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Regular Physical Activity and Life Satisfaction: Unpacking the Roles of Self-Control and Emotion Regulation

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Abstract: Physical activity is an essential component of a healthy lifestyle. Regular exercise and physical activity have many benefits for both the body and mind. This study examined the possible mediating effects of self-control and the forms of emotion regulation on life satisfaction. A total of 186 adults participated in the online survey. Subjects answered questions regarding their regular participation in various forms of physical activity and completed questionnaires assessing self-control, emotional regulation, and life satisfaction. The Satisfaction with Life Scale and the Brief Self-Control Scale were used to assess life satisfaction and dispositional self-control. The Emotion Regulation Questionnaire was used to measure two different forms of emotion regulation: cognitive reappraisal and expressive suppression. Based on self-reported average minutes spent exercising per week, participants were classified into four levels of physical activity according to the World Health Organization guidelines. The mediation analysis results showed that dispositional self-control and cognitive reappraisal fully mediated the relationship between physical activity level and life satisfaction. This suggests that regular physical activity may increase levels of self-control and cognitive reappraisal, which, in turn, leads to greater life satisfaction. These findings highlight the importance of regular exercise in promoting well-being and increasing life satisfaction through its beneficial effects on self-control and emotion regulation.

Keywords: physical activity; life satisfaction; self-control; emotion regulation; expressive suppression; cognitive reappraisal

1. Introduction

Quality of life and psychological well-being play crucial roles in an individual's functioning, influencing their ability to cope effectively with difficulties, establish satisfying social relationships, and achieve their goals. Life satisfaction has attracted particular attention because it is considered an essential component of subjective well-being. Life satisfaction is understood to be a cognitive evaluation of one's quality of life based on individual criteria. Although research on life satisfaction has been ongoing for many years, it remains a complex concept requiring further exploration. Life satisfaction plays a key role in shaping one's attitude toward their own existence, fostering the experience of positive emotions, and reducing the occurrence of negative feelings, thus serving as an important element of subjective well-being and a broadly defined quality of life [1,2]. It is also important to distinguish life satisfaction from related constructs such as happiness and quality of life. Happiness is often understood as the immediate experience of positive emotions, whereas life satisfaction represents a more enduring cognitive assessment of overall quality of life [3]. In addition, life satisfaction is a component of subjective well-being, along with affective balance, which measures the prevalence of positive versus negative emotions [4]. Assessing one's overall life satisfaction encompasses various domains, such as well-being, social connections, and economic status, and can be considered across the temporal dimensions of the past, present, and future. People integrate evaluations from different facets of their lives to create a comprehensive view of their life satisfaction.

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A quantitative assessment of the overall feeling of satisfaction can be conducted using a one-dimensional self-evaluation tool [5].

One factor that may be important for achieving a high level of life satisfaction is regular physical activity at an appropriate intensity. Current research has shown that regular exercise benefits both physical and mental health. Participation in sports training reduces stress and positively affects life satisfaction [6,7]. Physical activity has important implications for well-being regardless of age, and on days when people are more physically active than typical, they report greater life satisfaction [8]. During emerging adulthood (18-25 years), people's global assessment of their well-being appears to deteriorate more than at any other time, but daily physical activity has a positive impact on emerging adults' life satisfaction [9]. Additional research findings, also including longitudinal studies indicate that engaging in long–term and regular physical activity is linked to higher subjective well–being and more effective coping with negative emotions [10–13]. Recent research has also underscored that regular physical activity is consistently associated with improved subjective well-being across diverse populations. A meta-analysis by Buecker et al. (2021) demonstrated a positive association between physical activity and well-being in healthy individuals across different age groups and activity types. Similarly, a systematic review by Marquez et al. (2020) confirmed that physical activity significantly improves quality of life and well-being in adults and older adults [14,15].

The link between physical activity and life satisfaction seems to be well established, so it is now worth focusing on identifying factors that might further explain this relationship. Accordingly, the authors examined the mediators between physical activity and life satisfaction by analyzing different determinants. Deng et al. (2023) explored the influence of physical activity on life satisfaction through self-efficacy and resilience. Using validated scales and statistical analyses, this study found that physical activity positively impacts life satisfaction, both directly and indirectly. Self-efficacy and resilience were identified as mediators in this relationship, with a significant effect of these factors amplifying the impact of physical activity on life satisfaction [16]. Other results have indicated that physical activity positively impacts self-esteem and life satisfaction while reducing social-physique anxiety. Social-physique anxiety was found to mediate the relationship between physical activity and life satisfaction, whereas self-esteem mediated the link between social-physique anxiety and life satisfaction. These findings highlight the dual pathways through which physical activity promotes psychological well-being. By mitigating social-physique anxiety and fostering self-esteem, physical activity directly and indirectly improves life satisfaction [17].

Researchers recommend that the causal relationship between sports participation and psychosocial health should be further investigated and that the conceptual model of health through sports should be tested [7]. Therefore, in this article, we attempt to clarify the mechanism by which physical activity may influence life satisfaction, and look for additional psychological variables that may mediate this relationship.

The increase in life satisfaction resulting from physical activity can be explained by the fact that regular participation in sports is associated with enhanced overall health status, which has a considerable influence on life satisfaction [18]. Regular physical activity is essential to prevent chronic diseases by improving immune function, blood pressure, and insulin sensitivity. Research has highlighted its role in reducing mortality risk and improving mental health [19,20]. Individuals with severe or chronic illnesses had significantly worse subjective well–being and lower life satisfaction [18,21,22]. In addition, people often train in sports clubs where they experience social integration, which may enhance well–being by reducing feelings of loneliness and fulfilling the need to belong [6,23–25].

One of the most important psychological variables related to life satisfaction is self-control, which can be defined as the ability to change one’s behaviors or reactions and suppress undesirable impulses to effectively adjust to a given situation. Self–control plays a crucial role in motivational conflicts, where individuals must resist a pleasurable temptation to satisfy a long–term goal [26,27]. Individuals who control their reactions less frequently are considered to have lower dispositional

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self–control [27,28]. Self–control positively contributes to well–being by dealing with motivational conflicts, and its level is a significant predictor of life satisfaction [26].

Baumeister's strength model of self-control further explains that self-control operates like a muscle, requiring discipline, persistence, and effort, which can be strengthened through consistent practice, such as physical exercise [29]. Exercise trains self-control by challenging individuals to overcome short-term discomfort for long-term benefits, enhancing focus, stress regulation, and resilience [30]. This improved self-control not only supports consistent exercise, but also transfers it to other life domains, fostering goal achievement, emotional stability, and overall well-being [26,27].

In addition to self-control, emotion regulation is an important factor contributing to life satisfaction. Emotion regulation refers to the set of processes involved in monitoring, evaluating, and modifying emotional reactions by initiating, suppressing, or modulating them [31,32]. The emotion regulation model developed by James Gross is one of the most widely accepted approaches to understanding how people regulate their emotions. The author suggested that emotions develop over time and can be influenced by different stages. Within this model, Gross focuses on two common forms of emotion regulation. The first strategy is cognitive modification or reinterpretation of a situation to change its emotional meaning, which also plays a key role. For example, a stressful situation, such as giving a public speech, can be seen not as a potential failure, but as an opportunity to demonstrate one's abilities. The second strategy is response modulation, which involves controlling the expression of emotions and the physiological responses of the body. This may involve, for example, inhibiting anger or hiding sadness [33]. Different emotion regulation strategies have different consequences on well-being, interpersonal relationships, and mental health. Strategies such as reappraisal (cognitive change) tend to be more adaptive than those such as expressive suppression (response modulation) [34–36].

Gross and John's emotion regulation model connects cognitive reappraisal and expressive suppression to exercise and contentment with life by emphasizing their impact on emotional health. Cognitive reappraisal, which involves changing one's perspective on situations to modify emotional effects, works in tandem with physical activity to boost mood, psychological resilience, and positive feelings, ultimately enhancing life satisfaction. On the other hand, expressive suppression, which involves restraining outward displays of emotion, can potentially counteract these advantages by elevating stress levels and diminishing emotional genuineness, although engaging in physical activity may help offset some of its negative consequences. In summary, effective regulation strategies, such as reappraisal, when combined with regular exercise, contribute to optimal well-being and overall life satisfaction [37,38].

Studies have shown that engaging in physical activity can have positive effects not only on well-being but also on self-regulation [39]. The level of self-control is positively associated with physical activity. People exercise more on days when their self-control is high than on days when their self-control is low [40]. Additionally, people with low self-control benefit from physical activity. Research has indicated that regular physical activity can improve self–control. Three months of martial arts training can directly improve self–control in elementary school students [41], and five weeks of aerobic exercise may be an effective intervention to enhance self–control in college students [42]. Other studies have indicated that light-to-moderate physical exercise may be beneficial for executive control functions, which may be linked to higher dispositional self–control [43,44]. Regular physical activity can be beneficial for emotional regulation by promoting adaptive forms [45]. Both endurance and coordinative exercise training have been shown to positively influence certain aspects of emotion regulation and social cognition, including empathy [46]. Similarly, an eight-week intervention focusing on mind-body exercises was found to improve implicit emotion regulation skills [47]. Making progress in training requires a high level of self–regulation and self–motivation [48–50]. Therefore, self–control and emotional regulation may play important roles in the relationship between physical activity and life satisfaction.

The main objective of this study was to examine the potential mediating effects of self-control and two common forms of emotion regulation: cognitive reappraisal and expressive suppression, on

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the relationship between engagement in regular physical activity and life satisfaction. It was hypothesized that regular physical activity would positively influence self-control and the use of cognitive reappraisal as an adaptive form of emotion regulation while reducing reliance on expressive suppression, which is considered a less adaptive strategy. In turn, higher levels of self-control and more effective emotion regulation strategies were expected to contribute to greater life satisfaction. This sequential pathway was intended to capture the indirect mechanisms through which physical activity might enhance overall well-being. For this purpose, we examined participants who did not regularly participate in any training and those who reported exercising regularly for at least one year. The latter were classified into three groups based on the average training time. We aimed to investigate whether self–control and emotion regulation mediate the effect of involvement in physical activity on life satisfaction.

2. Materials and Methods

2.1. Participants and Study Design

The study was conducted on a group of 186 adults (91% women) who completed the survey. The mean age of the respondents was 20.7, with standard deviation 2.92. Fifty-six subjects (mean age 20.5, with standard deviation, 2.40) attended regular training (32% under coach supervision) for at least 1 year (mean 6.21 years). The remaining 130 participants (mean age 20.8, with a standard deviation of 3.12) did not do regular physical activity. This study employed a cross-sectional design and utilized self-report methodology for data collection.

2.2. Data Collection

The data were collected via online social networking, mainly among university students, using an online survey platform called Lime Survey. Participants completed the survey anonymously and provided background information regarding age and gender. No personal information was collected to identify the respondents. The first page of the web-based survey form informed participants that their participation in the study was voluntary and confidential and that they may withdraw from the study at any time. Before the survey, the participants confirmed that they had read the study information and participation rules and agreed to participate voluntarily. Ethical approval was obtained from the University of the National Education Commission, Krakow.

2.3. Measurements

First, we asked questions related to background information, including participants' age, sex, place of residence, and participation in regular physical activities for at least 1 year. Respondents answered self–report questionnaires on the variables studied.

2.3.1. The Level of Involvement in Physical Activity

The physical activity level (PA level) of the subjects who reported regular training was assessed based on the reported average number of minutes spent training per week. The assessment of PA level followed the World Health Organization (WHO) Guidelines on Physical Activity and Sedentary Behavior [51], which recommend that adults should engage in 150–300 minutes of moderate-intensity aerobic activity per week, or 75–150 minutes of vigorous-intensity activity, or an equivalent combination of both. Based on these guidelines, we categorized regularly trained individuals into three PA levels: 1 – less-active individuals (17 subjects engaging in regular physical activity below WHO guidelines); 2 – active individuals (25 subjects engaging in regular physical activity according to WHO guidelines); and 3 – more-active individuals (14 subjects engaging in regular physical activity beyond WHO guidelines). In addition, 130 participants who reported not regularly training (130 subjects) were assigned a PA level of 0.

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2.3.2. Satisfaction with Life Scale

The cognitive–judgmental aspect of subjective well-being was assessed using the Polish version of The Satisfaction With Life Scale (SWLS) [52] created by Diener et al. [53]. The five positively worded statements included in this tool were rated on a seven–point Likert–type scale. The summed score ranges from 5 to 35, with higher values indicating greater satisfaction with life. The Polish version of the SWLS has good internal consistency (Cronbach's alpha = 0.86) and temporal stability. Test–retest reliability in 3–week intervals was 0.85–0.93; in 6–week intervals it was 0.87–0.88; in the 9–week interval, it was 0.86 [52].

2.3.3. Brief Self–Control Scale

To assess dispositional self–control, we used the Brief Self–Control Scale (BSCS) developed by Tangney et al. [27] and adapted into Polish by Pilarska and Baumeister [54]. This questionnaire contains thirteen statements (nine negatively worded) rated on a five–point Likert–type scale. After reverse coding negatively worded statements and summing all answers, we obtained a total score (high values reflect greater self–control). The Polish version of the BSCS has good internal consistency (Cronbach's alpha: 0.84) and satisfactory temporal stability in a 2–week test–retest (Pearson correlation for test–retest: 0.87).

2.3.4. Emotion Regulation Questionnaire

To assess aspects of emotion regulation, we used the Polish version of the Emotion Regulation Questionnaire (ERQ) [55] developed by Gross and John [34]. Participants were asked to evaluate their personal emotion regulation strategies using ten items on a seven-point Likert scale. The scores obtained on the two ERQ scales assess two aspects of emotion regulation: "expressive suppression" (four items) and "cognitive reappraisal" (six items). Higher scores on both scales indicated a stronger tendency to use these two strategies. The internal consistency of the ERQ scales, as assessed by Cronbach's α was 0.77 for Reappraisal and 0.74 for Suppression [56].

2.4. Statistical Analysis

First, descriptive statistics of the scores on the scales of the questionnaire tool were analyzed. Means with 95% confidence intervals and medians were used as measures of central tendency. Standard deviations and interquartile ranges were used to describe the dispersion of the scores. Possible deviations from normality, in terms of the shape and normality of the score distribution, were assessed using skewness and kurtosis. Correlation analysis was then performed with a two–tailed significance test and 95% confidence intervals between the scores on the scales of the questionnaire tool and the amount of time spent in regular physical activity and life satisfaction. Pearson's or Spearman's correlation coefficients were used depending on the level of measurement of the variables studied. A p–value of < 0.05 was used as the threshold for statistical significance.

Mediation analysis in the structural equation modeling approach was then used to test whether self–control, suppression, and reappraisal mediated the impact of the amount of time spent in regular physical activity on satisfaction with life. Therefore, in our analytical approach, the categorized amount of time spent in regular physical activity was the explanatory variable, the SWLS scores were the response variable, while the BSCS scores and the two ERQ subscales were the mediating variables. No violation of the model assumptions regarding homoscedasticity was found by visual inspection of the residual scatter plots. As the level of measurement of the categorized amount of time spent in regular physical activity was ordinal, the diagonally weighted least squares (DWLS) estimation method was chosen. Standardized parameter estimates for indirect, direct, and total effects were calculated and tested for significance using bootstrapped 95% confidence intervals. The accelerated bias–corrected percentile bootstrap method with 5000 resamples was used. Parameter estimates were considered significant at the 0.05 threshold if the bootstrapped 95% confidence intervals around them did not include zero. As all questions in the online form were mandatory, the

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dataset analyzed was entirely complete, eliminating the need for any methods to address missing values. The R-squared values for the mediating and dependent variables were reported to assess the strength and explanatory power of the proposed model. Statistical analyses were performed using the open-source software jamovi [57], based on the R programming language [58] for statistical computing. The jamovi SEMLj module for structural equation modelling was employed to conduct mediation analysis. [59]. The path diagram was created using draw.io desktop, which is a graph-drawing, open-source application.

3. Results

The descriptive statistics for the BSCS, ERQ, and SWLS scores are shown in Table 1. The skewness and kurtosis values were all less than one, indicating that their distribution did not substantially deviate from normality.

Table 1. Descriptive Statistics and reliability coefficients for Scores on the Scales of the Questionnaire Tool.

	Mean	95% CI		Median	SD	IQR	Skewness	Kurtosis	Cronbach's α	95% CI	
		Lower	Upper							Lower	Upper
Self–control	36.5	35.2	37.8	36	8.90	10.75	0.314	–0.127	0.827	0.788	0.862
ERQ Reappraisal	26.6	25.5	27.6	28	7.19	9.00	–0.164	–0.105	0.818	0.775	0.856
ERQ Suppression	14.3	13.5	15.2	15	5.80	9.00	0.032	–0.814	0.806	0.756	0.848
Satisfaction with life	18.7	17.8	19.6	19	6.29	9.75	0.015	–0.352	0.847	0.809	0.879

Correlations between self–control, suppression, reappraisal, life satisfaction, and amount of time spent on regular physical activity are shown in Table 2. Scores on the suppression scale of the ERQ were not significantly correlated with scores on the ERQ reappraisal scale and BSCS. The correlation coefficient between reappraisal and self–control is 0.25, indicating a positive but modest relationship between these two variables. The correlation coefficients between the SWLS scores and self–control and reappraisal are 0.43 and 0.41, indicating that life satisfaction is positively and moderately related to these two variables. The correlation coefficient between satisfaction with life and suppression was –0.27, indicating a modestly negative relationship. Time spent in regular physical activity was positively correlated with self–control (0.34), reappraisal (0.15), and life satisfaction (0.25) but was not significantly associated with suppression.

Table 2. Correlations between the scores on the scales of the questionnaire tool and the level of involvement in physical activity.

	Statistics	Variables			
		Self–control	Reappraisal	Suppression	Satisfaction with life
Reappraisal	Pearson's r	.250			
	p–value	.001			
	95% CI Lower	.110			
	95% CI Upper	.380			
Suppression	Pearson's r	–.022	–.140		
	p–value	.765	.057		
	95% CI Lower	–.165	–.278		

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	95% CI Upper	.122	.004		
Satisfaction with life	Pearson's r	.427	.412	–.268	
	p–value	< .001	< .001	< .001	
	95% CI Lower	.301	.285	–.396	
	95% CI Upper	.537	.524	–.129	
The Level of Involvement in Physical Activity	Spearman's rho	.341	.148	.028	.248
	p–value	< .001	.044	.707	< .001
	95% CI Lower	.204	.003	–.116	.105
	95% CI Upper	.465	.287	.171	.380

The mediation analysis results showed that self–control and cognitive reappraisal mediated the relationship between level of participation in regular physical activity and satisfaction with life. Higher levels of participation in regular physical activity were associated with greater self–control and reappraisal, which in turn led to greater satisfaction with life. The indirect effect of emotional suppression was close to zero and not statistically significant. Level of involvement in regular physical activity had no direct relationship with life satisfaction. The R-squared value of the dependent variable (SWLS) is 0.296. Detailed results of the mediation analysis are presented in Table 3 and Figure 1.

Table 3. Raw and standardized estimates with bootstrapped 95% confidence intervals for indirect effects and their components, direct and total effects in mediation analysis.

Effect type	**Effect**	**Estimate**	**SE**	**95% C.I.**		**β**	**β 95% C.I.**	
				Lower	**Upper**		**Lower**	**Upper**
Indirect	PA level ⇒ Self–control ⇒ SwL	0.813	0.234	0.431	1.365	0.127	0.059	0.195
	PA level ⇒ Reappraisal ⇒ SwL	0.309	0.151	0.073	0.687	0.048	0.004	0.093
	PA level ⇒ Suppression ⇒ SwL	–0.003	0.105	–0.230	0.195	–0.001	–0.031	0.030
Component	PA level ⇒ Self–control	3.632	0.640	2.361	4.872	0.402	0.274	0.530
	Self–control ⇒ SwL	0.224	0.051	0.128	0.329	0.317	0.189	0.444
	PA level ⇒ Reappraisal	1.229	0.473	0.307	2.193	0.168	0.042	0.294
	Reappraisal ⇒ SwL	0.252	0.059	0.139	0.367	0.288	0.157	0.418
	PA level ⇒ Suppression	0.014	0.419	–0.780	0.840	0.002	–0.137	0.142
	Suppression ⇒ SwL	–0.240	0.072	–0.379	–0.101	–0.221	–0.351	–0.091
Direct	PA level ⇒ SwL	0.528	0.401	–0.253	1.322	0.083	–0.041	0.206
Total	PA level ⇒ SwL	1.646	0.418	0.810	2.440	0.258	0.133	0.383

PA level – The Level of Involvement in Physical Activity; SwL – Satisfaction with Life.

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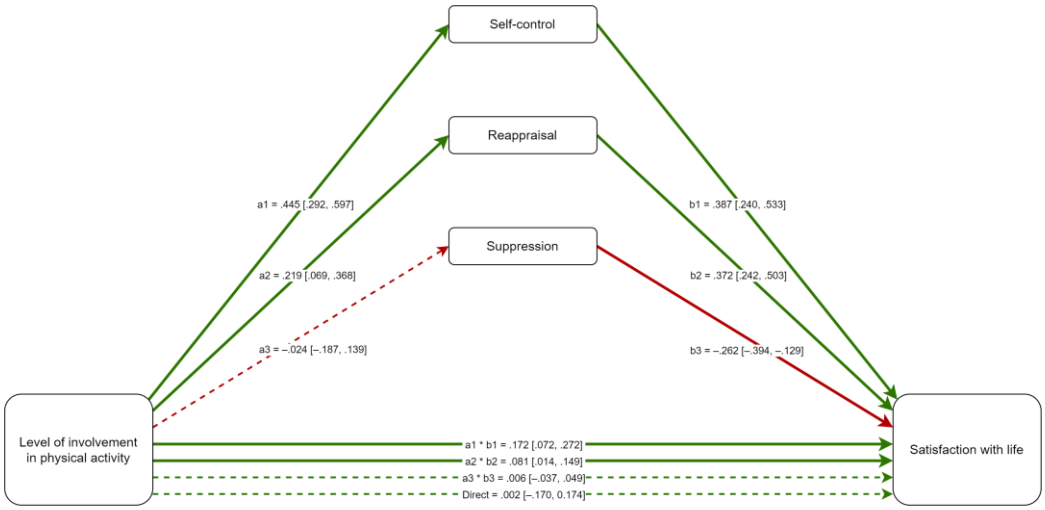

Figure 1. Path diagram presenting mediation model with standardized estimates and bootstrapped 95% confidence intervals. Green color: positive effects, red color: negative effects; solid line: significant effect, dashed line: insignificant effects.

4. Discussion

This study is one of the first to investigate whether self–control and distinct aspects of emotion regulation play an intermediate role in the relationship between involvement in regular physical activity and life satisfaction. We found that the level of involvement in physical activity, as expressed by the average weekly training time, is indirectly related to life satisfaction through indirect pathways that lead through self–control and cognitive reappraisal. Regular physical activity has been associated with improvements in life satisfaction, partly because of its effects on self-control and cognitive reappraisal. This relationship is rooted in the psychological benefits of physical activity, which enhance an individual's ability to manage emotions effectively and prioritize long-term goals over immediate impulses [26,34,35]. As outlined in Baumeister's strength model, self-control functions as a muscle that can be strengthened through consistent physical exercise, resulting in improved goal achievement and emotional stability [30]. This means that regular training is related to high self–control and cognitive reappraisal, which consequently increases life satisfaction. The results obtained are consistent with those of previous studies, which showed that physical activity plays a critical role in enhancing self-control, emotion regulation, and overall psychological well-being. Regular exercise is an effective strategy for maintaining mental health and emotional resilience by promoting positive emotional states, reducing stress, and lowering the risk of depression, regular exercise is an effective strategy for maintaining mental health and emotional resilience [7,12,60]. Training intensity is also associated with well–being, positive affect, and negatively associated with depression [61–63]. Regular physical activity may enhance self–control and adaptive emotion regulation strategies [42–47]. Sports practitioners often use more flexible and effective strategies for emotion regulation, adapting them to the demands of the situation [45]. The link between regular physical activity and self-control has been documented, with evidence suggesting that consistent exercise fosters self-regulation skills and the ability to adapt emotion regulation strategies to dynamic challenges [39,45]. Previous findings have also shown that cognitive regulatory strategies such as reappraisal can improve mood and promote emotional well–being [35]. Cognitive reappraisal, a key component of adaptive emotion regulation, enables individuals to reinterpret stressful situations positively, which when combined with physical activity, contributes to elevated life satisfaction [34]. People who prefer reappraisal can cope more effectively with negative emotions, and expressive suppression is associated with reduced well–being [34,64]. An R-squared value of approximately 30%

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indicated that engagement in regular physical activity and the mediating variables (self-control, cognitive reappraisal, and expressive suppression) together accounted for a moderate amount of variance in life satisfaction. This finding highlights the importance of both behavioral (physical activity) and psychological (self-control and emotion regulation) factors as pathways to well-being, and emphasizes the indirect effects in the causal chain. This underscores the complexity of life satisfaction and suggests that interventions that promote physical activity alongside psychological skills, such as self-control and adaptive emotion regulation, could significantly improve overall well-being.

The results further broaden the understanding of the mechanisms underlying the relationship between physical activity and life satisfaction by identifying self-control and cognitive reappraisal as key mediators. Consistent with previous studies highlighting the role of self-efficacy, resilience, self-esteem, and social anxiety [16,17], our results identified additional pathways through which physical activity enhances psychological well-being. Specifically, individuals who engaged in regular physical activity reported higher levels of self-control and a greater tendency to use cognitive reappraisal strategies, both of which were significantly associated with improved life satisfaction. These mediators suggest that physical activity not only promotes emotional regulation through cognitive reappraisal but also strengthens self-discipline, thereby facilitating more adaptive responses to challenges. This dual pathway complements and extends the existing models of the psychological benefits of physical activity, highlighting its multifaceted effects on life satisfaction.

On the other hand, some analyses indicate that more physical activity does not lead to better outcomes, and the minutes spent on vigorous–intensity activity may reduce the level of subjective well–being [65,66]. However, these studies only focused on physical activity in the last week and did not consider overall training time throughout life. While physical activity is generally beneficial, the relationship may vary depending on intensity and individual circumstances. This underscores the need for personalized approaches to exercise routines. Our study examined people who had been engaged in regular training for at least a year. Regular participation in training leads to increased endurance and strength of the participants, which can mitigate the negative effects of high–intensity training. Additionally, regular training may improve self–control [39,42], which is a significant predictor of life satisfaction [26]. Therefore, our results show that regular physical activity improves practitioners' life satisfaction, regardless of the level of involvement in training.

In our previous study, we examined the mediating effects of self–control and emotion regulation on the relationship between regular karate training and life satisfaction [67]. Eastern martial arts, as a specific form of physical activity, can improve practitioners' discipline and self–control of the practitioners [39,41,68]. This study shows that other regular physical activities may also increase life satisfaction by improving self–control and using more adaptive emotion regulation strategies, such as cognitive reappraisal.

4.1. Limitations and Further Research Directions

This study was limited by its cross-sectional design, which does not allow for the direct establishment of causal relationships. Mediation analyses based on cross-sectional data may yield biased estimates of indirect effects owing to the lack of temporal sequencing, potentially leading to inaccurate or misleading interpretations. Therefore, inferring longitudinal mediation processes from cross-sectional analyses should be approached cautiously. Despite these limitations, the cross-sectional design serves as an appropriate initial approach and provides valuable preliminary insight into the relationships under investigation. However, these findings highlight the importance of future research using a longitudinal design. Longitudinal data would allow for a more accurate understanding of temporal dynamics, provide clearer insights into mediation mechanisms, and strengthen the validity of the conclusions. While this study serves as a strong starting point, further research using longitudinal methods is essential to confirm and extend the preliminary findings.

Another limitation of this study was the demographic composition of the sample, particularly the overrepresentation of female participants. This gender imbalance may limit the generalizability

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of the findings, as the effects of physical activity, self-control, and emotion regulation on life satisfaction may differ between genders owing to biological, psychological, or social differences. To address this issue, future research should prioritize recruiting a more diverse and gender-balanced sample to ensure that the results are more reflective of the general population. Additionally, exploring potential gender-specific patterns in the relationship between physical activity, self-control, emotion regulation, and life satisfaction could provide deeper insights and help in designing interventions that are sensitive to the unique needs of different demographic groups.

Although self-reporting techniques are valuable, they have inherent limitations. The data collected through these methods may be affected by memory distortions, inclination to provide socially acceptable answers, and other social factors that can compromise the accuracy of self-reported information. Given these constraints, future research should incorporate additional methodologies along with self-reporting. Notably, research systems that leverage wearable devices show particular promise as methodological approaches worthy of further exploration in upcoming studies. Future studies should also investigate whether such a relationship exists in people who exercise for less than a year or who exercise irregularly.

4.2. Strengths and Practical Implications

This study has several strengths that contribute to its originality and value. This study makes a unique contribution by examining, for the first time, the mediating roles of self-control and cognitive reappraisal in the relationship between physical activity and life satisfaction. This approach broadens the scope of understanding beyond the traditional benefits of physical activity by incorporating psychological constructs to elucidate their impact on well-being. In addition, the study highlights the multifaceted benefits of physical activity, demonstrating its role not only in improving physical health but also in enhancing emotional regulation and self-control.

By linking physical activity to broader emotional and decision-making aspects, this study offers important practical applications to improve well-being and life satisfaction through consistent exercise. Health awareness campaigns can highlight the psychological benefits of physical activity, including improved emotional regulation, self-control, and life satisfaction, in addition to physical health benefits. In addition, institutions could promote regular exercise as a means of promoting mental and emotional health, helping individuals to cope with stress, and improving their overall quality of life.

5. Conclusions

The study findings revealed that self–control and emotion regulation play intermediate roles in the relationship between involvement in regular physical activity and satisfaction with life. The level of involvement in physical activity is positively related to life satisfaction through indirect pathways that lead through self–control and cognitive reappraisal. The results indicate that regular physical activity and time spent on training support such forms of regulating one's own emotions and actions, which may consequently lead to greater life satisfaction.

Author Contributions: W.P., L.K., and R.H-K. developed the study concept and drafted the first manuscript. W.P. organized and conducted the survey. R.H-K. supervised the research. L.K. performed the statistical analysis and prepared the figure. All authors contributed equally to the revision of the manuscript and approved the submitted version.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Participants completed the survey anonymously and provided background information regarding age and gender. No personal information was collected to identify the respondents. The first page of the web-based survey informed the participants that their participation in the study was voluntary and that they could withdraw from the study at any time during the survey.

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References

1. Diener, E. Subjective Well-Being. *Psychological Bulletin* **1984**, *95*, 542–575, doi:10.1037/0033-2909.95.3.542.
2. Pavot, W.; Diener, E. Review of the Satisfaction With Life Scale. *Psychological Assessment* **1993**, *5*, 164–172, doi:10.1037/1040-3590.5.2.164.
3. Veenhoven, R. The Four Qualities of Life Ordering Concepts and Measures of the Good Life. In *Understanding Human Well-being*; United Nations University Press, 2006; pp. 74–100.
4. Diener, E.; Napa Scollon, C.; Lucas, R.E. The Evolving Concept of Subjective Well-Being: The Multifaceted Nature of Happiness. In *Assessing Well-Being: The Collected Works of Ed Diener*; Diener, E., Ed.; Springer Netherlands: Dordrecht, 2009; pp. 67–100 ISBN 978-90-481-2354-4.
5. Diener, E.; Suh, E.M.; Lucas, R.E.; Smith, H.L. Subjective Well-Being: Three Decades of Progress. *Psychological Bulletin* **1999**, *125*, 276–302, doi:10.1037/0033-2909.125.2.276.
6. Eime, R.M.; Harvey, J.T.; Brown, W.J.; Payne, W.R. Does Sports Club Participation Contribute to Health-Related Quality of Life? *Med Sci Sports Exerc* **2010**, *42*, 1022–1028, doi:10.1249/MSS.0b013e3181c3adaa.
7. Eime, R.M.; Young, J.A.; Harvey, J.T.; Charity, M.J.; Payne, W.R. A Systematic Review of the Psychological and Social Benefits of Participation in Sport for Adults: Informing Development of a Conceptual Model of Health through Sport. *International Journal of Behavioral Nutrition and Physical Activity* **2013**, *10*, 135, doi:10.1186/1479-5868-10-135.
8. Maher, J.P.; Pincus, A.L.; Ram, N.; Conroy, D.E. Daily Physical Activity and Life Satisfaction across Adulthood. *Developmental Psychology* **2015**, *51*, 1407–1419, doi:10.1037/dev0000037.
9. Maher, J.P.; Doerksen, S.E.; Elavsky, S.; Hyde, A.L.; Pincus, A.L.; Ram, N.; Conroy, D.E. A Daily Analysis of Physical Activity and Satisfaction with Life in Emerging Adults. *Health Psychology* **2013**, *32*, 647–656, doi:10.1037/a0030129.
10. Asztalos, M.; Wijndaele, K.; De Bourdeaudhuij, I.; Philippaerts, R.; Matton, L.; Duvigneaud, N.; Thomis, M.; Duquet, W.; Lefevre, J.; Cardon, G. Specific Associations between Types of Physical Activity and Components of Mental Health. *J Sci Med Sport* **2009**, *12*, 468–474, doi:10.1016/j.jsams.2008.06.009.
11. Downward, P.; Rasciute, S. Does Sport Make You Happy? An Analysis of the Well-being Derived from Sports Participation. *International Review of Applied Economics* **2011**, *25*, 331–348, doi:10.1080/02692171.2010.511168.
12. Ku, P.-W.; Fox, K.R.; Chen, L.-J. Leisure-Time Physical Activity, Sedentary Behaviors and Subjective Well-Being in Older Adults: An Eight-Year Longitudinal Research. *Soc Indic Res* **2016**, *127*, 1349–1361, doi:10.1007/s11205-015-1005-7.
13. Lechner, M. Long-Run Labour Market and Health Effects of Individual Sports Activities. *Journal of Health Economics* **2009**, *28*, 839–854, doi:10.1016/j.jhealeco.2009.05.003.
14. Buecker, S.; Simacek, T.; Ingwersen, B.; Terwiel, S.; Simonsmeier, B.A. Physical Activity and Subjective Well-Being in Healthy Individuals: A Meta-Analytic Review. *Health Psychology Review* **2021**, *15*, 574–592, doi:10.1080/17437199.2020.1760728.
15. Marquez, D.X.; Aguiñaga, S.; Vásquez, P.M.; Conroy, D.E.; Erickson, K.I.; Hillman, C.; Stillman, C.M.; Ballard, R.M.; Sheppard, B.B.; Petruzzello, S.J.; et al. A Systematic Review of Physical Activity and Quality of Life and Well-Being. *Translational Behavioral Medicine* **2020**, *10*, 1098–1109, doi:10.1093/tbm/ibz198.
16. Deng, J.; Liu, Y.; Chen, R.; Wang, Y. The Relationship between Physical Activity and Life Satisfaction among University Students in China: The Mediating Role of Self-Efficacy and Resilience. *Behavioral Sciences* **2023**, *13*, 889, doi:10.3390/bs13110889.
17. Yildirim, S.; Özgökçe, G. The Relationship Between Physical Activity and Life Satisfaction: The Mediating Role of Social-Physique Anxiety and Self-Esteem. **2023**, doi:10.54141/psbd.1312256.
18. Abe, M.; Abe, H. Lifestyle Medicine – An Evidence Based Approach to Nutrition, Sleep, Physical Activity, and Stress Management on Health and Chronic Illness. *Personalized Medicine Universe* **2019**, *8*, 3–9, doi:10.1016/j.pmu.2019.05.002.

19. Lee, I.-M.; Shiroma, E.J.; Lobelo, F.; Puska, P.; Blair, S.N.; Katzmarzyk, P.T.; Lancet Physical Activity Series Working Group Effect of Physical Inactivity on Major Non-Communicable Diseases Worldwide: An Analysis of Burden of Disease and Life Expectancy. *Lancet* **2012**, *380*, 219–229, doi:10.1016/S0140-6736(12)61031-9.
20. Pedersen, B.K.; Saltin, B. Exercise as Medicine – Evidence for Prescribing Exercise as Therapy in 26 Different Chronic Diseases. *Scandinavian Journal of Medicine & Science in Sports* **2015**, *25*, 1–72, doi:10.1111/sms.12581.
21. Hutchinson, G.; Simeon, D.T.; Bain, B.C.; Wyatt, G.E.; Tucker, M.B.; LeFranc, E. Social and Health Determinants of Well Being and Life Satisfaction in Jamaica. *Int J Soc Psychiatry* **2004**, *50*, 43–53, doi:10.1177/0020764004040952.
22. Strine, T.W.; Chapman, D.P.; Balluz, L.S.; Moriarty, D.G.; Mokdad, A.H. The Associations Between Life Satisfaction and Health-Related Quality of Life, Chronic Illness, and Health Behaviors among U.S. Community-Dwelling Adults. *J Community Health* **2008**, *33*, 40–50, doi:10.1007/s10900-007-9066-4.
23. Mellor, D.; Stokes, M.; Firth, L.; Hayashi, Y.; Cummins, R. Need for Belonging, Relationship Satisfaction, Loneliness, and Life Satisfaction. *Personality and Individual Differences* **2008**, *45*, 213–218, doi:10.1016/j.paid.2008.03.020.
24. Schumaker, J.F.; Shea, J.D.; Monfries, M.M.; Groth-Marnat, G. Loneliness and Life Satisfaction in Japan and Australia. *The Journal of Psychology* **1993**, *127*, 65–71, doi:10.1080/00223980.1993.9915543.
25. Vilhjalmsson, R.; Thorlindsson, T. The Integrative and Physiological Effects of Sport Participation: A Study of Adolescents. *The Sociological Quarterly* **1992**, *33*, 637–647, doi:10.1111/j.1533-8525.1992.tb00148.x.
26. Hofmann, W.; Luhmann, M.; Fisher, R.R.; Vohs, K.D.; Baumeister, R.F. Yes, But Are They Happy? Effects of Trait Self-Control on Affective Well-Being and Life Satisfaction. *Journal of Personality* **2014**, *82*, 265–277, doi:10.1111/jopy.12050.
27. Tangney, J.P.; Baumeister, R.F.; Boone, A.L. High Self-Control Predicts Good Adjustment, Less Pathology, Better Grades, and Interpersonal Success. *J Pers* **2004**, *72*, 271–324.
28. Duckworth, A.; Steinberg, L. Unpacking Self-Control. *Child Dev Perspect* **2015**, *9*, 32–37, doi:10.1111/cdep.12107.
29. Baumeister, R.F.; Heatherton, T.F. Self-Regulation Failure: An Overview. *Psychological Inquiry* **1996**, *7*, 1–15, doi:10.1207/s15327965pli0701_1.
30. Schmeichel, B.J.; Baumeister, R.F. Self-Regulatory Strength. In *Handbook of self-regulation: Research, theory, and applications*; The Guilford Press: New York, NY, US, 2004; pp. 84–98 ISBN 978-1-57230-991-3.
31. Niven, K.; Totterdell, P.; Holman, D. A Classification of Controlled Interpersonal Affect Regulation Strategies. *Emotion* **2009**, *9*, 498–509, doi:10.1037/a0015962.
32. Thompson, R.A. Emotion Regulation: A Theme in Search of Definition. *Monographs of the Society for Research in Child Development* **1994**, *59*, 25–52, doi:10.2307/1166137.
33. Gross, J.J. Antecedent and Response-Focused Emotion Regulation: Divergent Consequences for Experience, Expression, and Physiology. *Journal of Personality and Social Psychology* **1998**, *74*, 224–237, doi:10.1037/0022-3514.74.1.224.
34. Gross, J.J.; John, O.P. Individual Differences in Two Emotion Regulation Processes: Implications for Affect, Relationships, and Well-Being. *Journal of Personality and Social Psychology* **2003**, *85*, 348–362, doi:10.1037/0022-3514.85.2.348.
35. Balzarotti, S.; Biassoni, F.; Villani, D.; Prunas, A.; Velotti, P. Individual Differences in Cognitive Emotion Regulation: Implications for Subjective and Psychological Well-Being. *J Happiness Stud* **2016**, *17*, 125–143, doi:10.1007/s10902-014-9587-3.
36. Hu, T.; Zhang, D.; Wang, J.; Mistry, R.; Ran, G.; Wang, X. Relation between Emotion Regulation and Mental Health: A Meta-Analysis Review. *Psychol Rep* **2014**, *114*, 341–362, doi:10.2466/03.20.PR0.114k22w4.
37. Wang, X.; Liu, T.; Jin, X.; Zhou, C. Aerobic Exercise Promotes Emotion Regulation: A Narrative Review. *Exp Brain Res* **2024**, *242*, 783–796, doi:10.1007/s00221-024-06791-1.
38. Cohn, M.A.; Fredrickson, B.L.; Brown, S.L.; Mikels, J.A.; Conway, A.M. Happiness Unpacked: Positive Emotions Increase Life Satisfaction by Building Resilience. *Emotion* **2009**, *9*, 361–368, doi:10.1037/a0015952.
39. Vertonghen, J.; Theeboom, M. The Social-Psychological Outcomes of Martial Arts Practise Among Youth: A Review. *J Sports Sci Med* **2010**, *9*, 528–537.

 doi:10.20944/preprints202412.0242.v2

40. Schöndube, A.; Bertrams, A.; Sudeck, G.; Fuchs, R. Self-Control Strength and Physical Exercise: An Ecological Momentary Assessment Study. *Psychology of Sport and Exercise* **2017**, *29*, 19–26, doi:10.1016/j.psychsport.2016.11.006.
41. Lakes, K.D.; Hoyt, W.T. Promoting Self-Regulation through School-Based Martial Arts Training. *Journal of Applied Developmental Psychology* **2004**, *25*, 283–302, doi:10.1016/j.appdev.2004.04.002.
42. Zou, Z.; Liu, Y.; Xie, J.; Huang, X. Aerobic Exercise As a Potential Way to Improve Self-Control after Ego-Depletion in Healthy Female College Students. *Frontiers in Psychology* **2016**, *7*.
43. Duckworth, A.; Kern, M. A Meta-Analysis of the Convergent Validity of Self-Control Measures. *Journal of Research in Personality* **2011**, *45*, 259–268, doi:10.1016/j.jrp.2011.02.004.
44. Kamijo, K.; Nishihira, Y.; Higashiura, T.; Kuroiwa, K. The Interactive Effect of Exercise Intensity and Task Difficulty on Human Cognitive Processing. *International Journal of Psychophysiology* **2007**, *65*, 114–121, doi:10.1016/j.ijpsycho.2007.04.001.
45. Kucharski, B.; Strating, M.A.; Ahluwalia Cameron, A.; Pascual-Leone, A. Complexity of Emotion Regulation Strategies in Changing Contexts: A Study of Varsity Athletes. *Journal of Contextual Behavioral Science* **2018**, *10*, 85–91, doi:10.1016/j.jcbs.2018.09.002.
46. Sadeghi Bahmani, D.; Razazian, N.; Motl, R.W.; Farnia, V.; Alikhani, M.; Pühse, U.; Gerber, M.; Brand, S. Physical Activity Interventions Can Improve Emotion Regulation and Dimensions of Empathy in Persons with Multiple Sclerosis: An Exploratory Study. *Multiple Sclerosis and Related Disorders* **2020**, *37*, 101380, doi:10.1016/j.msard.2019.101380.
47. Zhang, Y.; Fu, R.; Sun, L.; Gong, Y.; Tang, D. How Does Exercise Improve Implicit Emotion Regulation Ability: Preliminary Evidence of Mind-Body Exercise Intervention Combined With Aerobic Jogging and Mindfulness-Based Yoga. *Front. Psychol.* **2019**, *10*, doi:10.3389/fpsyg.2019.01888.
48. Kavussanu, M.; Kitsantas, A. Acquisition of Sport Knowledge and Skill: The Role of Self-Regulatory Processes. In *Handbook of Self-Regulation of Learning and Performance*; 2011.
49. Kitsantas, A.; Kavussanu, M.; Corbatto, D.; Van de Pol, P. Self-Regulation in Athletes: A Social Cognitive Perspective. In; 2017.
50. Kitsantas, A.; Kavussanu, M.; Corbatto, D.; Pol, P. van de Self-Regulation in Sports Learning and Performance. *Handbook of self-regulation of learning and performance* **2018**, 194–207.
51. *WHO Guidelines on Physical Activity and Sedentary Behaviour*; World Health Organization: Geneva, 2020;
52. Jankowski, K.S. Is the Shift in Chronotype Associated with an Alteration in Well-Being? *Biological Rhythm Research* **2015**, *46*, 237–248, doi:10.1080/09291016.2014.985000.
53. Diener, E.; Emmons, R.A.; Larsen, R.J.; Griffin, S. The Satisfaction With Life Scale. *Journal of Personality Assessment* **1985**, *49*, 71–75, doi:10.1207/s15327752jpa4901_13.
54. Pilarska, A.; Baumeister, R.F. Psychometric Properties and Correlates of the Polish Version of the Self-Control Scale (SCS). *Polish Psychological Bulletin* **2018**, *49*, 95–106, doi:10.24425/119476.
55. Kobylińska, D. Kwestionariusz Regulacji Emocji [Emotion Regulation Questionnaire]. *Stanford Psychophysiology Laboratory* 2011.
56. Śmieja, M.; Kobylińska, D. Emotional Intelligence and Emotion Regulation Strategies. *Studia Psychologiczne (Psychological Studies)* **2011**, *49*, 55–64, doi:10.2478/v10167-010-0040-x.
57. Jamovi. (Version 2.3.28) 2023.
58. R: A Language and Environment for Statistical Computing. (Version 4.3) 2023.
59. Gallucci, M. jAMM: Jamovi Advanced Mediation Models. [Jamovi Module]. *The jamovi project* **2021**, doi:https://jamovi-amm.github.io.
60. Delextrat, A.A.; Warner, S.; Graham, S.; Neupert, E. An 8-Week Exercise Intervention Based on Zumba Improves Aerobic Fitness and Psychological Well-Being in Healthy Women. *Journal of Physical Activity and Health* **2016**, *13*, 131–139, doi:10.1123/jpah.2014-0535.
61. Costigan, S.A.; Lubans, D.R.; Lonsdale, C.; Sanders, T.; del Pozo Cruz, B. Associations between Physical Activity Intensity and Well-Being in Adolescents. *Preventive Medicine* **2019**, *125*, 55–61, doi:10.1016/j.ypmed.2019.05.009.

62. Panza, G.A.; Taylor, B.A.; Thompson, P.D.; White, C.M.; Pescatello, L.S. Physical Activity Intensity and Subjective Well-Being in Healthy Adults. *J Health Psychol* **2019**, *24*, 1257–1267, doi:10.1177/1359105317691589.
63. Zhang, Z.; He, Z.; Chen, W. The Relationship between Physical Activity Intensity and Subjective Well-Being in College Students. *Journal of American College Health* **2022**, *70*, 1241–1246, doi:10.1080/07448481.2020.1790575.
64. Haga, S.M.; Kraft, P.; Corby, E.-K. Emotion Regulation: Antecedents and Well-Being Outcomes of Cognitive Reappraisal and Expressive Suppression in Cross-Cultural Samples. *J Happiness Stud* **2009**, *10*, 271–291, doi:10.1007/s10902-007-9080-3.
65. Wicker, P.; Frick, B. The Relationship between Intensity and Duration of Physical Activity and Subjective Well-Being. *European Journal of Public Health* **2015**, *25*, 868–872, doi:10.1093/eurpub/ckv131.
66. Wicker, P.; Frick, B. Intensity of Physical Activity and Subjective Well-Being: An Empirical Analysis of the WHO Recommendations. *Journal of Public Health* **2017**, *39*, e19–e26, doi:10.1093/pubmed/fdw062.
67. Potoczny, W.; Herzog-Krzywoszanska, R.; Krzywoszanski, L. Self-Control and Emotion Regulation Mediate the Impact of Karate Training on Satisfaction With Life. *Frontiers in Behavioral Neuroscience* **2022**, *15*.
68. Messaoud, W.B. Social Representations of Karate among Young People. *Ido Movement For Culture - Journal of Martial Arts Anthropology* **2015**, *15*, 39–48, doi:DOI: 10.14589/ido.15.4.6.