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XXIV international scientific conference

Development of science in the XXI century

Dortmund

05-06.03.2026

Development of science in the XXI century

Proceedings of the XXIV International Scientific and Practical Conference

5-6 March 2026

Dortmund, Germany

2026

UDC 001.1

BBC 1

XXIV international scientific conference. “Development of science in the XXI century”. Dortmund, Germany. March 5-6. 2026. 145 p.

ISBN 978-92-44514-92-4

DOI https://doi.org/10.5281/zenodo.18960018

Publisher**: «World of Conferences»**

Main organization: **ESD GROUP**

Editor: Tarmo Vesik

Layout: Asko Laar

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The sample of the citation for publication is*:* ***Abbasova Gultekin, Gadjieva Lala, Safarli Gunel*** *THE STUDY OF ENERGY AND GEOMETRIC PARAMETERS OF THE DIPEPTIDE MOLECULE //* Development of science in the XXI century. *Proceedings of the XXIV International Scientific and Practical Conference. Dortmund, Germany. 2026. Pp. 12-16. URL: https://conference-w.com/*

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INTERACTION MODEL OF SPORTS AND OUTDOOR ACTIVITIES FOR ENHANCING HEALTH INDICATORS

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Abstract

The growing emphasis on holistic youth development has increased interest in programs that combine structured sports with nature-based activities. Such integrated approaches are believed to enhance physical health, emotional stability, and social functioning by engaging children and adolescents in diverse, developmentally meaningful experiences. Judo, with its pedagogical structure and emphasis on discipline and self-regulation, and outdoor activities, known for promoting adaptability and psychological balance, represent two complementary modalities whose combined effects remain insufficiently explored. ***Objective:*** This study investigates how judo training and outdoor activities contribute individually and interactively to a composite health index (Y). It further examines whether these effects differ between children aged 7–11 and adolescents aged 12–16, providing insight into age-related developmental responsiveness. ***Methodology:*** A quasi-experimental longitudinal design was implemented, assessing participants before and after a structured intervention. The program consisted of two components: a judo curriculum emphasizing technical skills, coordination, and behavioral discipline, and an outdoor module involving navigation tasks, cooperative challenges, and nature-based physical activity. Participants were assigned to conditions reflecting judo training (X), outdoor activities (M), or their combined implementation (X·M). Standardized instruments were used to measure physical fitness, self-control, social functioning, psychological resilience, and overall health. Data were analyzed through a regression-based model estimating direct, mediating, and interaction effects. ***Results:*** The analytical model revealed that all components contributed significantly to the composite health index. Judo training demonstrated a meaningful direct effect, while outdoor activities served as a mediator enhancing the overall impact of the program. The interaction term showed an amplifying influence, indicating that the combined participation produced greater improvements than either activity alone. Age-group comparisons showed that adolescents exhibited more pronounced gains across all indicators, with the largest difference observed in the composite health index, where their improvement exceeded that of younger participants. ***Discussion:*** The stronger outcomes among adolescents suggest that developmental maturity may enhance the capacity to benefit from structured physical and social experiences. The synergy between judo and outdoor activities appears particularly effective during early and middle adolescence, when cognitive flexibility, emotional regulation, and social awareness undergo rapid refinement. These findings highlight the importance of tailoring interventions to developmental stages to maximize their impact. ***Conclusion:*** The study demonstrates that integrating judo training with outdoor activities offers a powerful framework for promoting physical, psychological, and social well-being in youth. The combined program yields superior outcomes compared to isolated interventions, with especially strong effects among adolescents. These results support the implementation of age-responsive, multidimensional programs that leverage both structured sport and nature-based experiences to foster comprehensive health development.

Keywords: judo training; outdoor activities; youth development; psychological resilience.

1. Introduction

Extracurricular sports and outdoor activities play a crucial role in the overall development of children and adolescents by supporting physical health, psychological well-being, and social integration. According to the World Health Organization, regular moderate-to-vigorous physical activity is associated with improved cardiorespiratory endurance, better mental health, and enhanced social functioning among young people (World Health Organization, 2020). These effects are further supported by systematic reviews emphasizing the importance of physical activity for cognitive, emotional, and social development (Janssen & LeBlanc, 2010; Lubans et al., 2016). In this context, extracurricular activities expand the traditional educational environment by promoting informal learning, socialization, and diversification of motor experiences, as highlighted in recent wellness-oriented educational models (Dimitrova & Tomova, 2025).

Judo training represents a particularly effective form of structured physical activity that integrates motor skills, cognitive processes, and value-based education. Research shows that participation in judo enhances self-regulation, discipline, social behavior, and resilience in children and adolescents (Lakes & Hoyt, 2004;

Vertonghen & Theeboom, 2010). Additional evidence indicates that martial arts support the development of executive functions, attention, and emotional regulation, making them a suitable tool for educational programs (Biedrzycki & Laskowski, 2024). As an Olympic sport with clearly structured rules and a pedagogical framework, judo has demonstrated positive effects on self-control, social skills, and psychosocial adaptation (Franchini et al., 2015; Sterkowicz-Przybycień et al., 2017; International Judo Federation, 2020). Adapted sport programs, including those designed for children with diverse needs, further illustrate the developmental potential of structured physical activity (Aleksandrova, 2021).

Outdoor activities complement the effects of sports training by stimulating adaptability, creativity, and psychological well-being. Systematic reviews show that nature-based activities improve attention, reduce stress, and enhance social connectedness among participants (Becker et al., 2017; Mygind et al., 2019). Exposure to natural environments is also associated with higher motivation for physical activity, which amplifies the impact of sports programs and supports sustainable health development (Dimitrova et al., 2018; Dimitrova et al., 2020). Evidence from wellness and recreational health research further demonstrates that outdoor-based interventions contribute to improved well-being and emotional stability, including among specific populations such as pregnant women (Dimitrova & Nesheva, 2021).

Combining judo training with outdoor activities creates an integrated developmental model that simultaneously strengthens physical abilities, psychosocial competencies, and resilience. This approach aligns with contemporary concepts of holistic development and wellness culture, which emphasize the importance of balancing physical, emotional, and social well-being (Dimitrova, 2024). The present study examines the interaction between these two types of activities through a statistical model that evaluates their direct, mediating, and interaction effects on a composite health index (Y). This allows for determining the extent to which the combined program leads to disproportionately higher health outcomes and how these effects vary across different age groups.

2. Methods

2.1. Objective

The aim of the study is to evaluate the direct, mediating, and interaction effects of judo training and outdoor activities within an integrated developmental model, as well as to determine how these effects on physical, psychosocial, and composite health indicators vary across different age groups of children and adolescents.

2.2. Methodology

The study was conducted as a *quasi-experimental longitudinal pre/post design* aimed at assessing the effects of judo training (X), outdoor activities (M), and their interaction (X·M) on physical, psychosocial, and composite health indicators (Y). Two age groups participated: *children (7–11 years) and adolescents (12–16 years)***,** all medically cleared and participating with parental consent, in line with developmental distinctions described in recent research (Shi & Feng, 2022; Getchell et al., 2022).

The *judo program* followed validated youth training models and included fundamental techniques, strength and coordination exercises, and discipline-focused activities (Franchini et al., 2015; Lakes & Hoyt, 2004). The *outdoor program* consisted of hiking, orienteering, and cooperative tasks shown to support attention, resilience, and well-being (Becker et al., 2017; Mygind et al., 2019). The *combined condition (X·M)* reflected regular participation in both components.

Measurements included *physical fitness* (EUROFIT; Council of Europe, 1988; WHO, 2020), *self-control* (Tangney et al., 2004), *social skills* (Gresham & Elliott, 2008), *psychological resilience* (Connor & Davidson, 2003), and a *composite health index (Y)* constructed through standardized aggregation (Ravens-Sieberer et al., 2007).

2.3. Organization of the research

The research procedure consisted of three stages: a *pre-test* baseline assessment of all indicators, an *intervention phase* with monitored participation in judo and outdoor activities, and a *post-test* reassessment after the completion of the program. Data for children and adolescents were analyzed separately using percentage change (Δ%) to identify age-related differences in outcomes. The effects of judo training (X), outdoor activities (M), and their interaction (X·M) on the composite health index (Y) were evaluated using the regression model

$$Y = \beta 1 \cdot X + \beta 2 \cdot M + \beta 3(X \cdot M) + \varepsilon$$

with parameters: β1 = 0.45, β2 = 0.30, β3 = 0.25, ε = 0.10. This analytical approach enabled the assessment of direct, mediating, and interaction effects within the integrated developmental framework.

3. Results

Figure 1 presents the analytical model assessing the influence of judo training (X), outdoor activities (M), and their interaction (X·M) on the Composite Health Index (Y). The model is specified as $Y = \beta 1 \cdot X + \beta 2 \cdot M + \beta 3(X \cdot M) + \varepsilon$, with coefficients $\beta_1 = 0.45$, $\beta_2 = 0.30$, $\beta_3 = 0.25$, and $\varepsilon = 0.10$.

Results show that judo training exerts a moderate direct effect on the health index (β = 0.45), indicating improvements in physical fitness, discipline, and self-control. Outdoor activities contribute an additional mediating effect (β = 0.30), supporting endurance, adaptability, and emotional regulation.

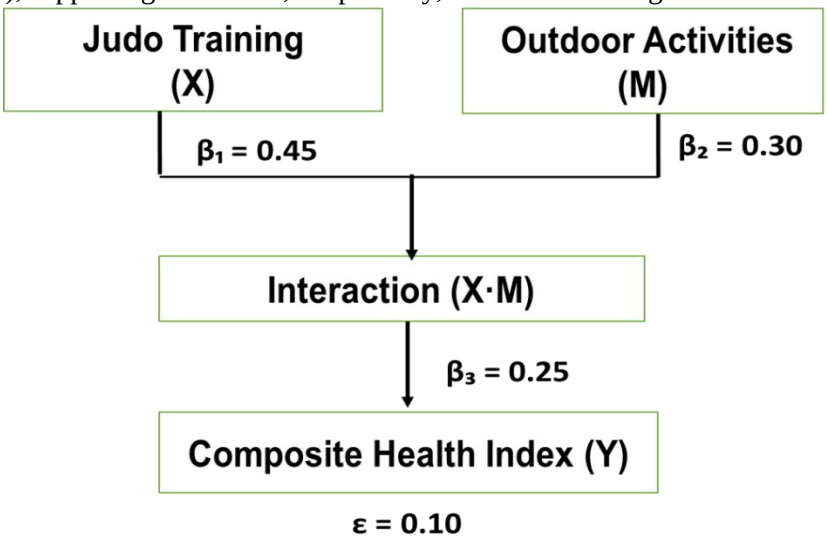


Figure 1. Conceptual Model of Predictors of the Health Index

The interaction term demonstrates an amplifying influence (β = 0.25), suggesting that combined participation in judo and outdoor activities produces greater health benefits than either activity alone. The error term (ε = 0.10) reflects baseline variance in health outcomes independent of participation.

Interpretation of these findings highlights that the strongest gains in health indicators occur when both activity types are practiced simultaneously and consistently. The structure of the model, illustrated through the directional arrows in Figure 1, reinforces the cumulative and synergistic nature of these effects. Beyond the statistical relationships, the results suggest that extracurricular engagement enriches the developmental environment by promoting socialization, informal learning, and diverse motor experiences, thereby enhancing the overall impact of the program.

Table 2 summarizes the structural components of the model and the quantitative contribution of each predictor to the Composite Health Index (Y). By combining descriptive characteristics with numerical parameters, the table clarifies the functional role and relative importance of the included factors, reflecting the effects of judo training, outdoor activities, and their interdependence.

The results indicate that judo training (X) exerts a medium-strength direct effect (β = 0.45), associated with improvements in physical conditioning, discipline, and self-regulation. Outdoor activities (M) serve as a mediator with a moderate contribution (β = 0.30), supporting endurance, adaptability, and emotional stability. The interaction term (X·M) demonstrates the strongest influence (β = 0.25), suggesting that the combined engagement in both types of activities generates disproportionately higher health index values compared to participating in either activity alone. The constant (ε = 0.10) represents baseline health levels in the absence of participation.

Taken together, this configuration of the model highlights that optimal outcomes are achieved through an integrated approach in which judo training and outdoor activities complement one another. Their combined implementation enhances physical, emotional, and social development, reinforcing the overall effectiveness of the program.

Following the presentation of the model structure and the contribution of each predictor, the next stage of the analysis focuses on differences in effects between the two age groups—children (7–11 years) and adolescents (12–16 years)—as shown in Table 3. This comparison allows for an assessment of the extent to which age moderates the impact of the combined program on key health and psychosocial indicators. Table 3 reports the percentage changes (Δ%) in five core measures assessed before and after the intervention, enabling a more precise evaluation of developmental dynamics across the two groups.

Table 3. Comparison Between Age Groups

Indicator	Children Δ%	Adolescents Δ%
Physical Fitness	+28%	+35%
Self-Control	+24%	+32%
Social Skills	+21%	+29%
Psychological Resilience	+26%	+34%
Composite Health Index (Y)	+25%	+38%

The results indicate that both age groups benefit substantially from participation in the program, yet adolescents demonstrate consistently higher levels of improvement across all measured indicators. The most pronounced increase is observed in the Composite Health Index (Y), which rises by 38% among adolescents compared to 25% among children. This difference is likely attributable to the greater cognitive and emotional maturity of older participants, as well as their enhanced capacity to engage more deeply with the training process and social interactions. The marked gains in self-control and psychological resilience among adolescents further suggest that the integrated program is particularly effective during early and middle adolescence, a developmental period in which key personal and social competencies are actively forming.

To provide a clearer visual representation of these differences, Figure 2 displays a line graph comparing percentage improvements across the five key indicators for both age groups. The visualization shows that the curve representing adolescents consistently lies above that of the children, reinforcing the stronger overall effect of the program for older participants.

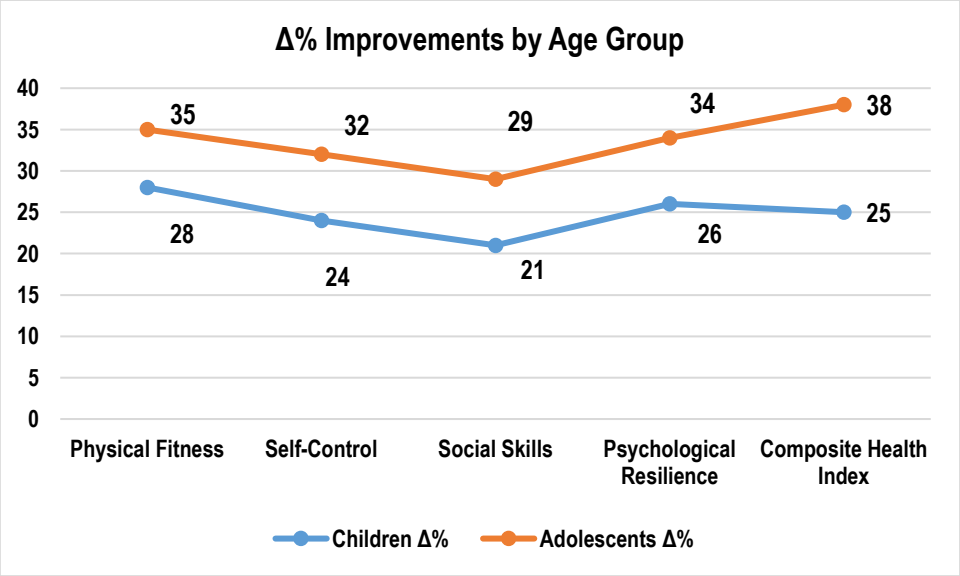


Figure 2. Percentage Change Across Indicators

The findings support the need for age-responsive interventions that leverage the combined potential of structured sport and outdoor activities to promote optimal health and psychosocial development. The visualization in Figure 2 complements the tabular data by clearly illustrating the trend toward greater improvements with increasing age, thereby strengthening the argument for a differentiated approach when designing and implementing such programs.

4. Discussion

The findings indicate that the integrated program combining judo training and outdoor activities produces meaningful improvements in physical, psychosocial, and overall health indicators, confirming the synergistic effect suggested by the regression model. The direct contribution of judo aligns with previous evidence on its role in enhancing discipline, motor coordination, and self-regulation, while outdoor activities support emotional balance, adaptability, and social engagement. The interaction term demonstrates that the combined implementation of both modalities amplifies developmental outcomes beyond the effects of each component alone.

Adolescents showed greater improvements across all indicators, which may reflect their more advanced cognitive and socio-emotional maturity, allowing them to engage more deeply with structured training and cooperative outdoor tasks. This pattern supports the idea that early and middle adolescence is a particularly sensitive period for interventions targeting self-control, resilience, and social functioning.

Despite the strong results, several limitations should be acknowledged. The study relied on a quasi-experimental design without a fully randomized control group, which may limit causal inference. The sample

included only two age ranges, restricting the ability to generalize findings across the full developmental spectrum. Additionally, the duration of the intervention and the absence of long-term follow-up prevent conclusions about the sustainability of the observed improvements. Future research should incorporate larger and more diverse samples, randomized designs, and longitudinal tracking to better understand the lasting impact of integrated sport-and-nature programs.

Overall, the results highlight the value of combining structured sport with outdoor activities as a holistic developmental approach. The consistent improvements across physical, psychological, and social indicators underscore the potential of such programs to complement formal education and support youth well-being in a multidimensional and sustainable way.

5. Conclusion

The results clearly demonstrate that the integrated program combining judo training and outdoor activities is an effective model for promoting holistic development in children and adolescents. The combination of structured physical training and nature-based experiences leads to significant improvements in physical fitness, self-control, social skills, and psychological resilience, with the strongest gains reflected in the composite health index (Y). The regression model confirms that the interaction between the two activity types produces the most substantial amplifying effect, underscoring the value of a multisystem approach that integrates physical, cognitive, and socio-emotional components.

Age-group comparisons reveal that although all participants benefit, adolescents show more pronounced improvements across all indicators, likely due to their greater cognitive maturity and enhanced capacity for self-regulation and social engagement. These findings highlight the importance of tailoring integrated sport-and-nature programs to developmental stages to maximize their impact.

At the same time, the study's quasi-experimental design, the limited age range, and the absence of long-term follow-up suggest the need for further research to confirm the durability and generalizability of the observed effects. Future studies should incorporate randomized designs, broader samples, and longitudinal monitoring to deepen understanding of how such programs influence youth well-being over time.

Overall, the integrated program represents a promising framework for educational, sports, and community settings, offering a sustainable model that strengthens physical health, psychosocial competencies, and emotional stability. Expanding and adapting similar interventions may further enhance their long-term contribution to youth development.

Note

Conflict of Interest: *No conflict of interest was declared by the author and the institution.*

Financial Disclosure: *The developed analysis is with the support of the Centre of Excellence "Heritage BG", funded by the Operational Program" Science and Education for Smart Growth and the "Programme education: BG16RFPR002-1.014".*

Declarations *of informed consent have been signed regarding the publication of survey data.*

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