RESEARCH ARTICLE

Exercise Adherence in Chronic Obstructive Pulmonary Disease: Review of Current Evidence from the Netherlands

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ABSTRACT

Chronic obstructive pulmonary disease is one highly prevalent chronic disease that demands increasing care; it is already the third leading cause of death worldwide. There is accumulating evidence that in patients with chronic obstructive pulmonary disease pulmonary rehabilitation is effective in improving the prognostic risk factor profile and in delaying mortality. In order to benefit from pulmonary rehabilitation, exercise adherence plays a crucial role. The present review discusses the current evidence on exercise adherence in chronic obstructive pulmonary disease and provides practical tips for assessing and adopting strategies to improve adherence in the Dutch context.

Studies from the Netherlands identify varying rates of exercise adherence depending on the complexity of the disease, such as comorbidities, and its treatment. Multiple factors determine exercise adherence in chronic obstructive pulmonary disease. In the Netherlands, factors such as perceived behavioral control, self-efficacy, exercise history, motivation, education, physical health, comorbidities, depressive symptoms and fatigue determine exercise adherence.

The Dutch version of the Rehabilitation Adherence Measure for Athletic training and a prediction model, the Predicting Adherence in paTients with CHronic diseases tool, can be used to identify poor adherence. Improving exercise adherence requires a multifaceted approach with strategies targeting healthcare providers, patients and healthcare systems. In the Dutch context, raising awareness of the patient's context, emphasizing the importance of the patient-therapist relationship, providing clearer information, and enhancing social support within the patient's environment are essential for improving exercise adherence and chronic obstructive pulmonary disease control.

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] The prevalence of COPD increased by almost 40% between 1990 and 2017, and by 2017, COPD had become the third leading cause of death globally. [2] In the European Union, the total costs of respiratory disease are estimated to be about 6% of the total annual healthcare budget, with COPD accounting for 56% (38.6 billion euros). [3] COPD prevalence, morbidity, and mortality vary across countries. [4]

Based on demographic trends, the absolute number of patients with COPD is expected to increase by 31% between 2015 and 2040 in the Netherlands. [5] COPD is associated with an increase in disability-adjusted life years and years of life lost across the life course, and with substantial social and economic consequences for both individual patients and health system. [2] Total healthcare costs for patients with COPD were 400 million euros in 2007 in the Netherlands, and will rise to nearly 1.4 billion euros in 2032, being more than three times what it was in 2007 (including a growth in healthcare spending of 2.3% per year). [6]

Pulmonary rehabilitation (PR) aims to reduce the levels of morbidity, improve functioning, and is currently an integral component of managing COPD. [7] PR is a cost-effective method for improving health-related quality of life in patients with COPD and is recommended in national guidelines. [8] Despite PR being cost- effective, increasing demand from an aging population and rising supply costs demand sustainable and affordable care. [9] In the medium term the cost of care is rising and a shortage of personnel is looming. [10] Due to the high number of consultations per patient per year (24.7), the cost of PR in primary care is relatively high: nearly 40 million euros in 2007. [6] To keep healthcare affordable and to make PR less labor-intensive, there is a need for more focus on self-management, without compromising the effectiveness of PR. [11]

Attention to self-management in patients with chronic diseases is becoming increasingly important to provide effective and efficient care. [12] Self-management programs in primary care may improve health behaviors, health outcomes, and quality of life and, in some cases, have demonstrated effectiveness for reducing healthcare utilization and the societal cost burden of chronic diseases. [13] Self-management can be defined as 'actions that individuals, families, and communities engage in to promote, maintain, or restore health

and cope with illness and disability, with or without the support of health professionals, and including but not limited to self-prevention, self-diagnosis, self-medication, and coping with illness and disability'. [14] This definition encompasses a range of self-management methods and approaches, one of the most important for self-management of chronic diseases being long-term adherence. [15] Long-term adherence in self-management can be conceptualized by three components: 1. Initiation: When the patient starts a lifestyle behavior change in accordance with his healthcare provider; 2. Implementation: The extent to which a patient's behavior corresponds with agreed recommendations from his healthcare provider; 3. Persistence: The time from initiation to discontinuation. [16] Non-adherence can occur in any of these phases, and may change over time in patients. So, appropriate attention should be paid to patients' level of adherence, as reduced adherence attenuates the benefits of the behavior change, and may negatively impact self-management and thus health outcomes. [15]

As adherence is one of the critical determinants of self-management and COPD control, measures must be adopted to enhance adherence. Given general unawareness and lack of COPD control, improving adherence is crucial in the Dutch context. This review discusses the current evidence on exercise adherence in COPD and provides practical tips for assessing and adopting strategies to improve adherence in the Dutch context.

2. Defining adherence

Adherence has been defined as follows: "the extent to which a person's behavior in therapeutic interventions, such as medication usage, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a healthcare provider". [17] Adherence is a complex, multi-dimensional construct encompassing patient-related, social/economic, therapy-related, condition-related and health system dimensions. [15] In pulmonary rehabilitation it can be indirectly observed through a collection of related events, including attendance at clinic appointments, the extent to which patients follow their prescribed treatment, their communication with their healthcare provider regarding their recovery, and providing feedback about their home-based healthcare activities (e.g., performance and frequency of the exercises). [1]
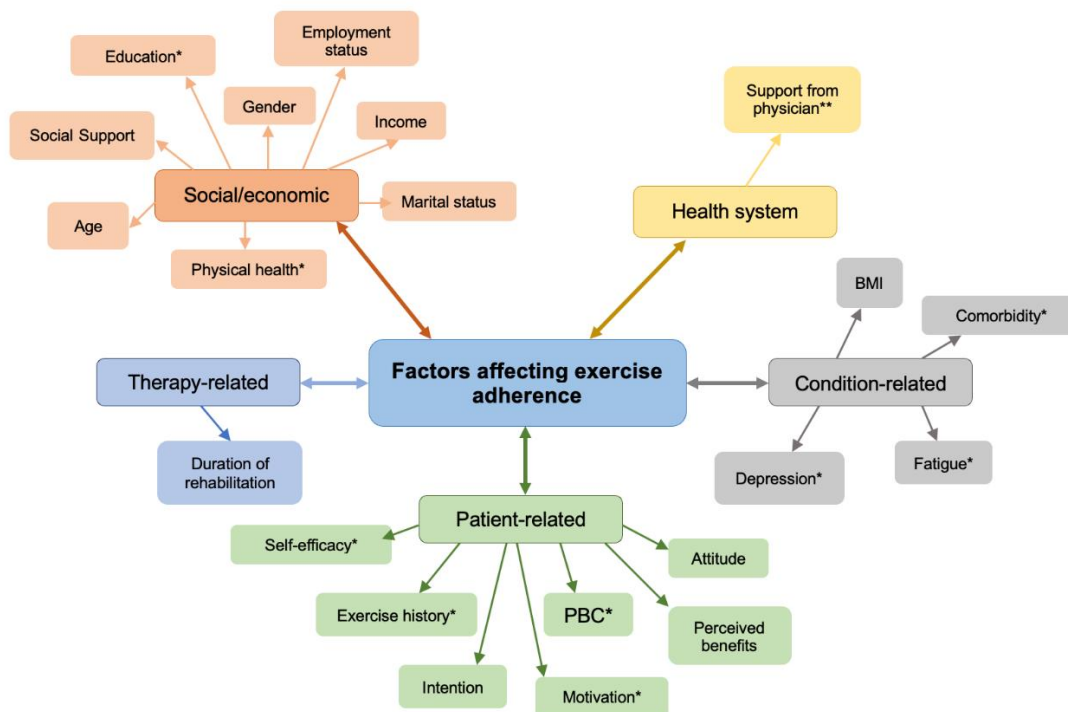
3. Factors affecting exercise adherence in COPD

Current evidence in the Netherlands shows variable

exercise adherence rates ranging from 50% to 75%.[12] The varying rates might be due to the complexity of the disease, such as comorbidities, and its treatment, but could also be due to methodological differences in defining and assessing adherence. [12] Thus, it is important to recognize that adherence is a complex phenomenon influenced by multiple factors. When interpreting reported rates, it is essential to consider the context and methodological details of the studies. Comparing rates between different studies can sometimes give a biased result due to this variability.

Numerous factors influence adherence in patients with COPD and, partly for this reason, there is great variability in reported measures of adherence. These factors encompass social/economic, healthcare team/system, therapy-related, condition-related, and patient-related factors (Figure 1). [19] More than one factor may be the reason for sub-optimal adherence. In Ricke et al.'s review (2023) high-quality evidence supported that higher exercise adherence was predicted by the patient-related prognostic factor perceived behavioral control. Moderate-quality evidence supported that higher exercise adherence was predicted by higher self-efficacy, having an exercise history and being motivated. Additionally, higher exercise adherence was predicted by the social/economic prognostic factors higher education (moderate-quality evidence) and better physical health (low-quality evidence). Condition-related prognostic factors, including fewer comorbidities (moderate-quality evidence), fewer depressive symptoms (low-quality evidence) and less fatigue (low-quality evidence), also predicted higher exercise adherence. When predicting exercise adherence, the most prognostic factors were found in the patient-related, social/economic, and condition-related domains. [19] Relatively little research has been conducted on the health-system factors and therapy-related factors of adherence. The common belief that patients are solely responsible for their treatment adherence is misleading and often reflects a misunderstanding of how other factors influence people's behavior and capacity to adhere to their treatment. [15] This holds true for the Dutch context as well. A recent study shows that the Theory of Planned Behavior, which consists only of patient-related factors, is insufficiently able to predict exercise adherence. When the Theory of Planned Behavior is extended with the patient-therapist relationship (health-system factor) and other factors are taken into account such as MRC dyspnea score (condition related factor) and education (social/economic) then this model is better able to predict exercise adherence. [20]

Figure 1 Factors affecting exercise adherence.
Note: * = significant predicting factor (p < 0.05); ** = only mentioned in qualitative research; PBC = Perceived Behavioral Control

4. Measuring adherence

Self-report diaries are the most commonly used measure of adherence. However, there is no standardized diary that can be used across research studies, making it difficult to compare results between studies. Additionally, poor completion rates for diaries, coupled with inaccurate recall and self-presentation bias, can further impact the validity of these data. [21] A more objective approach involves the use of electronic devices such as accelerometers and pedometers. [22] However, these devices require the patient to use them systematically, and therefore they might only be successful for more adherent patients. Furthermore, electronic devices might not be able to register all prescribed exercises. [23]

The literature has shown that two measurement instruments appear to be valid and reliable for assessing exercise adherence: the Sport Injury Rehabilitation Adherence Scale (SIRAS) [24] and the Rehabilitation Adherence Measure for Athletic Training (RAdMAT). [25] The RAdMAT allows for a more detailed and comprehensive assessment of adherence, covering items related to patients'

attitudes, communication and clinic behaviors. A cross-cultural validation of this measurement instrument was conducted in the Netherlands. [26,27] The Dutch version of the Rehabilitation Adherence Measure of Athletic Training, the RAdMAT-NL, has good psychometric properties making it suitable for quantifying exercise adherence in patients with COPD undergoing pulmonary rehabilitation in a primary physiotherapy practice. [27] 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. [27] The RAdMAT-NL consists of 2 subscales: Participation (items 1-5 and 9-16, range 13-52 points), Communication (items 6-8, range 3-12 points). The total scale range is 16-64, a higher score indicates a higher degree of adherence. Without the Communication items (item 6-8) the RAdMAT-NL can be used as a single measure of adherence. 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. [28] This means, a minimum total score of 45 or higher must be achieved on the Participation subscale of the RAdMAT-NL to be adherent.
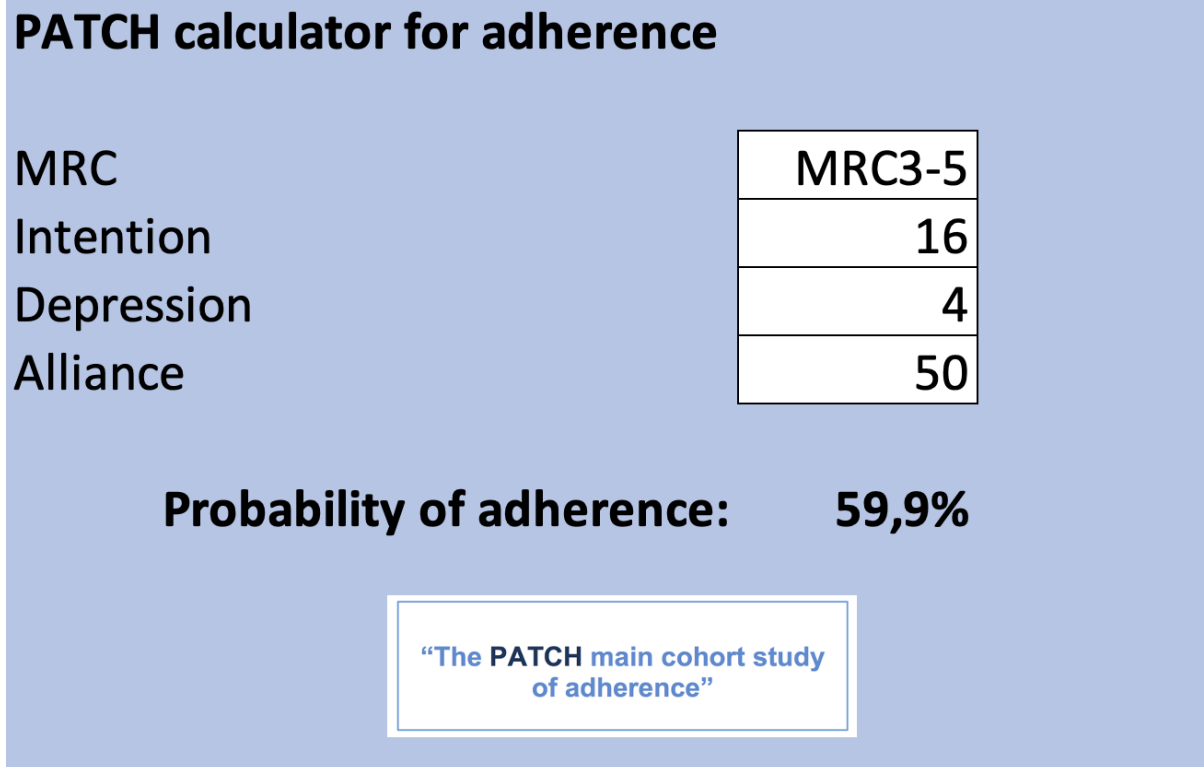
RAdMAT-NL

For each item, indicate the extent to which the item applies to the patient.

Item		Never	Occasionally	Often	Always
1	Attends scheduled rehabilitation sessions				
2	Arrives at rehabilitation on time				
3	Follows the physiotherapist's instructions during rehabilitation sessions				
4	Follows the prescribed rehabilitation plan				
5	Completes all tasks assigned by the physiotherapist				
6	Asks questions about his rehabilitation				
7	Communicates with the physiotherapist if there is a problem with the exercises				
8	Provides the physiotherapist feedback about the rehabilitation program				
9	Has a positive attitude during rehabilitation sessions				
10	Has a positive attitude toward the rehabilitation process				
11	Gives 100% effort in rehabilitation sessions				
12	Is self-motivated in rehabilitation sessions				
13	Is an active participant in the rehabilitation process				
14	Stays focused while doing rehabilitation exercises				
15	Is motivated to complete rehabilitation				
16	Shows interest in the rehabilitation process				

Figure 2 The Dutch version of the Rehabilitation Adherence Measure for Athletic Training (RAdMAT-NL).

To assess patient's adherence over an extended period and not just at the moment, a prediction model known as the Predicting Adherence in paTients with CHronic diseases (PATCH) tool is available for patients with COPD. [29] The predictors within the PATCH tool (intention, MRC-dyspnea score, depressive symptoms and alliance, which relates to the patient-therapist relationship) (Figure 3) can aid physiotherapist in better estimating the likelihood that a patient will be capable of more self-management. Information from the PATCH tool can be used by healthcare providers to facilitate discussions regarding clinical care and target services to better manage COPD and make more efficient use of healthcare by patients receiving prolonged pulmonary rehabilitation in a primary physiotherapy practice. [29] Counselling can possibly focus on patients who need it the most, the ones who are non-adherent. Both healthcare providers and patients gain substantial benefits; less time and costs spent and placing the patients central to address their needs leading to improved health behaviors, health outcomes, and quality of life.

PATCH calculator for adherence

MRC	MRC3-5
Intention	16
Depression	4
Alliance	50

Probability of adherence: 59,9%

"The **PATCH** main cohort study of adherence"

Figure 3 Example of the PATCH tool. A threshold of 53.5% is suggested as the optimal cut-off value to define adherent patients.

5. Strategies to improve exercise adherence

The World Health Organization (WHO) recognizes that improving patients' adherence may be the best investment for effectively treating chronic conditions. [15] Dutch research indicates that therapists can contribute to improving their patient's adherence in several ways. These include providing clear information about the purpose of advice and its potential benefits to the patient, collaboratively creating a treatment plan (shared-decision making) to ensure advice aligns within the patient's context, identifying and discussing barriers together with the patient (as patients often make cost-benefit analyses), and involving the environment to enhance social support. Patients can benefit from setting realistic and achievable exercise goals. Healthcare providers can assist patients in defining specific, measurable, and time-bound objectives by breaking down the exercise goals into smaller, achievable steps so patients may develop complete control over their prescribed exercises. [20] Regular monitoring of progress can help patients stay motivated and track their achievements.

Another approach to help patients achieve lasting behavior change and, therefore, improve adherence, is to invest in the patient-therapist relationship. The patient-therapist relationship in therapeutic situations refers to the sense of collaboration, warmth, and support between the patient and therapist. [30] An impaired patient-therapist relationship may arise from e.g., when patients feel unheard, disrespected, or otherwise

out of partnership with their healthcare provider. [31] Alliance has a direct impact on patient satisfaction, defined as "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". [32] Alliance consists of four elements – trust, knowledge, regard, and loyalty - and the nature of this alliance has a direct impact on patient satisfaction and, consequently, on exercise adherence. [32] Patients who trust and "like" their healthcare provider experience higher levels of satisfaction. Patient satisfaction increases when healthcare providers have knowledge about patients' concerns and address their expectations, as well as when healthcare providers encourage patients to share information. Healthcare providers' friendliness, warmth, emotional support, and caring (regard) are all associated with patient satisfaction. Patients report higher satisfaction when healthcare providers offer continued support (loyalty); continuity of care enhances patient satisfaction. [32]

Take home message

Poor adherence limits the potential of pulmonary rehabilitation to improve patients' health and quality of life. Furthermore, this non-adherence has been associated with substantial costs (for patients and society), including avoidable morbidity, increased hospital admissions, and prolonged hospital stays. [33] Conscious efforts from treating physiotherapists and patients are necessary to enhance exercise adherence and COPD control. Identifying who will adhere and who might not, is the initial step in the strategy to determine the level of support required during pulmonary rehabilitation. Focusing on the five factors affecting adherence, i.e., social/economic, healthcare team/system, therapy-related, condition-related, and patient-related factors, can offer practical suggestions for improving exercise adherence, including recognizing the significance of the patient-therapist relationship.

Considering the current evidence of the effectiveness of pulmonary rehabilitation and the influence of adherence on maximizing the potential of pulmonary rehabilitation, research should focus on improving adherence based on research. Future research could focus on patients who are non-adherent: can psychosocial interventions —based on the factors predicting adherence — in combination with the current biomedical interventions, increase adherence so that this patient group also achieves better health outcomes and ultimately gains the ability for increased self-management? Subsequently, it can be examined whether improved adherence and increased self-management lead to a sustainable, more active lifestyle in patients with COPD.

Conclusion

Exercise adherence plays a pivotal role in achieving COPD control, but it can often be overlooked in routine clinical practice. Given that various factors contribute to poor adherence in patients with COPD, a holistic approach is essential to identify and address these issues. Strategies involving patients, physiotherapists, and health systems are necessary. In the Dutch context, raising awareness of the patient's context, emphasizing the importance of the patient-therapist relationship, providing clearer information, and enhancing social support within the patient's environment are essential for improving exercise adherence and COPD control.

Conflicts of Interest Statement

Funding Statement

References

1. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. Dec 15 2012;380(9859):2095-128. doi:10.1016/s0140-6736(12)61728-0

2. Stolz D, Mkorombindo T, Schumann DM, et al. Towards the elimination of chronic obstructive pulmonary disease: a Lancet Commission. *The Lancet*. 2022;400(10356):921-972. doi:10.1016/S0140-6736(22)01273-9

3. FIRS. *The global impact of respiratory disease*. 2021. https://www.firsnet.org/images/publications/FIRS_Master_09202021.pdf

4. GOLD. *Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease*. 2023. https://goldcopd.org/2023-gold-report-2/

5. Vzinfo.nl. COPD. Accessed November 22, 2023. https://www.vzinfo.nl/copd

6. RIVM. *Maatschappelijke kosten voor astma, COPD en respiratoire allergie*. [Social costs of asthma, COPD and respiratory allergy]. 2012. https://www.rivm.nl/bibliotheek/rapporten/260544001.pdf

7. Spruit MA, Singh SJ, Garvey C, et al. An Official American Thoracic Society/European Respiratory Society Statement: Key Concepts and Advances in Pulmonary Rehabilitation. *Am J Respir Crit Care Med*. 2013;188(8):e13-e64. doi:10.1164/rccm.201309-1634ST

8. Griffiths R, Jones A, Davies H, Mitra R. An observation of the predictors of patient adherence and performance in a multidisciplinary regional cardiac rehabilitation programme. Conference Abstract. *Heart*. 2020;106(SUPPL 2):A35-A36. doi:10.1136/heartjnl-2020-BCS.42

9. Winkelmann J, Williams GA, Rijken M, Polin K, Maier CB. Chronic conditions and multimorbidity: skill-mix innovations for enhanced quality and coordination of care. In: Maier CB, Kroezen M, Wismar M, Busse R, eds. *Skill-mix Innovation, Effectiveness and Implementation: Improving Primary and Chronic Care*. Cambridge University Press; 2022:152-220. *European Observatory on Health Systems and Policies*.

10. Zeilstra A, den Ouden A, Vermeulen W. *Middellangetermijn- verkenning zorg 2022-2025*. [Medium-Term Care Exploration 2022-2025]. Accessed November 22, 2023. https://www.cpb.nl/sites/default/files/omniddownload/CPB-Middellangetermijnverkenning-zorg-2022-2025-nov2019.pdf

11. Holman H, Lorig K. Patient self-management: a key to effectiveness and efficiency in care of chronic disease. *Public Health Rep*. May-Jun 2004;119(3):239-43. doi:10.1016/j.phr.2004.04.002

12. Bakker JH. *Therapietrouw; van ervaren belang naar gedeeld belang*. 2016. [Therapy adherence; from perceived importance to shared importance. 2016]. Accessed December 30, 2023. https://zoek.officielebekendmakingen.nl/blg-671330.pdf

13. Allegrante JP, Wells MT, Peterson JC. Interventions to support behavioral self-management of chronic diseases. *Annu Rev Public Health*. 2019;40:127-146. doi:10.1146/annurev-publhealth-040218-044008

14. WHO. *WHO Guideline on Self-Care Interventions for Health and Well-Being*. WHO Guideline on Self-Care Interventions for Health and Well-Being. World Health Organization; 2021.

15. Sabaté E. *Adherence to long-term therapies. Evidence for action* World Health Organization; 2003.

16. Wiecek E, Tonin FS, Torres-Robles A, Benrimoj SI, Fernandez-Llimos F, Garcia-Cardenas V. Temporal effectiveness of interventions to improve medication adherence: a network meta-analysis. *PLoS One*. 2019;14(3). doi:10.1371.journal.pone.0213432

17. Meichenbaum D, Turk D. *Facilitating treatment adherence*. Plenum; 1987.

18. Clark H, Bassett S, Siegert R. Validation of a comprehensive measure of clinic-based adherence for physiotherapy patients. *Physiotherapy*. 2018;104(1):136-141. doi: 10.1016/j.physio.2017.07.003

19. Ricke E, Dijkstra A, Bakker EW. Prognostic factors of adherence to home-based exercise therapy in patients with chronic diseases: A systematic review and meta-analysis. *Front Sports Act Living*. 2023;5:1035023. doi:10.3389/fspor.2023.1035023

20. Ricke E, Dijkstra A. 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*. 2023;11(8). doi: https://doi.org/10.18103/mra.v11i8.4346

21. Stone AA, Shiffman S, Schwartz JE, Broderick JE, Hufford MR. Patient compliance with paper and electronic diaries. *Control Clin Trials*. Apr 2003;24(2):182-99. doi:10.1016/s0197-2456(02)00320-3

22. Yuen HK, Wang E, Holthaus K, et al. Self-reported versus objectively assessed exercise adherence. *Am J Occup Ther*. Jul-Aug 2013;67(4):484-9. doi:10.5014/ajot.2013.007575

23. Yang CC, Hsu YL. A review of accelerometry-based wearable motion detectors for physical activity monitoring. *Sensors (Basel)*. 2010;10(8):7772-88. doi:10.3390/s100807772

24. Brewer BW, van Raalte JL, Peptitpas AJ, et al. Preliminary psychometric evaluation of a measure of adherence to clinic-based sport injury rehabilitation. *Physical Therapy in Sport*. 2000;1:68-74.

25. Granquist M, Gill D, Appaneal R. Development of a Measure of Rehabilitation Adherence for Athletic Training. *Journal of Sport Rehabilitation*. 2010;19(3):249-267.

26. Ricke E, Bakker E. Measuring Adherence in Clinic-Based Physiotherapy; A Study of the Inter-Rater Reliability of A Dutch Measurement. *International Journal of Physiotherapy and Rehabilitation*. 2019;5(1)

27. Ricke E, Lindeboom R, Dijkstra A, Bakker EW. Measuring Adherence to Pulmonary Rehabilitation: A Prospective Validation Study of the Dutch Version of the Rehabilitation Adherence Measure for Athletic Training (RAdMAT-NL). *Patient Prefer Adherence*. 2023;17:1977-1987. doi:10.2147/ppa.S423207

28. American College of Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*. Lippincott Williams & Wilki; 2021.

29. Ricke E, Bakker E. Development and validation of a multivariable exercise adherence prediction model for patients with COPD: a prospective cohort study. *Int J Chron Obstruct Pulmon Dis*. 2023;18:385-398. doi:10.2147/COPD.S401023

30. Hall AM, Ferreira PH, Maher CG, Latimer J, Ferreira ML. The influence of the therapist-patient relationship on treatment outcome in physical rehabilitation: a systematic review. *Physical Therapy* 2010;90(8):1099-1110. doi:10.2522/ptj.20090245

31. Gordon C, Beresin EV. The doctor-patient relationship. In: Stern TA, Fava M, Wilens TE, et al., eds. *Massachusetts General Hospital Comprehensive Clinical Psychiatry*. 2nd ed. Elsevier Health Sciences; 2016:1-7.

32. Chipidza FE, Wallwork RS, Stern TA. Impact of the Doctor-Patient Relationship. *Prim Care Companion CNS Disord*. 2015;17(5). doi:10.4088/PCC.15f01840 PMC4732308,

33. Bassett S. Measuring Patient Adherence to Physiotherapy. *Journal of Novel Physiotherapies*. 2012;2(7). doi:10.4172/2165-7025.1000e124