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Weight cutting in judo: a bibliometric analysis of scientific publications

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Abstract

Purpose. Purpose: to conduct a bibliometric analysis of scientific publications devoted to the problem of weight cutting in judo using data from the PubMed database and VOSviewer visualization tools.

Material and methods. To create the study sample as of December 31, 2025, a bibliometric analysis of the PubMed database was performed. The following search terms were used: «judo»; «rapid weight loss» or «weight cutting» or «dehydration» or «weight cycling» or «body composition»; «performance» or «health» or «physiology». The publication analysis covered the period from 1981 to 2025. The software VOSviewer 1.6.19 was used, including keyword co-occurrence analysis and direct citation analysis with the construction of bibliometric maps, cluster density visualization, and weighting by citations.

Results. using VOSviewer 1.6.19, a total of 288 publications were identified. All publications were written in English. A substantial increase in the number of publications was observed in each five-year period, which can be explained by the growing popularity of the studied topic. A total of 1128 researchers from 622 organizations investigated the issue of weight cutting in judo. The publication activity of 1128 authors was analyzed, and they were grouped into 16 clusters. The most productive authors were Franchini E. (16), Real R. (10), Drid P. (8), Silva A. (7), Lakicevic N. (6), Langan-Evans C. (6), and Kirk C. (6). For network visualization, 117 keywords were selected and grouped into 5 clusters. The most prominent research topics were centered around the keywords «humans», «male», «martial arts», «body composition», «female», «adults», «athletes», «young adults», «weight loss», «adolescent». Temporal analysis of keywords showed an evolution of scientific approaches: early studies were mainly focused on fundamental physiological and biochemical mechanisms of adaptation to physical exercise without a clear specialization in combat sports. Later, research interest shifted toward applied aspects, particularly body mass reduction and nutritional support for athletes.

Conclusions. The results of the bibliometric analysis indicate a clearly structured research field in body mass reduction among judo athletes, with a predominance of studies related to rapid weight loss, physiological adaptation mechanisms, and body composition control. The interdisciplinary nature of the problem, integrating sports training, medicine, and nutrition science, was confirmed. The contradictory evidence regarding the effects of rapid weight loss on performance and athletes' health highlights the need for cautious application of such practices. Future research should focus on developing safe and scientifically grounded strategies for body weight management in athletes.

Keywords: combat sports, judo, weight cutting, VOSviewer, bibliometric mapping, cluster, citation.

Анотація

Згонка ваги у дзюдо: бібліометричний аналіз наукових публікацій

Сорока В.М., Пономарьов В.О.

Мета. Мета: проведення бібліометричного аналізу наукових публікацій, присвячених проблемі згонки ваги у дзюдо, з використанням даних бази PubMed та інструментів візуалізації VOSviewer.

Матеріал і методи. Для створення вибірки досліджень на 31.12.2025 року використано бібліометричний аналіз даних бази PubMed. Для пошуку було використано такі фрази: «дзюдо»; «швидка втрата ваги» або «зниження ваги» або «зневоднення» або «циклічна зміна ваги» або «склад тіла»; «продуктивність» або «здоров'я» або «фізіологія». Аналіз публікацій проводився з 1981 року по 2025 рік. Використовувалася програма VOSviewer 1.6.19: метод аналізу ключових слів та аналіз прямого цитування з побудова бібліометричних карт, візуалізація щільності кластерів, ваги – цитувань.

Результати. За допомогою програми VOSviewer 1.6.19 знайдено 288 публікацій. Усі публікації були написані англійською мовою. Спостерігається велике збільшення публікацій в кожному п'ятиріччі. Це пояснюється популяризацією проблеми, яка досліджувалась. 1128 вчених з 622 організацій вивчали проблему згонки ваги в дзюдо. Проаналізована публікаційна активність 1128 авторів. Автори були згруповані в 16 кластерів. Найбільшу кількість публікацій мали такі автори: Franchini E. (16), Real R. (10), Drid P. (8), Silva A. (7), Lakicevic N. (6), Langan-Evans C. (6), Kirk C. (6). Для візуалізації мережі було вибрано 117 ключових слів. Вони були згруповані у 5 кластерів. Найпопулярніші дослідження знаходяться навколо ключових слів: «люди», «чоловіки», «бойові мистецтва», «склад тіла», «жінки», «дорослі», «спортсмени», «молоді люди», «втрата ваги», «підлітки». Результати аналізу часової динаміки ключових слів засвідчили еволюцію наукових підходів: ранні наукові дослідження були зосереджені переважно на фундаментальних фізіологічних і біохімічних механізмах адаптації організму до фізичних навантажень без чіткої спеціалізації на єдиноборствах. Надалі відбулося зміщення наукового інтересу у бік прикладних аспектів, зокрема проблеми зниження маси тіла та нутриційного забезпечення спортсменів.

Висновки. Отримані результати бібліометричного аналізу свідчать про чітку структурованість наукових досліджень у сфері зниження маси тіла дзюдоїстів із домінуванням напрямів, пов'язаних із швидкою втратою ваги, фізіологічними механізмами адаптації та контролем складу тіла. Встановлено міждисциплінарний характер проблеми, що поєднує аспекти спортивної підготовки, медицини та нутриціології. Виявлена суперечливість даних щодо впливу швидкої згонки ваги на працездатність і здоров'я спортсменів підкреслює необхідність обережного її застосування. Подальші дослідження мають бути спрямовані на розробку безпечних і науково обґрунтованих стратегій управління масою тіла у спортсменів.

Ключові слова: єдиноборства, дзюдо, згонка ваги, VOSviewer, бібліометричне картування, кластер, цитування.

Introduction

In modern sports that use weight categories, body mass control is one of the key factors determining athletes' competitive strategy (Бойченко & Шандригось, 2023; Curby et al., 2023). The system of weight categories encourages athletes to purposefully reduce body mass before the official weigh-in in order to obtain a potential competitive advantage. In this context, the practice of so-called rapid weight loss has become widespread. It involves a substantial reduction in body mass over a short period of time, usually from a few hours to several days before the start of competition.

Weight-cutting methods in judo are diverse and often combine restrictions on fluid and food intake, sauna use, special clothing to increase sweating, and increased physical loads. Despite the prevalence of these approaches, scientific studies indicate their ambiguous effects on the athlete's body. In particular, rapid body mass loss may lead to disturbances in water-electrolyte balance, reduced glycogen stores, changes in the functioning of the cardiovascular and thermoregulatory systems, and may also negatively affect cognitive functions, the speed of sensorimotor reactions, and overall performance (Bialowas et al., 2023; Staśkiewicz-Bartecka et al., 2025).

Particular concern is caused by the prevalence of aggressive weight-cutting practices among young athletes, which may have long-term consequences for their physical development and health (Berkovich et al., 2016; Samanipour et al., 2025). In this regard, the safety, effectiveness, and expediency of using various body mass reduction methods remain a subject of active scientific discussion. In recent years, researchers' interest in the effects of rapid weight loss on sports performance, recovery processes, hormonal status, injury risk, and athletes' psychological state has grown considerably.

At the same time, it should be noted that the available studies are characterized by substantial variability in methodology, samples, analyzed indicators, and approaches to evaluating the effectiveness of weight cutting. This complicates the formation of a holistic understanding of the current state of scientific knowledge in this field. Under such conditions, the generalization and systematization of scientific publications using modern scientometric approaches becomes especially relevant (Okun et al., 2024; Saltan et al., 2025).

Bibliometric analysis makes it possible not only to quantitatively assess the dynamics of scientific research but also to identify key thematic areas, the structure of scientific knowledge, relationships between research topics, as well as leading authors, institutions, and countries shaping the current scientific discourse. The use of visualization tools, in particular VOSviewer, in combination with the capabilities of the PubMed database creates a basis for in-depth analysis of scientific trends and for identifying promising directions for further research in the field of weight cutting in judo.

Thus, conducting a comprehensive bibliometric analysis of scientific publications makes it possible to systematize the available knowledge, determine the evolution of research approaches, and outline current scientific issues that require further study.

Relationship of the study with scientific programs, plans, and topics. The study was conducted in accordance with the research topic of Kharkiv State Academy of Physical Culture, «Innovative Technologies and Modern Approaches to Improving Competitive Preparation in Combat Sports».

Purpose – the purpose of the study was to conduct a bibliometric analysis of scientific publications devoted to the problem of weight cutting in judo using data from the PubMed database and VOSviewer visualization tools.

Material and methods

The bibliometric method was used in the study (Sofyan & Abdullah, 2022). For this purpose, VOSviewer 1.6.19 was applied. VOSviewer is software used for constructing and visualizing bibliometric networks. These networks may include journals, researchers, or individual publications and are built on the basis of citation, bibliographic coupling, co-citation, or co-authorship relations (Boychenko et al., 2025; Tropin et al., 2023).

For visual and bibliometric analysis, the following data were extracted: author name, article title, journal, keywords, publications, and total citation count. To create the sample of studies, a bibliometric analysis of the PubMed database was used. The following search terms were applied: «judo»; «rapid weight loss» or «weight cutting» or «dehydration» or «weight cycling» or «body composition»; «performance» or «health» or «physiology». Publication analysis covered the period from 1981 (the year of the first publication) to December 31, 2025.

Research results and discussion

Querying the PubMed scientometric database for the study period yielded 288 publications. All publications were written in English. A substantial increase in the number of publications was observed in each five-year period (Figure 1). This can be explained by the growing popularity of the studied problem. A total of 1128 researchers from 622 organizations studied the issue of weight cutting in judo.

Using VOSviewer 1.6.19, bibliometric maps were created. Analysis of these maps was devoted to the issue of weight cutting in judo, identifying priority research areas and leading authors. Results for the leading authors whose publications addressed the problem are presented in Figure 2. The analysis involved 1128 authors connected to one another. A specific feature of Figure 2 is its division into 16 clusters. These clusters are characterized by 1172 links and a total link strength of 1387. The following authors had the greatest number of publications: Franchini E. (16), Real R. (10), Drid P. (8), Silva A. (7), Lakicevic N. (6), Langan-Evans C. (6), and Kirk C. (6).

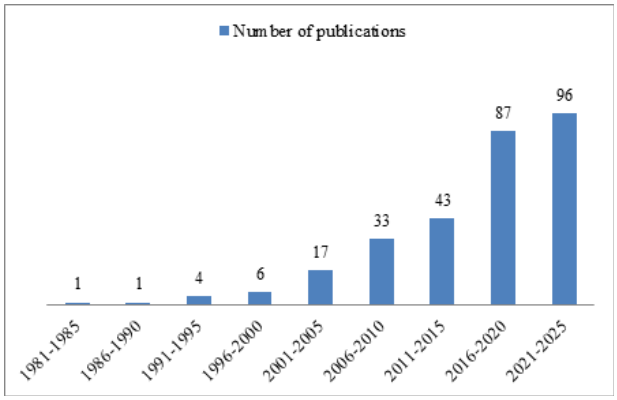

Figure 1 – **Dynamics of publications over the study period**

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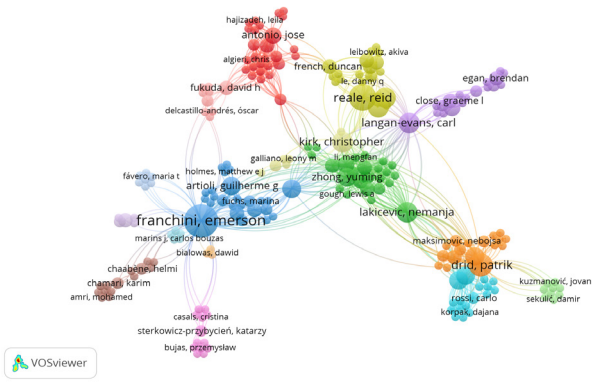

Figure 2 – **Bibliometric map of leading authors who studied the problem of weight cutting in judo**

Figure 3 shows a bibliometric map of the main keywords in publications devoted to the problem of weight cutting in judo. The minimum threshold for keyword occurrence was 5, as suggested by the software. For network visualization, 117 keywords were selected. Based on keyword co-occurrence analysis, a network map including five clusters was formed, reflecting the leading thematic directions of contemporary research. The network includes 2904 links with a total strength of 13882. The most popular research topics are centered around the keywords «humans», «male», «martial arts», «body composition», «female», «adults», «athletes», «young adults», «weight loss», «adolescent». Each keyword is located inside a circle. The larger the circle, the greater the number of links to that keyword. The proximity of circles on the map reflects the strength of correlation between the objects.

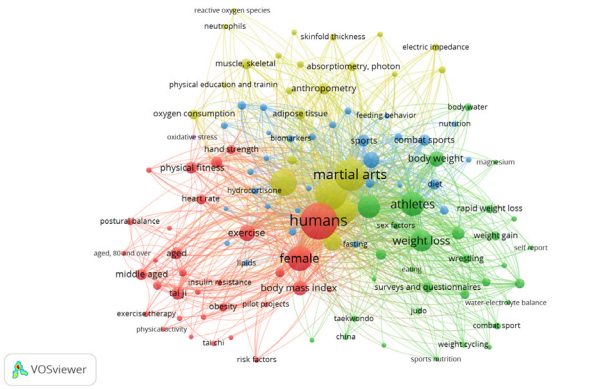

Figure 3 – **Bibliometric map of the main keywords in publications devoted to the problem of weight cutting in judo**

In the center of the map are the most generalized terms – «humans», «martial arts», «athletes» - which have the greatest number of links and act as integrative elements between all thematic clusters. This indicates the interdisciplinary nature of the studied problem and its orientation toward both the general population and athletes.

The first cluster contains 32 keywords and is shown in red on the map. It reflects studies devoted to physical activity, metabolic health, and demographic characteristics. Its main keywords are «physical fitness», «exercise», «body mass index», «obesity», «insulin resistance», «middle aged», «aged», «heart rate», «postural balance», «physical therapy». The content of this cluster reflects scientific interest in the effect of physical loads on the functional state of the body, prevention of metabolic disorders, and health maintenance in different age groups. A considerable part of the studies has an applied character and concerns both sports practice and the general population.

The second cluster contains 31 keywords and is shown in green. It includes scientific works directly related to body mass reduction strategies in athletes. It contains such keywords as «weight loss», «rapid weight loss», «diet», «nutrition», «body mass», «athletes», «wrestling», «judo», «combat sports», «sports nutrition», «water-electrolyte balance». This cluster is central in the context of the present study because it reflects the specific preparation of athletes competing in weight categories. It addresses rapid weight cutting, nutritional features, regulation of water-electrolyte balance, and risks associated with repeated cycles of body mass reduction and recovery.

The third cluster contains 30 keywords and is shown in blue. It characterizes studies aimed at examining physiological and biochemical mechanisms that support sports activity. Its main keywords are «sport», «biomarkers», «adipose tissue», «eating behavior», «oxygen consumption», «oxidative stress», «hand strength». Within this direction, researchers analyze the body's functional capacities, adaptive responses to physical loads, and the role of metabolic and biochemical indicators in ensuring sports performance.

The fourth cluster contains 23 keywords and is shown in yellow. It combines studies related to anthropometry and methods for assessing body composition. It is formed by such keywords as «anthropometry», «skinfold thickness», «absorptiometry», «muscle, skeletal», «electrical impedance», «body water». Within this cluster, modern methods for determining body composition are considered, including bioimpedance analysis and dual-energy X-ray absorptiometry, which are important tools for monitoring changes in athletes' body mass during training and weight cutting.

The fifth cluster includes one keyword – «oxidative stress» – and is shown in purple on the map. The research themes of this cluster are associated with this keyword.

Thus, the results of the bibliometric analysis indicate the presence of a clearly structured scientific field in which the leading place is occupied by studies related to body mass reduction in combat sports athletes, physiological adaptation mechanisms, and body composition control methods. The relationship between clusters confirms the complex nature of the problem, which combines aspects of sports training, medicine, and nutrition science.

The overlay visualization function in VOSviewer 1.6.19 allows researchers to assign scores to elements and sort them according to a predefined score. This function makes it possible to identify the most popular research themes. The publication date was assigned as the score for each analyzed item, and then VOSviewer 1.6.19 generated a map visualizing the average number of publications per year for the most frequently occurring keywords. The period from 2006 to 2025 was taken for analysis because it contained the largest number of publications. On the map, colors vary from purple (corresponding to the lowest score value, that is, an earlier average publication

date), through green, to yellow (showing keywords with the highest value, that is, the most recent average publication year) (Figure 4).

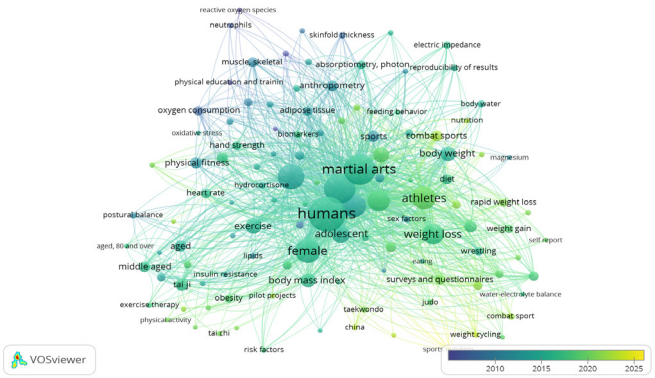

Figure 4 – **Average publication year of the most frequently occurring keywords in research on weight cutting in judo (period from 2006 to 2025)**

The color gradation of the map indicates the temporal dynamics of research, where the newest publications are concentrated mainly around problems of rapid weight cutting, nutritional support, and water-electrolyte balance, which points to growing scientific interest in safe strategies of body mass management in athletes. The early stage of development of this scientific field was characterized by fundamental study of physiological mechanisms and adaptations to physical exercise, which later became the basis for more applied studies focused on the specificity of weight categories and sports nutrition.

Discussion

The article presents the results of a bibliometric analysis of the PubMed database using the VOSviewer software. VOSviewer can significantly facilitate the work of a researcher in analyzing and structuring information obtained from bibliographic data. A large number of contemporary scholars use this software to analyze various databases (Piatysotska et al., 2023; Podrigalo et al., 2025; Tropin et al., 2026).

The obtained bibliometric results indicate a steady growth of scientific interest in the problem of weight cutting in judo, which is confirmed by a considerable increase in the number of publications in each subsequent five-year period (Figure 1). Such dynamics are consistent with global trends in sports science and sports medicine, particularly with increased attention to athlete health preservation, injury prevention, and optimization of training and competitive activity (Latyshev et al., 2022; Matkarimov et al., 2024; Pashkov et al., 2021).

Analysis of the network of leading authors showed the presence of a large number of clusters, which indicates fragmentation but at the same time diversity of scientific approaches to weight cutting in judo. Most articles were written in coauthorship, which suggests a high level of collaboration among authors studying this topic (Figure 2).

The bibliometric review of the literature on weight cutting in judo using VOSviewer 1.6.19 made it possible to identify five keyword clusters (Figure 3). The obtained results make it possible to better understand the current state of scientific research on body mass reduction in combat sports athletes and are consistent with the findings of previous works represented in the analyzed publication corpus.

First of all, the identification of a separate cluster associated with weight cutting and nutritional strategies confirms the central place of this issue in sports science. Analysis of the content of the selected body of sources indicates a high prevalence of rapid body mass reduction among athletes, particularly judokas, where its use may reach 80-90% of cases (Lakicevic et al., 2020; Stangar et al., 2022). This is consistent with the density of links in the green cluster, where key terms form the core of the network.

At the same time, the results of the literature analysis demonstrate the contradictory nature of the influence of weight cutting on sports performance. On the one hand, some studies indicate that short-term body mass reduction followed by recovery may not have a significant negative effect on specific performance (Brechney et al., 2022). On the other hand, a considerable number of works emphasize health risks, including dehydration, metabolic disturbances, hormonal changes, and reduced functional capabilities of the body (Lakicevic et al., 2021; Zhong et al., 2025). This contradiction explains the high inter-cluster connectivity between the second cluster (weight cutting) and the third cluster (physiological mechanisms).

The identification of a cluster associated with physiological and biochemical markers reflects a trend toward deeper study of mechanisms of adaptation in athletes. In particular, the analyzed sources focus on changes in aerobic productivity, insulin resistance, hormonal status, and inflammatory processes under the influence of training or its cessation (Martinez-Aranda et al., 2023; Reale et al., 2020). This confirms that contemporary studies are focused not only on practical aspects of weight reduction but also on the investigation of underlying physiological mechanisms.

No less important is the cluster uniting studies of anthropometry and body composition, which is closely associated with weight control. The use of modern methods for body composition assessment, such as bioimpedance and DXA, makes it possible to determine changes in fat and muscle mass more precisely, which is of key importance for optimizing athlete preparation. Literature data confirm that changes in body composition during cycles of body mass reduction and restoration are accompanied by complex metabolic rearrangements, including changes in bone metabolism and hormonal balance (Barley et al., 2018; Reale et al., 2017).

Special attention should also be paid to the cluster associated with general physical activity and health, which goes beyond the strictly sports-related issue. The presence in the network of such terms as «obesity», «physical therapy», «physical activity» indicates the integration of combat sports research into the broader context of public health. In particular, it has been established that martial arts can be used as an effective means of body mass correction and improvement of anthropometric indicators in different population groups (Larkey et al., 2018; Moreira et al., 2022).

An important aspect emerging in the formation of weight-reduction strategies is the role of behavioral and social factors. In particular, coaches and the athlete's environment exert a substantial influence on the decision to cut weight, as does

the prevalence of irrational practices such as fasting, fluid restriction, sauna use, and water loading. This underlines the necessity of developing educational programs and regulatory mechanisms in athlete preparation systems (Franchini et al., 2011; Reale et al., 2018).

The results of temporal keyword dynamics analysis demonstrated the evolution of scientific approaches: early studies were primarily focused on fundamental physiological and biochemical mechanisms of adaptation to physical loads without clear specialization in combat sports. Later, scientific interest shifted toward applied aspects, particularly the problem of body mass reduction and nutritional support for athletes (Figure 4).

Thus, the study results confirm that the modern scientific field related to body mass reduction in judo is complex and interdisciplinary. The main research directions include practical aspects of weight cutting, physiological mechanisms of adaptation, methods of body composition control, and the impact of physical activity on health. At the same time, contradictory findings regarding the effectiveness and safety of rapid body mass reduction point to the need for further research aimed at developing scientifically grounded, safe, and effective strategies for athlete body mass management.

Conclusions

The results of the bibliometric analysis indicate a clearly structured field of scientific research in body mass reduction among judokas, with the dominance of directions related to rapid weight loss, physiological adaptation mechanisms, and body composition control. The interdisciplinary nature of the problem, which combines aspects of sports training, medicine, and nutrition science, was established. The contradictory evidence regarding the influence of rapid weight cutting on athletes' performance and health highlights the need for cautious application of such practices. Further studies should be aimed at developing safe and scientifically grounded strategies for body mass management in athletes.

Prospects for further research. Prospects for further research in this area will be aimed at developing safe and scientifically grounded strategies for body mass management in judokas.

Conflict of interest
The authors note that there is no conflict of interest.

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