Medical Research Archives

European Society of Medicine

OPEN ACCESS

Published: August 31, 2023

Citation: Ricke E and Dijkstra A, 2023. Determinants of Exercise Adherence in a Prospective Cohort Study of Patients with Chronic Obstructive Pulmonary Disease: An Application of the Theory of Planned Behavior and the Concept of Alliance, Medical Research Archives, [online] 11(8). https://doi.org/10.18103/mra.v11i8.4346

DOI
https://doi.org/10.18103/mra.v11i8.4346

ISSN: 2375-1924

RESEARCH ARTICLE

Determinants of Exercise Adherence in a Prospective Cohort Study of Patients with Chronic Obstructive Pulmonary Disease: An Application of the Theory of Planned Behavior and the Concept of Alliance

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ABSTRACT

Introduction: Pulmonary rehabilitation is considered an important method of improving health-related quality of life in patients with chronic obstructive pulmonary disease. A critical component to the success of pulmonary rehabilitation is exercise adherence, which is often lower than 50%. When there is a better understanding on the psychological determinants of adherence, theory-informed interventions can be developed to improve adherence. Therefore, the aim of this study was to examine the utility of the Theory of Planned Behavior in combination with the therapeutic alliance in explaining exercise adherence in a prospective cohort study of pulmonary rehabilitation in patients with chronic obstructive pulmonary disease to ultimately increase adherence with psychological interventions. In addition, we examined the influence of the Theory of Planned Behavior determinants and alliance in combination with clinical determinants on adherence.

Methods: At baseline, 196 patients from 53 physiotherapy practices in the Netherlands and Belgium completed measures of the Theory of Planned Behavior, and disease and demographic characteristics. After three months they completed measures of alliance. Their physiotherapist provided exercise adherence measures after 12 months. Data were analyzed using Spearman's correlations, hierarchical linear multiple regression analyses and mediation analysis.

Results: Hierarchical linear multiple regression analyses indicated that intention ($\beta = 0.72$; $p < 0.001$) and alliance ($\beta = 0.26$; $p < 0.001$) explained 24.8% of the variance in exercise adherence. After adding Medical Research Council dyspnea score and depression to the model, 35.6% of the variance could be explained. Perceived behavioral control, attitude, and alliance, explained 37.9% of variance in exercise intention. The effect of alliance on adherence was partially mediated by intention.

Conclusion: Extending the Theory of Planned Behavior with the concept of alliance is a promising innovation to understand exercise adherence of patients who are coached by a health care professional. Healthcare providers should obtain information about their patients' attitudes, perceived behavioral control, and alliance, to inform their coaching and further psychosocial interventions. Concrete recommendations are provided for effectively addressing these psychosocial determinants of adherence within the patient-coaching relationship.

Keywords: Exercise adherence, Chronic obstructive pulmonary disease, Theory of Planned Behavior, Alliance

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality worldwide with an economic and social burden that is both substantial and increasing. [1] Pulmonary rehabilitation (PR) aims to reduce the levels of morbidity, to improve functioning and quality of life of people living with COPD, and is currently an integral component of managing COPD. [2] A critical component to the success of PR is achieving high levels of exercise adherence (i.e., the extent to which patients follow the prescribed treatment). Non-adherence to exercise therapy, often exceeding 50% in patients with chronic diseases, [3] is a problem which does not only affect the patient but also the healthcare system. [4] Before interventions can be developed and implemented to increase exercise adherence, it is necessary to understand the determinants of adherence to pulmonary rehabilitation in patients with COPD.

Previously, we developed a prediction model with the aim of determining who is adherent and who is non-adherent. [5] When there is a better understanding on the psychological determinants of adherence, theory-informed interventions can be developed to improve adherence. The purpose of the present study was to examine the psychological determinants of exercise adherence with data from the **P**redicting **A**dherence in pa**T**ients with **CH**ronic diseases (PATCH) study. [5] To guide our research, Ajzen's (1991) Theory of Planned Behavior (TPB) [6] was used, complemented with the concept of the therapeutic alliance.

Developments in health and social psychology have contributed to several models for explaining variations in health-related behaviors, which can be applied to exercise adherence. One of the most widely used models to search for psychological determinants of adherence behaviors in patients with a chronic disease, is the Theory of Planned Behavior (TPB). [7] The TPB supposes that a person's intention to perform a behavior is the major determinant of that behavior. [6] Furthermore, a person's intention is determined by three theoretically independent variables: a person's attitude, indicated by a positive or negative evaluation of performing the behavior; subjective norm, which refers to the perceived social pressure that a person may feel to perform or not to perform the behavior; and perceived behavioral control, which is the perceived ease or difficulty of performing the behavior. The TPB poses that people will intend to perform a behavior when they evaluate it positively (attitude), believe that important others think they should perform it (subjective norm), and perceive it to be under their control (perceived behavioral control). [6]

The TPB makes a useful contribution to understanding adherence in chronic illness, but focusing solely on the operationalizations of the Theory of Planned Behavior may be insufficient to predict exercise adherence in patients with COPD. Although studies showed that the TPB variables can predict exercise adherence, the explained variance in adherence is far from satisfying. [7-10] Therefore, to re-examine the potentially causal psychological determinants of exercise adherence in patients with COPD, the TPB was expanded with the concept and specific operationalization of the therapeutic alliance. [7] That is, patients in rehabilitation are regularly coached and under surveillance of healthcare professionals that influence patient adherence. They develop a relationship with their practitioner that can be perceived as an alliance, in the framework of rehabilitation and adherence. This important and complex cause of adherence, typical for rehabilitation, is insufficiently represented in the TPB. In paramedical professions, it is widely accepted that the treatment regimen alone cannot fully account for patient outcomes. [11] The relationship between patient and therapist, the therapeutic alliance, has been viewed as an important determinant of treatment outcome and is considered central to the therapeutic process. [12]

The construct of alliance in therapeutic situations refers to the sense of collaboration, warmth, and support between the patient and therapist. [12] In relation with TPB it has been shown that patients who experience a positive alliance experience higher self-efficacy (similar to perceived behavioral control), and stronger positive outcome expectations (similar to attitude). In turn, these two determinants are highly correlated with patient adherence to treatment. [13] Thus, therapeutic alliance may influence the three TPB-determinants (attitude, subjective norm and perceived behavioral control), which, in turn, may determine intention and adherence. However, because the therapeutic alliance is a powerful and complex phenomenon, it is expected that the common operationalizations of the TPB are insufficient to grasp its influence. Therefore, it is expected that the therapeutic alliance will determine adherence over and above the three TPB determinants. In addition, the clinical determinants depression and Medical Research Council (MRC) dyspnea score (clinical predictors of exercise adherence) as reported in the PATCH study[5] were included to gather knowledge on their role, and their benefit to explain adherence.

The aim of this study was to examine the utility of the Theory of Planned Behavior in combination with the therapeutic alliance in explaining exercise adherence in patients with chronic obstructive pulmonary disease. Insights in these determinants can provide useful information for the development and implementation of psychological interventions to improve exercise adherence rates. Based on the theory described above, we hypothesized that there is an indirect effect of alliance on adherence through intention. In addition, we examined the influence of the TPB determinants and alliance in combination with clinical determinants on adherence.

2. Methods

2.1 PARTICIPANTS

The methods of the PATCH study have been presented elsewhere. [5] Briefly, participants were 196 Dutch/Flemish-speaking COPD patients aged ≥18 years from primary physiotherapy practices, and from the COPD patient-organizations from the Netherlands and Belgium who: (1) had airflow limitation stage GOLD II–IV, (2) had rehabilitation sessions for at least once a month, and (3) had sufficient mastery of the Dutch/Flemish language to complete the questionnaires.

The study was approved by the Ethical Committee Psychology of the University of Groningen (PSY-1920-S-0504).

2.2 DESIGN AND PROCEDURES

Physiotherapy practices were approached by e-mail and social media for participation in this 12-month prospective cohort study, and patients were recruited by their attending physiotherapist. Patients were also recruited via the COPD patient-organization in the Netherlands and Belgium who, in turn, invited their physiotherapist for participation. After signing informed consent and inclusion, patients completed an online (Qualtrics) [14] or paper form on their demographic characteristics: age (years), gender (male/female), country (Netherlands/Belgium), education (low/ middle/ higher), moderate (MPA) and vigorous physical activity (VPA) (days per week), exercise history (yes/no), physiotherapy history (yes/no), smoking status (never smoked/quit smoking/still smoking), medication adherence (yes/no), and depression (4-16). The physiotherapist provided information on the characteristics of the disease of the patient: classification of severity of airflow limitation (GOLD classification) [15] (GOLD II/III/IV), degree of baseline functional disability due to dyspnea (MRC-score) (0/1/2/3/4/5), duration of COPD since diagnosis (years), and duration of physiotherapy (years).

Patients and physiotherapists provided information at baseline and 12 months after inclusion. Patients provided additional information three months after inclusion.

2.3 MEASURES

Exercise adherence

Exercise adherence was assessed by the Dutch version of the Rehabilitation Adherence Measure for Athletic Training (RAdMAT-NL). [16] The RAdMAT-NL is a 16-item questionnaire that uses a 4-point rating scale (never = 1, occasionally = 2, often = 3, always = 4) to evaluate clinic-based adherence. [16] The RAdMAT-NL consists of 2 subscales: Participation (items 1–5 and 9-16, range 13–52 points) and Communication (items 6–8, range 3–12 points). The total scale range is 16–64, a higher score indicates a higher degree of adherence. The RAdMAT-NL was completed at 12 months by the physiotherapist, independent of the patient and not in their presence.

Theory of Planned Behavior constructs

Theory of Planned Behavior constructs were assessed by the patient at baseline. The constructs were measured according to the questions from Ajzen. [6] The four intention items focused on goals and plans for exercise and uses a 5-point rating scale (totally disagree = 1, disagree = 2, do not disagree/do not agree = 3, agree = 4, totally agree = 5). The total scale range is 4–20, a higher score indicates a higher degree of intention. Attitude was measured using seven bipolar adjective scales (5-point rating scales) that asked about both instrumental (e.g., useful–useless, bad–good) and affective (e.g., enjoyable–unenjoyable, boring– interesting) attitude. The total scale range is 7–35, a higher score indicates a more positive attitude. Subjective norm was measured by three items that asked about approval and support for exercise and uses a 5-point rating scale (totally disagree = 1, disagree = 2, do not disagree/do not agree = 3, agree = 4, totally agree = 5). The total scale range is 3–15, a higher score indicates more social pressure. Perceived behavioral control was measured by three questions that asked about aspects of controllability and ease/difficulty and uses a 5-point rating scale. The total scale range is 3–15, a higher score indicates higher perceived behavioral control.

Alliance

Alliance was assessed after three months by the Working Alliance Inventory (WAI). [12] The patient-therapist relationship was measured with 12 questions rated on a 5-point scale (range 12–60) and a higher score indicated a higher level of alliance.

2.4 STATISTICAL ANALYSES

Data were analyzed using R version 4.0.3. Descriptive statistics were used to summarize the baseline demographic and disease characteristics of the patients. Variables were expressed in percentages or as the median with interquartile range (IQR). For the main analyses first, Spearman's correlations between each of the TPB determinants and alliance and exercise adherence were computed. Correlations of 0.10, 0.30, and 0.50 are considered small, medium, and large effect sizes, respectively. [17] Variables that had significant ($p < 0.05$) correlations with exercise adherence were retained for a hierarchical linear multiple regression analysis (HMRA). Second, HMRA were performed. Linear regression analysis produces explained variances (R^2) and regression coefficients (β). R^2 values of 0.02, 0.15, and 0.35 are considered small, medium, and large effect sizes, respectively. [17] β's are interpreted only relative to other β's in the regression equation and can be considered on a ratio level scale. HMRA were conducted using stepwise regression within theoretically based blocks of variables. The order and the content of the steps were based on previous research using TPB in the exercise context and the tenets of TPB. [18] For each analysis, the order of the blocks was as follows: (1) Theory of Planned Behavior constructs (attitude, subjective norm and perceived behavioral control), (2) Alliance, and (3) Intention. If any block of variables did not contain a significant univariate predictor, that block was skipped for that particular HMRA. The validity of the TPB lies in its ability to predict behavior through intention. [6] By examining the relationship between these constructs separately, the strength of the intention-behavior link can be assessed, and the accuracy of the TPB model in different contexts can be evaluated. So, third, to determine the influence of the TPB constructs and alliance on exercise intention, exercise intention was regressed onto attitude, subjective norm, perceived behavioral control, and alliance. Then, mediation analysis was used to test if there was an indirect effect of alliance on adherence by intention.

Finally, an HMRA was performed adding depression and MRC dyspnea score as the clinical determinants to the model.

Table 1 Patient demographic and disease characteristics (n = 196)

Demographic data	
Male gender (%)	51.5
Median age in years (IQR)	68.1 (64.0-73.0)
Resident of the Netherlands (%)	58.7
Education (%)[a]	
- Low	21.4
- Middle	53.1
- Higher	25.5
Smoking status (%)	
- Never smoked	1.5
- Quit smoking	84.7
- Still smoking	13.8
Adherent to medication (%)	88.8
Median depression (IQR)	6.0 (4.0-8.0)
Disease characteristic data	
GOLD classification (%)[b]	
- GOLD II	27.6
- GOLD III	36.2
- GOLD IV	36.2
MRC-score (%)[c]	
- 0	0.5
- 1	5.1
- 2	18.4
- 3	36.7
- 4	27.0
- 5	12.3
Median time in years since diagnose (IQR)	10.5 (5.0-14.0)

***Notes*: a)** Low = elementary education, Middle = secondary education, High = university of applied sciences or research university **b)** GOLD: Global Initiative for Chronic Obstructive Lung Disease. The GOLD guidelines classify patients into four different categories: GOLD I (mild), GOLD II (moderate), GOLD III (severe), or GOLD IV (very severe) based on their level of airflow limitation[15] **c)** MRC-score: Medical Research Council dyspnea scale as a measure of disability in patients with chronic obstructive pulmonary disease: 0 = I do not suffer from breathlessness, 5 = I am too breathless to leave the house, or I am too breathless when dressing or undressing[19]

Abbreviation: IQR = interquartile range

Table 2 Determinants of the Theory of Planned Behavior, alliance, and exercise adherence (n = 196)

Planned behavior (at baseline)	
Median intention (IQR)	16.0 (14.0-17.0)
Median perceived behavioral control (IQR)	11.0 (9.0-11.3)
Median attitude (IQR)	26.0 (20.0-30.0)
Median subjective norm (IQR)	10.0 (8.0-11.0)
Alliance (after 3 months)	
Median alliance (IQR)	47.0 (39.8-50.0)
Exercise adherence (after 12 months)	
Median adherence (IQR)	53.0 (48.8-57.0)

Abbreviation: IQR = interquartile range

3. Results

Table 1 summarizes the demographic and disease characteristics of the patients. Table 2 presents the baseline TPB determinants, alliance after three months and exercise adherence after twelve months.

3.1 EXERCISE ADHERENCE

The median score on the RAdMAT-NL was 53.0 with an IQR van 48.8 to 57.0. According to the American College of Sports Medicine guidelines, a score of at least 85% must be achieved to be adherent to the rehabilitation program. [20] This means, a minimum total score of 54 or higher must be achieved on the RAdMAT-NL to be adherent. Dichotomizing the scores at this cut-off point, showed that 57.1% (112/196) of patients in this cohort were non-adherent.

3.2 PREDICTORS OF EXERCISE ADHERENCE

Significant moderate to large correlations were found between exercise adherence and intention, perceived behavioral control, attitude, and alliance (Table 3).

Table 3 Spearman's correlations with exercise adherence

Predictor	***r***	***p***
Intention	0.43	< 0.001
Perceived behavioral control	0.36	< 0.001
Subjective norm	0.01	0.55
Attitude	0.23	< 0.001
Alliance	0.37	< 0.001

Note: Strength of correlations: 0.10-0.29 = small, 0.30-0.49 = medium and 0.50-1.0 = large

These four significant variables were examined in the stepwise HMRA. With perceived behavioral control and attitude in the model, only perceived behavioral control predicted adherence (R^2 = 11.4%). After entering alliance in the next step, perceived behavioral control and alliance predicted adherence (R^2 = 21.9%). In step 3 after entering intention, only intention and alliance Predicted adherence (R^2 = 25.8%).

Two variables entered the final model, intention and alliance, and explained 24.8% (medium effect) of variance in exercise adherence (Table 4). Independent predictors of exercise adherence in the final model were: intention (β = 0.72; p < 0.001) and alliance (β = 0.26; p < 0.001).

Table 4 Hierarchical stepwise regression of exercise adherence on selected Theory of Planned Behavior variables and alliance (n = 196)

Step	**Predictor**	**R^2**	**F**	**df**	**β_1**	**β_2**
1.	Intention	0.169	39.34	194	0.956*	0.723*
2.	Alliance	0.248	31.88	193		0.258*

Note: Explained variance (R^2): 0.02-0.14 = small, 0.15-0.34 = medium and 0.35-1.0 = large effect

*p < 0.001; df = degrees of freedom; β_1-β_2 = regression coefficients for model 1 and model 2

3.3 PREDICTORS OF INTENTION

Significant moderate to large correlations were found between exercise intention and perceived behavioral control, attitude and alliance. A significant small correlation was found between exercise intention and subjective norm (Table 5).

Table 5 Significant Spearman's correlations with exercise intention

Predictor	*r*	*p*
Perceived behavioral control	0.57	< 0.001
Attitude	0.42	< 0.001
Subjective norm	0.13	0.01
Alliance	0.36	< 0.001

Note: Strength of correlations: 0.10-0.29 = small, 0.30-0.49 = medium and 0.50-1.0 = large

These four variables were examined in a stepwise HMRA, entered in the following blocks: (1) TPB variables (Perceived behavioral control, attitude, and subjective norm), and (2) Alliance. With perceived behavioral control, attitude and subjective norm in the model, only perceived behavioral control and attitude predicted exercise intention (R^2 = 34.5%). When adding alliance to the model, all three variables (perceived behavioral control, attitude, alliance) explained intention (R^2 = 37.9%). Three variables entered the final model, perceived behavioral control, attitude, and alliance, and explained 37.9% (large effect) of variance in exercise intention (Table 6).

Table 6 Hierarchical stepwise regression of exercise intention on selected Theory of Planned Behavior variables and alliance (n = 196)

Step	Predictors	R^2	F	df	β_1	β_2	β_3
1.	Perceived behavioral control	0.311	87.39	194	0.845*	0.720*	0.662*
2.	Attitude	0.334	48.45	193		0.095**	0.086**
3.	Alliance	0.379	38.99	192			-0.080*

Note: Explained variance (R^2): 0.02-0.14 = small, 0.15-0.34 = medium and 0.35-1.0 = large effect
*p < 0.001, **p = 0.01; df = degrees of freedom; β_1-β_3 = regression coefficients for model 1 to model 3

3.4 MEDIATION

Mediation analysis according to Hayes (2017) showed that the effect of alliance on adherence was partially mediated via intention. [21] As Figure 1 illustrates, the regression coefficient between alliance and adherence and the regression coefficient between intention and adherence were significant. The indirect effect was 0.23. We tested the significance of this indirect effect using bootstrapping procedures. Unstandardized indirect effects were computed for each of 1,000 bootstrapped samples, and the 95% confidence interval was computed by determining the indirect effects at the 2.5th and 97.5th percentiles. The bootstrapped unstandardized indirect effect was 0.23, and the 95% confidence interval ranged from 0.09 to 0.42. Thus, the indirect effect was statistically significant (p < 0.001).

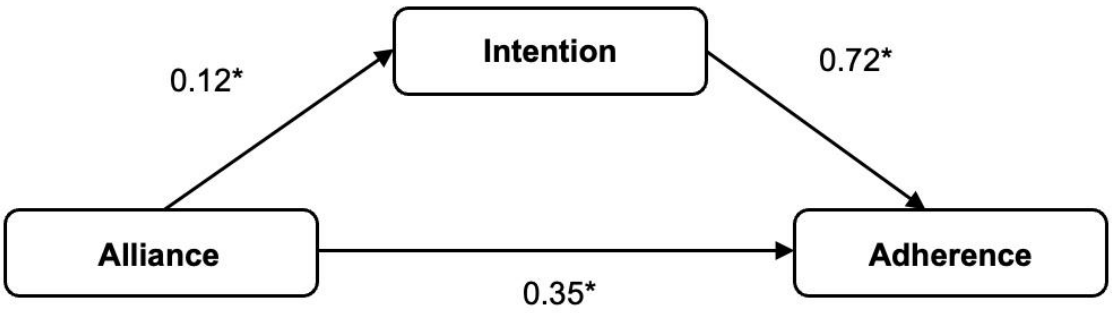

Figure 1 Mediation: an indirect effect of alliance on adherence by intention.
Note: *p < 0.001

3.5 TPB, ALLIANCE AND CLINICAL DETERMINANTS

Previously, the PATCH study showed significant moderate correlations between exercise adherence and MRC dyspnea score and depression. [5] These two variables were examined in the HMRA together with intention and alliance. All variables significantly explained adherence (R^2 = 35.6%) (large effect). Independent predictors of exercise adherence in this model were: MRC (β = -1.24; p = 0.001), intention (β = 0.63; p < 0.001), depression (β = -0.59; p < 0.001) and alliance (β = 0.21; p < 0.001). Despite the fact that the MRC dyspnea score largely determines the degree of exercise adherence, this model shows that intention and

alliance as psychological determinants have a significant influence on exercise adherence in addition to clinical determinants.

4. Discussion

We examined the determinants of the Theory of Planed Behavior and alliance from the PATCH study in relation to exercise adherence. Our results showed that the strongest predictors of exercise adherence were intention, and alliance, whereby the effect of alliance on adherence was partially mediated by intention. When the clinical determinants MRC dyspnea score and depression were added, the MRC dyspnea score largely predicted exercise adherence, however, intention and alliance remained as psychological determinants significant predictors of adherence. These results confirm our hypothesis that there is an indirect effect of alliance on adherence through intention, and that the Theory of Planned Behavior extended with the concept of alliance might be a useful theory for explaining exercise adherence in patients with chronic obstructive pulmonary disease.

More specifically, hierarchic regression analyses indicated that attitude, and perceived behavioral control, explained 34.5% of variance in exercise intention during pulmonary rehabilitation, with attitude, and perceived behavioral control each making significant unique contributions to intention. Subjective norm did not have a significant influence on exercise intention, which is consistent with general exercise literature, [22] and previous research in phase II cardiac rehabilitation. [23] The explained variance of 34.5% is slightly less than the explained variance in exercise intention of 41% found in the general literature. [24] This may be due to the fact that this cohort of patients has an average of ten years of COPD, and had been following PR for an extended period of time (70% of patients followed PR for $\geq$ 1 year). The TPB has demonstrated better predictions with shorter time intervals, indicating a possible reduced predictive power of the model with this long-term prediction, [7] although exercise adherence was constant over a 12-month period in this cohort of patients. [25]

Furthermore, exercise intention explained 16.9% of the variance in exercise adherence. This is less compared to the 22.5% explained variance in exercise adherence found in the general literature. [24] Also, perceived behavioral control did not add any additional variance in exercise adherence, as this has been found in the general literature. [24] This is in accordance with results found in phase II cardiac rehabilitation. [23] The data suggest that perceived behavioral control was related to the initial development of the intention, but not anymore to the actual execution of the behavior in these patients who already engage in the behavior for a longer time. Finally, alliance made a significant unique contribution to explaining exercise adherence scores and to exercise intention. Adding the concept of alliance to the TPB further increased the explained variance in adherence up to 24.8%, which is consistent with the study by Hagger et al. [10] They indicated in their study that an extended TPB model can better explain exercise behavior (explained variance of 46%) than the TPB alone (explained variance of 27%).[10] That alliance in particular is an important predictor of adherence, is consistent with other studies. Bennett et al. (2011) previously demonstrated the importance of alliance in their study of patients with lupus[26]; they showed that alliance is a significant predictor of adherence to treatment. Ratanawongsa et al. (2012) demonstrated that the percentage of non-adherent patients was lower when they were involved in the treatment decision and had a trusting relationship with their doctor. [27] A recent qualitative study in people with type 2 diabetes showed that gaining patients' trust, effective patient-provider communication, patient-centered decision-making, and ensuring continuity of care improved both insulin acceptance and adherence. [28]

These results may indicate that TPB needs to be operationalized differently in behaviors that are under close surveillance and coaching by professionals, rather than under the individuals' control only. Adding the construct of alliance to the TPB model seems to do justice to this.

4.1 STRENGTHS AND LIMITATIONS

The results of this study should be interpreted in relation to the strengths and limitations of this study. The main strength is the use of a 12-month prospective cohort study, to test the potential causes of later behavior. The psychological determinants predicted behavior after twelve months, over and above all kinds of external influences that may have influenced patient's adherence during that interval. This suggests that the assessed determinants can be reliably assessed and are stable in this type of patients. One limitation concerns the operationalizations that were used: although the typical TPB format of questions was generally applied in our measures, the scales were brief and possibly not assessing all relevant aspects of the TPB determinants in this particular sample of patients. Further research is needed that includes patients who are just diagnosed with COPD or just started pulmonary rehabilitation, and more elaborate measures might be developed to further explore the determinants.

Nonetheless, the findings of these analyses suggest that healthcare providers should obtain information about their patients' attitudes, perceived behavioral control, and alliance, when their patients with COPD are following PR. In doing so, they can target the specific psychological factors to monitor and increase their patients' exercise intention and exercise adherence during PR. Since the TPB constructs on their own had limited value in predicting exercise adherence, interventions based on the additional construct alliance must be considered to influence exercise adherence.

4.2 IMPLICATIONS

Depending on the measures of behavior, the percentage of explained variance in our study ranged between 24.8% (psychological determinants only) and 35.6% (psychological and clinical determinants). To improve exercise adherence scores and health outcomes in patients, psychosocial interventions must take place simultaneously with the biomedical treatment to improve treatment results. Psychosocial determinants on which interventions may focus:

Attitude: Attitude refers to the positive or negative feelings, beliefs, and evaluations that an individual holds toward performing a particular behavior, here exercise adherence. It encompasses their thoughts, emotions, and judgments regarding the behavior, here exercise adherence, and its potential outcomes. The attitude is the core of patient's motivation and in adherence it is based on the belief that adhering to the prescriptions will lead to actual positive effects, such as less severe physical complaints, a better physical stamina, and possibly caused by this the maintenance of social participation and increased self-esteem. Professionals can influence the patients' attitude by providing the patient with information on the positive effects of adequate adherence, and by exploring the idiosyncratic positive effects the patient might experience or actual experiences. In thoughtful and respectful coaching, the professional can summarize, repeat and reinforce the totality of expected positive effects of adherence. Designing and interpreting positive experiences for the patient using simple exercises (that are part of the prescription) can contribute to attitude change by providing firsthand evidence of the benefits or positive outcomes. [29]

Perceived behavioral control: Perceived behavioral control refers to an individual's perception of the ease or difficulty of performing a behavior and their perceived level of control over it. It reflects their beliefs about whether they have the necessary resources, skills, and opportunities to engage in the behavior successfully. [6] Patients will only spend effort to engage in adequate adherence on the longer term when they belief that they do it in the correct way, and are able to maintain the behavior on the longer term, despite different barriers, for example, muscle pain, fear of dyspnea, a busy schedule or fatigue. Providing understandable information on the specific exercises, and coached practicing can help patients to build confidence and flexible control over adherence. Furthermore, guiding patients in creating a supportive physical and social environment, and gradual goal setting (break down the behavior into smaller, achievable steps or goals) [29] may help patients to develop complete control over their prescribed exercises.

Alliance: The construct of alliance, the patient-therapist relationship, in therapeutic situations refers to the sense of collaboration, warmth, and support between the patient and therapist. [12] An impaired patient-therapist relationship may arise from e.g., when patients feel unheard, disrespected, or otherwise out of partnership with their healthcare provider. [30] Alliance has a direct impact on patient satisfaction; "the degree to which the individual regards the healthcare service or product or the manner in which it is delivered by the provider as useful, effective, or beneficial". [31] There are four elements that form alliance, and the nature of this alliance has an impact on patient satisfaction and thus on exercise adherence; trust, knowledge, regard, and loyalty. [31] Patients who trust and "like" their healthcare provider have higher levels of satisfaction. When healthcare providers have knowledge about patients concerns and address patients' expectations, patient satisfaction increases as it does when healthcare providers allow patients to give information. Healthcare providers' friendliness, warmth, emotional support, and caring (regard) are associated with patient satisfaction. Patients feel more satisfied when healthcare providers offer continued support (loyalty); continuity of care improves patient satisfaction. [31]

Conclusion

Overall, it can be concluded that the TPB with the additional construct of alliance has satisfactory power to explain exercise adherence during pulmonary rehabilitation. This extended TPB model provides a promising psychological theoretical framework for understanding exercise adherence during PR in patients with COPD. Findings of this study suggest that healthcare providers should obtain information about their patients' attitudes, perceived behavioral control, and alliance, to adequately coach the patients. To improve exercise adherence and health outcomes in patients,

psychosocial coaching or more intensive psychosocial interventions must take place simultaneously with the biomedical treatment to improve treatment results.

Conflicts of Interest Statement

The authors have no conflicts of interest to declare.

Funding Statement

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Acknowledgements

The authors wish to acknowledge the contributions of the patients and physiotherapists involved in this study. Working Alliance Inventory used and reprinted by permission of the Society for Psychotherapy Research © 2016.

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