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ORIGINAL ARTICLE

Role of received social support in the physical activity of coronary heart patients: The Health Action Process Approach

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Abstract

Physical activity (PA) plays a crucial role in the management of coronary artery disease (CAD). The Health Action Process Approach provides a useful framework for understanding and predicting the process of health behaviors. The aim of the current study was to unveil the role of received social support in the HAPA model, concerning the physical activity of CAD patients. A longitudinal sample of 117 CAD patients filled out a questionnaire during three measurement points (baseline, 2 months, and 6 months later). The constructs within the model were measured by the previously validated HAPA scales. PA was assessed with four items, which were also included in the HAPA questionnaire. To test the direct and indirect associations between the variables, structural equation modeling with latent variables was employed. Received social support was proven to have a significant and strong effect on both action planning and action control, suggesting a synergistic effect on the individual factors, as well as increasing the explained variance of PA. Results confirmed the important role of received social support in the PA of CAD patients. It could be presumed that strengthening the social support from family and friends could support the regular physical activity of CAD patients.

KEYWORDS

coronary artery disease, Health Action Process Approach, social support

INTRODUCTION

Cardiovascular diseases (CVD) are one of the leading causes of death, and coronary artery disease (CAD) is the most common cause of CVD in Europe and worldwide (Khan et al., 2020; Timmis et al., 2020) as well. In Europe, CVD accounts for 43% of total mortality, for which coronary heart disease is largely (~41% from all CVD deaths) responsible (Timmis et al., 2020). In Central and Eastern Europe, including Hungary, mortality rates from CAD are generally higher (in Hungary 24%) than in other parts of Europe (Timmis et al., 2020; Wilkins et al., 2017).

Due to the development of preventive procedures and rehabilitation programs (Townsend et al., 2016), the rates of CAD mortality have improved significantly between 2005 and 2015 worldwide, including in the EU and Hungary (Timmis et al., 2020), though this improvement was not so consistent in Central and Eastern Europe (Wilkins et al., 2017). However, since the number of new cases in CAD increased in the past few decades in Europe, nowadays there are more than 30 million people living with CAD in the continent (Wilkins et al., 2017). Consequently, the treatment of the chronic condition of CAD patients requires enhanced attention from healthcare providers (Sanchis-Gomar et al., 2016). Independently of the applied therapeutic method, it can be stated that the one significant influencing factor in the prognosis of CAD patients is the health behavior of the patients, such as physical activity (Winzer et al., 2018).

Physical activity (PA) could reduce the risk of various health problems. Regular physical activity can reduce the risk of developing CAD (Winzer et al., 2018) as well as the risk of all-cause (Ku et al., 2020; Stewart et al., 2017) and cardiovascular mortality among healthy individuals and CAD patients as well (Cheng et al., 2018; Lear et al., 2017). On the one hand, the positive effects of physical activity prevail against several risk factors of CAD, including hypertension, the level of LDL and non-HDL cholesterol, body weight, and type 2 diabetes (Glazer et al., 2013; Winzer et al., 2018). On the other hand, having a sedentary lifestyle is one of the major risk factors for coronary artery disease worldwide (Lee et al., 2012), as well as for secondary prevention (Vasankari et al., 2021). Relatedly, several studies (Janssen et al., 2014; Meng et al., 2014) have consistently proved that interventions targeting physical activity in cardiac rehabilitation could be useful and efficient in the initiation and maintenance of physical activity among cardiac patients. Therefore, due to the pivotal role of physical activity in health status and CAD and taking into consideration the efficiency of interventions in promoting physical activity, the understanding of the process of health behaviors, for example, physical activity, is a priority in the field of health psychology.

In the explanation, prediction, and modification of health behavior, evidence-based theories are crucial. Empirically, proven theories and frameworks can help health educators to understand a comprehensive process of the behavior and therefore to design tailored interventions that best fit the target audience, the certain behavior, the circumstances, the goals, and the resources. Applying only one or a few elements without understanding the process behind it presumably results in rigid practice or trial-by-trial luck outcomes. Moreover, theories enable the reliable measurement of the desired outcomes that reciprocally can lead to better-tailored interventions (Glanz et al., 2008).

A possible theoretical framework to understand the process of health behaviors is the Health Action Process Approach (HAPA; Schwarzer, 2011; Schwarzer & Luszczynska, 2015). HAPA was applied successfully in examining various health behaviors of different cultures, genders, ages, and patients' groups (Gholami et al., 2014; Schwarzer et al., 2008; Steca et al., 2015). The HAPA model was proven to be effective in predicting and modifying physical activity of patients attending cardiac rehabilitation (Sniehotta, Scholz, & Schwarzer, 2005), breast cancer survivors (Paxton, 2016), overweight individuals (Parschau et al., 2014), and patients attending physiotherapy (Clark & Bassett, 2014).

According to HAPA, changes in health behavior are the result of a self-regulatory process in which a distinction could be made between a motivational (leading to the motivation to change one's behavior) and a volitional (leading to the actual behavior) phase (2011; Schwarzer et al., 2003). In the initial, motivational phase, perception of the health risk (risk perception), positive outcome expectancies, and perceived self-efficacy (a sense of personal effectiveness; Schwarzer & Luszcynska, 2016) jointly influence the development of the behavioral intention (Sniehotta, Scholz, Schwarzer, Fuhrmann, et al., 2005). The HAPA concept makes a distinction between the three constructs of perceived self-efficacy. These phase-specific self-efficacy beliefs (see Scholz et al., 2005), as one of the unique and highlighted parts of the HAPA model, allow the more reliable measurement and the practically important differentiation of self-efficacy beliefs. Action self-efficacy is relevant in the first phase of the process. When facing a new challenge, one with high action self-efficacy is more likely to start the new behavior (Sniehotta, Scholz, & Schwarzer, 2005). Maintenance self-efficacy (a sense of competence in successfully overcoming obstacles) and recovery self-efficacy (supporting resumption from setbacks) become important in the later stages of the behavior change, so they are jointly labeled volitional self-efficacy (Schwarzer et al., 2008; Schwarzer & Luszcynska, 2016). After the intention—the behavioral goal—formation, the volitional process requires a high level of self-regulatory efforts to achieve the desired goals (Sniehotta, Scholz, & Schwarzer, 2005). Such self-regulatory strategies could be (1) action planning (the specific steps and scenarios of the implementation of the desired behavior, possibly based on the SMART principles (Doran, 1981)—specific, measurable, assignable, realistic, and time-related strategies to achieve a difficult task), (2) coping planning (based on the anticipated barriers that results in the formation of alternative responses and behaviors that could overcome these obstacles), or (3) action control: a concurrent, in situ self-regulatory strategy, in which the current behavior is permanently compared with and adjusted to the behavioral goals (Scholz et al., 2007; Sniehotta, Scholz, & Schwarzer, 2005; Sniehotta, Scholz, Schwarzer, Fuhrmann, et al., 2005). Action control is based on three underlying mechanisms that could be seen as its subfacets: self-monitoring (e.g., "I consistently monitored when, where, and how long I exercise"), awareness of standards (e.g., "I have always been aware of my prescribed training program"), and self-regulatory efforts ("I took care to practice as much as I intended to"; Schwarzer, & Luszczynska, 2015, 257). Several studies have found action control to be a good predictor (Scholz et al., 2009), as well as the most proximal predictor of health behavior (Godinho et al., 2014; Sniehotta, Scholz, & Schwarzer, 2005).

Social support in the HAPA model

Social support from family and friends has been introduced as a volitional factor in the HAPA model. In difficult or stressful situations, social support can promote adaptive cognitive appraisal processes as well as coping efforts (Fernández et al., 2014). If social support is present, it is a resource supporting the implementation or the maintenance of the behavior. If it is absent, that could be a barrier

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for the individual (Schwarzer et al., 2011). Social support in the adoption and maintenance of lifestyle changes could promote long-term success (Bandura, 2004). Importantly, several types of social support could be distinguished, such as informational (e.g., giving advice or sharing experiences), instrumental (e.g., giving tangible help with a problem), and emotional (e.g., giving reassurance, encouragement), and each of them could be useful and beneficial depending on the situation. In the context of health behavior change, emotional support presumably can be beneficial because it could strengthen the self-beliefs of the individual, and thus, it could help to overcome barriers and recover from relapses (Schwarzer et al., 2004). However, it could be necessary to make a distinction between perceived and received social support. Perceived social support usually is prospective and refers to the anticipation of help, whereas received social support is always retrospective and refers to actual support within a given period (Schwarzer et al., 2004). Studies, including meta-analyses, have found positive associations between both perceived (e.g., Smith et al., 2017) and received (e.g., Parschau et al., 2014) social support and physical activity. However, since received social support reflects on the actual support that a person is given, this construct could be more accurate in examining the extent of actual exercise in the previous period. Nevertheless, it should be noted that the association between social support and physical activity could be varied across studies, with different effect sizes and even between positive or negative directions (Scarapicchia et al., 2017).

In the framework of the HAPA model, it is presumed that social support has a more significant role after an individual has formed an intention to change (Scarapicchia et al., 2017). Similarly, a study (Franks et al., 2006) that examined different forms of support from partners of cardiac patients found that health-related support was beneficial in the long term only if it was consistent with the patients' efforts and will. Translating this to the HAPA framework, it could be presumed that the received social support could be more effectively integrated into the process after the intention has been formed. However, empirical studies that have integrated perceived or received social support into the HAPA model—even in the motivational or in the volitional phase—presented inconsistent findings. A study by Parschau et al. (2014) has found social support to be a significant predictor of intention to engage PA and the actual behavior, while another study (Arbour-Nicitopoulos et al., 2017) failed to find a connection between social support and intention or behavior. Moreover, another study (Fernández et al., 2014) found that social support could be a moderator factor in the process of PA.

Furthermore, regarding this patient group, a recent study (Teleki et al., 2019) has shown that received social support can be a crucial factor in modifying the dietary behavior of CAD patients after an invasive cardiological intervention, while another study, examining physical activity in a sample of CAD patients, has found that HAPA-based intervention together with support from family is effective in the maintenance of physical activity after cardiac rehabilitation (Aliabad et al. 2014).

The extensive validity and applicability of HAPA are well researched and confirmed (see the meta-analysis of Gholami et al., 2014; Zhang et al., 2019), yet these inconsistent findings regarding social support in the HAPA model require further examination.

To the best of our knowledge, so far there is no study examining physical activity among Hungarian coronary artery patients in the framework of the HAPA concept.

Aim of the study

The general aim of our study was, therefore, to examine the applicability and the possible predictive utility of the Health Action Process Approach concerning the physical activity of Hungarian coronary artery patients. We hypothesized that in the process of physical activity in this population, planning, self-efficacy, and self-regulatory constructs also emerge as important mediator factors, with this result confirming the findings of previous studies. Finally and most importantly, our aim is to reveal the possible role of received social support in the physical activity of CAD patients. Previous analyses resulted in inconsistent findings, but considering the theoretical assumptions (Scarapicchia et al., 2017) as well, we hypothesized that received social support has a synergistic effect on volitional variables. However, since the previous data are unclear, we examine this hypothesis with an exploratory approach.

METHODS

Sample and procedure

A total of 151 patients with CAD voluntarily participated in our study between September 2015 and July 2017. The sample size matched a previous study (Teleki et al., 2019) that applied a similar paradigm based on the HAPA model and examined a similar patient group. The required sample size for this experiment was determined by computing estimated statistical power with a conservative approach (AGFI = 0.95, $\beta > .95$, $df = 219$) using the semPower package for R (Moshagen & Erdfelder, 2016; R Core Team, 2020). The analysis indicated a required total sample size of 74; thus, our study was adequately powered. As the inclusion criteria, all the patients underwent either elective percutaneous coronary intervention (PCI) or elective coronary artery bypass grafting (CABG) for the first time in a heart clinic in Hungary. Patients under 45 years and above 75 years, as well as patients with a prior psychiatric history or decreased cognitive ability (including dementia), were excluded. The timing of recruitment and the first questionnaire were varied across patient groups. Both groups were recruited during the hospital stay before or after their surgery: Patients in the CABG group filled out the questionnaire before surgery during their anesthesia examination, while patients in the PCI group filled out the questionnaire after the intervention, since their CAD diagnosis was confirmed as the result of the intervention. This different procedure was necessary because of the hospital protocol, the availability of the patients, and ethical considerations. Participants were given oral and written information by the first author about the purpose, method, and time schedule of the study;[1] thereafter, they signed an informed-consent form. To ensure the equivalent level of information about the importance of physical activity in coronary artery disease, all participants received a short brochure at the time of recruiting. Then, they received in person and filled out the first (Time 1, T1) questionnaire during their hospital stay. A personal code was matched to each participant to ensure anonymity. Two follow-up questionnaires were sent two (Time 2, T2) and six months (Time 3, T3) after discharge by post. Completing the questionnaires (Times 1, 2, 3) required approximately 25–30 min. The follow-up questionnaire in Time 2 was sent back by 122 (80.7%) participants. A total of 117 people (77.4%) participated at all three measurement points (Times 1, 2, and 3).

Sample characteristics

The mean age of the final sample ($N = 117$; 77 men, 40 women) was 62.48 years ($SD = 6.22$, range = 46–74). Of the 117 total participants, 62 underwent CABG (40 men, 22 women; $M_{age} = 62.26$, $SD = 5.75$, range = 49–72), and 55 underwent PCI (37 men, 18 women; $M_{age} = 62.4$, $SD = 7.04$, range = 45–74). Fifteen participants had primary school education (12.8%), 70 participants (59.8%) had secondary, and 32 (27.4%) had higher education. The majority were married or living with a partner (92; 78.6%), 11 participants (9.4%) were widowed, 3 (2.6%) single, and 11 (9.4%) divorced or separated. More than half of the respondents were retired (73; 62.3%), and 37 (31.6%) participants were employed. Mean body mass index was 29.7 ($SD = 5.24$, range = 18.6–50.2). Overall, 16.15% of the participants dropped out in Time 2, and a further 9.28% in Time 3. There was no significant difference between patients who participated in all three measurement points ($N = 117$) and patients who dropped out ($N = 34$) regarding age (mean = 62.33 ± 6.37 and 61.13 ± 6.83, respectively; U = 1758.5; $p > .05$), educational level (U = 1636; $p > .05$), gender ($\chi^2 = 0.863$, $df = 1$, $p > 0.05$), family status ($\chi^2 = 3.361$, $df = 5$, $p > .05$), and financial status (χ^2 =2 .198, $df = 4$, $p > .05$).

Measures

Regarding the measurement of the constructs of the HAPA model, we used several scales. Regarding these questionnaires, the copyright author (Ralf Schwarzer) has provided his written consent for the scales of HAPA to be used in the present study. The process of translation and adaptation of the HAPA scales followed the recommendations of the American Psychiatric Association (2013). All items were translated from German to Hungarian by two psychologists, both of whom were fluent in German. Then, a third person with a Master's degree in psychology was asked to compare the two versions and merge them into one to avoid any discrepancies and mistranslations. Subsequently, a person with a PhD in psychology who is fluent in German translated this version back to German. This back-translated version was checked by the copyright author. The wording of the items of the scales was essentially similar to the examples presented by Schwarzer and Luszczynska (2015). The items and scales were used and demonstrated to be valid in previous studies (Godinho et al., 2014; Scholz, Ochsner, & Luszczynska, 2013; Sniehotta, Scholz, & Schwarzer, 2005).[2]

Time 1

Risk perception ($M = 3.67 \pm 1.73$) was measured with 1 item. For the item: "If you maintain your current level of activity (or inactivity), what is the likelihood that you will get a cardiovascular disease (such as high blood pressure or heart attack) within your entire life span?" the response format was a 6-point Likert-type scale (very unlikely – very likely; score range =5).[3]

Outcome expectancies ($M = 3.71 \pm 1.37$) was measured with 4 items. The item stem "If I am physically active on a regular basis, to the point that I sweat and become short of breath, then…" was followed by (e.g.,) "…I am afraid that I might hurt myself." The response format was a 6-point Likert-type scale (not at all true—totally true; score range = 5; Cronbach's α/Spearman-Brown coefficient =.706/.736; ICC = 0.302 (95% CI [0.205, 0.407]).

Action self-efficacy ($M = 3.76 \pm 1.41$) was measured with 2 items. The item stem "I am sure I can do more regular physical activity, even if..." was followed by (e.g.,) "…I have to force myself to start immediately." The response format was a 6-point Likert-type scale (not at all true—totally true; score range = 5; Cronbach's α/Spearman-Brown coefficient = .420/.423; ICC = 0.221 (95% CI [0.028, 0.395]).

For the measurement of *intention* ($M = 3.27 \pm 1.06$), the stem "Which activity goals do you have for the next weeks? I have a strong commitment to..." was followed by: "….to vigorously exercise regularly, so that I sweat and become short of breath," "….to be regularly and moderately active, so that I sweat a bit in leisure time," and "...to be active in daily life (walking, biking, house and garden work)." For building the measurement model, one item where the value of the intention was the strongest was used.[4]

Time 2

Action planning ($M = 2.47 \pm 1.54$) was measured with 3 items. The item stem "I have made concrete and detailed plans about my physical activities. I have planned…" was followed by (e.g.,) "...when, where and how to exercise." The response format was a 6-point Likert-type scale (not at all true—totally true; score range = 5; Cronbach's α/Spearman-Brown coefficient = .840/.880; ICC = .714 (95% CI [0.635, 0.782]).

Coping planning ($M = 2.60 \pm 1.76$) was measured with 2 items. The item stem "Very often, obstacles arise, and one needs to have a strategy how do deal with them. I have planned…" was followed by (e.g.,) "...which alternative activity I will choose, in case I cannot perform my originally planned activity (for example, swimming instead of running)." The response format was a 6-point Likert-type scale (not at all true—totally true; score range = 5; Cronbach's α/Spearman-Brown coefficient = .931/.931; ICC = .868 (95% CI [0.812, 0.908]).

Maintenance self-efficacy ($M = 3.46 \pm 1.70$) was measured with 2 items. The item stem "I am sure I can keep being physically active regularly in the long run, even if..." was followed by (e.g.,) "...I don't see success immediately." The response format was a 6-point Likert-type scale (not at all true-totally true; score range = 5; Cronbach's α/Spearman-Brown coefficient = .868/.868; ICC = .765 (95% CI [0.677, 0.831]).

Recovery self-efficacy ($M = 3.76 \pm 1.79$) was measured with 2 items. The item stem "In spite of good intentions, smaller or larger relapses may occur. Imagine you stopped exercising for some time. I am sure I can be physically active again regularly, even if…" was followed by (e.g.,) "...I have already paused for several times." The response format was a 6-point Likert-type scale (not at all true – totally true; score range = 5; Cronbach's α/Spearman-Brown coefficient = .938/.939; ICC = .878 (95% CI [0.826, 0.915]).

Action control ($M = 2.62 \pm 1.46$) was measured with 4 items. The item stem "During the last weeks, have you always been aware of your exercise goals, and have you noticed when and how much you were active?" was followed by (e.g.,) "I have monitored how active I was in terms of how often, how long, and which intensity." The response format was a 6-point Likert-type scale (not at all true—totally true; score range=5; Cronbach's α/Spearman-Brown coefficient = .843/.794; ICC = .532 (95% CI [0.420, 0.634]).

Received social support ($M = 2.37 \pm 1.53$) was measured with 3 items. The item stem "During the last weeks, my family (or members of my household) or friends…" was followed by (e.g.,) "…exercised with me." The response format was a 6-point Likert-type scale (not at all true – totally true; score range = 5; Cronbach's α/Spearman-Brown coefficient = .790/.773; ICC = .539 (95% CI [0.430, 0.638]).

Time 3

The *physical activity* (PA; $M = 16.17 \pm 5.72$) scores applied in modeling were measured with 4 items that were part of the HAPA scale. In this case, answering the question "During the last week, how many hours did you spend on each of the following activities?" participants could mark their answer on a 4-point Likert scale (1-None—4-Three hours or more). The cumulative score was calculated by weighting each activity based on their intensity (considering metabolic equivalent), where the most intense activity was scored with the highest degree.[5] The correlation matrix for the variables is presented in Table 1.

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Data analyses

To explore the longitudinal associations between HAPA constructs and to reveal the possible indirect mechanisms, structural equation modeling with latent variables and with maximum likelihood estimation was executed with SPSS Amos 4 (Arbuckle & Wothke, 1999). To evaluate model fit, we used absolute fit indexes: RMSEA, SRMR and CMIN/df, and goodness of fit indexes: TLI, CFI, and IFI. The cutoffs for acceptable model fit were TLI, CFI, and IFI >.90, RMSEA, and SRMR value of.08 or lower and CMIN/*df* < 2 (Browne & Cudeck, 1992; Tabachnick & Fidell, 2001).

We tested our hypothesis in two steps. First, in model A, based on the theoretical assumptions, risk perception, action self-efficacy, and outcome expectancies at T1 were included as predictor variables of behavioral intention. Intention to PA at T1 was used as the predictor variable of measured PA at T3. The volitional latent constructs of action planning and coping planning as possible mediators between intention at T1 and physical activity at T3 were added. Volitional self-efficacy constructs at T2 were introduced as possible meditators of action and coping planning (T2), also testing the possible role of these constructs between PA intention (T1) and physical activity (T3), as the HAPA framework hypothesized. Action control based on the theoretical considerations was assumed to be the most proximal predictor of physical activity in T3, while behavioral intention and coping planning were used as predictors of action control. In the second step and when testing the main hypotheses, received social support was also added to the Model B. Based on the theoretical assumptions, received social support is supposed to influence every factor included in the volitional phase as a possible predictor variable (in T2 action and coping planning, maintenance and recovery self-efficacy, action control, and in T3 physical activity; see Figure 1).

RESULTS

Model A

The final model yielded an appropriate fit: CFI = .93, TLI = .92, IFI = .93, RMSEA = .05 (90% CI [0.041, 0.071]), SRMR = .72, and CMIN/df = 1.37 (χ^2 = 221,314; *df* = 161), while the explanatory power of the model was relatively high (R^2 = .38).

Regarding the most widely studied factors and mechanisms of HAPA, significant differences could be observed compared to the theoretical assumptions. As shown in Figure 1, of the three variables related to the motivational phase, only outcome expectancies proved to be a significant predictor of Intention (β = .80, p = .01). Neither risk perception (β = −.11, p = .371) nor action self-efficacy (β = .14, p = .299) had a direct effect on intention. Moreover, there was no significant correlation between the variables of motivational phase (see Figure 1). However, outcome expectancies (T_1) as significant factor predicting intention, supplemented with the nonsignificant coefficients, explained 53% of the variance of the construct.

Regarding the volitional phase, there were no direct relationship between intention and action planning (β = .30; p = .143) or coping planning (β = .15; p = .151). Instead, a significant relationship between intention and maintenance self-efficacy (β = .70, p = .01) appeared, whereas maintenance self-efficacy served as a predictor of recovery self-efficacy ($T_{2;}$ β = .65, p = .01). Maintenance self-efficacy significantly predicted action planning (β = .45, p = .01), but not coping planning (β = .12, p = .211). Moreover, recovery self-efficacy proved to be a predictor of coping planning (β = .16, p = .034), whereas it had no effect on action planning (β = .21, p = .88). No relationship was found between recovery self-efficacy and physical activity (β = .05, p = .615), or action planning and physical

TABLE 1 Correlation coefficients of variables in the HAPA model

Construct	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Risk perception T1	1.00										
2. Outcome expectancies T1	0.01	1.00									
3. Action self-efficacy T1	0.05	−0.20*	1.00								
4. Intention T1	0.03	0.04	0.04	1.00							
5. Action planning T2	−0.09	0.20*	−0.31**	0.14	1.00						
6. Coping planning T2	−0.07	0.29**	−0.18*	0.11	0.68**	1.00					
7. Maintenance self-efficacy T2	−0,06	0.32**	−0.10	0.15	0.37**	0.41**	1.00				
8. Recovery self-efficacy T2	0.02	0.23**	0.02	0.29**	0.39**	0.39**	0.55**	1.00			
9. Action control T2	−0.04	−0.00	−0.17	0.30**	0.57**	0.55**	0.28**	0.29**	1.00		
10. Social support T2	−0.14	−0.01	−0.19*	0.13	0.50**	0.35**	0.20*	0.15	0.58**	1.00	
11. Physical activity T3	−0.06	0.23*	−0.08	0.30**	0.41**	0.39**	0.45**	0.36**	0.34**	0.14	1.00

$*p < .05$; $**p < .01$.

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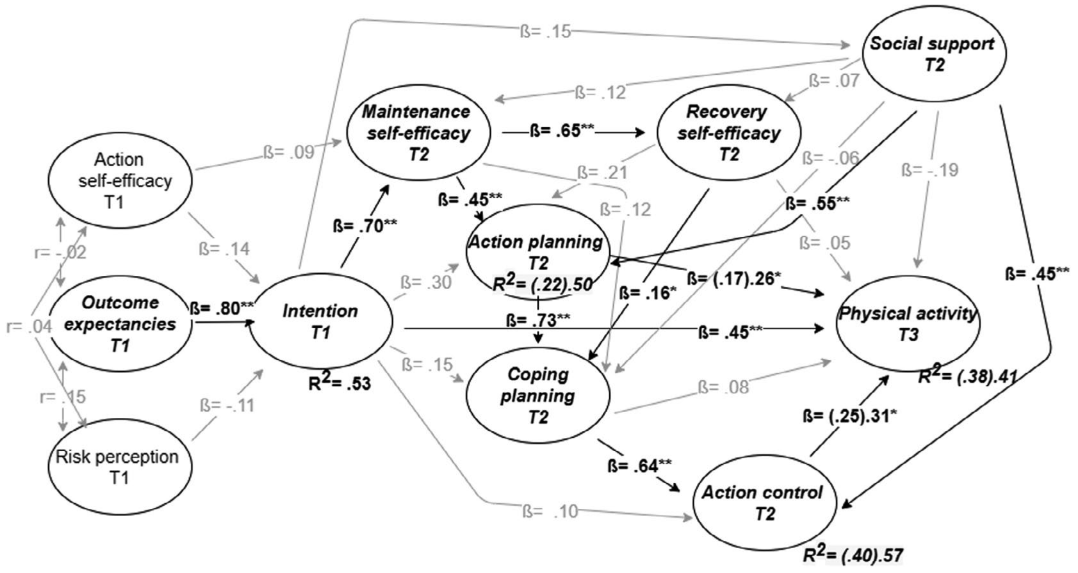

FIGURE 1 Model PA with standardized regression coefficients (regression coefficients and R^2 of Model A are in parentheses). (*$p < .05$; **$p < .01$). T_1—Time 1; T_2—Time 2; T_3—Time 3; significant variables and pathways are indicated in black; nonsignificant variables and pathways are indicated in gray

activity ($\beta = .17$, $p = .085$). Furthermore, a direct relationship between action planning–coping planning ($\beta = .73$, $p = .01$) and intention–physical activity ($\beta = .45$, $p = .01$) appeared.

In line with the hypothesized relationships, coping planning had no direct effect on physical activity ($\beta = .08$, $p = .506$), presumably it appeared as an indirect relationship. Instead, a strong significant relationship between coping planning and action control ($\beta = .64$, $p = .01$) appeared, whereas action control became a direct predictor of physical activity ($\beta = .31$, $p = .037$).

The constructs specified in Model A explained 38% of the variance in physical activity.

Model B

As a second step, social support was added to the model as a variable affecting the volitional factors (see Figure 1). The model supplemented with received social support yielded an acceptable fit: CFI = .91, TLI = .89, IFI = .91, RMSEA = .06 (90% CI [0.048, 0.074]), SRMR = .79, and CMIN/*df* = 1.44 ($\chi^2 = 314{,}329$; $df = 217$).

On the on hand, social support could not be integrated fully into the model: There was no significant predictor of social support between the present variables (intention–social support relationship was not significant: $\beta = .15$, $p = .153$), and no relationship was found with maintenance ($\beta = .12$, $p = .232$), or with recovery self-efficacy ($\beta = .07$, $p = .385$), neither with coping planning ($\beta = -.06$, $p = .519$), nor with actual physical activity ($\beta = -.19$, $p = .199$). On the other hand, received social support appeared to be a significant predictor of action planning ($\beta = .55$, $p = .01$) and action control ($\beta = .45$, $p = .01$), increasing the explained variance of these factors compared to Model A (coping planning $R^2_{\text{Model A}} = .22$ and $R^2_{\text{Model B}} = .50$; action control $R^2_{\text{Model A}} = .40$ and $R^2_{\text{Model B}} = .57$). Moreover, although the other associations outlined earlier and their strengths have not changed, the effect of both action planning ($\beta = .26$, $p = .044$) and action control ($\beta = .31$, $p = .039$) on physical activity increased, with this the predictive effect of action planning on PA has turned to be significant.

Presumably because of the effect of received social support, the explanatory power of the model increased. Model B, supplemented with received social support, could explain 41% of the variance in physical activity.

DISCUSSION

The general aim of our study was to test the applicability and validity of the Health Action Process Approach model in the physical activity of Hungarian CAD patients. Moreover, our aim was also to reveal the possible effect and role of received social support in the HAPA model in this context. In sum, our results confirmed the utility of the HAPA concept in predicting the PA of CAD patients. We provided further evidence of the important role of planning, volitional self-efficacy, and action control constructs, though our results offer an alternative path compared to the theoretical assumptions. Finally, we found that received social support could be successfully integrated into HAPA.

Concerning *the motivational phase*, significant alterations were found compared to the theoretical framework. Neither risk perception nor action self-efficacy proved to be a predictor of intention connected to physical activity. The insignificant result regarding risk perception is in line with several previous studies (Chow & Mullan, 2010; Gholami et al., 2014; Ochsner et al., 2013; Scholz, Ochsner, Hornung et al., 2013) showing that being aware of a health risk alone is not sufficient to develop an intention to change. Schwarzer and Luszczynska (2015) furthermore pointed out that risk perception is likely to play a greater role in certain preventive behaviors (e.g., participation in screening examinations). Moreover, as Benyamini (2011) suggested, risk perception, independently from the objective health status, could be the part of one's subjective illness perception, and its integration in one's health belief system could be difficult or inconsistent. An example of that is individuals who smoke. They are usually aware of the negative health consequences of their smoking habits, yet it does not result in changing their behavior or even in forming the intention of doing so (Benyamini, 2011). Also, it could be presumed that in this patient group, risk perception is no more a relevant and significant indicator of intention to change their behavior. Since these patients underwent surgery at the time of the first data collection and thus are aware of their cardiac condition, it seems possible that they already exceeded the period of risk perception.

In contrast, we did not expect a nonsignificant result regarding action self-efficacy, since self-efficacy has been found to be an essential component of social–cognitive models in many studies (Bandura, 2004; Schwarzer et al., 2003), and the role of self-efficacy proved to be especially important concerning physical activity (see Gholami et al., 2014; Zhang et al., 2019). It should be noted, however, that in a study by Chiu et al. (2011), neither risk perception nor action self-efficacy was a predictor of intention.

One plausible explanation of this result could be found in the low reliability of the scale measuring action self-efficacy construct (Cronbach's $\alpha = 0.420$). Action self-efficacy was measured by two items, as described above. It could be assumed that our participants were unable to properly interpret these multiple compound sentences. To our knowledge, this was the first study to use the HAPA constructs in a Hungarian sample, so we had no data on its translation and psychometric features. Given this, the modification of the wording of the items needs to be considered in future research. Moreover, as an interesting finding, Reuter et al. (2010) have found that baseline self-efficacy did not predict changes in behavior or planning. The predictive effect appeared only when they took into account the true changes in self-efficacy during a given period. According to the authors, this result points out that the effect of changes in cognition (e.g., in self-efficacy) should be getting more attention in modeling behaviors.

Another possible explanation for this insignificant result could be the lack of categorization regarding the specific behavioral stages in which participants were. According to the theoretical framework (Schwarzer et al., 2011), individuals could be categorized into three stages, and these stages could be characterized by different social–cognitive factors and mechanisms. In line with that, Lippke and Plotnikoff (2014) have found that the extent of self-efficacy or its associations with other variables (e.g., action planning or behavior) differ between stages (e.g., the association between self-efficacy and behavior was significant only in the group of actors but not in the groups of preintenders and intenders). Based on that important finding, it could be assumed that participants in our study could have been categorized in different behavioral stages, and therefore, they might differ in certain social-cognitive factors (e.g., self-efficacy). For this reason, the proper diagnosis of behavioral stages of the participant seems to be essential in future studies. However, the significance of the outcome expectancies construct in predicting the physical activity of the patients is in line with numerous studies confirming the importance of positive outcome expectations in the process of health behaviors (Godinho et al., 2013; Hankonen et al., 2013), especially regarding physical activity (Williams et al., 2005). In addition, Schwarzer and Renner (2000) emphasize that the relevant motivational factors can vary significantly across different health behaviors and groups studied.

However, the fact that positive outcome expectancies—together with the insignificant factors—can account for 53% of the explained variance in behavioral intention can provide important practical implications for designing interventions to increase the intention of physical activity of coronary heart patients. The explained variance of intention (53%) is a little smaller than in other studies that examined physical activity in the framework of HAPA (e.g Sniehotta, Scholz, & Schwarzer, 2005; Steca et al., 2015), which could be due to the insignificant associations between action self-efficacy and risk perception in the volitional phase.

Regarding *the volitional phase*, action and coping planning were proven to be important mediators in the model, repeating and supporting previous results (Carraro & Gaudreau, 2013; Gholami et al., 2014; Sniehotta, Scholz, & Schwarzer, 2005) and emphasizing the importance of planning constructs in the process of health behavior. In our model, action planning strongly predicted coping planning and physical activity as well, whereas coping planning mediated between action planning and—through action control—actual health behavior. Given the longitudinal design of this research, and in line with the results of former studies (Ziegelmann & Lippke, 2007; Ziegelmann et al., 2006), we assume that coping planning plays a more important role in the long-term maintenance of behavior than action planning. As Schwarzer and Luszczynska (2015) pointed out, the alternative (coping) plans can only be developed after the individual has already planned the original behavior; thus, coping planning could be built on action planning (Schwarzer & Luszczynska, 2015). The importance of planning has also been highlighted and confirmed by several previous studies and meta-analyses (Carraro & Gaudreau, 2013; Gollwitzer & Sheeran, 2006; Kwasnicka et al., 2013; Luszczynska et al., 2007). SMART principles can provide a reliable basis for plans—the planned behavior should be specific, measurable, applicable, realistic, and time-bound (Doran, 1981; Schwarzer & Luszczynska, 2015). It should be emphasized, however, that planning interventions can only be effective for the appropriate target group (see the second layer of the HAPA model; Schwarzer, 2011). Schwarzer and Luszczynska (2015) point out that once one has planned when, where, and how the desired behavior will be performed (action planning), optimally one imagines the possible difficulties and barriers that may hinder its implementation, and based on these anticipated situations one develops possible alternative ways and responses (coping planning), which ultimately allows one to still act in the desired way. Since alternative options can only be developed after the initial responses and strategies have been planned in the first place, coping planning only makes sense based on action planning (Schwarzer & Luszczynska, 2015). Thus, before designing and incorporating different kinds of planning interventions, the first step should be the proper categorization of the actual phase of the health behavior change process that the individual is in.

The volitional self-efficacy constructs and their relationships were consistent with the theoretical framework, with the exception that, since action self-efficacy did not prove to be a significant predictor in the motivational phase, and in this study, intention proved to be the predictor of volitional self-efficacy constructs. In a similar study, Crawford et al. (2018) found that, along with action self-efficacy, intention had a significant effect on volitional self-efficacy. Further, maintenance self-efficacy had a significant effect on action planning and recovery self-efficacy, while the latter fitted into the model as a predictor of coping planning. These relationships were previously demonstrated by the physical activity of cardiac patients (Luszczynska & Sutton, 2006; Scholz et al., 2005) and suggest a synergistic effect between the variables, meaning that volitional self-efficacy can strengthen the effect of planning (Luszczynska et al., 2011; Richert et al., 2010). The distinction and inclusion of volitional self-efficacy constructs in the intention–behavior relationship is a unique and important part of the HAPA concept, and however, it should be noted that most studies incorporated either only the maintenance (e.gOchsner et al., 2013; Schwarzer & Renner, 2000; Sniehotta, Scholz, & Schwarzer, 2005) or only the recovery self-efficacy (Schwarzer et al., 2007); thus, the present study may provide further evidence that the distinction between the volitional self-efficacy constructs is indeed reasonable. Based on these results, it could be assumed that one's belief that one can maintain the implemented behavior can reinforce one's formation of the necessary action plans; however, it does not help in overcoming the obstacles that arose. Recovery self-efficacy, on the other hand, the belief that one can return and continue the planned behavior when one has faced difficulties that have even changed the original plans or interrupted the previous behavior, can help the individual to return to the desired behavior by allowing him or her to learn from the experiences and develop alternative (coping) plans (Schwarzer & Luszczynska, 2015). Therefore, one focus of the intervention should be the increasing of these self-efficacy constructs depending on the phase of the health behavior change (e.g., maintenance or restarting after a relapse). Strategies that allow gaining of experiences in the present, reflecting on relevant prior experiences or behaviors (see "mastery"), providing feedback on progress, promoting skills needed to cope with relapses, or learning via appropriate role models to gain positive vicarious experiences, can enhance the sense of self-efficacy (Bandura, 2004).

We also demonstrated the significant role of action control in health behavior. The variable fitted into the model properly, wedged in between coping planning and behavior, and appeared as a direct predictor of physical activity. Several studies have found action control to be a strong and good predictor, even the most proximal predictor of health behavior (Fernández et al., 2014; Godinho et al., 2014; Sniehotta, Scholz, & Schwarzer, 2005). In two other longitudinal studies concerning low-fat diet and smoking, it was found that changes in the level of action control had the strongest direct effect on changes in actual behavior (Scholz et al., 2009).

Finally, our results provided evidence that the construct of received social support could also have an important role in the HAPA concept (see also Teleki et al., 2019). However, in this sample, received social support was not fit into the process of physical activity integrally; there was no significant predictor of social support in the present model. In contrast, received social support had a significant and strong effect on both action planning and action control; both had a direct, significant effect on physical activity, significantly increasing the explained variance of both constructs (28% and 17%, respectively), and further increasing the explained variance of PA by 3%. These results suggest a synergistic effect of received social support on individual factors (Fernández et al., 2014; Ochsner et al., 2014). In their research on smoking cessation, Ochsner et al. (2014) found that those individuals were able to stay abstinent who, besides having high levels of volitional self-efficacy or coping planning, received significant social support from their partners as well. The factors of the volitional phase thus expressed their impact jointly, as can be assumed in the present study as well. Several studies and meta-analyses examining the possible correlates of physical activity have found social support to be a consistent and strong correlate or even predictor of physical activity in various samples and contexts (e.gBauman et al., 2012; Demmelmaier et al., 2013; Duan et al., 2013; Sherwood & Jeffery, 2000; Trost et al., 2002). However, other studies failed to prove the strong or even the positive association between various types and sources of social support and physical activity (e.gAmireault et al., 2013; Scarapicchia et al., 2017). The present study thus provides further evidence for the important—though indirect—role of received social support in the initiation and maintenance of physical activity.

Based on this result, the construct of received social support could be an important and significant part of future studies examining physical activity. Considering theoretical assumptions (Scarapicchia et al., 2017) as well, received social support may have a more prominent role in the volitional phase, after an intention to change has formed. However, taking into consideration previous studies (e.g., Parschau et al., 2014) that ended in slightly different findings, it could be more justified to design and measure different forms of phase-specific support, especially when considering other aspects as well. One study (Franks et al., 2006) examined the health-related support and control from spouses of patients who participated in cardiac rehabilitation. Support involved the attempts to reinforce the patient's efforts to change health behaviors, while control described the attempts to induce changes in health behavior when the patients themselves were unable or unwilling to implement such changes. According to the results, long-term spouses' support increased, while spouses' control decreased, the health behavior of patients. This result draws attention to the importance of matching the form and timing of social support depending on the susceptibility or receptivity of the individual. Translating it to the framework of HAPA, it could be assumed that different forms of social support could be beneficial depending on the mindset (see Schwarzer, 2011) of the recipient (e.g., whether one is a preintender, or an actor).

As a final point, we can conclude that 41% of physical activity 6 months after the hospital discharge can be explained by the social–cognitive variables included in the model. This value is quite similar, though a little higher, to those reported in other studies that examined health behaviors over the same period (e.g Scholz, Ochsner, Hornung et al., 2013; Sniehotta, Scholz, & Schwarzer, 2005; Steca et al., 2015), while other studies have found much lower explained variance in a similar paradigm but in other health behaviors (e.g., dietary behavior; Teleki et al., 2019). One plausible explanation for this difference could be the nature of the examined behaviors. Dietary behavior is significantly based on habits (Verhoeven et al., 2012) and is determined by other factors as well, such as familiarity, price, availability, and the process of preparation of foods (Neuhouser, 2010). Because of that, it could be assumed that those social–cognitive factors that better relate to self-regulatory processes play a smaller role in predicting dietary behavior than physical activity, which is much more based on the conscious intention of the individual and self-regulatory strategies, and so can be more successfully predicted with these variables.

PRACTICAL IMPLICATIONS AND LIMITATIONS OF THE STUDY

Summarizing the experience of applying the HAPA model to the physical activity of patients with CAD, some practical conclusions can be drawn. In forming an intention to change any health behavior, emphasizing the positive consequences of the behavior (Schwarzer & Luszczynska, 2016) seems to be an effective approach. After forming a behavioral intention, the development of detailed plans (e.g., using the SMART principles; Doran, 1981) can help the individual turn that intention into actual behavior (Schwarzer & Luszczynska, 2015). However, planning interventions can only be effective for the right target group (see Lippke et al., 2004). Based on the confirmed significant role of volitional self-efficacy constructs, we believe that interventions should target enhancing the sense of self-efficacy by selecting a specific strategy (Bandura, 2004). Supporting the self-regulatory skills of the individual, such as action control (using a diary or calendar to monitor one's behavior), can also be an effective component of behavior change interventions (see Schwarzer et al., 2015). Furthermore, the current study provides evidence for the importance of support from family and friends in maintaining a proper level of physical activity in the long term after an invasive cardiological intervention.

Some limitations of the study are also worth considering when interpreting the results. First, as a main limitation, physical activity was assessed by a four-item, self-reported questionnaire. To measure physical activity different levels of PA were included and participants were asked to estimate the duration they performed the exercise in question. The responses were weighted by the metabolic equivalent of the levels of PA. This could create a relevant distortion. However, our method is similar to previous studies (e.g., Sniehotta, Scholz, & Schwarzer, 2005), and other methods have disadvantages as well (such as the reactive changes in behavior due to the examination). However, applying a different, standardized physical activity questionnaire in future studies could be necessary. Second, the low internal consistency of the pre-action self-efficacy items might modify the theoretical and practical implications of the model, and thus, conclusions must be drawn carefully. It could be presumed that the conditional structure of the pre-action self-efficacy items made it difficult to interpret, and thus, the participants might have been unable to connect properly the two parts of these sentences. Since this is the first study in Hungary that used the HAPA scales, data were not available regarding translation issues. For this reason, future studies should consider the rewording of the items. Third, the relatively small sample size in this study is one of its weaknesses. In favor of the reliable analysis, the two groups of CAD patients were treated together, and although they did not differ significantly regarding the HAPA variables or physical activity, future studies with larger and therefore segregated samples are needed to confirm the present results. Fourth, it is also important to emphasize that the model presented in this study does not necessarily represent the only true model of the relationship between these variables. However, these models fit well on the empirical data. All in all, examining the fit of the developed model on further, independent samples is necessary to confirm the present results and the basic and widespread validity of the model presented.

These limitations notwithstanding our findings confirmed the efficiency of HAPA in predicting the physical activity of Hungarian CAD patients six months after an invasive cardiological procedure. Furthermore, the present study provides evidence of the importance of planning, self-efficacy, and action control constructs as individual variables, as well as of the role of support from family and friends in adopting and maintaining health-enhancing physical activity after surgical intervention.

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DATA AVAILAILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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ENDNOTES

[1] The authors declare that the study meets the ethical guidelines of the Declaration of Helsinki and affirm that the research has received permission from the Medical Research Council of Hungary. Approval number: 58462–57 U/2015/EKU.

[2] The Hungarian translation of the items can be seen in Supplementary.

[3] Reliability and intraclass correlation could not be calculated with one item.

[4] Reliability and intraclass correlation could not be calculated with one item.

[5] The number of items, score range, mean, and std. deviations, Cronbach's α / Spearman-Brown coefficients and intraclass correlations can also be seen in the Supplementary (see Table 0.).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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