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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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AN INVESTIGATION OF PSYCHOLOGICAL AND PHYSIOLOGICAL FACTORS AFFECTING PERFORMANCE IN ADOLESCENT JUDOKAS

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Abstract.

The purpose of this study was to investigate the psychological and physiological factors affecting performance levels in adolescent judokas.

Materials and Methods: The research was performed in the "Sport EMI" scientific-research center of Armenian State Institute of Physical Culture and Sport. Participants' performance levels were assessed based on their kyu rankings, a hierarchical ranking system in judo. The psychological assessment involved the completion of the Well-being, Activity, and Mood (WAM) test. The physiological assessment focused on heart rate variability (HRV) measurements, which were obtained using the Varikard 2.51 complex equipment. A total of 23 male teenage judokas, aged between 10 and 16 years, were randomly selected from a judo club to participate in this study.

Results: Participants demonstrated high levels of well-being, activity, and positive mood, indicating positive psychosocial outcomes associated with judo practice. Analysis of heart rate variability (HRV) revealed deviations in certain variables, suggesting potential irregularities in autonomic nervous system regulation. Specifically, the Index of Activity of Regulatory Systems (IRSA), low-frequency power (LF), and total power (TP) exceeded normal ranges, indicating increased tension and overall activity in the regulatory systems. In addition, one-way analysis showed significant main effects of age, training duration, and high-frequency power (HF) on the participants' performance level (Kyu).

Conclusion: The findings suggest that psychological and physiological factors play significant roles in the performance levels of adolescent judokas. Coaches and practitioners should consider both aspects in optimizing training strategies for young athletes.

Key words. Adolescence judokas, well-being, heart date variability, performance, autonomic nervous system, physiological adaptation.

Introduction.

Judo, a traditional Japanese martial art characterized by its combination of physical techniques and mental discipline, has gained significant popularity worldwide as both a competitive sport and a holistic practice for physical and mental development. In recent years, there has been a growing interest in exploring the effects of judo on the physical and mental health of adolescents [1-3], considering the unique challenges they face during this transformative phase of development, which encompasses profound biological, social and psychological changes [4,5].

Numerous studies have highlighted the positive influence of judo training on the physical health of adolescent judokas, leading to improved aerobic capacity, strength, flexibility, and cognitive performance [6-8]. Moreover, judo training has been associated with significant physiological benefits, such as improved cardiovascular fitness and bone health parameters in young athletes [9]. Engaging in judo, a combat sport, not only offers physical advantages but also positively impacts adolescents' psychosocial well-being [10]. Research indicates higher levels of well-being, life satisfaction, and quality of life among judo participants compared to normative samples [11]. Judo involvement during adolescence fosters the development of identity, self-esteem, and competence [12-15]. Kleiber and his colleagues have observed that sport, including judo, provides a structured context for learning character values such as responsibility, conformity, persistence, risk-taking, courage, and self-control [14,16]. This aspect of judo training is particularly valuable for adolescents as they navigate through their formative years, providing them with essential life skills and a sense of purpose.

To optimize judo performance and foster holistic development in adolescent judokas, a comprehensive approach encompassing physical, psychological, technical, and tactical aspects of training is imperative [17]. Psychological factors play a significant role in judo performance [18]. Sport anxiety and psychological capital have been identified as influential factors in collegiate judo athletes' performance [19]. Additionally, elite judo athletes exhibit higher confidence levels, highlighting the importance of psychological factors in achieving success [20].

In addition to psychological considerations, a thorough understanding of the intricate physiological and physical demands specific to judo is crucial. This includes knowledge of physiological adaptations during training and competition, heart rate responses, anthropometric parameters, maximal oxygen uptake, hormonal markers, and more [21-23]. Analyzing factors like age, somatic maturation, body composition, and training experience provides valuable insights into judo-specific assessments among young athletes [24]. Integrating this knowledge into training methodologies allows coaches to optimize performance and enhance overall athletic development in judokas.

In the field of judo, physiological assessment through the analysis of heart rate variability (HRV) has already found utility. Resting HRV has been used as a physiological indicator of pre-competitive anxiety in judo, although further research with larger samples is needed to determine whether HRV can classify athletes with different performance levels [25,26]. Additionally, the effects of training on the autonomic nervous system (ANS) in healthy children and adolescents have remained relatively unexplored, indicating a need for further investigation in this area [27].

While considerable information exists regarding various psychological and physiological variables that impact the performance levels of adolescent judokas, there remains a noticeable research gap in terms of an integrated assessment of these components. Specifically, there is a lack of studies that investigate how psychological and physiological factors interact and collectively contribute to the overall performance

of adolescent judokas. By addressing this research gap, we can develop a more holistic understanding of the multidimensional aspects that influence judo performance.

The purpose of this study was to investigate the psychological and physiological factors affecting performance levels in adolescent judokas.

Materials and Methods.

Participants: A total of 23 male teenage judokas, aged between 10 and 16 years (mean age = 13.3043 ± 1.69 years), were randomly selected from the "Zeytun" judo club to participate in this study. The selection process aimed to ensure a diverse and representative sample of adolescent judokas within the specified age range. The participants' mean training experience was 4.7826 ± 2.63 years, indicating a considerable level of engagement and dedication to the sport. Informed consent was obtained from both the participants and their legal guardians prior to their inclusion in the study. To minimize potential biases, random sampling was employed to recruit participants from the judo club's roster. Participants were required to be free from any known physical or psychological conditions that could affect their performance or well-being, ensuring the validity of the collected data.

Performance Level Assessment: As part of the study, participants' performance levels were assessed based on their kyu level, which is a hierarchical ranking system commonly used in judo to indicate skill proficiency. The distribution of participants across different kyu levels was as follows: 5 participants had white kyu, 3 participants had yellow kyu, 4 participants had orange kyu, 6 participants had green kyu, 4 participants had blue kyu, and 1 participant had brown kyu. This range of kyu levels allowed for a comprehensive analysis of psycho-physiological profiles across different performance levels, facilitating a deeper understanding of the factors influencing skill development in adolescent judokas.

Psychological Assessment: Upon obtaining consent, participants completed the "Well-being, Activity, Mood" (WAM) test. The WAM test, which is a self-report measure designed to assess participants' subjective feelings of well-being, activity levels, and mood. The psychological assessment took place in a quiet and comfortable environment, ensuring minimal distractions. Clear instructions were provided to participants on how to respond to the questionnaires, and any questions or concerns were addressed to ensure accurate and reliable data collection.

Physiological Assessment: Following the completion of the psychological assessment, the physiological assessment was conducted at the Sport EMI Scientific Research Center of the Armenian State Institute of Physical Culture and Sport. Participants' heart rate variability (HRV) measurements were obtained in the morning, approximately at the same time, to minimize the potential influence of diurnal variations. Participants were instructed to refrain from consuming stimulants such as caffeine and to avoid intense physical activity for at least 12 hours prior to the measurements. The HRV measurements were collected using the Varikard 2.51 complex equipment, and the data were analyzed using the ISCIM6 software. The device has an input voltage range of 0.3 mV to 5 mV, with estimated deviations of ±14% for stress estimation and ±10% for time intervals.

The following heart rate variability indicators were analyzed during the study to assess the athletes' physiological state:

- Standard deviation - SDNN (ms): Reflects the overall effect of autonomic regulation of blood circulation.
- Coefficient of variation - CV (%): A normalized indicator of the overall effect of regulation.
- Stress index - SI: Indicates the degree of tension in regulatory systems.
- Centralization index - CI: Reflects the degree of centralization of heart rate regulation.
- Index of activity of regulatory systems - IRSA: Provides information about the activity of regulatory systems.
- Number of arrhythmias - Narr (%).
- High-frequency power - HF power (%): Reflects the relative level of activity of the parasympathetic regulation.
- Low-frequency power - LF power (%): Reflects the relative level of activity of the vasomotor center.
- Very low-frequency power - VLF power (%): Reflects the relative level of activity of the regulatory sympathetic connection.
- Total power of heart rate variability - TR: Represents the overall level of activity of regulatory systems.

Data Collection: All data, including subjective well-being scores, mood ratings, activity levels and HRV parameters, were collected for each participant. The data collection process involved ensuring the accuracy of data recording and documentation while maintaining participant confidentiality and anonymity.

Statistical Analysis: The collected data were subjected to a comprehensive statistical analysis using the Statistical Package for the Social Sciences (SPSS) version 23. Descriptive statistics, including means and standard deviations, were computed to summarize the data for subjective well-being scores, mood ratings, activity levels, and HRV parameters.

To investigate the differences in psychological and physiological variables across different performance levels, a one-way analysis of variance (ANOVA) was conducted. This analysis allowed for the comparison of means between the various performance groups (e.g., white kyu, yellow kyu, orange kyu, green kyu, blue kyu, and brown kyu) for each variable of interest.

Furthermore, correlation analyses were performed to explore the relationships between well-being scores, mood ratings, activity levels, HRV parameters, and performance levels based on kyu rankings. Pearson's correlation coefficients were calculated to determine the strength and direction of these relationships. The significance level for all statistical analyses was set at $p<0.05$, indicating statistical significance.

Results.

The following section presents the results of the study, starting with an overview of the Well-Being, Activity, and Mood (WAM) test scores. The mean scores for well-being, activity, and mood were calculated based on the responses of the participants. The descriptive statistics for the WAM test are presented in Table 1.

As can be seen from table 1, the scores obtained in all three

Table 1. *Descriptive Statistics for Well-Being, Activity, and Mood.*

	N	Minimum	Maximum	Mean	Std. Deviation
Well-being	23	36.00	70.00	56.17	7.761
Activity	23	31.00	68.00	50.69	8.368
Mood	23	47.00	70.00	61.34	7.708

Table 2. *Descriptive Statistics for HRV Variables.*

	Mean	Std. Deviation	Normal Range
Heart Rate	87.08	12.16	70-85
Standard Deviation	62.27	23.84	30-100
CV	8.70	2.52	3-12
Stress Index	124.64	106.28	50-150
Index centralization	3.47	2.11	2.0-8.0
IRSA	4.73*	1.51	1-3
NArr	.15	.31	0-4
HF	27.81	14.01	10-30
LF	49.00*	13.75	15-45
VLF	23.16	11.18	20-60
TP	3921.69*	3180.22	800-1500

domains were generally higher than 50, which can be interpreted as indicating a relatively high level of well-being, activity, and positive mood among the participants. Specifically, the mean well-being score was 56.1739, suggesting that, on average, participants reported a high level of overall well-being. The mean activity score was 50.6957, indicating an average level of physical and mental activity. Furthermore, the mean mood score was 61.3478, indicating a relatively high level of positive mood among the participants. These findings suggest that the participants generally experienced positive well-being, engaged in adequate levels of activity, and reported predominantly positive moods.

Following the psychological assessment, the study also examined Heart Rate Variability (HRV) measures as indicators of autonomic nervous system functioning. Descriptive statistics for HRV variables are presented in Table 2.

The HRV measures provide valuable insights into the regulation of the autonomic nervous system and cardiovascular functioning in the participants. Notably, certain HRV variables, namely IRSA, LF, and TP, exhibited values that deviated from the normal ranges, indicating potential irregularities or variations in the regulatory systems. IRSA, the Index of Activity of Regulatory Systems, had a mean value of 4.73, which falls outside the recommended range of 1-3. This indicates a state of moderate tension in the regulatory systems, suggesting that the body requires additional functional reserves to adapt to environmental conditions. This state of tension commonly occurs during work adaptation, emotional stress, or exposure to adverse environmental factors.

LF, which specifically characterizes sympathetic nervous activity and the regulation of vascular tone, had a mean value of 49.00, surpassing the normal range of 15-45. Similarly, TP, representing the overall level of activity of regulatory systems, had a mean value of 3921.69, exceeding the normal range of 800-1500. This suggests a higher overall activity level in the regulatory systems responsible for autonomic nervous system regulation and cardiovascular functioning.

In the analysis of correlations, noteworthy associations between performance-related variables were observed, providing valuable insights for this research. The correlation heatmap in Table 3 presents the relationships between psychological and Heart Rate Variability (HRV) variables in adolescent judokas, shedding light on the intricate interplay between these factors.

Performance, as measured by kyu level, exhibited significant positive associations with age ($r = 0.618^{**}$, $p < 0.01$) and training duration ($r = 0.802^{**}$, $p < 0.01$). Moreover, age and training duration displayed a significant positive correlation with each other ($r = 0.546^{**}$, $p < 0.01$). These findings suggest that longer training duration is a prominent factor contributing to performance among teenage judokas, while age also plays a role in performance outcomes.

Regarding heart rate variability (HRV) parameters, significant relationships with performance were observed. SDNN, a measure of heart rate variability, displayed a positive correlation with performance ($r = 0.457^{*}$, $p < 0.05$), indicating that participants with higher SDNN values exhibited greater performance levels. Similarly, the Index of Centralization demonstrated a positive correlation with performance ($r = 0.433$, $p < 0.01$). On the other hand, heart rate showed a significant negative correlation with performance ($r = -0.519^{**}$, $p < 0.01$). Additionally, high-frequency (HF) power of HRV displayed a negative correlation with performance ($r = -0.551^{**}$, $p < 0.01$), indicating that participants with higher HF power had lower performance levels. These findings highlight the influence of HRV variables on performance outcomes in adolescent judokas.

Furthermore, the well-being and mood variables were found to be dependent on HRV parameters. HF power exhibited a positive correlation with both well-being ($r = 0.458^{*}$, $p < 0.05$) and mood ($r = 0.450^{*}$), suggesting that individuals with higher HF power reported greater well-being and more positive mood states. Conversely, other HRV variables displayed negative correlations with well-being. The Index of Centralization exhibited a significant negative correlation with well-being ($r = -0.547^{**}$, $p < 0.01$), indicating that individuals with more centralized HRV patterns reported lower levels of well-being. Similarly, the Index of activity of regulatory systems (IRSA) displayed a negative correlation with well-being ($r = -0.449$, $p < 0.05$). While lower scores of IRSA indicate higher physiological adaptation and lower tension in regulatory systems, and lower well-being scores indicate lower levels of well-being, the negative correlation between these two variables suggests that individuals with a more favorable functional state and lower tension in regulatory systems tend to have higher levels of well-being. These findings highlight the complex interplay between HRV variables and psychological well-being outcomes among judokas.

An analysis of variance (ANOVA) was conducted to examine the effects of different variables on the performance level (Kyu) of the participants. The results revealed significant main effects of Age ($F = 0.018$, $p < 0.05$), Training Duration ($F = 0.000$, $p < 0.05$), and HF ($F = 0.010$, $p < 0.05$) on the participants' performance level.

Age emerged as a significant factor influencing the performance level. The specific age groups may exhibit variations in their performance levels, indicating that participants of different

Table 3. *Correlation Heatmap for Psychological and Heart Rate Variability (HRV) Variables in Adolescent Judokas.*

	Age	Experience	Well-being	Activity	Mood	Heart Rate	SDNN	CV	SI	IC	IRSA	NArr	HF	LF	VLF	TP	Kyu
Age	1																
Experience	.546**	1															
Well-being	.072	-.219	1														
Activity	-.147	-.190	.194	1													
Mood	.162	.063	.539**	.126	1												
Heart Rate	-.547**	-.389	-.210	-.126	-.291	1											
SDNN	.379	.227	-.115	.076	-.021	-.741**	1										
CV	.247	.149	-.226	.072	-.146	-.49*	.937**	1									
SI	-.208	-.135	-.094	-.278	-.019	.716**	-.695**	-.598**	1								
IC	.167	.307	-.547**	.035	-.328	.165	.107	.210	.073	1							
IRSA	.174	.102	-.449*	-.085	-.307	.307	-.032	.087	.385	.559**	1						
NArr	.129	.360	-.325	.209	-.255	-.357	.503*	.485*	-.317	.175	-.027	1					
HF	-.192	-.428*	.458*	.088	.45*	-.011	-.236	-.293	.132	-.864**	-.397	-.262	1				
LF	.283	.295	-.332	-.135	-.280	.261	-.119	-.042	.218	.711**	.801**	-.177	-.676**	1			
VLF	-.106	.176	-.166	.055	-.219	-.308	.443*	.419*	-0.433*	.209	-0.488*	.547**	-.423*	-.382	1		
TP	.277	.124	-.086	.036	-.056	-.627**	.955**	.931**	-.617**	.089	.063	.406	-.227	-.077	.379	1	
Kyu	.618**	.802**	-.274	-.118	.067	-.519**	0.457*	.347	-.253	0.433*	.117	.301	-.551**	.315	.306	.348	1
**. Correlation is significant at the 0.01 level (2-tailed).																	
*. Correlation is significant at the 0.05 level (2-tailed).																	

age ranges perform differently in terms of Kyu level. The duration of training appears to play a crucial role in determining the Kyu level achieved by the participants. Longer training durations may be associated with higher performance levels, indicating the importance of consistent and prolonged training in skill development. Furthermore, HF was identified as another significant factor affecting the performance level. Variations in HF levels seem to be associated with differences in the participants' performance.

Discussion.

The primary objective of this study was to explore the psychological and physiological factors affecting the performance levels of adolescent judokas, focusing specifically on the influence of these factors based on their kyu rankings. The findings of the research provided information about the participants' well-being, activity levels, moods, and physiological indicators, all of which had an impact on how well adolescent judokas performed.

Psychological Assessment: According to the findings of the psychological assessment, the adolescent judokas reported relatively high levels of well-being, reflecting positive psychological states and an overall feeling of satisfaction with their life. These findings align with the fundamental principles of judo, which emphasize not only the physical aspects of the sport but also its impact on the psychological well-being of practitioners.

The high levels of well-being reported by judokas can be attributed to several factors. Firstly, the nature of judo as a martial art promotes personal growth and self-improvement, emphasizing the development of mental resilience, emotional stability, and a positive mindset. Sports sociologists and psychologists recognize that discipline and training in judo are key factors in overcoming fear, nervousness, and aggression. In the practice of judo, individuals are encouraged to pursue higher levels of personal development of the mind, spirit, and stable emotions, which have a positive impact on wellness. The practice of judo also instills values of cooperation, modesty, and respect for teachers and others, creating harmony in both the training environment and social situations [28]. These psychological attributes contribute to a heightened sense of well-being and a positive outlook on life.

The positive psychological outcomes observed in this study are consistent with prior research investigating the psychological impact of judo participation. Previous studies have consistently demonstrated that engaging in judo is associated with higher levels of psychosocial well-being, life satisfaction, and overall quality of life among participants [11,29,30]. These findings suggest that the psychological benefits of judo extend beyond the physical aspects of the sport and play a vital role in fostering the overall well-being of adolescent judokas.

Heart Rate Variability (HRV) Analysis: The analysis of heart rate variability (HRV) in this study provides valuable insights into the autonomic nervous system's functioning among adolescent judokas. The variations observed in HRV variables, including IRSA, LF, and TP, offer potential maladaptation of these athletes' regulatory systems. Drawing upon the expertise and framework proposed by Baevsky and Chernikova [31], the interpretation of these physiological findings underscores the significance of autonomic balance in optimizing sports performance.

One notable HRV parameter is IRSA, which emerged as a comprehensive and diagnostic measure of heart rate variability in this study. IRSA provides insights into the delicate interplay between the sympathetic and parasympathetic branches of the autonomic nervous system. The observed state of pronounced tension in the regulatory systems suggests a dynamic mobilization of protective mechanisms, characterized by heightened activity within the sympathetic-adrenal and pituitary-adrenal axes. This finding underscores the complex regulatory processes involved in judo performance and highlights the role of the autonomic nervous system in optimizing physiological responses during training and competition.

The elevated levels of low-frequency (LF) power observed in this study indicate enhanced sympathetic modulation and regulation of vascular tone among adolescent judokas. The augmented LF power reflects slow waves of the first order and sympathetic modulation, suggesting a sophisticated regulation of vascular tone. This heightened sympathetic activity in judo athletes may be attributed to the physical and psychological demands of the sport, as well as the competitive nature of judo training and competition. These findings are consistent with previous research, such as the study by Bae et al. which found that high-performance athletes had more dominant sympathetic nervous activity, indicating higher levels of overtraining and competition stress compared to the low-performance group [32]. Similarly, Morales et al. observed an imbalance of sympathetic and parasympathetic activity in judo athletes enrolled in a high training load program, leading to a decrease in vagal modulation [33]. According to these studies, judo athletes' heart rate variability may be influenced by their training load and level of performance.

In result, judo athletes may be more susceptible to increased sympathetic activity due to elevated LF power, a sign of enhanced sympathetic modulation. This physiological reaction meets the sport's requirements and the necessity for enhanced sympathetic activation to handle the physical and mental challenges of practice and competition.

Relationship between HRV, Well-being and Performance: The study's findings show a strong relationship between psychological and physiological factors and how they affect adolescent judokas' performance. The correlation observed between the Index of Regulatory Systems Activity (IRSA) and well-being provides significant insights into the complex relationship between autonomic regulation and psychological states among adolescent judokas. The results demonstrate the impact of autonomic regulation on psychological well-being by showing that individuals with a more favorable functional state and less tension in regulatory systems tend to have a higher sense of well-being.

The holistic approach to well-being in judo recognizes the inseparable connection between the mind and body, emphasizing the reciprocal influence between psychological and physiological processes. It takes into account the psychological states and general wellbeing of judokas in addition to physical fitness and technique expertise.

These results underline the significance of maintaining a healthy autonomic regulation in promoting wellbeing in adolescence judokas. An ideal balance between sympathetic and parasympathetic activity is essential for overall health and wellbeing since the autonomic nervous system regulates both physiological and psychological processes.

Among the heart rate variability (HRV) parameters examined, the high-frequency (HF) power stands out as a sensitive indicator of functional state and a significant predictor of both psychological and performance outcomes. This parameter reflects the oscillations in heart rate associated with parasympathetic activity and plays a vital role in the regulation of respiratory sinus arrhythmia.

The positive correlation between HF power and well-being highlights the importance of parasympathetic activity in fostering positive emotional states. The parasympathetic branch of the autonomic nervous system is involved in promoting relaxation, calmness, and emotional stability. When parasympathetic activity is heightened, individuals are more likely to experience improved mood, positive affect, and overall satisfaction.

These findings are in line with previous research that consistently supports the association between parasympathetic activity and psychological well-being. Studies have demonstrated the link between parasympathetic regulation of heart rate, often measured as resting respiratory sinus arrhythmia or cardiac vagal tone (CVT), and psychological well-being [34]. Maintaining a balance between sympathetic and parasympathetic activity is crucial for promoting optimal psychological well-being in athletes.

However, the negative correlation observed between high-frequency (HF) power, reflecting increased parasympathetic activity, and performance outcomes in adolescent judokas raises questions about the influence of parasympathetic activity on athletic performance. Our findings suggest that higher levels of HF power may have a detrimental effect on performance. This finding aligns with a study conducted by Cayres et al., which found that sports practice was positively associated with autonomic parasympathetic nervous system activity in adolescents [35].

One possible explanation for the negative correlation between HF power and performance is the concept of parasympathetic "overshoot". When parasympathetic activity becomes excessive, it can lead to a state of parasympathetic dominance, resulting in reduced sympathetic activation and compromised physiological readiness for optimal performance. This imbalance in autonomic regulation may impact crucial factors such as alertness, reaction time, and muscular readiness, ultimately influencing performance outcomes.

Furthermore, the ANOVA analysis revealed that HF power was the only HRV parameter that significantly influenced performance. While other HRV parameters, such as low-frequency (LF) power, provide valuable insights into sympathetic modulation and vascular tone regulation, it is the balance between sympathetic and parasympathetic activity, as reflected by HF power, that appears to be critical in achieving both optimal performance and well-being. Notably, HF power was found to be within the normal range among our sample, indicating no significant deviation in parasympathetic activity. In contrast, LF power was higher, suggesting an emphasis on sympathetic activity. These findings highlight the need for further research to explore the optimal range of HF power that maintains a balance between sympathetic and parasympathetic activity, ensuring optimal performance outcomes and well-being.

To optimize performance while promoting positive well-being and mood, it is essential to conduct further research and develop individualized approaches that consider the specific physiological and psychological characteristics of judokas. By striving for a harmonious balance between sympathetic and parasympathetic activity, coaches and practitioners can design training strategies that enhance performance outcomes while simultaneously fostering overall psychological well-being among adolescent judokas. These efforts will contribute to a

more comprehensive understanding of the intricate relationship between autonomic regulation, performance, and well-being in judo.

The findings of the study indicate a significant relationship between the age and duration of training and the performance levels of teenage judokas. This suggests that the kyu levels, which reflect skill development and performance, may vary among participants in different age groups. Consequently, it is crucial to consider athletes' physical development and capacity when designing training regimens in judo. These findings are consistent with prior research by Pocecco et al., emphasizing the importance of tailoring training programs to individual needs and developmental stages to maximize judo performance [36].

Furthermore, the results reveal a significant positive correlation between training duration and performance levels. This supports previous studies underscoring the significance of consistent and prolonged training sessions in the development of judo skills and performance [37]. The positive relationship between training duration and performance suggests that longer and more consistent training sessions contribute to higher performance levels among adolescent judokas. It is essential to strike a balance between training intensity, volume, and recovery to optimize performance outcomes while minimizing the risks of overtraining and injuries. By tailoring training programs to individual needs and maintaining a balanced approach, athletes can maximize their potential in judo.

Limitations: While the present study contributes valuable insights into the relationship between psychological and physiological factors and their influence on performance in adolescent judokas, it is important to acknowledge its limitations. Firstly, the study relied on a cross-sectional design, which limits the ability to establish causality between the variables of interest. Longitudinal studies that track participants over an extended period would provide a more robust understanding of the dynamic interplay between autonomic regulation, psychological well-being, and performance outcomes.

Another limitation of the study is the sample size, which may limit the generalizability of the findings. Future research should aim to include larger and more diverse samples to enhance the external validity of the results. Additionally, considering gender differences and potential variations across different skill levels or competition levels would further enrich our understanding of the complex interactions between psychological and physiological factors in judo performance.

Conclusion.

Based on the findings and analysis presented in this article, the following main conclusions can be drawn:

1. The study demonstrated that adolescent judokas exhibit a high level of well-being, activity, and positive mood, possibly attributed to the fundamental principles of judo that prioritize holistic development of the mind and spirit.

2. Heart rate variability (HRV), specifically the high-frequency (HF) component, has been found to impact the performance of adolescent judokas. However, the negative correlation between HF power and performance outcomes raises questions regarding the influence of parasympathetic activity on athletic performance. Excessive parasympathetic activity can potentially compromise physiological readiness for optimal performance by reducing sympathetic activation, affecting important factors such as alertness, reaction time, and muscular readiness. Further research is necessary to gain a deeper understanding of the underlying mechanisms and to develop strategies that optimize the balance between parasympathetic and sympathetic activity, ultimately enhancing athletic performance in judo.

3.The influence of autonomic regulation on well-being has been discovered, highlighting the importance of maintaining a balanced autonomic regulation. A lower tension in the regulatory system is crucial for promoting well-being among judo athletes. The holistic approach to well-being in judo acknowledges the interconnection between the mind and body, emphasizing the reciprocal influence of psychological and physiological processes.

4. Age and training duration are significant factors associated with performance in judo. Participants of different age groups may exhibit variations in their skill levels, emphasizing the importance of considering age-related differences in training programs. Longer and consistent training duration contributes to improved performance outcomes. Tailoring training programs to individual needs and stages of development is crucial for optimizing performance and achieving desired outcomes in judo.

These main conclusions highlight the importance of addressing psychological well-being, understanding autonomic nervous system regulation through HRV parameters, considering age-related differences, and integrating psychological and physiological factors in optimizing training strategies for adolescent judokas. By incorporating these findings into practice, coaches and practitioners can enhance the performance levels and overall athletic development of young judokas.

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