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Underlying Mechanisms of Improving Physical Activity Behavior after Rehabilitation

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Background: *Regular physical activity is beneficial for the health and functioning of people with a disability. Effective components of successful physical activity promotion interventions should be identified and disseminated.* ***Purpose:*** *To study the underlying mechanisms of the combined sport stimulation program "Rehabilitation & Sports" (R&S) and daily physical activity promotion program "Active after Rehabilitation" (AaR).* ***Method:*** *Subjects in four rehabilitation centers received R&S + AaR ($n = 284$). Subjects in six control centers ($n = 603$) received usual care. Physical activity and its determinants were assessed with questionnaires at seven weeks before and nine weeks and one year after rehabilitation.* ***Results:*** *Variables that were determinants of the intervention-induced improvement in physical activity behavior at both follow-up measurements were attitude, the perceived benefits "improved health and reduced risk of disease," "better feeling about oneself," and "improved fitness," and the barrier "limited environmental possibilities." The percentage change in the intervention coefficient caused by these determinants ranged from –35.3% to –16.3% and from –28.4% to –11.3% at nine weeks and one year after rehabilitation, respectively.* ***Conclusion:*** *Personalized tailored counseling interventions can improve physical activity behavior in people with a disability by targeting both personal and environmental determinants of physical activity behavior.*

Key words: people with disabilities, rehabilitation, physical exercise, leisure activities, determinants

Introduction

For the general population, it is well documented that a physically active lifestyle is beneficial for a person's health (Committee of Ministers, 1995; Department of Health, Physical Activity, Health Improvement and Prevention, 2004; Pate et al., 1995; U.S. Department of Health and Human Services, 1996; WHO/FIMS, 1995). Such a lifestyle could improve every day functioning, reduce disability, and reduce the risk of secondary health problems in people with a physical disability (Cooper et al., 1999; Durstine et al., 2000; Heath & Fentem, 1997; Rimmer, Braddock, & Pitetti, 1996; Rimmer, 1999; Shephard, 1991). However, a sedentary lifestyle is more common among people with a disability than among the general population (Chong, Klein, Plepys, & Troiano, 1998; U.S. Department of Health and Human Services, 2000). Consequently, getting people with disabilities more physically active is probably even more important than it

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already is for the general population. This warrants the development of effective physical activity promotion interventions and the identification and dissemination of effective components of successful interventions. Especially the identification and understanding of the role of determinants of physical activity in improving physical activity behavior is important in the construction of successful physical activity promotion interventions (Baranowski, Anderson, & Carmack, 1998).

In a recent large multi-center intervention study ($n = 1{,}202$) the effectiveness of two physical activity promotion programs for people with a physical disability during and after their in- or outpatient rehabilitation was assessed. The first program was a personalized, tailored counseling sport stimulation program called "Rehabilitation & Sports" (R&S). The second personalized, tailored counseling program was called "Active after Rehabilitation" (AaR) and promoted physical activity behavior in general. The results of this intervention study showed that the combination of the R&S and AaR program successfully improved physical activity behavior nine weeks and one year after rehabilitation (van der Ploeg et al., 2006; van der Ploeg et al., 2007).

The reported improvement in physical activity behavior is believed to have been caused by improvements in determinants of physical activity, induced by the combined R&S and AaR interventions. The theoretical framework of this study, the "Physical Activity for people with a Disability model" (PAD model), covers the theoretical basis of the two interventions (van der Ploeg, van der Beek, van der woude, & van Mechelen, 2004). This model conceptualizes the possible relationship between physical activity, its determinants, and functioning in people with a disability. Physical activity is thought to be determined by an interaction of personal and environmental factors. The PAD model suggests that attitude, self-efficacy, a person's health condition, personal and environmental facilitators and barriers, and social influence determine a person's intentions and actual physical activity participation. The stages of behavioral change concept of the Transtheoretical model (Prochaska & DiClemente, 1983) is also integrated in the PAD model since for people with different intentions and behaviors, the determinants of physical activity play different roles. Hence, the stages of change concept could be a useful tool in intervention studies to target determinants of physical activity differently for people in different stages.

The PAD model conceptualizes the theoretical determinants of the intervention effect on physical activity behavior. However, which variables were actual determinants of the intervention effect on physical activity behavior has yet to be shown. Knowledge about determinants in physical activity promotion interventions can be helpful in the design of new interventions, as well as in the improvement of existing interventions, such as R&S + AaR. Consequently, the objective of this study is to study the underlying mechanisms of the combined R&S + AaR intervention by identifying determinants through which the intervention improved physical activity behavior at nine weeks and one year after rehabilitation.

Methods

Study Subjects

All in- or outpatients over 18 years of age from 10 Dutch rehabilitation centers were candidates for inclusion in the study if they had one of the following diagnoses: amputation, stroke, neurological disorders, orthopedic disorders, spinal cord injury, rheumatic-related disorders, back disorders, or whiplash. Subjects were excluded if one of the following criteria were met: (1) insufficient cognitive abilities to participate, (2) medical contraindications for participating, (3) terminal or very progressive disease, (4) insufficient understanding of the Dutch language, (5) no interest at all in sport participation. Written informed consent was obtained by a research assistant from 1,202 subjects. In January 2001, the study was approved by the Medical Ethics Committee of Rehabilitation Center Het Roessingh in Enschede, the Netherlands.

Study Design

This study included four intervention rehabilitation centers in which the R&S program already existed and six control rehabilitation centers. Subjects in the control centers received usual care. Subjects in the intervention centers were randomly assigned to the R&S program only, or to both the R&S and AaR intervention programs. However, since the R&S intervention alone was shown to be ineffective (van der Ploeg et al., 2006; van der Ploeg et al., 2007), the current analysis contains only data from the subjects that have received both the R&S and AaR intervention programs and from the control group.

Interventions

The R&S program aimed at improving sport participation after rehabilitation. The program consisted of a 30-min personalized, tailored counseling session with a sport counselor six weeks before the end of rehabilitation and a 10-min telephone check-up six weeks after rehabilitation. Recommended sports were usually non-competitive and most commonly consisted of swimming activities, exercising at a fitness center, or exercising in a diagnosis-specific group.

The AaR program aimed at improving physical activity behavior in general after rehabilitation and used the stages of change concept of the Transtheoretical model (Prochaska & DiClemente, 1983). Subjects

received a 40-min personalized tailored counseling session from a physical activity counselor six weeks before the end of rehabilitation and three 20-min counseling sessions by telephone at two, five, and eight weeks after the end of rehabilitation. The sessions were supported by stage of physical activity change-specific folder material. The program focused on identifying physical activity possibilities, integrating facilitators, overcoming barriers, and using strategies to become more physically active, such as goal setting and rewarding. Both interventions are described in more detail elsewhere (van der Ploeg et al., 2006).

Data Collection and Outcome Assessment

Data collection took place from March 2001 until December 2004. Questionnaires were administered under the supervision of a research assistant at the rehabilitation center seven weeks before the end of rehabilitation ($T = 0$), and at home nine weeks ($T = 1$) and one year after rehabilitation ($T = 2$). At baseline, personal characteristics were assessed using questionnaires. Body mass index was calculated from self-reported body height and body weight. Duration of treatment and hours of sport-related physical activities during treatment were obtained from the computerized registration system of each rehabilitation center at $T = 1$.

At all three measurements, physical activity behavior was assessed with the 7-day recall Physical Activity Scale for Individuals with Physical Disabilities (PASIPD; Washburn, Zhu, McAuley, Frogley, & Figoni, 2002). This 12-item questionnaire (Cronbach $\alpha = 0.6$) identifies leisure time, household, and work-related physical activities. If only one of the items of the PASIPD was missing for a subject, imputation was performed using the most conservative value (least physically active option) of the missing item to calculate a total physical activity score ($T = 0$, $T = 1$, and $T = 2$ had 22, 59, and 35 imputations, respectively).

The following determinants of physical activity were measured at $T = 0$, $T = 1$, and $T = 2$ using questionnaires: attitude (1 item) towards physical activity behavior (Biddle, Goudas, & Page, 1994), self-efficacy (5 items, Cronbach $\alpha = 0.82$) towards physical activity behavior (Marcus, Selby, Niaura, & Rossi, 1992), and social influence from family (1 item) and friends (1 item) concerning physical activity behavior (Biddle et al., 1994). In addition, seven important barriers to physical activity and six perceived benefits were selected from a questionnaire of Sallis, Calfas, Alcaraz, Gehrman, & Johnson (1999). These barriers were lack of money, lack of time, lack of energy, lack of motivation, limited possibilities in the person's environment, transportation problems, and the person's health conditions. The perceived benefits of regular physical activity were improved health and reduced risk of disease, better feeling about oneself, improved fitness, improved daily functioning, weight loss, and meeting new people. All determinants were scored on a 1–5 Likert-type scale, except self-efficacy (0–10 scale).

Statistical Analyses

Data analysis was performed in March and April 2005 according to a pre-established analysis plan. The $T = 1$ and $T = 2$ data were analyzed separately using multilevel analysis (Goldstein, 1995; Twisk, 2003) performed with the MLwiN statistical computer program (version 1.1, Institute of Education, London, UK). Since more standard techniques for mediation analysis are not possible for multilevel analysis, an alternative approach was used. This approach is based on a technique to define confounders in regression analysis, but instead of looking for confounders, theoretical determinants of the intervention effect were tested. The approach worked with a basic model that was used in the earlier analysis that assessed the effect of the combination of both interventions on the PASIPD score (van der Ploeg et al., 2006; van der Ploeg et al., 2007).

$$T1\text{PASIPD} = \text{intercept} + T0\text{PASIPD} + \text{intervention} + \text{confounders} \quad (1)$$

The basic model for $T = 1$ is schematically shown in Equation 1, and the model for $T = 2$ was similar. The basic model corrects for the following confounders: time between baseline and end of rehabilitation, diagnosis, rehabilitation form, and level of education. The basic model also corrects for the rehabilitation center level, which was the multilevel component of the analyses. Furthermore, the basic model of $T = 1$ also corrected for duration of treatment and age, while the $T = 2$ basic model corrected for hours participating in sport related physical activities during treatment.

The actual analysis adds the values on $T = 0$ and $T = 1$ (or $T = 2$) for a single determinant to the basic model (see Equation 2). In order to look at the intervention induced *change* in a determinant, both the baseline and follow-up value of that determinant were added to the basic model.

$$T1\text{PASIPD} = \text{intercept} + T0\ \text{PASIPD} + \text{intervention} + \text{confounders} + T0\text{determinant} + T1\text{determinant} \quad (2)$$

The percentage change in the intervention regression coefficient that was caused by adding a determinant to the basic model was recorded for each determinant of physical activity. By correcting the basic model for each determinant separately, the role of this

determinant in the underlying mechanism of the interventions could be assessed. Variables that reduced the intervention regression coefficient by at least 10% were considered as determinants of the R&S + AaR intervention-induced improvement in physical activity behavior (Twisk, 2006). In order to assess the direction of the relationship between each determinant and the PASIPD score, the regression coefficients of the determinant were studied. After adding all determinants separately to the basic model, the six strongest determinants were added simultaneous to the basic model to see how much of the intervention effect was linked to these determinants.

Only subjects in the intervention group who actually received the interventions (i.e., "on treatment") were analyzed. On treatment was defined as all subjects who had received at least the first two AaR sessions between baseline and the particular measurement. Furthermore, the time between the last intervention session and one-year follow-up had to be shorter and longer than 120 days for the $T = 1$ and $T = 2$ on treatment definitions, respectively.

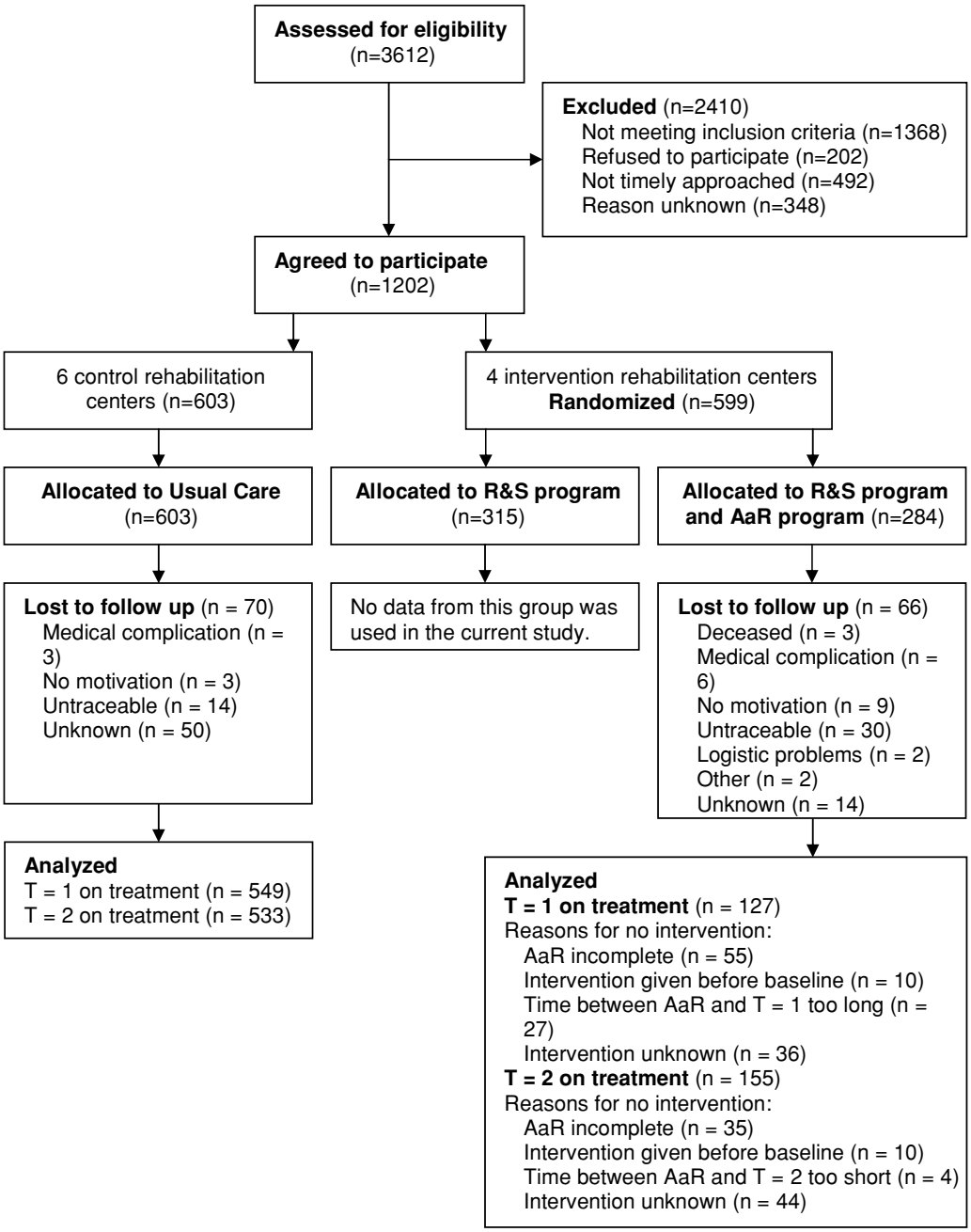

Figure 1. Flow of participants through the study.

Table 1. *Characteristics of the Subjects in Both Groups*

Characteristic	Control ($n = 566$)	R&S + AaR ($n = 165$)
Gender male, n (%)	290 (51)	79 (48)
Mean age ± SD, *y*	46 ± 14	46 ± 13
Mean body mass index ± SD, $kg \cdot m^{-2}$	25.8 ± 5.0	25.4 ± 4.2
Treatment form, *n*(%)		
Inpatient	15 (3)	34 (21)
Outpatient, first inpatient	139 (25)	44 (27)
Outpatient	408 (72)	85 (52)
Mean duration of treatment ± SD, *h*	90 ± 128	164 ± 185
Mean total time of sport–related activities during treatment ± SD, *h*	19 ± 24	42 ± 69
Mean time between baseline and end of rehabilitation ± SD, days	71 ± 71	111 ± 117
Education, *n*(%)		
Primary school	59 (11)	11 (7)
Secondary school low	234 (41)	53 (32)
Secondary school high/College low	160 (28)	65 (40)
College high/University	112 (20)	35 (21)
Diagnosis group, *n* (%)		
Amputation	28 (5)	16 (10)
Stroke	162 (29)	34 (21)
Neurological disorders	101 (18)	18 (11)
Orthopedic disorders	60 (11)	12 (7)
Spinal cord injury	18 (3)	15 (9)
Rheumatic-related disorders	42 (7)	23 (14)
Back disorders	90 (16)	16 (10)
Chronic pain/whiplash	60 (11)	30 (18)

Note: R&S = rehabilitation and sport intervention; AaR = active after rehabilitation intervention; SD = standard deviation.

Results

The flow of participants through the study is presented in Figure 1, including lost to follow-up and on treatment data. Table 1 shows the baseline personal characteristics of all analyzed subjects ($n = 731$). The characteristics show some differences between the intervention and control group in treatment form, duration of treatment, total time of sport related activities during treatment, time between baseline and end of rehabilitation, education, and diagnosis. The $T = 1$ or $T = 2$ basic models were corrected for these variables. The absolute uncorrected values of the determinants in the intervention and control group at all three measurements are presented in Table 2.

Table 3 shows at $T = 1$ and at $T = 2$ the percentage of change in the intervention regression coefficient caused by adding each determinant separately to the basic model. For example, the results mean that the effect at $T = 1$ of the R&S + AaR intervention on the PASIPD score was reduced by 14.8% due to the difference in self-efficacy scores between the intervention and control group at $T = 1$. This means that self-efficacy was a determinant of the intervention-induced improvement in physical activity behavior at $T = 1$. Table 3 shows that attitude, the barrier health conditions, and the perceived benefits of improved health and reduced risk of disease, feeling better about oneself, improved fitness, and improved daily functioning were the strongest determinants at $T = 1$. All six determinants were added simultaneously to the basic model, which resulted in a reduction of the intervention effect by 102.6% at $T = 1$. For the $T = 2$ analysis, the six strongest determinants (attitude, social influence from family, the barrier-limited environmental possibilities, and the perceived benefits improved health and reduced risk of disease, feeling better about oneself, as well as improved fitness) were added to the basic model, resulting in a reduction of 59.0% in the intervention effect.

The direction of the relation between each determinant and physical activity behavior was usually as had been expected. Higher scores for self-efficacy, attitude, social influence, and perceived benefits were associated with higher PASIPD scores. Furthermore, subjects who experienced a certain barrier more frequently had, on average, lower PASIPD scores.

Discussion

The results of this study showed that the earlier reported increase in physical activity behavior (van der Ploeg et al., 2006; van der Ploeg et al., 2007) can partly be explained by differences in determinants of physical activity between the intervention and control group that were induced by the combination of the R&S and AaR interventions. Several determinants were identified through which the intervention was effective, and these were similar to the theoretical determinants that were modeled in the conceptual framework of the study (the PAD model).

The intervention effects on physical activity behavior worked through improving attitude and four of the six perceived benefits of physical activity. This suggests that the intervention was especially effective on awareness of the importance of a physically active lifestyle. The intervention also seemed to have been effective through the other measured psychosocial determinants, i.e., self-efficacy and social influence. This shows that the strong cognitive behavioral component, with an emphasis on psychosocial determinants of physical activity in the R&S and AaR interventions, induced improvements in physical activity behavior.

The intervention was also able to reduce the three highest rated barriers to physical activity, i.e., health conditions, lack of energy, and limited environmental possibilities. The reduction of limited environmental possibilities as a barrier was probably caused by the suggested physical activity opportunities in the direct environment during the counseling sessions. The

Table 2. *Determinant Score (± SD) for the Intervention and Control Group at T = 0, T = 1, and T = 2*

	Control Mean ± SD			Intervention Mean ± SD		
Determinant	**T = 0**	**T = 1**	**T = 2**	**T = 0**	**T = 1**	**T = 2**
Self-efficacy	5.3 ± 1.9	5.0 ± 2.0	5.0 ± 2.1	5.4 ± 2.1	5.3 ± 2.1	5.3 ± 2.2
Attitude	4.3 ± 0.9	4.2 ± 0.9	4.1 ± 1.0	4.4 ± 0.8	4.4 ± 0.7	4.4 ± 0.8
Social influence family	4.3 ± 0.9	4.2 ± 1.0	4.1 ± 1.0	4.4 ± 0.8	4.4 ± 0.8	4.4 ± 0.9
Social influence friends	4.2 ± 0.9	4.1 ± 0.9	4.0 ± 1.1	4.4 ± 0.8	4.3 ± 0.8	4.2 ± 0.9
Perceived benefits						
Improved health, reduced risk of disease	3.8 ± 1.1	3.6 ± 1.1	3.5 ± 1.2	3.8 ± 1.1	3.9 ± 1.1	3.8 ± 1.1
Better feeling about oneself	4.1 ± 0.9	4.0 ± 0.9	3.8 ± 1.0	4.2 ± 0.9	4.2 ± 0.7	4.1 ± 0.9
Improved fitness	4.2 ± 0.9	4.0 ± 0.9	3.8 ± 1.0	4.2 ± 0.9	4.2 ± 0.7	4.1 ± 0.9
Improved daily functioning	3.9 ± 0.9	3.7 ± 1.0	3.6 ± 1.0	4.1 ± 0.8	4.0 ± 0.8	3.8 ± 1.0
Weight loss	3.3 ± 1.2	3.3 ± 1.1	3.3 ± 1.2	3.3 ± 1.2	3.4 ± 1.1	3.2 ± 1.2
Meeting new people	3.5 ± 1.1	3.5 ± 1.0	3.5 ± 1.0	3.8 ± 1.0	3.6 ± 1.0	3.6 ± 1.0
Barriers						
Health conditions	3.7 ± 1.1	3.5 ± 1.1	3.5 ± 1.2	3.7 ± 1.0	3.5 ± 1.1	3.5 ± 1.0
Limited environmental possibilities	2.5 ± 1.2	2.4 ± 1.2	2.5 ± 1.3	2.6 ± 1.2	2.3 ± 1.2	2.5 ± 1.2
Lack of time	2.2 ± 1.0	2.2 ± 1.0	2.2 ± 1.0	2.2 ± 1.0	2.2 ± 0.9	2.3 ± 0.9
Lack of motivation	2.2 ± 1.0	2.3 ± 1.0	2.4 ± 1.0	2.2 ± 1.0	2.2 ± 0.9	2.3 ± 0.9
Lack of money	1.7 ± 1.0	1.9 ± 1.1	2.0 ± 1.1	1.9 ± 1.1	2.0 ± 1.2	2.2 ± 1.2
Lack of energy	3.0 ± 1.2	3.0 ± 1.2	3.1 ± 1.2	3.1 ± 1.2	3.0 ± 1.1	3.1 ± 1.0
Transportation problems	2.0 ± 1.2	1.9 ± 1.2	1.8 ± 1.1	2.0 ± 1.3	2.0 ± 1.2	1.9 ± 1.2

Note: $T = 0$ = measurement at seven weeks before the end of rehabilitation; $T = 1$ = measurement at nine weeks after rehabilitation; $T = 2$ = measurement at one year after rehabilitation; SD = standard deviation.

barriers, health conditions and lack of energy, were probably reduced because the physical activity advice was based on the person's possibilities, including these two barriers. However, these two barriers were only important determinants on the short and not the long term. This could be due to a reduction in these barriers on the longer term in the control group, caused by improved overall health over time. This would imply that these two barriers were reduced at an earlier stage in the intervention group, but that the control group caught up over time.

Table 3. *Change in the Intervention Regression Coefficient by Adding a Determinant at T = 1 and T = 2*

Determinant	**T = 1 % Change**	**T = 2 % Change**
Self-efficacy	–14.8	–2.6
Attitude	–29.6	–11.3
Social influence family	–8.6	–11.3
Social influence friends	–5.8	–10.2
Perceived benefits of physical activity		
Improved health, reduced risk of disease	–35.3	–28.4
Better feeling about oneself	–18.0	–13.4
Improved fitness	–24.7	–14.3
Improved daily functioning	–26.1	–9.4
Weight loss	2.3	2.3
Meeting new people	–2.6	4.6
Barriers to physical activity		
Health conditions	–47.0	4.4
Limited environmental possibilities	–16.3	–26.0
Lack of time	–8.8	–7.3
Lack of motivation	–4.5	–1.8
Lack of money	29.6	7.5
Lack of energy	–13.5	12.1
Transportation problems	11.2	2.1

Note: $T = 1$ = measurement at nine weeks after rehabilitation; $T = 2$ = measurement at one year after rehabilitation.

Unexpectedly, corrections of the basic model for lack of money and lack of transportation increased the intervention effect at $T = 1$. Since more lack of money was associated with a higher physical activity score, it could be that the more active subjects had actual physical activity costs, but these costs did not prevent them from being physically active even though the costs were perceived as a barrier. It seems that while trying to become more physically active, transportation to a physical activity location also became a problem for more people. In contrast to a lack of money, these transportation problems actually hindered people to become more physically active. Fortunately, transportation was seldom perceived as a barrier to physical activity (average score was only around 2.0 on the 5-point scale), and the interventions did not have a negative effect on transportation at the long-term follow-up measurement.

Literature Perspective

Most of the assessed determinants of physical activity have been documented repeatedly to be associated

with physical activity in the general population (Trost, Owen, Bauman, Sallis, & Brown, 2002). In the population of people with a disability, much less is known about the determinants of physical activity. However, the few available studies suggest that identified determinants are important determinants of physical activity behavior in people with physical disabilities (Rimmer, Rubin, & Braddock, 2000; Finch Owen, & Price, 2001; Kinne, Patrick, & Maher, 1999; Rimmer, Riley, Wang, Rauworth, & Jurkowski, 2004). No studies were found on working mechanisms of effective physical activity promotion interventions in people with physical disabilities.

The results of the current study are somewhat surprising when compared to physical activity interventions in other populations. The literature shows mixed evidence for the effectiveness of cognitive behavioral exercise interventions in the general population (Sallis, 1998), as well as for stages of physical activity change-based interventions in the primary care setting (van Sluijs, van Poppel, & van Mechelen, 2004). However, the R&S + AaR intervention had a strong cognitive behavioral component, and especially the psychosocial factors associated with this component were identified as determinants. Furthermore, the stages of physical activity change concept was thought to be a useful tool in the R&S + AaR intervention, providing some structure to the personalized, tailored counseling. It seems likely that the effectiveness of these components was linked to the difference in setting and population compared to the above-mentioned studies.

It has been suggested that cognitive behavioral interventions in the healthy population should be combined with environmental interventions to be more effective in improving physical activity behavior (Sallis, Bauman, & Pratt, 1998; Kerr, Eves, & Carroll, 2003). Although the current intervention had an environmental component, there seems to be room for improvement with respect to this component. The interventions mostly helped the subjects to cope with the existing environmental barriers rather than improve the environment with respect to factors, such as possibilities and transportation. Lack of sufficient environmental possibilities and transportation could be issues that need more attention, especially from policymakers (Sallis and Owen, 1999; Sallis et al., 1998; Kerr et al., 2003).

Limitations

Interpretation of the analyses has some limitations. The combined analysis on the $T = 1$ data showed a reduction of the intervention effect of more than 100%, which was possible because determinants that had an association opposite to the intervention effect were not added. Due to the use of self-report questionnaires, these percentages are also subject to possible information bias (e.g., recall bias). Furthermore, the cut-off value of 10% to identify determinants of the intervention effect should be interpreted with care, because determinants just below the cut-off value might be just as important as those just above it.

Another limitation in the interpretation of the results is that the intervention effects at $T = 1$ and $T = 2$ were non-significant ($p = 0.16$) and borderline significant ($p = 0.05$), respectively. However, the effect sizes at both time moments were substantial enough to be considered as clinically relevant. Nevertheless, the non-significant intervention effect could have led to an overestimation of the role of the determinants at $T = 1$. However, the same analysis at $T = 1$ for the other (and significant) physical activity outcome (i.e., whether or not participants were moderately physically active at least five days a week for 30 min per day) showed similar but lower results. These similar results suggest that the non-significant intervention effect on the PASIPD at $T = 1$ did not lead to large misinterpretations in the current study. Since the other physical activity outcome was dichotomous, and hence not as sensitive to change in the determinants, the PASIPD was preferred as the primary outcome.

Finally, some of the determinants measured quite similar constructs. Social influence from family had a correlation higher than 0.8 with social influence from friends. Some perceived benefits showed correlations of 0.6–0.7 between them. These determinants have some overlap and the positive effects of these determinants on physical activity behavior do not add up cumulatively. This is illustrated by the reduction in the intervention effect by the six strongest determinants at $T = 1$ together (103%) compared to the reduction by the sum of the individual determinants (181%).

Conclusions

The current study gave some insights into the underlying mechanisms of the effective combination of the R&S and AaR interventions. The combined interventions improved several theoretical determinants of physical activity compared to the control group. Almost all psychosocial variables as well as several barriers to physical activity were identified as determinants of the intervention-induced improvements in physical activity behavior. This study suggests that personalized, tailored counseling interventions can improve physical activity behavior in people with a disability by targeting both personal and environmental determinants of physical activity behavior.

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