

Self-Efficacy and Habit as the Mechanisms Underlying Physical Activity: A Cross-Sectional Study

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Abstract

Background: In a modern, predominantly sedentary society, the importance of physical activity for both physical and mental health is increasingly emphasized. Hence, it is essential to examine the factors underpinning the initiation and maintenance of regular physical activity.

Aim: The main aim of this study was to test the role of physical activity (PA) self-efficacy and PA habit in explaining the PA intensity of recreational exercisers and athletes.

Methods: We conducted an Internet-based study from July 15 to July 31, 2023, using a cross-sectional design and a non-probability (convenient) sample. Participants completed a questionnaire containing scales to assess their PA self-efficacy, PA habit and PA intensity, questions on their physical exercise and sports involvement, and questions on their sociodemographic background.

Results: The study comprised 491 participants, of whom 424 were athletes (27.4%) or individuals who regularly exercise (72.6%), (53.8% of whom were female), of an average age of 28.39 years. The results showed a direct positive contribution of PA self-efficacy to PA intensity among athletes. PA self-efficacy did not directly contribute to PA intensity in exercisers. PA self-efficacy indirectly contributed to PA intensity through enhanced PA habit, across all the observed groups.

Conclusion: The study findings demonstrated the importance of PA self-efficacy and PA habit in explaining PA intensity, with possible distinct mechanisms of contribution for athletes and regular exercisers. Specifically, the data suggest a positive impact of PA self-efficacy on PA intensity among athletes both directly and indirectly, through enhanced PA habit, while enhanced PA habit completely mediated the positive impact of PA self-efficacy on PA intensity among exercisers. This empirical evidence illustrates the necessity of providing individuals with effective skills and knowledge, which are crucial for fostering a sense of PA self-efficacy, strengthening the PA habit and, ultimately, for more effective engagement in PA.

Keywords: physical activity, recreational exercisers, athletes, self-efficacy, habit

Introduction

The empirical and theoretical significance of physical activity (PA) is not surprising given its numerous benefits on physical and mental health as well as daily functioning (1-5).

Therefore, to acquire a deeper understanding and provide efficient guidelines and practical tools, it is essential to identify the factors and processes that foster regular physical activity (PA).

One such factor might be self-efficacy, which is the individual's belief in their capacity to perform a specific task, achieve a particular goal or effectively handle various situations (6,7).

An empirically demonstrated positive correlation between PA self-efficacy and PA involvement suggests a higher probability of engaging in more strenuous PA with increased PA self-efficacy (3,8,9). Moreover, PA self-efficacy has been demonstrated to be a significant determinant in actualizing intended PA behaviors (10,11). These findings provide further insights into the theory of planned behavior, which proposes the factors that determine the intention and the ability to anticipate behavior based on an intention (12). Thus, they support the theory's assumption that perceived behavior control, a concept closely linked to self-efficacy, not only enhances intention but also operates as the mechanism through which intentions to engage in regular PA or exercise are converted into actual behavior.

Another mechanism that has been found to be correlated with PA (13-15) and potentially plays a role in translating intentions into real behaviors is the PA habit strength (10,13,16,17,18,19). It seems that habits, as processes that operate with a high degree of automaticity, responsiveness and efficiency, thus requiring less energy and effort, significantly determine more regular PA (19,20).

These empirical findings improved the theory of planned behavior by elucidating the potential processes and mechanisms contributing to the manifestation of PA. They additionally support the multi-process

action control model, which posits reflective processes such as perceived self-efficacy and habit as crucial mechanisms of sustained behavioral action (21). More specifically, this model assumes that reflective processes, such as perceived capability, lead to behavior until the reflexive processes, such as habit or identity, begin to co-determine and regulate action control and, ultimately, behavior manifestation. Simply stated, when specific behaviors are repeated regularly, reflexive processes begin to influence future actions and mediate the influence of reflective processes on behavior.

Thus, to test this model's prediction and gain new insights into the relationship among PA self-efficacy, PA habit and PA intensity, this study aimed to examine the direct and indirect effects of PA self-efficacy, through PA habit strength, on PA intensity among athletes and exercisers.

Materials and method

Study design

The study employed a cross-sectional design.

Ethics

The study was conducted in compliance with the ethical guidelines outlined in the 1964 Declaration of Helsinki and subsequent amendments thereto and in accordance with the General Regulation on the Protection of Personal Data (EU) 2016/679, (GDPR) and the Law on the Implementation of the General Regulation on the Protection of Personal Data (NN 42/2018). Participants were informed about the study's objectives, characteristics, protocol and data analysis, and were informed that by proceeding with the online form, they were consenting to participate in the study. The Ethics Committee of the Catholic University of Croatia approved the study (Document Class: 602-04/23-11/029; No.: 498-15-06-23-001).

Participants

This study's target population was physically healthy adults in Croatia with various levels of PA. The study's sample was convenient

and consisted of adults who had received an invitation letter to participate in the study and who were not facing any challenges in carrying out ordinary physical tasks.

Procedure

We prepared an invitation letter that encompassed all the crucial details about the study, along with the hyperlink to the online questionnaire. We emphasized the main objective of the study, as well as its scientific and practical significance. Additionally, we noted that the study is intended for all adult individuals who do not experience any challenges in carrying out ordinary physical tasks. The invitation letter was disseminated using email, smartphone applications and social media channels. The questionnaire was created using the SurveyRock web platform. In the questionnaire's introductory section, we reiterated the study's objective and informed the participants about the confidentiality and anonymity of their data. Furthermore, we explicitly stated that the data would be evaluated strictly at the group level. We also emphasized the option to discontinue participation in the study at any time without incurring any repercussions. Upon concluding this section, we notified the participants that by proceeding (clicking the "next" button), they were consenting to participate in the study. The time needed to complete the questionnaire was up to 10 minutes. The study was conducted between July 15 and July 31, 2023.

The initial section of the questionnaire comprised scales measuring PA self-efficacy, PA habit strength and PA intensity. The questionnaire concluded with questions regarding physical exercise, sports participation and the participants' sociodemographic profiles.

Measures

Physical activity self-efficacy

We operationalized PA self-efficacy using the Self-Efficacy for Physical Activity (SEPA) scale [22,23]. The scale consists of five items that form one factor. An example of an item is "I am confident I can participate in

regular physical activity when I am tired." Participants answer on a five-point scale, ranging from 1 (not at all confident) to 5 (extremely confident). The total score is obtained by summing the answers to all the items, where a higher score indicates higher PA self-efficacy.

For this study, the questionnaire was translated from English to Croatian using the double-blind translation procedure. The study also demonstrated acceptable scale reliability, with an internal consistency Cronbach alpha of 0.82.

Physical activity habit strength

We used the self-report index of habit strength (SHRI) [24] to measure habit strength for physical activity. The scale consists of ten items that form one factor. An example of an item is "Exercise is something I do frequently." The response options are on a scale ranging from 1 (I completely disagree) to 5 (I completely agree). The total score is obtained by summing the answers to all the items, where a higher score indicates higher PA habit strength. The internal consistency of the scale in this study suggested highly satisfactory reliability (Cronbach alpha = 0.96).

Physical activity intensity

To assess PA intensity, we used the Godin-Shephard Leisure-Time Physical Activity Questionnaire [25,26]. The participants answered the following question: "In your usual week, how many times, on average, do you perform the following forms of physical activity/physical exercise for more than 15 minutes?"

Then, three kinds of physical activity/exercise were presented and described: strenuous exercise (heart beats rapidly), moderate exercise (not exhausting) and mild/light exercise (minimal effort), with examples of activities listed, such as running, fast walking and easy walking, respectively. The participants wrote the number for each kind of exercise. A total score was formed by multiplying each score by the corresponding ponder (the score for mild exercise \times 3, the score for moderate exercise \times 5, and the score

for strenuous exercise \times 9), with higher scores indicating more intense PA.

Physical activity levels

To report on their physical activity/sports engagement, the participants were asked to respond to the following question: *Are you engaged in any exercise or sports activity, and if so, at what level?* Choose one option, a number between 1 and 5 (1—I am not, or I am very rarely engaged in exercise or sports activities; 2—I am recreationally but not so actively engaged in sports (for example, once a week, three times in two weeks, occasionally or similar); 3—I am recreationally actively engaged in sports (for example, a couple of times a week, 2–3 times and more); 4—I train for a certain sport and compete at an amateur level, 5—I train for a certain sport and compete at a professional level).

To encompass physically active individuals, we removed the participants who reported being either not physically active or engaging in exercise or sports activities very rarely (participants who answered *I am not, or I am very rarely engaged in exercise or sports activities*). Therefore, three groups of participants remained: athletes, more active recreational exercisers and less active recreational exercisers.

Data analysis

To test the direct contribution of PA self-efficacy to PA intensity and the mediation role of PA habit in this relationship among athletes and more and less active exercisers, we utilized a moderation mediation with a multi-categorical moderator (Model 8) (27).

Considering the different types of involvement and distinct PA characteristics in those who exercise and compete, we used Helmert coding to differentiate between athletes and exercisers. Specifically, besides the relationship among PA self-efficacy, PA habit and PA intensity, this method's regression coefficient (bs) estimated the difference between athletes and exercisers, both less and more active (W1) and the difference between less and more active exercisers (W2) in PA habit and PA intensity.

Furthermore, the interaction effects of the estimated moderated mediation model showed the possible different relationships among PA self-efficacy, PA habit, PA self-efficacy and PA intensity among amateur athletes compared to exercisers (PA self-efficacy \times W1) and between less active exercisers compared to more active exercisers (PA self-efficacy \times W1). The statistical significance level was set at .05. Figure 1 depicts a hypothesized model's conceptual diagram, which illustrates PA self-efficacy's contribution to PA intensity, both directly and indirectly through PA habit and its dependence on PA levels.

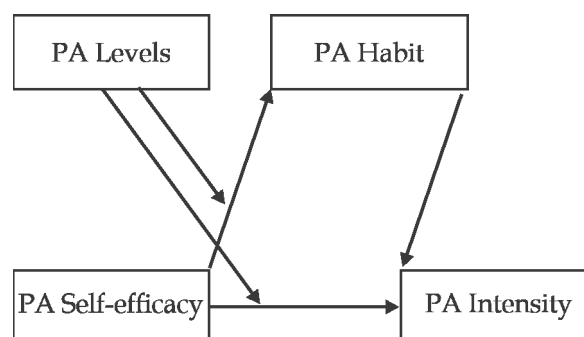


Figure 1. Conceptual diagram of the mediation role of PA habit in relation to PA self-efficacy and PA intensity and its dependence on PA levels (as a moderator)

Results

A total of 491 adults participated in the study. Among them, 64 reported that they are not or are very rarely engaged in exercise or sports activities. Due to the aim of this study, these participants were excluded from the analysis. Furthermore, we excluded three participants (one among the less active and two among the more active exercisers) with aberrant results on the PA intensity scale (z values of 4.92, 6.89 and 8.63). Therefore, the study sample consisted of 424 adults (53.8% females), of whom 24.3% were less active exercisers (N=103), 48.3% were more active exercisers (N=205), and 27.4 athletes (N= 17), with an average age of 28.39 (SD=9.69).

Table 1. Descriptive statistics and intercorrelations among variables

Exercisers									
	Less active		More active		Athletes				
	M (SD)	Range	M (SD)	Range	M (SD)	Range	1	2	3
PA self-efficacy (1)	13.10 (3.72)	6–24	16.77 (4.26)	5–25	19.90 (4.41)	9–25	-	0.67**	0.52**
PA habit (2)	24.30 (8.71)	10–46	37.96 (9.34)	12–50	44.26 (6.98)	12–50		-	0.55**
PA intensity (3)	33.58 (19.27)	3–105	58.48 (24.37)	6–220	81.00 (30.51)	22–185			-

** $P < 0.01$

The results of correlation analysis (Table 1) showed a positive relationship between PA intensity and both PA self-efficacy ($r=0.52$, $P<0.01$) and PA habit ($r=0.55$, $P<0.01$). PA self-efficacy and PA habit were also positively

related ($r=0.67$, $P<0.01$).

The results of moderated mediation showed that the model accounted for 44.26% of the PA intensity, $F(6, 417)=10.923$, $P<0.001$ (Table 2).

Table 2. Moderated mediation analysis predicting physical activity intensity (Helmert coding)

	<i>b</i>	SE	<i>t</i>	<i>p</i>	95% CI	
					LL	UL
PA habit						
PA self-efficacy	1.07	0.09	11.77	<0.001	0.89	1.24
W1	-17.82	3.53	-5.05	<0.001	-24.76	-10.88
W2	-8.25	3.32	-2.48	0.014	-14.79	-1.71
W1 × PA self-efficacy	0.55	0.19	2.87	0.004	0.17	0.92
W2 × PA self-efficacy	-0.05	0.23	-0.24	0.809	-0.50	0.39
PA intensity						
PA self-efficacy	1.41	0.33	4.27	<0.001	0.76	2.06
PA habit	0.65	0.15	4.23	<0.001	0.35	0.96
W1	33.09	11.47	2.88	0.004	10.55	55.63
W2	-16.64	10.57	-1.57	0.116	-37.41	4.14
W1 × PA self-efficacy	-2.87	0.61	-4.74	<0.001	-4.06	-1.68
W2 × PA self-efficacy	0.16	0.71	0.22	0.826	-1.24	1.56

Note. W1 = athletes vs. exercisers; W2 = more vs. less active exercisers

The results revealed stronger PA habits of athletes compared to exercisers ($b=-17.82$, $P<0.001$) and stronger PA habits of more active exercisers than less active exercisers ($b=-8.25$, $P=0.014$).

The results also showed the significant positive contribution of PA self-efficacy to PA habit ($b=1.07$, $P<0.001$). However, the significant interaction effect ($b=0.55$, $P<0.001$) suggested a stronger correlation between PA self-efficacy and PA habit among exercisers than athletes. The correlation between PA self-efficacy and PA habit was similar for more and less active exercisers ($b=-0.05$, $P=0.809$) (Figure 2).

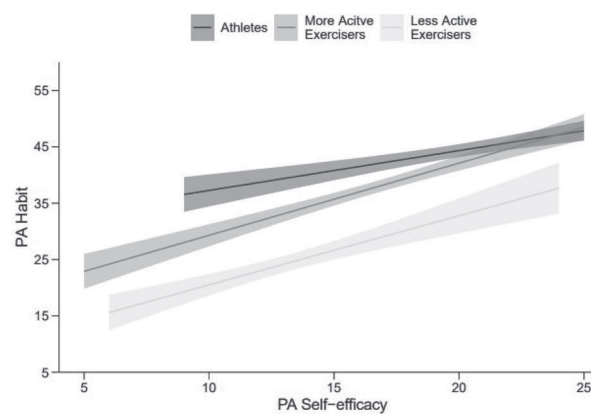


Figure 2. The relationship among PA self-efficacy and PA habit among athletes and more and less active exercisers

The results also revealed higher PA intensity of athletes compared to exercisers ($b=33.09$, $P<0.001$). Although the data indicated a tendency toward a higher PA intensity of more active exercisers compared to less active ones, the difference was not statistically significant ($b=-16.64$, $P=0.116$).

PA self-efficacy positively contributed to PA intensity ($b=1.41$, $P<0.001$). However, this relationship was different between athletes and exercisers ($b=-.287$, $P<0.001$), suggesting a stronger correlation between PA self-efficacy and PA intensity among athletes compared to exercisers. In other words, the PA self-efficacy of athletes contributed more to their PA intensity than in exercisers. The contribution of PA self-efficacy to PA intensity in less and more active exercisers was similar ($b=0.16$, $P=0.826$) (Figure 3).

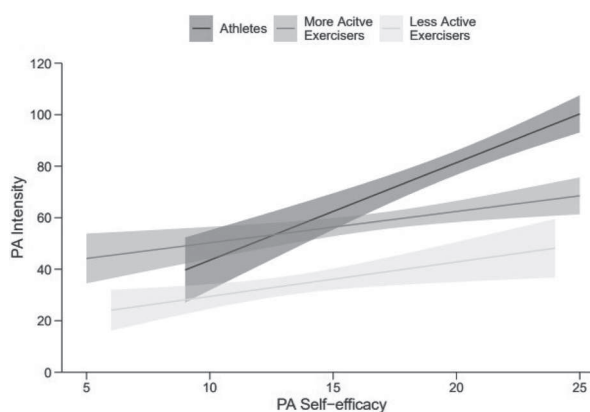


Figure 3. The relationship between PA self-efficacy and PA intensity between athletes and more and less active exercisers

Regarding the study's primary aim, the results of moderation mediation showed different contribution paths of PA self-efficacy on PA intensity through the mediation of the PA habit between athletes and exercisers. In particular, the PA self-efficacy of athletes impacted PA intensity both directly, $b_{\text{athletes}}=3.33$, [2.35–4.29], and indirectly through PA habit, $b_{\text{athletes}}=0.46$, [0.25–0.70]. In contrast, the PA self-efficacy of more active exercisers and less active exercisers impacted PA intensity only via the PA habit, $b_{\text{more active exercisers}}=0.84$, [0.46–1.25], $b_{\text{less active exercisers}}=0.80$, [0.39–1.27].

Discussion

In this study, we examined the contribution of PA self-efficacy to PA intensity and the mediating role of the PA habit in this relationship among athletes and exercisers.

We found that the contribution of PA self-efficacy to PA intensity and the mediation role of PA habit in this effect differ in athletes and exercisers. Specifically, the athletes' PA self-efficacy contributed to their PA intensity both directly and indirectly through enhanced PA habit. On the other hand, the PA self-efficacy of exercisers influenced their PA intensity only through an enhanced PA habit.

Our findings of the mediation role of PA habit in the relationship between PA self-efficacy and PA intensity support previous empirical evidence on the significance of habit in determining physical activity intensity (16,19,20). Additionally, these findings provide a deeper understanding of the underlying mechanism by which PA self-efficacy influences PA intensity.

This empirical evidence aligns with the multi-process action control model, which posits reflexive processes such as habit as the most effective means of maintaining behavior due to learned associations and less effort required, and the means by which reflective processes such as self-efficacy influence PA intensity (21).

Nevertheless, the partial mediation shown in athletes, i.e., the direct contribution of PA self-efficacy to PA intensity besides the indirect, via PA habit, provides a valuable insight into the importance of PA self-efficacy. The importance of self-efficacy is particularly pronounced among athletes, most likely due to the nature of sports. We found the strongest PA habits in athletes, and an insufficiently developed habit is surely not the factor that led to the direct effect of PA self-efficacy on PA intensity. However, sports require specific skills and expertise, which is why PA self-efficacy arguably plays a more crucial role in the training and competition process and, as a result, in PA intensity (28,29).

Furthermore, as among exercisers, our study's findings indicated the contribution of athletes' PA self-efficacy to their PA intensity, also through the PA habit, which further emphasizes the importance of this reflexive mechanism acquired via purposeful, deliberate and repetitive engagement in PA. This engagement is arguably affected by PA self-efficacy, which in turn results in the development of PA habit strength. Our study's findings support this path and align with previous empirical insights into the impact of consistent engagement in PA on forming PA habit strength, whether through structured sports training or in self-engaged recreational engagement (30). The significant role of PA self-efficacy is also conceptually supported by the self-efficacy theory (7) and the theory of planned behavior (12), which posit self-efficacy or perceived behavior control as a significant determinant of the execution of an action. However, as previously stated, our findings contribute to the current understanding of the mechanisms underlying the manifestation and regulation of action, highlighting the significant role of the PA habit in the relationship between PA self-efficacy and PA intensity.

Encompassing diverse PA-level groups, this study allowed us to gain new insights into the roles of PA self-efficacy and PA habit among populations who are differently engaged in PA. These insights benefit researchers and healthcare providers by identifying and defining the essential components for maintaining sustainable PA. They are also of particular importance in creating effective interventions for individuals seeking to establish consistent exercise routines, which will involve tools and strategies to improve individuals' beliefs in their abilities to engage in PA and other reflective processes that facilitate habit formation or a stronger connection to PA. Nevertheless, considering our study's cross-sectional design, future longitudinal studies are recommended to verify and reinforce these findings. In addition, future studies ought to encompass other potentially relevant factors that could feasibly help individuals translate their intentions into tangible PA behaviors.

Conclusion

Our study highlights the importance of PA self-efficacy and PA habit for the degree of PA intensity. The significance of PA habit is particularly evident among exercisers, as habit acts as a complete mediator in the association between PA self-efficacy and the intensity of PA. On the other hand, PA self-efficacy is essential for forming habits for both exercisers and amateurs. It also directly contributes to the PA intensity of athletes.

Therefore, this study indicates the necessity for creating and offering tools, strategies and guidance to enhance an individual's PA skills and beliefs, likely leading to a strengthened PA habit and sustainable PA.

Declarations

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Authors' contributions

DG, VĆ and DD: study design; DG, VĆ and DD: data collection and analysis; DG, VĆ and DD: data interpretation; DG and VĆ: writing first draft of the manuscript; DG, VĆ and DD: revising the manuscript for critical intellectual content; DG, VĆ and DD: approval of the final version of the manuscript.

Ethics consideration

The Ethics Committee of the Catholic University of Croatia approved the study (Document number: Class: 602-04/23-11/029; No.: 498-15-06-23-001). After the participants had been given all necessary the information regarding the study and anonymity in accordance with the General Data Protection Regulation (GDPR), they gave informed consent before taking part in the study.

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Competing interests

The authors declare no conflict of interest.

Data sharing statement

The authors confirm that the data can be obtained by contacting the corresponding author.

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