., Ekström, M. P., & Berg, C. M. (2013). Practices of Weight Regulation Among Elite Athletes in Combat Sports: A Matter of Mental Advantage? *Journal of Athletic Training*, *48*(1), 99–108. https://doi.org/10.4085/1062-6050-48.1.04

RA, O., AC, U., JR, S., RW, D., & D, K. (2006). NCAA rule change improves weight loss among national championship wrestlers. *Medicine and Science in Sports and Exercise*, *38*(5), 963–970. https://doi.org/10.1249/01.MSS.0000218143.69719.B4

Rahayusari Ramadhani, D. M. H. S. T. P. (2021). *Hubungan Pola Konsumsi Cairan Terhadap Status Hidrasi Pada Atlet Weight Categori Sport Unit Kegiatan Mahasiswa Universitas Gajah Mada*. Universitas Gajah Mada.

Copyright © 2022, Jurnal Keolahragaan, ISSN 2339-0662 (print), ISSN 2461-0259 (online)

Rhyu, H., & Cho, S.-Y. (2014). The effect of weight loss by ketogenic diet on the body composition, performance-related physical fitness factors and cytokines of Taekwondo athletes. *Journal of Exercise Rehabilitation*, *10*(5), 326. https://doi.org/10.12965/JER.140160

Rismayanthi, C. (2012). PERSEPSI ATLET TERHADAP MACAM, FUNGSI CAIRAN, DAN KADAR HIDRASI TUBUH DI UNIT KEGIATAN MAHASISWA OLAHRAGA UNIVERSITAS NEGERI YOGYAKARTA. FIK UNY: Yogyakarta

Seyhan, S. (2018). Evaluation of the Rapid Weight Loss Practices of Taekwondo Athletes and Their Effects. *Journal of Education and Training Studies*, *6*(10), 213–218. https://doi.org/10.11114/jets.v6i10.3663

Sundgot-Borgen, J., Meyer, N. L., Lohman, T. G., Ackland, T. R., Maughan, R. J., Stewart, A. D., & Müller, W. (2013). How to minimise the health risks to athletes who compete in weight-sensitive sports review and position statement on behalf of the Ad Hoc Research Working Group on Body Composition, Health and Performance, under the auspices of the IOC Medical Commission. *British Journal of Sports Medicine*, *47*(16), 1012–1022. https://doi.org/10.1136/BJSPORTS-2013-092966

Todorović, N., Ranisavljev, M., Tapavički, B., Zubnar, A., Kuzmanović, J., Štajer, V., Sekulić, D., Veršić, Š., Tabakov, S., & Drid, P. (2021). Principles of rapid weight loss in female sambo athletes. *International Journal of Environmental Research and Public Health*, *18*(21), 3–9. https://doi.org/10.3390/ijerph182111356

Yagmur, R., Isik, O., Kilic, Y., & Dogan, I. (2019). Weight Loss Methods and Effects on the Elite Cadet Greco-Roman Wrestlers. *JTRM in Kinesiology*.

Yu, X. (2020). *Fatigue and Recovery of Wushu Athletes Based on Fatigue Damage Model*. https://doi.org/10.1088/1757-899X/914/1/012016

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