UHASSELT

KNOWLEDGE IN ACTION

Faculteit Revalidatiewetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

How does prescribed exercise therapy by physiotherapists correspond with the recent guidelines in cardiovascular patients

Sybrun Das
Noah Timmerman

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij musculoskeletale aandoeningen

PROMOTOR :

Prof. dr. Dominique HANSEN

BEGELEIDER :

Mevrouw Nastasia MARINUS

2021
2022

UHASSELT

KNOWLEDGE IN ACTION

www.uhasselt.be
Universiteit Hasselt
Campus Hasselt:
Martelarenlaan 42 | 3500 Hasselt
Campus Diepenbeek:
Agoralaan Gebouw D | 3590 Diepenbeek

UHASSELT

KNOWLEDGE IN ACTION

Faculteit Revalidatiewetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

How does prescribed exercise therapy by physiotherapists correspond with the recent guidelines in cardiovascular patients

Sybrun Das
Noah Timmerman

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij musculoskeletale aandoeningen

PROMOTOR :

Prof. dr. Dominique HANSEN

BEGELEIDER :

Mevrouw Nastasia MARINUS

Acknowledgements

The authors would like to thank Prof. dr. Dominique Hansen and Drs. Nastasia Marinus for their guidance, expertise and feedback during the process of writing this master-thesis.

Neermolenstraat 3, 3680 Neeroeteren, 06/06/2022 D.S.

Jagersstraat 12, 3590 Diepenbeek, 06/06/2022 T.N.

Research context

Movement is an essential part in the health of the human species. Its absence in a person's lifestyle translates almost directly in functional loss, diseases and pain (Bull et al., 2020; Institute for Health Metrics and Evaluation, 2019 & World Health Organization, 2020). In the medical world, movement is a valid method for the prevention and rehabilitation of multiple chronic and acute pathologies (Arundale et al., 2018; Hansen, Niebauer, et al., 2018; Jette et al., 2020; Lewinter et al., 2015). In this context, the term "exercise therapy" is more commonly used. Exercise therapy consists of multiple segments which are called 'the exercise modalities' (intensity, frequency, session duration, program duration). All these can be used separately to modify and individualize the exercise therapy to the preference and profile of the patient. This kind of intervention has an increasingly growing base of scientific evidence that supports its effectiveness. However, research also shows that the prescription of exercise therapy is not that easy, as a lot of incongruencies between prescribers can be detected (Abell, Glasziou, Briffa, & Hoffmann, 2016; Bjarnason-Wehrens et al., 2010; Hansen, Ruiz, et al., 2018; Vromen et al., 2013). Most of this research was focussed on clinicians in general and, even if physiotherapists were included, they portrayed merely a tiny fraction of the research sample. In Belgium, the physiotherapist is to the utmost extent responsible for the exercise therapy in rehabilitation programmes. Since physiotherapists are considered as experts in movement and exercise therapy is a learned competence in their education, it would surely be relevant to research their ability to prescribe exercise therapy. People with cardiovascular disease (CVD) have been shown experiencing significant benefits due to exercise therapy, which is therefore an important part in their rehabilitation (Hansen, Niebauer, et al., 2018; Lewinter et al., 2015). Because of the possibly fragile nature of this type of patient, it is just as crucial to prescribe the right amount of exercise therapy that should be individualised for each patient. With the previously stated information in mind, it is certainly clinically relevant to research the exercise prescription of physiotherapists to patients with CVD.

This study has been executed under the guidance of Prof. Dr. Dominque Hansen, a member of the European Association of Preventive Cardiology (EAPC) Exercise Prescription in Everyday Practice and Rehabilitative Training (EXPERT) working group. He collaborated with the working union AXXON of Belgian physiotherapists who shared a big amount in the recruitment of participants, Drs. Nastasia Marinus and Dr. Gustavo Rovelo Ruiz. They set up

the design and method of the study: “The evaluation of exercise prescription by physiotherapists to patients with (elevated risk for) CVD by digitised patient simulations”, from which the baseline data is used in the following study. Two master students physiotherapy & rehabilitation sciences form UHasselt were appointed to support them for the data processing. The data was gathered in the EXPERT tool which is a DDSS created by the EXPERT working group which can be used as a training tool as well as an aid in practice to implement scientifically based exercise therapy in the rehabilitation of cardiovascular patients (Hansen et al., 2017; Hansen, Niebauer, et al., 2018). To receive the data, the students supported in some practical issues like: filling out the baseline and training cases, controlling the solutions given by the EXPERT tool & providing e-mail addresses for gathering an as large as possible sample. The students received a raw Excel spreadsheet with the gathered data and were responsible for the processing of this data. In consultation with Drs. Nastastia Marinus, the students specified the statistical methods. The students performed the statistical analyses independently with the program JMP v.16.2 from SAS. Finally, the students were responsible for the translation of this raw research data in a continuously written text. After the writing, they received a final feedback from their promotor Prof. Dr. Dominque Hansen and Drs. Nastasia Marinus, which led to the following master thesis: “How does the prescribed exercise therapy by physiotherapists correspond with the recent guidelines in cardiovascular patients?”.

References

1. Abell, B., Glasziou, P., Briffa, T., & Hoffmann, T. (2016). Exercise training characteristics in cardiac rehabilitation programmes: a cross-sectional survey of Australian practice. *Open Heart, 3*(1). doi:10.1136/openhrt-2015-000374
2. Arundale, A. J. H., Bizzini, M., Giordano, A., Hewett, T. E., Logerstedt, D. S., Mandelbaum, B., . . . Snyder-Mackler, L. (2018). Exercise-Based Knee and Anterior Cruciate Ligament Injury Prevention. *J Orthop Sports Phys Ther, 48*(9), A1-a42. doi:10.2519/jospt.2018.0303
3. Bjarnason-Wehrens, B., McGee, H., Zwisler, A. D., Piepoli, M. F., Benzer, W., Schmid, J. P., . . . Mendes, M. (2010). Cardiac rehabilitation in Europe: results from the European Cardiac Rehabilitation Inventory Survey. *Eur J Cardiovasc Prev Rehabil, 17*(4), 410-418. doi:10.1097/HJR.0b013e328334f42d
4. Hansen, D., Dendale, P., Coninx, K., Vanhees, L., Piepoli, M. F., Niebauer, J., . . . Doherty, P. (2017). The European Association of Preventive Cardiology Exercise Prescription in Everyday Practice and Rehabilitative Training (EXPERT) tool: A digital training and decision support system for optimized exercise prescription in cardiovascular disease. Concept, definitions and construction methodology. *European Journal of Preventive Cardiology, 24*(10), 1017-1031. doi:10.1177/2047487317702042
5. Hansen, D., Niebauer, J., Cornelissen, V., Barna, O., Neunhäuserer, D., Stettler, C., . . . Dendale, P. (2018). Exercise Prescription in Patients with Different Combinations of Cardiovascular Disease Risk Factors: A Consensus Statement from the EXPERT Working Group. *Sports Med, 48*(8), 1781-1797. doi:10.1007/s40279-018-0930-4
6. Hansen, D., Ruiz, G. R., Doherty, P., Iliou, M. C., Vromen, T., Hinton, S., . . . Grp, E. E. W. (2018). Do clinicians prescribe exercise similarly in patients with different cardiovascular diseases? Findings from the EAPC EXPERT working group survey. *European Journal of Preventive Cardiology, 25*(7), 682-691. doi:10.1177/2047487318760888
7. Institute for Health Metrics and Evaluation. (2019). *GBD compare*. Vizhub Healthdata. Retrieved 13-02-2022, from https://vizhub.healthdata.org/gbd-compare/
8. Jette, D. U., Hunter, S. J., Burkett, L., Langham, B., Logerstedt, D. S., Piuzzi, N. S., . . . Zeni, J., Jr. (2020). Physical Therapist Management of Total Knee Arthroplasty. *Phys Ther, 100*(9), 1603-1631. doi:10.1093/ptj/pzaa099
9. Lewinter, C., Doherty, P., Gale, C. P., Crouch, S., Stirk, L., Lewin, R. J., . . . Bland, J. M. (2015). Exercise-based cardiac rehabilitation in patients with heart failure: a meta-analysis of randomised controlled trials between 1999 and 2013. *Eur J Prev Cardiol, 22*(12), 1504-1512. doi:10.1177/2047487314559853
10. Vromen, T., Spee, R. F., Kraal, J. J., Peek, N., van Engen-Verheul, M. M., Kraaijenhagen, R. A., . . . Kemps, H. M. (2013). Exercise training programs in Dutch cardiac rehabilitation centres. *Neth Heart J, 21*(3), 138-143. doi:10.1007/s12471-013-0374-2
11. World Health Organization. (2020, December 9). *The top 10 causes of death*. WHO. Retrieved 18-02-2022, from https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

Abstract

Background: Numerous studies formed guideline recommendations for cardiovascular diseases. These were included in the EXPERT tool, a digital decision support system, to support the exercise prescription of clinicians.

Objectives: The objective of this study was to determine whether the prescribed exercise therapy by physiotherapists in cardiovascular diseases is in line with the current guidelines.

Participants: 35 Belgian physiotherapists from the contact list of Axxon filled in the informed consent and were therefore able to participate in the study. Participants needed to be active in the field and only were excluded if they had no device to support the EXPERT tool.

Measurements: The EXPERT tool was used to gather data regarding the exercise prescriptions in three different cases. These were compared for each individual exercise modality (intensity, frequency, session duration, program duration and strength included). Additionally, possible correlations between socio-demographic factors were analysed.

Results: Prescribed intensity was too high and showed a significant difference in case (PTE) 1 (p-value 0.0019) and PTE 2 (p-value 0.0003), whereas PTE 3 revealed no significant differences (p-value 1.000). Frequency prescription was too low in all 3 cases (p-value <0.0001) and session duration showed in PTE 1 (p-value <0.0001) and PTE 2 (p-value 0.0193) significant values. No significant differences could be found for program duration, indicating that it corresponds with the guidelines. Strength training should be included in all three cases and was prescribed by most of the therapists in each case (>90%). No significant correlations could be found.

Conclusion: Physiotherapist seemed to not entirely succeed to prescribe exercise therapy for cardiovascular diseases in concordance with the current guidelines. This could be due to the wide variety of exercise prescription among physiotherapists. No correlations for socio-demographic factors were found.

Key-words: physiotherapists, exercise prescription, guideline recommendations, digital decision support system

1. Introduction

In line with the growing evidence that physical activity has a whole-body effect as stated in Abell et al. (2016) and Blair (2009), the world health organisation (WHO) states that, for a healthy individual, weekly physical activity of a moderate intensity for 150-300 minutes is required to maintain healthy (World Health Organization, 2020). A higher exercise load even provides additional benefits and will translate curvilinearly in a better health condition (Bull et al., 2020; Warburton, Nicol, & Bredin, 2006).

For the more chronic conditions, such as diseases of affluence, exercise therapy has been proven to decrease the mortality risk. Lewinter et al. (2015) and Hansen, Niebauer, et al. (2018) have shown that exercise therapy was improving the exercise capacity and health condition of patients with cardiovascular diseases (CVD).

CVD is an umbrella term for a diverse group of disorders that can either be congenital or acquired. Coronary heart disease, stroke & transient ischaemic attack, peripheral arterial disease, aortic disease: these are all diseases listed under this collective term. The NHS website (2022) defines CVDs as conditions that affect the heart or blood vessels. Many risk factors are identified to elevate the risk of developing CVD. Among these are: smoking, consumption of unhealthy food, obesity, physical inactivity, etc. (Andersson & Vasan, 2018). Movement will improve vascular function, cardiac preconditioning and anti-inflammatory effects (Fiuza-Luces, Garatachea, Berger, & Lucia, 2013; Green, Hopman, Padilla, Laughlin, & Thijssen, 2017; Niessner et al., 2006; Sahebkar et al., 2015; Shimada et al., 2011; Thijssen, Redington, George, Hopman, & Jones, 2018). Additionally, exercise therapy protects the patient against sarcopenia, which is known to be a sustaining factor for CVD (Kinugasa & Yamamoto, 2017; Minn & Suk, 2017; Spahillari et al., 2016). With all the stated benefits that come with physical activity, it is no surprise that exercise therapy is a crucial part in CVD rehabilitation to maintain or improve the quality of life (Fiuza-Luces et al., 2018). Shoemaker, Dias, Lefebvre, Heick, and Collins (2020) state in their practice guideline that physical therapists have the main goal to improve functionality and reduce hospital admission in CVD with an individualized therapy to increase daily physical activity levels. Moreover, they should be able to give education on the management of the patients' chronic disease. This includes advice on nutrition & self-care behaviour. So, physical therapists have a key-task within the interdisciplinary team as they work close with the patient (Shoemaker et al., 2020). A problem

is that there are many different guidelines, which results in a large inter-clinician variance in exercise prescription (Abell et al., 2016). The way in which exercise prescription is performed even varies between different countries and rehabilitation centra in the same country (Bjarnason-Wehrens et al., 2010; Vromen et al., 2013).

When comparing different work settings, in hospital-based rehabilitation, objective instruments like an ergospirometry test are available. Another advantage of this setting is the availability of extensive arsenal of fitness equipment to perform exercise therapy. The downside is that patients rehabilitate in group, causing physiotherapists not being able to work one on one, which is an asset in a private practice setting. Such setting however has probably less resources and sophisticated material for training and assessments.
A possible solution for both individualization in a hospital setting as well as the use of sophisticated equipment in private practice could be a digital decision support system (DDSS). Previously, DDSS were mainly used for management and medication prescription, so logically this is where the most research has been done. For medication prescription, the evidence is also quite old, but there is a positive trend towards the improvement of drug dosing as seen in (Hunt, Haynes, Hanna, & Smith, 1998; Walton, Dovey, Harvey, & Freemantle, 1999). Most of the above-mentioned articles were written about physicians. In case physiotherapists even were involved, they represented merely a tiny fraction of the sample. Because exercise therapy is considered a competence of physiotherapists and is implemented in the physiotherapy education package, it would be interesting to research the inter-clinician variance and the usability of a DDSS in this profession. The EXPERT tool is an example of a DDSS aiming to facilitate the implementation of up-to-date guidelines and expert opinions in cardiac rehabilitation (CR) (Hansen et al., 2017; Hansen, Niebauer, et al., 2018).

This application will be used to analyse the following research question: “How does the prescribed exercise therapy by physiotherapists correspond with the recent guidelines in cardiovascular patients?”. The secondary analysis to find possible correlations is stated as followed: “Which socio-demographic factors have a correlation with the compliance of exercise therapy to the current guidelines?” The hypothesis is that physiotherapists are up to date to the most recent guidelines and therefore comply with these. For the secondary analysis, the hypothesis states that there are certain participant factors that correlate with this compliance.

2. Method

2.1. Participants

The study consists of Belgian physiotherapists who were contacted by Axxon, the union of physiotherapists in Belgium. Axxon contacted all potential participants in their contact list via an e-mail. The recruitment/participation period was running from December 2021 till March 2022. The invitation mail (appendix 1) send to all potential participants by Axxon was accompanied by study information (appendix 2), a link to an online consent form (appendix 3) and a privacy notice (appendix 4). Only after the completion of this form, participants were able to access the study and share their personal details with the researchers. The recruitment ended after all participants had received two more reminders of participation by e-mail. The contacted physiotherapists were informed that participation was voluntary and would in no means impact their relationship with Axxon. After completion of the study, the participants had access to a debrief sheet and the possibility to acquire a summary of the findings on request. This was asked in the online consent form accompanied with the question to provide their email address for this purpose.

2.2. Inclusion/exclusion criteria

Eligible participants were active Belgian physiotherapists, no restrictions were made for years of experience or characteristics of the rehabilitation program they apply to their patients. The single exclusion criteria was not being able to access a device to run the EXPERT tool (appendix 6), which will be used to gather the data.

2.3. Study-design

This study is part of another larger study: “The evaluation of exercise prescription by physiotherapists to patients with (elevated risk for) CVD by digitised patient simulations where participants will undergo a training period to research the training effect of the EXPERT tool”. For this study, only the baseline measures of this larger study will be used, which causes the cross-sectional character of this study.

The set-up of this study posed no threat to the participants as they only had to fill out questionnaires and solve cases. The only inconvenience the participants could possibly experience was the time spend to execute the tasks. Although this was to the utmost extent

resolved because participants could choose a convenient time and location on their own to dedicate to their participation.

The data for this cross-sectional study will be gathered through the EXPERT tool (Hansen et al., 2017; Hansen, Niebauer, et al., 2018) which was developed by EDM at Hasselt University in Belgium. This is a DDSS that has been approved by the European Association of Preventive Cardiology (EAPC) and aims to facilitate the implementation and scientific knowledge around CR. The application bases its recommendation on current clinical guidelines, research and expert opinions, which are periodically updated (Hansen et al., 2017). The retrieved data will be stored securely on Hasselt University networks.

Participants needed to complete a baseline questionnaire (appendix 5) to acquire a socio-demographic image of the researched sample. More detailed will they be asked about their gender, age, qualifications, special competence for CR, delivery mode of CR, work setting, years of CR experience and choice of existing guidelines to rely on. This data is important for the secondary analysis as possible correlations regarding the concordance with the EXPERT tool will be researched. To elaborate on the use of these guidelines, potential barriers and facilitators for implementation will be questioned as well as available resources/abilities to improve this. Additionally, this will partially focus on their knowledge and the attitude towards the use of technology and DDSS in the practice with a customized version of the Technology Acceptance Model (TAM) (appendix 5). Finally, they will be asked if they have had any prior experience of working with the EXPERT tool as it is already commercially available. After this procedure, the participants gain access to the EXPERT tool in which they will be asked to fill in three cases. The primary outcome of this study is the assessment of exercise prescription in physiotherapy. The different training modalities from the exercise prescription as given by the participants will be compared against the recommendations given by the EXPERT tool, which will in this study be considered as the gold standard. This will lead to two analyses. On the one hand, it will be determined whether the participants have given a prescription in resemblance to the EXPERT tool recommendations. On the other hand, the congruency between the different physiotherapists will be analysed. After this outcome, the characteristics of the participants will be implemented in the analysis to search for relations to detect influencing factors.

The primary outcome of this study is the assessment of exercise prescription in physiotherapists. The prescribed training parameters were compared to the recommendations of the EXPERT tool and compared to each other to check for congruency.

2.4. Cases

The three cases consist of fictional patients which suffer increasingly more complex CVDs or risks, which result in three different difficulty levels: easy, intermediate and difficult. The participants are asked to give an exercise prescription as best as they can to their knowledge by determining the exercise modalities considering the patient's profile. This includes exercise intensity (beats per minute), exercise frequency (days/week), program duration (weeks), exercise session duration (min/session) and whether strength training is recommended (Y/N). At the end, they can indicate in an open text box whether they would give additional exercise training and if yes, which types should be considered.

Table 1
Baseline cases

	Case 1	Case 2	Case 3
Sex (M/F)	Male	Male	Female
Date of birth	26/02/1950	04/10/1945	05/08/1950
VO2max (l/min)	2.5	1.5	0.767
Resting HR (bpm)	55	52	52
Peak exercise HR (bpm)	123	112	100
Body weight (kg)	65	80	90
Body Height (cm)	171	182	165

Blood pressure (mmHg)	145/82	125/80	135/75
Fasting glycemia (mg/dl)	95	102	115
Smoker (Y/N)	No	No	No
Primary indication	Acute myocardial infarction with PIC (CAD, PCI, CABG & endo-ACAB)	AMI with CABG (CAD, PCI, CABG & endo-ACAB)	Myocardial ischemic threshold at 90 bpm
Co-morbidities	Dyslipidaemia, hypertension	Obesity, Dyslipidaemia, Hypertension	Obesity, Type II diabetes, hypertension
Exercise modifier	/	COPD	Sarcopenia/frailty
Medication intake	Beta blocker, Statin	Beta blocker, Statin	Beta blocker, statin, insulin

3. Statistical analyses

The parameters included in the statistical analysis were 'intensity' (bpm), 'frequency' (sessions/week), 'session duration' (minutes/session), 'program duration' (weeks) and 'strength' (yes/no). These data were obtained from the analysis of the three control cases, respectively PTE1, PTE 2 and PTE 3, that the physiotherapists had to fill in. For 'intensity' and 'session duration', the EXPERT tool recommendation consisted of a range in which one should operate, for the statistical analysis the mean of those range extremities was taken.

The statistical analyses were executed by the statistical program JMP v.16.2 from SAS. Firstly, the distribution of the processed data was determined by the Shapiro-Wilk test. For assessing the difference between the exercise prescription of the participants and the EXPERT tool, a parametric paired t-test was used in case of normal distribution and a non-parametric Wilcoxon test if not. For examining potential existing relations between the participants characteristics (gender, age, qualifications, special competence in CR, work setting, years of experience & guideline choice) and their exercise prescription concordance with the EXPERT tool recommendation, the data has been processed and put in congruency tables. For determining the concordance, each training parameter in each case was investigated whether or not they equalized the matching EXPERT tool recommendation (Y/N) which then was analysed to the socio-demographic factors. If the conditions were met, the Pearson test was used for the data analysis otherwise the Fisher's exact test has been performed. For all statistical analyses, the significance level was set at $p<0.05$ (2-tailed).

4. Results

4.1. Participant characteristics

As a result, 35 Belgian physiotherapists from the contact list of Axxon filled in the informed consent and therefore were able to participate in the study. From these physiotherapists, 31 filled in all the questionnaires to form an image about the socio-demographic and professional profile of the sample. As seen in table 2 we can conclude that this study group represents a broad range of age. A big part of the researched sample has had a university education with the minimum level of a master's degree (45.46%). Much less physiotherapists have earned a special competence for CVD rehabilitation which was achieved by a minority of 36.36%, although almost everyone at least had one or more years of experience in CVD. More than 2/3 of the physiotherapists included in the study worked in a hospital setting as only 28.13% worked exclusively in a private practice. The average number of patients with a CVD daily treated for this sample is 15.19 ± 12.40. Three different official treatment guidelines and university courses or combinations of those were considered as a foundation for the rehabilitation plan. Almost half of the participants used the EAPC guidelines (45.16%). The current guidelines did not provide a clear understanding of concordant exercise prescription in CVD rehabilitation as indicated by 95% of the participants via another questionnaire (appendix 5). Therefore, this same amount of researched physiotherapists do not fully implement these guidelines in their rehabilitation. This is not surprising as 45.45% has the perception that the guidelines are difficult to read/understand and not specific enough for certain condition types. Of the participants, 57.57% thinks that their workplace does not have the right equipment and considers this as a barrier for the implementation of these guidelines. Although 72.72% thinks that their workplace does not affect their way of delivering rehabilitation. As soon as new guidelines appear, 54.54% of the physiotherapists reads them and applies them in their rehabilitation. One third of the participants says that the type of patient does not affect their decision-making process during exercise therapy.

4.2. Technology acceptance

A modified Technology Acceptance Model (mTAM) (appendix 5) was added to understand the attitude of the participants towards technology in their practice. Technology and innovation are daily implemented in their practice by 87.87% of the sample. These have a positive attitude towards the usage of computer programs. Most of the participants feel they have good skills using computer programs in their daily practice as said by 78.78%. When asked

about DDSS, 66.66% indicated that they did not know about the existence of such software and their use in medicine

4.3. Exercise prescription

4.3.1. Primary outcomes

Firstly, prescribed intensity by physiotherapists was compared with the intensity prescribed by the EXPERT tool. This showed a significant difference in PTE 1 & 2 (table 3). In PTE 1, the average intensity of 99.6086 (± 13.3365) bpm was significantly higher (p-value 0.0019) compared to the EXPERT tool which recommend an intensity of 92.0000 (± 10.000) bpm. The same was applicable for PTE 2 (p-value 0.0003) where the intensity prescribed by physiotherapists is 92.4063 (± 12.1486) bpm, while the EXPERT tool recommended an intensity of 84.5000 (± 8.5000) bpm. This is also shown in figure 1. The intensity of <91 bpm prescribed by the EXPERT tool in PTE 3 showed no significant differences (p-value 1.0000) compared to the prescribed intensity of 83.5645 (±7.73708) bpm by physiotherapists.

Secondly, the prescribed frequency by physiotherapists is lower in each case (p-value <0.0001) as shown in table 3. The prescribed frequencies were respectively 3.88571 (± 1.49059) days/week in PTE 1, 4.34375 (± 1.59858) days/week in PTE 2 and 4.20313 (± 1.46936) days/week in PTE 3 (figure 2).

Thirdly, session duration (figure 3), despite the majority lies within the interval of 20 – 60 min (average 40 min) recommended by the EXPERT tool, showed a significant difference in PTE 1 (p-value <0.0001) & PTE 2 (p-value 0.0193) (table 3). In PTE 1 average session duration was 50.7000 (± 13.9859) min and 48.9531 (± 21.8100) min in PTE 2. In PTE 3 no significant difference was found regarding session duration (p-value 0.5672). The recommended session duration prescribed by the EXPERT tool was 30 – 60 min (average 45 min), while physiotherapists prescribed a session duration of 45.071 (± 17. 5639) min.

Fourthly, the analysis of the prescribed program duration, shown in figure 4, found no significant differences when compared to the recommendation of the EXPERT tool (table 3). In PTE 1 a program duration of >12 weeks was recommended, physiotherapists prescribed a program duration of 16.0000 (± 8.41412) weeks. In PTE 2 & 3 the recommended program duration by the EXPERT tool was >24 weeks, respectively physiotherapists prescribed 19.000 (± 9.01322) weeks for PTE 2 (p-value 0.9976) and 20.2759 (± 8.52683) weeks for PTE 3 (p-value 0.9932).

Finally, therapists needed to respond if they should include strength training or not (figure 5). The EXPERT tool recommended the inclusion of strength training for each case. In PTE 1 91.43% of the physiotherapists included strength training, in PTE 2 90.23% and in PTE 3 90.63% as displayed in table 3.

4.3.2. Secondary outcomes

For the secondary outcomes, the socio-demographic and professional characteristics of the physiotherapists were matched with the exercise prescription parameters to research possible correlations. These can be found in table 4. Only one significant correlation could be indicated in PTE 2 where there was a correlation between the prescribed frequency and work setting of the physiotherapists. From the participants who did not prescribe a sufficient frequency, 58.62% were physiotherapists who did solely work in a hospital.

For PTE 1 session duration, no possible correlations could be researched because all given time values were within the range, prescribed by the EXPERT tool. The remaining participant characteristics showed no significant correlation with any of the exercise modalities.

Table 2
Socio-demographic & professional characteristics

Sex		33
	Female	25 (75.76)
	Male	8 (24.24)
Age		33
	<30 years	12 (36.36)
	30-39 years	6 (18.18)
	40-49 years	9 (27.27)
	50-59 years	5 (15.15)
	>59 years	1 (3.03)
Qualifications		33
	Graduate/A1	7 (21.21)
	Licentiate	4 (12.12)
	BSc physiotherapy	2 (6.06)
	MSc physiotherapy	15 (45.46)
	MSc + PhD	3 (9.09)
	Licentiate + MSc	1 (3.03)
	Licentiate + master manual therapy	1 (3.03)
Special professional competence CVD physiotherapy		33
	No	21 (63.64)
	Yes	12 (36.36)
Work setting		32
	Private practice	9 (28.13)
	Hospital	19 (59.38)
	Hospital & private practice	3 (9.38)
	Hospital & university	1 (3.13)
Years of experience in CR		32

	<1 year	4 (12.5)
	1-5 years	13 (40.62)
	6-10 years	7 (21.88)
	>10 years	8 (25.00)
Used guidelines		31
	University courses	2 (6.45)
	GERS (France)	1 (3.23)
	KNGF	9 (29.03)
	EAPC	14 (45.16)
	KNGF & EAPC	4 (12.90)
	KNGF & EAPC & Cardiac Rehab Courses KU Leuven	1 (3.23)
Awareness DDSS		33
	No	22 (66.67)
	Yes	11 (33.33)

BSc, Bachelor of Sciences*; MSc,* Master of Sciences; *PhD,* Doctor of physiotherapy; *CVD,* Cardiovascular disease; *GERS,* Groupe Exercise readaptation sport of the French Society of Cardiology; *KNGF,* Koninklijk Nederlands Genootschap voor Fysiotherapie; *EAPC,* European Association of Preventive Cardiology; *DDSS,* Digital Decision Support System

Table 3
Prescription of physiotherapists compared to recommendation EXPERT tool

		Physiotherapist Mean (±SD)	EXPERT tool Mean (±SD)	P-value
Intensity (bpm)	PTE 1	99.6086 (± 13.3365)	92.0000 (± 10.0000)	0.0019
	PTE 2	92.4063 (± 12.1486)	84.5000 (± 8.5000)	0.0003
	PTE 3	83.5645 (±7.73708)	<91.0000	1.0000
Frequency (days/week)	PTE 1	3.88571 (± 1.49059)	7.0000	<0.0001
	PTE 2	4.34375 (± 1.59858)	7.0000	<0.0001
	PTE 3	4.20313 (± 1.46936)	7.0000	<0.0001
Session duration (min)	PTE 1	50.7000 (± 13.9859)	40.0000 (± 20.0000)	<0.0001
	PTE 2	48.9531 (± 21.8100)	40.0000 (± 20.0000)	0.0193
	PTE 3	45.071 (± 17.5639)	45.0000 (± 15.0000)	0.5672
Program duration (weeks)	PTE 1	16.0000 (± 8.4141)	>12.0000	0.9957
	PTE 2	19.000 (± 9.0132)	>24.0000	0.9967
	PTE 3	20.2759 (± 8.5268)	>24.0000	0.9932
Strength included (%)	PTE 1	91.4300	100.0000	
	PTE 2	90.2300	100.0000	
	PTE 3	90.6300	100.0000	

SD, standard deviation ; *PTE 1,* Patient 1; *PTE 2,* Patient 2; *PTE 3,* Patient 3

Table 4
Correlations between exercise prescription parameters and socio-demographic and professional characteristics (Y/N)

		Gender	Age	Qualifications	Special professional competence	Setting	Experience	Guidelines
Intensity (p-value)	PTE 1	N (0.2419)	N (0.0587)	N (0.4483)	N (0.6918)	N (0.3323)	N (0.1025)	N (0.5384)
	PTE 2	N (0.6715)	N (0.3680)	N (0.2495)	N (0.0527)	N (0.9079)	N (0.8064)	N (0.8826)
	PTE 3	N (0.5575)	N (0.7586)	N (0.1762)	N (0.2463)	N (0.7198)	N (0.2551)	N (0.2973)
Frequency (p-value)	PTE 1	N (0.2412)	N (0.3914)	N (0.0726)	N (0.2713)	N (0.2122)	N (0.7976)	N (0.8178)
	PTE 2	N (0.5894)	N (0.1454)	N (0.1432)	N (0.6221)	Y (0.0240)	N (0.2318)	N (0.4691)
	PTE 3	N (0.5504)	N (0.1308)	N (0.5632)	N (0.6111)	N (0.0647)	N (0.1156)	N (0.3301)
Session duration (p-value)	PTE 1							
	PTE 2	N (1.0000)	N (0.6571)	N (0.2069)	N (0.0542)	N (0.4836)	N (0.5037)	N (0.8079)
	PTE 3	N (0.5688)	N (0.6580)	N (0.5968)	N (0.1296)	N (0.1765)	N (0.4641)	N (0.5437)
Program duration (p-value)	PTE 1	N (0.2412)	N (0.3914)	N (0.6944)	N (0.2602)	N (0.2747)	N (0.9114)	N (0.7903)
	PTE 2	N (0.2768)	N (0.0930)	N (0.5633)	N (0.6254)	N (1.0000)	N (0.7050)	N (0.5896)
	PTE 3	N (0.5453)	N (0.2346)	N (0.2692)	N (0.6125)	N (1.0000)	N (0.6465)	N (0.5821)
Strength (p-value)	PTE 1	N (0.1386)	N (0.7724)	N (0.2117)	N (1.0000)	N (0.3565)	N (0.5335)	N (1.0000)
	PTE 2	N (1.0000)	N (0.0854)	N (1.0000)	N (1.0000)	N (1.0000)	N (1.0000)	N (1.0000)
	PTE 3	N (1.0000)	N (0.2882)	N (1.0000)	N (0.2579)	N (1.0000)	N (0.8681)	N (1.0000)

Y, Yes *; N,* No*; PTE 1,* Patient 1; *PTE 2,* Patient 2; *PTE 3,* Patient 3

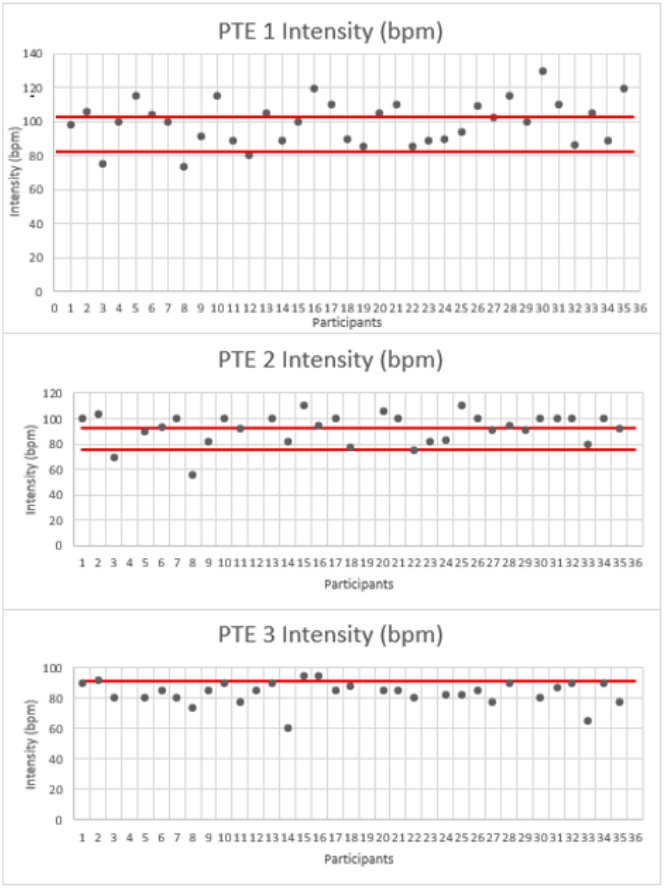


Figure 1: prescribed exercise intensity vs recommendations

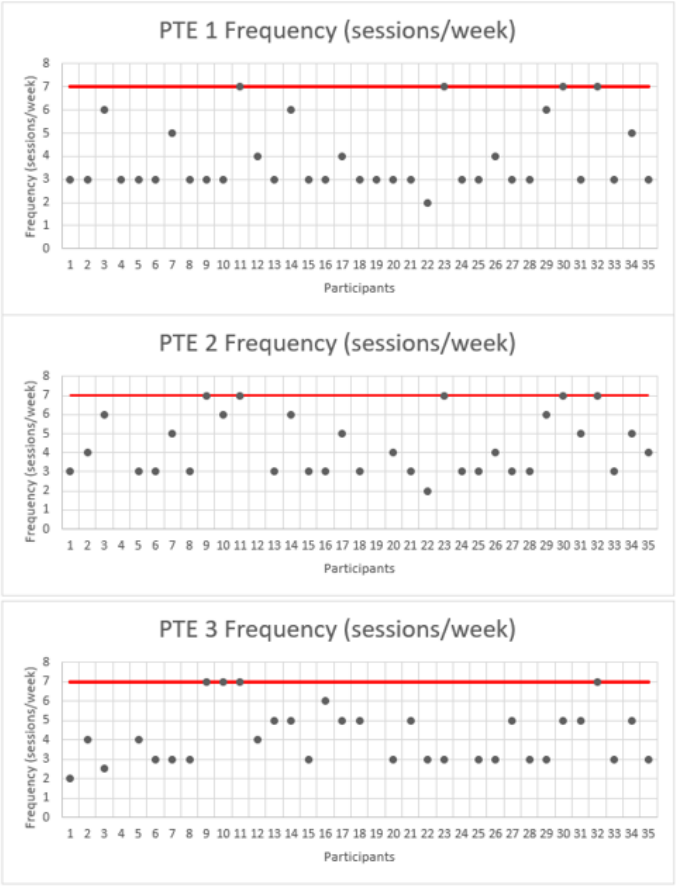


Figure 2: prescribed frequency vs recommendations

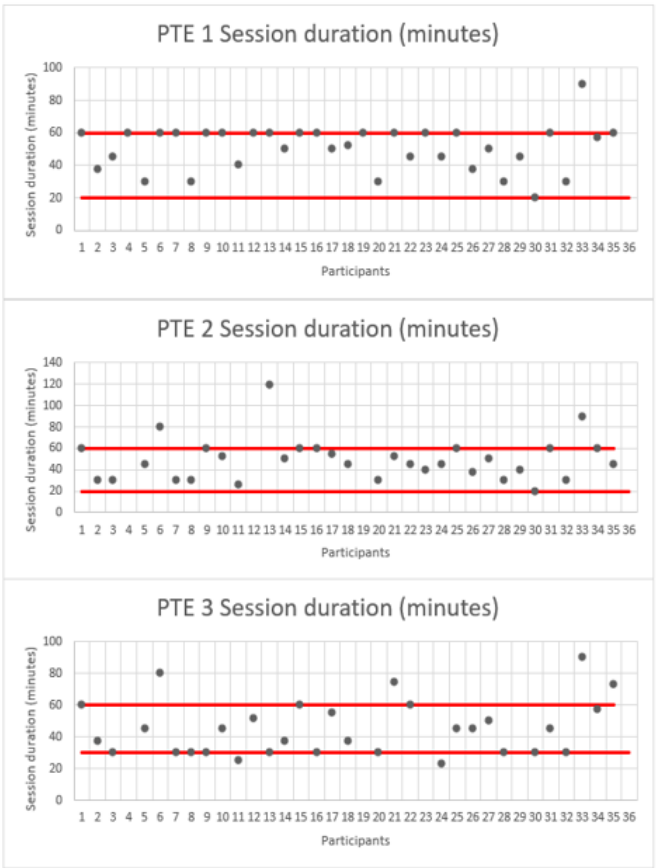


Figure 3: prescribed session duration vs recommendations

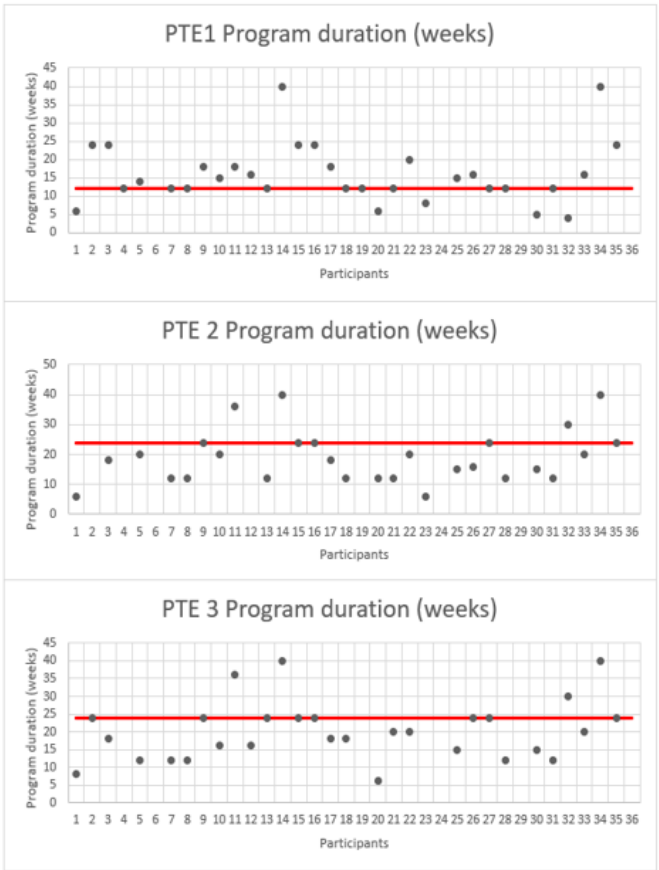


Figure 4: prescribed program duration vs recommendations

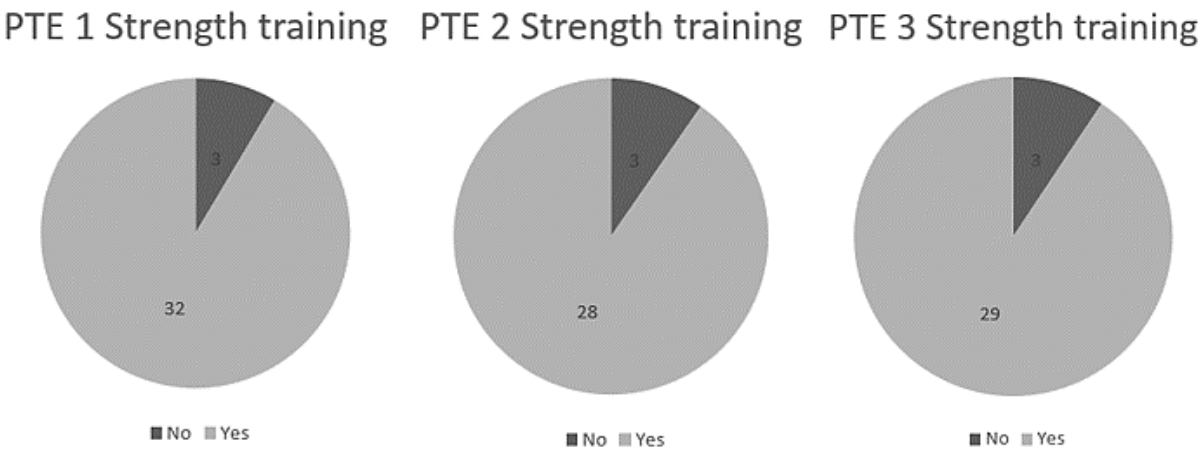


Figure 5: strength training included (#participants)

5. Discussion

The objective of this study was to determine to what extent physiotherapists prescribe exercise therapy according to the most recent guidelines. This resulted in an analysis of the exercise therapy prescribed by 35 physiotherapists.

The hypothesis for the first research question stated that physiotherapists would prescribe exercise therapy according to the most recent guidelines. By comparing the prescription parameters of physiotherapists and the recommendations of the EXPERT tool, some discrepancies became visible. These may be explained by different habits in the prescription of exercise therapy, as well as education and even the organisation where exercise therapy is provided.

The intensity prescribed by physiotherapists was significantly higher in PTE 1 (p-value 0.0019) and PTE 2 (p-value 0.0003) compared to the EXPERT tool, while in PTE 3 (p-value 1.0000), the prescribed intensity did meet the guideline recommendation (figure 1). Although it is important to note that the EXPERT tool only provided an upper limit and no training interval because of an ischemic threshold at 90 bpm, which was given in the case formulation. This made the intensity determination much easier and probably gives a distorted picture for the total intensity analysis because of the extremely low percentage of incorrect prescriptions. According to the guidelines published by Vanhees et al. (2012) and Piepoli et al. (2016), moderate exercise intensity is the most effective therapy. Vissers et al. (2013) confirm in their systematic review that for reduction of visceral adipose tissue, a moderate to vigorous intensity should be reached in obese patients. The reason why physiotherapists prescribed a higher intensity could be due to the EXPERT tool that gives an interval in which the patient needs to train, while the physiotherapists were not instructed to fill in an interval, resulting in a single heartbeat as the answer. Hansen et al. (2017) reported also in an earlier study (including cardiologists and physiotherapists) that 74% of the intensity prescription did not correspond with the recommendations. This does not match with the calculated percentage in this study of 42.31%, which is probably a distorted image because of the third case as explained earlier. When omitting this third case from the analysis, a higher percentage of 58.81% has been calculated which seems to be more accurate and more trustworthy. Another reason could be the application of high intensity interval training (HIIT) in rehabilitation as a couple of participants reported this as additional training. A recent systematic review and meta-analysis concluded that HIIT could improve peak VO2 in patients

with myocardial infarction(Qin, Kumar Bundhun, Yuan, & Chen, 2022). This same conclusion has been made for patients with type 2 diabetes in (Liu, Zhu, Li, Li, & Xu, 2019). So, after the analysis it is clear that the physiotherapists did not prescribe the correct amount of intensity as recommended by the EXPERT tool.

Frequency was significantly lower in each case. This indicates that the physiotherapists systematically underestimated the recommended frequency of seven times a week that was determined by the EXPERT tool as shown in figure 2. This is also stated in the guidelines of Corra et al. (2010) and Piepoli et al. (2016), who recommended a minimum of three to five sessions per week, but also declared that the favourable frequency is seven times per week. In addition, Thompson (2005), suggested to instruct patients with coronary artery disease to exercise on a daily basis. Choi and Choi (2022) linked an increased frequency of moderate to vigorous physical activity of more than five times per week to a decreasing risk of CVD in an elderly population. This was confirmed in a meta-analysis of 21 prospective cohort studies which found consistently that a high level of PA resulted in a lower risk of CVD (Li & Siegrist, 2012). Contradictory findings are reported in literature regarding the prescription of frequency as Uddin et al. (2016) shows a great variation among different studies. Current research indicates that the prescription of exercise frequency did correspond with the EXPERT tool (Hansen et al., 2017), while there are also reports of significant differences and significant inter-clinician variances regarding frequency prescription (Hansen, Ruiz, et al., 2018). A probable reason why physiotherapists prescribed a significant lower training frequency here could be due to misinterpretation. The given answers could be the actual number of sessions in the concerned work setting of the physiotherapist. Chances are high that these patients, in real life, should also have received some home-exercises which would result in a frequency that could be higher than the results indicate. Multiple participants indicated that, for additional training, they instructed the patient to do walking, cycling, yoga or other activities as home exercises to elevate their PA level. The analysis showed that the participants did systematically underestimate the training frequency.

The prescription of session duration showed a significant difference in PTE 1 and PTE 2 compared to the EXPERT tool although almost all the prescribed session durations laid between the interval (figure 3). In PTE 1 97.14% of the prescribed session durations lays between the interval recommended by the EXPERT tool. For PTE 2 is this 90.63% and for PTE 3 83.87%. Literature shows that the minimum session duration of a continuous training, as

recommended by the EXPERT tool, should be at least 20 minutes with at the end a mild to moderate perceived fatigue level (Mezzani et al., 2013). According to Piepoli et al. (2016) a session duration between 40 and 60-90 minutes is recommended for lipid control in patients with dyslipidaemia. Previous findings are, again, contradictory showing that the prescribed session duration matches with the recommendations on one hand (Hansen et al., 2017), while on the other hand (Hansen, Ruiz, et al., 2018) found significant differences and significant inter-clinician variances. Possibly, this distorted representation as seen in figure 3 can be the result of working with an average value in the statistical analysis instead of the median. Due to the great inter-clinician variance, it must be concluded that the prescribed session durations did not meet the current guidelines, although the mean lies within the recommended interval.

For program duration, no significant differences were observed in the analysis, meaning that the prescription of it was according to the guidelines (Corra et al., 2010; Mezzani et al., 2013; Piepoli et al., 2016). Still, large inter-clinician variances are present within the prescription of program durations ranging from three to 40 weeks (figure 4). This was also found by Hansen et al. (2017) with programs which ranged up to 52 weeks in similar cases as used in this study. Additionally, in PTE 2 and PTE 3 where the recommended program duration was >24 weeks, 67.86% of the physiotherapists prescribed a program duration <24 weeks in PTE 2 and 58.62% in PTE 3. However, program duration also depends on a lot of personal factors such as how satisfied the patient is with the perceived level of functioning, motivational level, are training goals achieved, etc., which is also reported by Achttien et al. (2013) & Kraal, Vromen, Spee, Kemps, and Peek (2017). Therefore, determining the duration of the program in advance is, considering the minimal programme duration, rather an estimation than a fixed number of weeks. Santiago de Araújo Pio, Marzolini, Pakosh, and Grace (2017) reported in their systematic review significantly less percutaneous coronary interventions (PCI) when at least 36 sessions of CR were implemented. They did suggest a minimum of 12 sessions for improvements with more sessions resulting in more benefits. In the long term it is beneficial to also work on the self-efficacy of the patient as Kalter-Leibovici et al. (2017) showed that disease management could elongate the time till hospital admission for heart failure. On top of this, it seemed to improve quality of life and mental state which are at least equally important as controlling the disease itself.

The implementation of strength training was recommended by the EXPERT tool in each case and most of the physiotherapists prescribed it. This results in an inclusion rate of 91.43% in PTE 1, 90.23% in PTE 2 and 90.63% in PTE 3. This could mean that the awareness of the positive effects of strength training among the included physiotherapists is high. Strength training can cause a reduction in heart rate and blood pressure in CVDs (Bjarnason-Wehrens et al., 2004), while it has also a positive effect on the blood glucose levels & glycemic control in diabetes mellitus type 2 according to the guideline of Colberg et al. (2010) and systematic review of Ishiguro et al. (2016). Multiple other studies have shown that the inclusion of strength training in addition to endurance training has superior effects rather than endurance training alone (Hansen et al., 2019; Lee, Lee, & Stone, 2020).

Based on the analysed data in this study, it is safe to say that great inter-clinician variances exist in prescribing exercise parameters. Due to the availability of multiple guidelines, differing with minor nuances, the uniformity in prescription drops which explains the high variety in exercise prescription and is likely to result in a lower quality of care. This is also stated in the study of Abell et al. (2016) and (Hansen, Ruiz, et al., 2018). Another reason that possibly can explain the variance are specific barriers to follow these recommendations (Goud et al., 2010), causing altered prescriptions of exercise parameters and therefore lower concordance to the guidelines. More than half of the participants in this study said that their workplace did not have the right equipment to follow the guidelines. Goud et al. (2010) detected via a semi-structured interview three possible barriers that withheld the clinician to properly follow the accessible guidelines; 1) barriers using objective instruments to assess the patient needs for CR, 2) barriers using the proper assessment of the risk behaviour and lifestyle of patients, 3) barriers to therapy decision-making according to guideline recommendations. More concretely, time-management and the inaccessibility of sufficiently sophisticated equipment needed to follow the guideline recommendations seem to be the most limiting factors, also referred to as external barriers. Another possibility is that 95% of our participants indicated that the current guidelines for exercise prescription were not always clear and did not fully implement them in their practice. Nevertheless, it must be considered that the EXPERT tool is not the gold standard in exercise prescription but only an instrument that prescribes exercise therapy according to the recommendations of the practice guidelines and expert opinions included in the tool (Hansen, Ruiz, et al., 2018).

6. Strengths & Limitations

Above-mentioned results and conclusions should be taken into consideration with some limitations of this study. The biggest limitation of this study is the small number of physiotherapists that responded to the invitation to partake. This resulted in a lower statistical power because mostly non-parametric tests had to be executed because of the requirements that were not fulfilled. Another result of this is that the generalisation of the results for physiotherapists must be carefully interpreted because of a potential non-participation bias. It is entirely possible that mostly physiotherapists that had interest in or worked in CR, agreed to participate in the study as 71.89% of the participants work at least partly in a hospital setting. Because of the focus in this study on CVD, further research has to be done to translate these findings to other diseases or exercise therapy in general. Questions were not always specific enough, for example when exercise intensity was asked in the form of bpm, it was not clearly stated that one should give a training interval. This resulted in mostly a single number of bpm for an answer, which was not clear if it was an upper or lower extremity of the training range or the mean of both, whereby a possible misinterpretation of the results exists. Another weakness is the limited amount of only three cases that the participants had to solve, which finally only provides three sources of data for each exercise parameter to come to a general conclusion. Especially for exercise intensity, the third case seemed to be too easy because of the information given in this case, causing a distortion of the analysis.

The chance of measurement errors has been reduced since the EXPERT tool is an objective instrument that provides the most recent guideline recommendations. This resulted in a uniform and standardised approach to gather the data for processing. Another strength of this study is the fact that firstly a systematic review has been conducted to research the evidence around the subject. This resulted in a study that focussed on a population that has not been researched separately in this domain before. So, this is the first study that researched the exercise prescription in physiotherapists only. An additional strength is that the subject of this study is clinically truly relevant as CVD have a growing incidence due to inactivity and is a disease which needs a very individualised approach according to the profile of the patient.

7. Conclusion

This study concludes that physiotherapists do not entirely succeed to prescribe exercise therapy for CVD in concordance with the current guidelines. Only for the program duration and implementation of strength training, the participants made the correct prescription. Another conclusion is the fact that a great inter-clinician variance is present as could be detected in every exercise modality. No correlations of socio-demographic factors with the correctness of exercise prescription in concordance with the current guidelines has been found. As this study has been executed on a small scale, further research on a much larger scale has to be done to generalize, confirm and consolidate these findings.

8. References

1. Abell, B., Glasziou, P., Briffa, T., & Hoffmann, T. (2016). Exercise training characteristics in cardiac rehabilitation programmes: a cross-sectional survey of Australian practice. *Open Heart, 3*(1). doi:10.1136/openhrt-2015-000374
2. Achttien, R. J., Staal, J. B., van der Voort, S., Kemps, H. M., Koers, H., Jongert, M. W., . . . Practice Recommendations Development, G. (2013). Exercise-based cardiac rehabilitation in patients with coronary heart disease: a practice guideline. *Neth Heart J, 21*(10), 429-438. doi:10.1007/s12471-013-0467-y
3. Andersson, C., & Vasan, R. S. (2018). Epidemiology of cardiovascular disease in young individuals. *Nat Rev Cardiol, 15*(4), 230-240. doi:10.1038/nrcardio.2017.154
4. Arundale, A. J. H., Bizzini, M., Giordano, A., Hewett, T. E., Logerstedt, D. S., Mandelbaum, B., . . . Snyder-Mackler, L. (2018). Exercise-Based Knee and Anterior Cruciate Ligament Injury Prevention. *J Orthop Sports Phys Ther, 48*(9), A1-a42. doi:10.2519/jospt.2018.0303
5. Bjarnason-Wehrens, B., Mayer-Berger, W., Meister, E. R., Baum, K., Hambrecht, R., Gielen, S., . . . Rehabilitation. (2004). Recommendations for resistance exercise in cardiac rehabilitation. Recommendations of the German Federation for Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil, 11*(4), 352-361. doi:10.1097/01.hjr.0000137692.36013.27
6. Bjarnason-Wehrens, B., McGee, H., Zwisler, A. D., Piepoli, M. F., Benzer, W., Schmid, J. P., . . . Mendes, M. (2010). Cardiac rehabilitation in Europe: results from the European Cardiac Rehabilitation Inventory Survey. *Eur J Cardiovasc Prev Rehabil, 17*(4), 410-418. doi:10.1097/HJR.0b013e328334f42d
7. Blair, S. N. (2009). Physical inactivity: the biggest public health problem of the 21st century. *Br J Sports Med, 43*(1), 1-2.
8. Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., . . . Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med, 54*(24), 1451-1462. doi:10.1136/bjsports-2020-102955
9. Choi, Y., & Choi, J. W. (2022). Changes in the Frequency of Moderate-to-Vigorous Physical Activity and Subsequent Risk of All-Cause and Cardiovascular Disease Mortality. *Int J Environ Res Public Health, 19*(1). doi:10.3390/ijerph19010504
10. Colberg, S. R., Sigal, R. J., Fernhall, B., Regensteiner, J. G., Blissmer, B. J., Rubin, R. R., . . . American Diabetes, A. (2010). Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement. *Diabetes Care, 33*(12), e147-167. doi:10.2337/dc10-9990
11. Corrà, U., Piepoli, M. F., Carré, F., Heuschmann, P., Hoffmann, U., Verschuren, M., Halcox, J., Giannuzzi, P., Saner, H., Wood, D., Piepoli, M. F., Corrà, U., Benzer, W., Bjarnason-Wehrens, B., Dendale, P., Gaita, D., McGee, H., Mendes, M., Niebauer, J., Zwisler, A. D., & Schmid, J. P. (2010). Secondary prevention through cardiac rehabilitation: physical activity counselling and exercise training: key components of the position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. Eur Heart J, 31(16), 1967-1974
12. Fiuza-Luces, C., Garatachea, N., Berger, N. A., & Lucia, A. (2013). Exercise is the real polypill. *Physiology (Bethesda), 28*(5), 330-358. doi:10.1152/physiol.00019.2013
13. Fiuza-Luces, C., Santos-Lozano, A., Joyner, M., Carrera-Bastos, P., Picazo, O., Zugaza, J. L., . . . Lucia, A. (2018). Exercise benefits in cardiovascular disease: beyond attenuation of traditional risk factors. *Nat Rev Cardiol, 15*(12), 731-743. doi:10.1038/s41569-018-0065-1
14. Goud, R., van Engen-Verheul, M., de Keizer, N. F., Bal, R., Hasman, A., Hellemans, I. M., & Peek, N. (2010). The effect of computerized decision support on barriers to guideline implementation: a qualitative study in outpatient cardiac rehabilitation. *Int J Med Inform, 79*(6), 430-437. doi:10.1016/j.ijmedinf.2010.03.001
15. Green, D. J., Hopman, M. T., Padilla, J., Laughlin, M. H., & Thijssen, D. H. (2017). Vascular Adaptation to Exercise in Humans: Role of Hemodynamic Stimuli. *Physiol Rev, 97*(2), 495-528. doi:10.1152/physrev.00014.2016
16. Hansen, D., Dendale, P., Coninx, K., Vanhees, L., Piepoli, M. F., Niebauer, J., . . . Doherty, P. (2017). The European Association of Preventive Cardiology Exercise Prescription in Everyday Practice and Rehabilitative Training (EXPERT) tool: A digital training and decision support system for optimized exercise prescription in cardiovascular disease. Concept, definitions and construction methodology. *European Journal of Preventive Cardiology, 24*(10), 1017-1031. doi:10.1177/2047487317702042
17. Hansen, D., Kraenkel, N., Kemps, H., Wilhelm, M., Abreu, A., Pfeiffer, A. F. H., . . . Voller, H. (2019). Management of patients with type 2 diabetes in cardiovascular rehabilitation. *European Journal of Preventive Cardiology, 26*(2_SUPPL), 133-144. doi:10.1177/2047487319882820
18. Hansen, D., Niebauer, J., Cornelissen, V., Barna, O., Neunhäuserer, D., Stettler, C., . . . Dendale, P. (2018). Exercise Prescription in Patients with Different Combinations of Cardiovascular Disease Risk Factors: A Consensus Statement from the EXPERT Working Group. *Sports Med, 48*(8), 1781-1797. doi:10.1007/s40279-018-0930-4
19. Hansen, D., Ruiz, G. R., Doherty, P., Iliou, M. C., Vromen, T., Hinton, S., . . . Grp, E. E. W. (2018). Do clinicians prescribe exercise similarly in patients with different cardiovascular diseases? Findings from the EAPC EXPERT working group survey. *European Journal of Preventive Cardiology, 25*(7), 682-691. doi:10.1177/2047487318760888
20. Hunt, D. L., Haynes, R. B., Hanna, S. E., & Smith, K. (1998). Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review. *Jama, 280*(15), 1339-1346. doi:10.1001/jama.280.15.1339
21. Ishiguro, H., Kodama, S., Horikawa, C., Fujihara, K., Hirose, A. S., Hirasawa, R., . . . Sone, H. (2016). In Search of the Ideal Resistance Training Program to Improve Glycemic Control and its Indication for Patients with Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis. *Sports Med, 46*(1), 67-77. doi:10.1007/s40279-015-0379-7
22. Jette, D. U., Hunter, S. J., Burkett, L., Langham, B., Logerstedt, D. S., Piuzzi, N. S., . . . Zeni, J., Jr. (2020). Physical Therapist Management of Total Knee Arthroplasty. *Phys Ther, 100*(9), 1603-1631. doi:10.1093/ptj/pzaa099
23. Kalter-Leibovici, O., Freimark, D., Freedman, L. S., Kaufman, G., Ziv, A., Murad, H., . . . Silber, H. (2017). Disease management in the treatment of patients with chronic heart failure who have universal access to health care: a randomized controlled trial. *BMC Med, 15*(1), 90. doi:10.1186/s12916-017-0855-z
24. Kinugasa, Y., & Yamamoto, K. (2017). The challenge of frailty and sarcopenia in heart failure with preserved ejection fraction. *Heart, 103*(3), 184-189. doi:10.1136/heartjnl-2016-309995
25. Kraal, J. J., Vromen, T., Spee, R., Kemps, H. M. C., & Peek, N. (2017). The influence of training characteristics on the effect of exercise training in patients with coronary artery disease: Systematic review and meta-regression analysis. *Int J Cardiol, 245*, 52-58. doi:10.1016/j.ijcard.2017.07.051

26. Lee, J., Lee, R., & Stone, A. J. (2020). Combined Aerobic and Resistance Training for Peak Oxygen Uptake, Muscle Strength, and Hypertrophy After Coronary Artery Disease: a Systematic Review and Meta-Analysis. *J Cardiovasc Transl Res, 13*(4), 601-611. doi:10.1007/s12265-019-09922-0
27. Lewinter, C., Doherty, P., Gale, C. P., Crouch, S., Stirk, L., Lewin, R. J., . . . Bland, J. M. (2015). Exercise-based cardiac rehabilitation in patients with heart failure: a meta-analysis of randomised controlled trials between 1999 and 2013. *Eur J Prev Cardiol, 22*(12), 1504-1512. doi:10.1177/2047487314559853
28. Li, J., & Siegrist, J. (2012). Physical activity and risk of cardiovascular disease--a meta-analysis of prospective cohort studies. *Int J Environ Res Public Health, 9*(2), 391-407. doi:10.3390/ijerph9020391
29. Liu, J. X., Zhu, L., Li, P. J., Li, N., & Xu, Y. B. (2019). Effectiveness of high-intensity interval training on glycemic control and cardiorespiratory fitness in patients with type 2 diabetes: a systematic review and meta-analysis. *Aging Clin Exp Res, 31*(5), 575-593. doi:10.1007/s40520-018-1012-z
30. Mezzani, A., Hamm, L. F., Jones, A. M., McBride, P. E., Moholdt, T., Stone, J. A., . . . Williams, M. A. (2013). Aerobic exercise intensity assessment and prescription in cardiac rehabilitation: a joint position statement of the European Association for Cardiovascular Prevention and Rehabilitation, the American Association of Cardiovascular and Pulmonary Rehabilitation and the Canadian Association of Cardiac Rehabilitation. *Eur J Prev Cardiol, 20*(3), 442-467. doi:10.1177/2047487312460484
31. Minn, Y. K., & Suk, S. H. (2017). Higher skeletal muscle mass may protect against ischemic stroke in community-dwelling adults without stroke and dementia: The PRESENT project. *BMC Geriatr, 17*(1), 45. doi:10.1186/s12877-017-0433-4
32. Niessner, A., Richter, B., Penka, M., Steiner, S., Strasser, B., Ziegler, S., . . . Huber, K. (2006). Endurance training reduces circulating inflammatory markers in persons at risk of coronary events: impact on plaque stabilization? *Atherosclerosis, 186*(1), 160-165. doi:10.1016/j.atherosclerosis.2005.06.047
33. Piepoli, M. F., Hoes, A. W., Agewall, S., Albus, C., Brotons, C., Catapano, A. L., . . . Zamorano, J. L. (2016). 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts): Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *Eur J Prev Cardiol, 23*(11), Np1-np96. doi:10.1177/2047487316653709
34. Qin, Y., Kumar Bundhun, P., Yuan, Z. L., & Chen, M. H. (2022). The effect of high-intensity interval training on exercise capacity in post-myocardial infarction patients: a systematic review and meta-analysis. *Eur J Prev Cardiol, 29*(3), 475-484. doi:10.1093/eurjpc/zwab060
35. Sahebkar, A., Kotani, K., Serban, C., Ursoniu, S., Mikhailidis, D. P., Jones, S. R., . . . Banach, M. (2015). Statin therapy reduces plasma endothelin-1 concentrations: A meta-analysis of 15 randomized controlled trials. *Atherosclerosis, 241*(2), 433-442. doi:10.1016/j.atherosclerosis.2015.05.022
36. Santiago de Araújo Pio, C., Marzolini, S., Pakosh, M., & Grace, S. L. (2017). Effect of Cardiac Rehabilitation Dose on Mortality and Morbidity: A Systematic Review and Meta-regression Analysis. *Mayo Clin Proc, 92*(11), 1644-1659. doi:10.1016/j.mayocp.2017.07.019
37. Shimada, K., Mikami, Y., Murayama, T., Yokode, M., Fujita, M., Kita, T., & Kishimoto, C. (2011). Atherosclerotic plaques induced by marble-burying behavior are stabilized by exercise training in experimental atherosclerosis. *Int J Cardiol, 151*(3), 284-289. doi:10.1016/j.ijcard.2010.05.057
38. Shoemaker, M. J., Dias, K. J., Lefebvre, K. M., Heick, J. D., & Collins, S. M. (2020). Physical Therapist Clinical Practice Guideline for the Management of Individuals With Heart Failure. *Phys Ther, 100*(1), 14-43. doi:10.1093/ptj/pzz127
39. Spahillari, A., Mukamal, K. J., DeFilippi, C., Kizer, J. R., Gottdiener, J. S., Djoussé, L., . . . Shah, R. V. (2016). The association of lean and fat mass with all-cause mortality in older adults: The Cardiovascular Health Study. *Nutr Metab Cardiovasc Dis, 26*(11), 1039-1047. doi:10.1016/j.numecd.2016.06.011
40. Thijssen, D. H. J., Redington, A., George, K. P., Hopman, M. T. E., & Jones, H. (2018). Association of Exercise Preconditioning With Immediate Cardioprotection: A Review. *JAMA Cardiol, 3*(2), 169-176. doi:10.1001/jamacardio.2017.4495
41. Thompson, P. D. (2005). Exercise prescription and proscription for patients with coronary artery disease. *Circulation, 112*(15), 2354-2363. doi:10.1161/CIRCULATIONAHA.104.502591
42. Uddin, J., Zwisler, A. D., Lewinter, C., Moniruzzaman, M., Lund, K., Tang, L. H., & Taylor, R. S. (2016). Predictors of exercise capacity following exercise-based rehabilitation in patients with coronary heart disease and heart failure: A meta-regression analysis. *Eur J Prev Cardiol, 23*(7), 683-693. doi:10.1177/2047487315604311
43. Vanhees, L., Rauch, B., Piepoli, M., van Buuren, F., Takken, T., Borjesson, M., . . . Writing Group, E. (2012). Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular disease (Part III). *Eur J Prev Cardiol, 19*(6), 1333-1356. doi:10.1177/2047487312437063
44. Vissers, D., Hens, W., Taeymans, J., Baeyens, J. P., Poortmans, J., & Van Gaal, L. (2013). The effect of exercise on visceral adipose tissue in overweight adults: a systematic review and meta-analysis. *Plos One, 8*(2), e56415. doi:10.1371/journal.pone.0056415
45. Vromen, T., Spee, R. F., Kraal, J. J., Peek, N., van Engen-Verheul, M. M., Kraaijenhagen, R. A., . . . Kemps, H. M. (2013). Exercise training programs in Dutch cardiac rehabilitation centres. *Neth Heart J, 21*(3), 138-143. doi:10.1007/s12471-013-0374-2
46. Walton, R., Dovey, S., Harvey, E., & Freemantle, N. (1999). Computer support for determining drug dose: systematic review and meta-analysis. *Bmj, 318*(7189), 984-990. doi:10.1136/bmj.318.7189.984
47. Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health benefits of physical activity: the evidence. *Cmaj, 174*(6), 801-809. doi:10.1503/cmaj.051351
48. World Health Organization. (2020, December 9). *The top 10 causes of death*. WHO. Retrieved 18-02-2022, from https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

9. Appendices

Appendix 1: participant invitation letter

Appendix 1: Version 3 Date: 22/06/2020
Participant invitation letter

Letter of invitation: English

Dear colleague,

Hasselt University is undertaking a study examining exercise prescription habits and skills by physiotherapists for people with (an elevated risk for) cardiovascular disease, using an online tool. The study includes both the assessment of current exercise prescription practice and the opportunity to access an online training tool (EXPERT tool) for a one-month period to train this skill. We would like to invite you to take part in the study, as you are a physiotherapist with expertise or interest in cardiovascular physiotherapy, or want to improve your exercise prescription skills to people with elevated risk for cardiovascular disease (such as obesity, diabetes, hypertension, etc.).

Taking part in the study will help to assess what exercise is prescribed by physiotherapists to people with (an elevated risk for) cardiovascular disease, and how it matches with the guidelines. It will also examine whether the 6-week use of the EXPERT tool changes or improves these exercise prescriptions or rehabilitation programs. The EXPERT tool is a digital decision support system for exercise prescription in cardiovascular disease, or an elevated disease risk for cardiovascular disease, developed by Hasselt University and the European Association of Preventive Cardiology (EAPC).[1] We would appreciate it if you would consider participating in this study. Participation is voluntary and free of charge.

If you feel interested to take part, please feel free to contact us by clicking on this weblink: https://study-expert-tool.edm.uhasselt.be. Before you decide whether to take part, however, it is important that you understand what the study is about and what you will be asked to do. Therefore, informed consent has to be read and signed first: by registering via the web link you are referred to these documents. All further steps in this study are then also explained in detail.

Your participation would be much appreciated. Thank you in anticipation.

Hasselt university

[1]Hansen D, et al. The European Association of Preventive Cardiology Exercise Prescription in Everyday Practice and Rehabilitative Training (EXPERT) tool: A digital training and decision support system for optimized exercise prescription in cardiovascular disease. Concept, definitions and construction methodology. Eur J Prev Cardiol 2017; 24: 1017-31.

Appendix 2: participant information

Participant information sheet

The evaluation of exercise prescription by physiotherapists to patients with (elevated risk for) cardiovascular disease by digitised patient simulations

You are invited to take part in a study. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. Talk to others about the study if you wish. Contact us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part.

What is the purpose of the study?
The aims of the study are (1) to examine current exercise prescription for those with (elevated risk for) cardiovascular disease (CVD) by physiotherapists and compare this with guidelines: (2) to examine whether the use of the EXPERT training tool for exercise prescription (developed by Hasselt university, Belgium; only available in English) for those with (elevated risk for) cardiovascular disease changes exercise prescription practice and skills in physiotherapists.

Why have I been asked to take part?
You have been asked to take part because you are currently a physiotherapist, with expertise or special interest in cardiovascular physiotherapy, or want to improve your exercise prescription skills to patients with an elevated risk for cardiovascular disease (obesity, diabetes, hypertension, etc.).

Do I have to take part?
No, it is up to you to decide whether to take part. If you decide to take part, please keep this information sheet and complete the online consent form that is accessible via the following web link: https://study-expert-tool.edm.uhasselt.be/docs/Consent Form.pdf. If you decide to take part, you are still free to withdraw at any time and without giving a reason.

What will happen if I take part?
If you agree to participate, you will complete an English baseline questionnaire, which will include information about you, how long you have been working in physiotherapy practice and your current exercise prescription practice. You will be asked whether you have used the EXPERT tool before and some questions about what you think about using an online support system for exercise prescription. You will receive online instruction about how to use the tool. You will then complete online exercise prescriptions for three patient cases using the EXPERT tool (only in English). Once you have completed the baseline tasks, you will have access to the online training part of the EXPERT tool for a 6-week period and will be asked to complete a minimum of nine patient cases (solutions will be available). In this way, you can train your exercise prescription skills whenever you want and make this as intense as you want. You will have access to other cases if you want to make greater use of the training. The tool will record which cases you access and how long you spend using it. You will receive a weekly reminder to use the tool. At the end of this period, you will be asked to repeat the same three patient cases that were in the baseline tasks and to answer questions about what you think about using an online support system for exercise prescription. Six months later you will be contacted and asked to complete a further three exercise prescription cases. We estimate that in total, you will spend between six and seven hours completing all the tasks and training over a seven-month period, for which accreditation points will be given. The role of Hasselt university in this study is to offer the EXPERT tool to you, and to assist you in case of technical difficulties.

If you decide to withdraw from the study, any information you provided before your withdrawal will be kept for analysis unless you specifically request otherwise.

Appendix 2: Version 3: 22/06/2021
Participant information sheet

What are the possible benefits of taking part?
You may increase your knowledge of exercise prescription guidelines by taking part in the study. The findings will help to inform whether it is possible to use an online training tool to assess and/or change cardiac rehabilitation exercise prescription practice, resulting in closer adherence to exercise guidelines.

What are the possible disadvantages and risks of taking part?
It is not thought that there are any disadvantages, however if you agree to participate, you will be required to give up between six and seven hours of your time to complete the tasks and online training.

Will my taking part in the study be kept confidential?
All personal identification information collected during the course of the research will be confidential and there are strict laws that safeguard your privacy at every stage. Your name and any other identifiable information will be removed from the data so that you cannot be recognised from it. Care will be taken to make sure that any data are non-identifiable if used in the presentation of findings.

What happens when the study is finished?
At the end of the research, the data you have provided will be stored once all personally identifiable data has been removed. This anonymised data may be made available to other researchers for further analysis once the results of the research have been published. The data will be stored for at least 10 years at Hasselt university.

What will happen to the results of the study?
The study findings may be published in healthcare journals and presented at conferences.

Who is organising the research and why?
The principal investigators organising the study are Prof. Dominique Hansen and Dr. Gustavo Rovelo Ruiz from Hasselt University. The study findings will help understand whether using an online training tool results in cardiovascular physiotherapy more closely adhering to exercise guidelines. This may result in improved training and support for physiotherapists working with people with (elevated risk for) cardiovascular disease.

Who has reviewed the study?
The study proposal has been reviewed and approved by the University of Hasselt ethics committee.

If you have further questions about the study protocol/content, please contact:
Dominique Hansen: Dominique.hansen@uhasselt.be
Hasselt university, Agoralaan, Building A, 3590 Diepenbeek, Belgium

If you have further technical questions concerning the EXPERT tool, please contact:
Gustavo Rovelo Ruiz:

Appendix 3: informed consent

Participant Consent Form

The evaluation of exercise prescription by physiotherapists to patients with (elevated risk for) cardiovascular disease by digitised patient simulations

I have read and understood the participant information sheet and this consent form.	☐
I have had the opportunity to ask questions about my participation.	☐
I understand that I am under no obligation to take part in this study.	☐
I understand that I have the right to withdraw from this study at any stage without giving any reason.	☐
I understand that data collected for the study may be shared with other researchers (on an anonymous basis). Data sharing will only be conducted as per the Economic Union General Data Protection Regulations (2017).	☐
I agree to participate in this study.	☐
I understand that the information collected about me will be used to support other research in the future.	☐
I give permission for the tracking of my use of the EXPERT training tool.	☐
I wish to receive a summary of the study results.	☐

If you wish to receive a summary of results, please provide an email address:

Name of participant: _____

Signature of participant: _____

Signature of researcher:

Date: _____

Contact details of the researcher

Name of researcher: Dominique Hansen
Address: Hasselt University, Agoralaan, Building A, 3590, Diepenbeek
Email / Telephone: Dominique.hansen@uhasselt.be / 0032 497 875866

Appendix 4: Privacy notice

Privacy Notice

Name of the research project: The evaluation of exercise prescription by physiotherapists to patients with (elevated risk for) cardiovascular disease by digitized patient simulations

Description of the research project: The study will consist of a baseline assessment of exercise prescription practice, 6-week-long access to an online training tool, and two further assessments of exercise prescription practice – one at the end of the training period and one six months later.

Data Controller	University of Hasselt
Purposes for collection/processing	To (1) examine current exercise prescription for those with cardiovascular disease (CVD) by physiotherapists and compare this with exercise prescription guidelines: (2) examine whether the use of the EXPERT training tool for exercise prescription for those with cardiovascular disease changes exercise prescription practice.
Legal basis	Under Article 6(1) of the General Data Protection Regulation (as the legal basis for processing data) the University of Hasselt is the data controller and the legal basis for this study is that you have given explicit consent to take part. You have been advised of your right to withdraw consent at any time and how to do this.
Whose information is being collected	Physiotherapists.
What type/classes/fields of information are collected	Information will be collected about your gender, age, qualifications, workplace, the experience of working in cardiac rehabilitation, and location. Information about exercise prescriptions assessed via the use of the EXPERT training tool and usage patterns of the training tool during the study.
Who is the information being collected from	Data is being collected directly from you.
How is the information being collected	The information is being collected via online questionnaires and via the use of the EXPERT training tool.
Is personal data shared externally	No
How secure is the information	Data will be stored on the University of Hasselt's secure data centers. These datacentres are resilient and feature access controls, environmental monitoring, backup power supplies, and redundant hardware. Information on these servers is backed up regularly. The University has various data protection and information security policies and procedures to ensure that appropriate organizational and technical measures are in place to protect the privacy of your personal data.
Who keeps the information updated	Professor Dominque Hansen is responsible for keeping the study information updated. He will ensure that your data is destroyed if you request this.
How long is the information kept for?	At the end of the research, electronic data will be kept securely for ten years and then will be destroyed as per the University of Hasselt guidance on the safe disposal of confidential waste. All electronic files containing data will be deleted from the secure university server where the data is held.
Will the data be used for any automated decision making?	No
Is information transferred to a third country outside the EEA and not included in the adequate countries list?	No

Appendix 5: baseline questionnaire

Baseline Questionnaire

Please complete the following details about yourself and your current practices:

Gender		Male
		Female
		Prefer not to say
Age		<30
		30-30
		40-49
		50-59
		60+
Qualifications (please tick all that apply):		
		Graduate/A1
		Licentiate
		BSc physiotherapy
		MSc physiotherapy
		PhD
Are you a member of AXXON?		
		Yes
		No
To how many patients with elevated cardiovascular risk (obesity, diabetes, hypertension, dyslipidemia) do you prescribe and/or implement exercise in a daily basis?		
To how many patients with cardiovascular disease do you prescribe and/or implement exercise on a daily basis?		
Do you have a 'bijzondere beroepsbekwaamheid in cardiovasculaire kinesitherapie'?		
		Yes
		No
In what setting do you work? (please tick all that apply)		
		Private practice
		Hospital
		Private practice and hospital
		Other (please state):

In cardiovascular rehabilitation, physiotherapists are advised to act according to published guidelines in order to maximize the clinical benefits and medical safety of exercise training. As part of this study, we would like to understand your personal opinion about the content, use, and implementation of these guidelines.

Please select which guideline you rely on when prescribing exercise to patients with (elevated risk for) cardiovascular disease:

☐ KNGF Guideline

☐ EAPC (European Association of Preventive Cardiology) Guideline

☐ Other (please define):

Below you find statements related to various factors that may be involved in the content, use, and implementation of clinical guidelines related to exercise prescription in cardiovascular rehabilitation. Please indicate your level of agreement with each of the following statements using the scale provided below. Only select a single option for each statement.

Totally disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Totally agree	Don't know
1	2	3	4	5	6	7	8

		1	2	3	4	5	6	7	8
1.	I fully understand how to prescribe cardiovascular rehabilitation exercise in accordance with the current guidelines (including for those with different combinations of CVD risk factors and diseases)								
2.	My workplace has the necessary infrastructure (e.g. space and equipment) to apply the current cardiovascular rehabilitation exercise guidelines in practice								
3.	There are no barriers to applying the current cardiovascular rehabilitation exercise guidelines in my work practice								
4.	I fully apply the current cardiovascular rehabilitation exercise guidelines in my work practice								
5.	The current cardiovascular rehabilitation exercise guidelines are easy to read and understand								
6.	The current cardiovascular rehabilitation exercise guidelines are specific to certain condition types								
7.	I am aware when an update of the cardiovascular rehabilitation exercise guidelines is published								
8.	I access and read any update of the cardiovascular rehabilitation exercise guidelines as soon as I am aware of it								
9.	I apply new cardiovascular rehabilitation exercise guidelines very soon after they have been published								
10.	The current cardiovascular rehabilitation exercise guidelines allow state-of-the art rehabilitation								

We are very interested to know whether your workplace or the people that you work with influence whether you choose to adhere (or are able to adhere) to the cardiovascular rehabilitation exercise guidelines. Please use your own words to tell us:

Do your work facilities affect your delivery of exercise prescription in cardiovascular rehabilitation? Yes ☐ No ☐	If Yes please tell us how:
Do the type of patients/participants that you work with affect your decisions about exercise prescription in cardiovascular rehabilitation? Yes ☐ No ☐	If Yes please tell us how:
Please tell us anything else that you feel would help us to understand how you make decisions about exercise prescription in cardiovascular rehabilitation:	

The following questions are about innovation and technology. Please select one response to each question:

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
I adopt innovation in my daily practice					
I have a positive attitude towards using computer programs in my daily practice					
I use computer programs in my daily practice					
I am comfortable using computer programs in my daily practice					
I am motivated to use computer programs as part of my daily practice					
I have good skills using computer programs for my daily practice					

Technology acceptance model

Clinical decision support systems (CDSS) are health information systems that support health/exercise professionals in their clinical decision making by providing them recommendations conform to clinical guidelines and scientific evidence. The EXercise Prescription in Everyday practice & Rehabilitative Training (EXPERT) tool is a clinical decision support system that provides a personalized exercise prescription for cardiovascular diseases that follows the latest EAPC recommendations and evidence. This system assists physicians and healthcare professionals in choosing and adopting the optimal exercise intervention in patients with various CVDs and/or a combination of risk factors.

Below you find 33 statements related to various factors that may be involved in the acceptance of clinical decision support systems as a working tool. Indicate your level of agreement with each of the following statements using the scale provided below. Only select a single option for each statement.

	Totally disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Totally agree
I feel comfortable with information and communication technologies.							
The use of CDSS could help me to prescribe exercise to my participants more rapidly.							
I think that I could easily learn how to use CDSS.							
I think it is a good idea to use CDSS to prescribe exercise to my participants.							
I would use a CDSS if it becomes available in my workplace.							
The use of CDSS may imply major changes in my exercise prescription practice.							
The use of CDSS may improve the exercise prescriptions for my participants.							
I think it would be easy to perform the tasks necessary for prescribing exercise to my participants using CDSS.							
Most of my participants will welcome the fact that I use CDSS.							
I think that my workplace has the necessary infrastructure to support my use of CDSS.							
CDSS could help me get the most out of my time to prescribe exercise to my participants.							
I believe that the exercise prescriptions made by CDSS would be clear and easy to understand.							
The use of CDSS is compatible with my work habits.							
Most of my colleagues will welcome the fact that I use CDSS.							
CDSS can improve my performance in participants' care.							
I think that CDSS is a flexible technology to interact with.							
I find it interesting to use CDSS for prescribing exercise to my participants.							

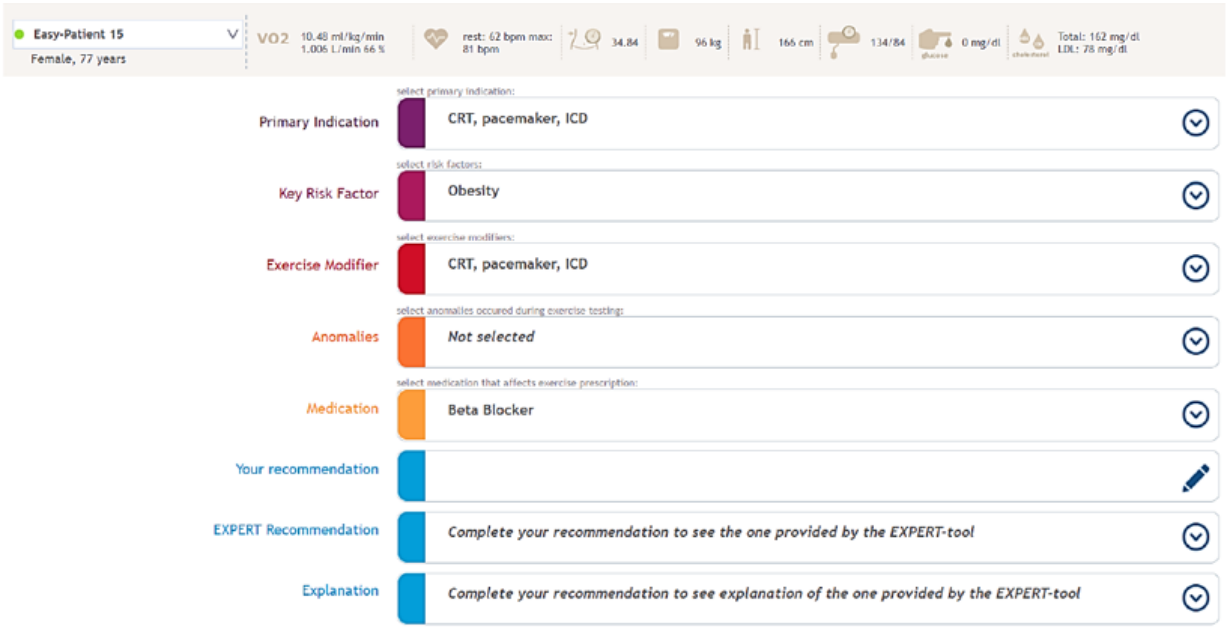
I have the intention to use CDSS when necessary to provide healthcare to my participants.							
I have already used CDSS to prescribe exercise to my participants.							
Health managers would welcome the fact that I use CDSS.							
CDSS can facilitate the care of my participants.							
The use of CDSS may promote the good clinical practice.							
The use of CDSS is beneficial for the care of my participants.							
I think I will find it easy to acquire the necessary skills to use CDSS.							
I would use CDSS if I receive appropriate training.							
Other health professionals (nurses, other specialists, etc...) would welcome the fact that I use CDSS.							
In general, CDSS may be useful to improve the care of my participants.							
I have the intention to use CDSS routinely for the care of my participants.							
The use of CDSS may interfere with the usual exercise prescribing for my participants.							
I think that the CSSS will be easy to use.							
In my opinion, the use of CDSS will have a positive impact.							
I would use CDSS if I receive the necessary technical assistance.							
I often use computing tools in my work.							

Further comments are welcome below

_____

_____

Appendix 6: EXPERT tool

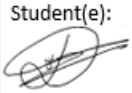
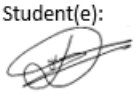
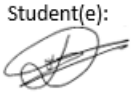
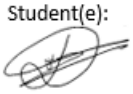


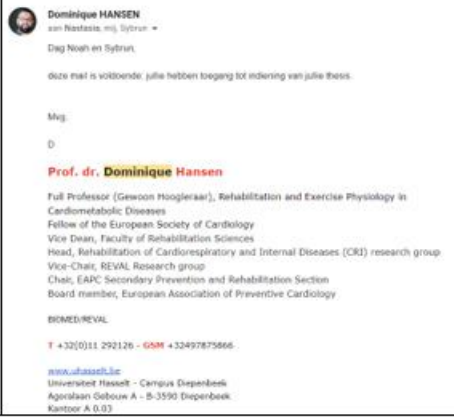
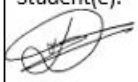
Appendix 7: Inventory MP II

www.uhasselt.be
Campus Hasselt | Martelarenlaan 42 | BE-3500 Hasselt
Campus Diepenbeek | Agoralaan gebouw D | BE-3590 Diepenbeek
T + 32(0)11 26 81 11 | E-mail: info@uhasselt.be

UHASSELT
KNOWLEDGE IN ACTION

INVENTARISATIEFORMULIER WETENSCHAPPELIJKE STAGE DEEL 2

DATUM	INHOUD OVERLEG	HANDTEKENINGEN
09/11/2021	- Overleg over ruwe data in Excel bestand om enkele zaken te verduidelijken. Hierna begon de verwerking van de verkregen data op zelfstandige basis. - Opdracht: invoeren casusoplossingen van de EXPERT tool.	Promotor: Copromotor/Begeleider: Student(e):  Student(e): 
15/02/2022	- Overleg statistische methoden en bespreking progressie data-extractie. De laatste data werd toegevoegd voor de verwerking waarna de finale statistische analyses zelfstandig uitgevoerd kon worden. - Opdracht: zoeken e-mail adressen afgestudeerde kinesitherapeuten in functie van contact name voor studie.	Promotor: Copromotor/Begeleider: Student(e):  Student(e): 
22/03/2022	- Controle statistische verwerking & bespreking vooruitgang MP 2.	Promotor: Copromotor/Begeleider: Student(e):  Student(e): 
25/05/2022	- Feedback MP 2 & overdracht appendices voor de MP. Deze feedback werd toegepast in de MP om voor het finale document de goedkeuring tot indiening te vragen.	Promotor: Copromotor/Begeleider: Student(e):  Student(e): 

30/05/2022	**Niet bindend advies:** De promotor verleent hierbij het advies om de masterproef **WEL**/NIET te verdedigen.  **Dominique HANSEN** aan Nastasia, mij, Sybrun Dag Noah en Sybrun, deze mail is voldoende: jullie hebben toegang tot indiening van jullie thesis. Mvg, D **Prof. dr. Dominique Hansen** Full Professor (Gewoon Hoogleraar), Rehabilitation and Exercise Physiology in Cardiometabolic Diseases Fellow of the European Society of Cardiology Vice Dean, Faculty of Rehabilitation Sciences Head, Rehabilitation of Cardiorespiratory and Internal Diseases (CRI) research group Vice-Chair, REVAL Research group Chair, EAPC Secondary Prevention and Rehabilitation Section Board member, European Association of Preventive Cardiology BIOMED/REVAL T +32(0)11 292126 - GSM +32497875866 www.uhasselt.be Universiteit Hasselt - Campus Diepenbeek Agoralaan Gebouw A - B-3590 Diepenbeek Kantoor A 0.03	Promotor: Copromotor/Begeleider: Student(e):  Student(e): 

In te vullen door de promotor(en) en eventuele copromotor aan het einde van MP2:

Naam Student(e): ..... Datum:.....

Titel Masterproef: .....

1) Geef aan in hoeverre de student(e) onderstaande competenties zelfstandig uitvoerde:
   - NVT: De student(e) leverde hierin geen bijdrage, aangezien hij/zij in een reeds lopende studie meewerkte.
   - 1: De student(e) was niet zelfstandig en sterk afhankelijk van medestudent(e) of promotor en teamleden bij de uitwerking en uitvoering.
   - 2: De student(e) had veel hulp en ondersteuning nodig bij de uitwerking en uitvoering.
   - 3: De student(e) was redelijk zelfstandig bij de uitwerking en uitvoering
   - 4: De student(e) had weinig tot geringe hulp nodig bij de uitwerking en uitvoering.
   - 5: De student(e) werkte zeer zelfstandig en had slechts zeer sporadisch hulp en bijsturing nodig van de promotor of zijn team bij de uitwerking en uitvoering.

Competenties	NVT	1	2	3	4	5
Opstelling onderzoeksvraag	O	O	O	O	O	O
Methodologische uitwerking	O	O	O	O	O	O
Data acquisitie	O	O	O	O	O	O
Data management	O	O	O	O	O	O
Dataverwerking/Statistiek	O	O	O	O	O	O
Rapportage	O	O	O	O	O	O

2) Niet-bindend advies: Student(e) krijgt toelating/geen toelating (schrappen wat niet past) om bovenvermelde Wetenschappelijke stage/masterproef deel 2 te verdedigen in bovenvermelde periode. Deze eventuele toelating houdt geen garantie in dat de student geslaagd is voor dit opleidingsonderdeel.

3) Deze wetenschappelijke stage/masterproef deel 2 mag wel/niet (schrappen wat niet past) openbaar verdedigd worden.

4) Deze wetenschappelijke stage/masterproef deel 2 mag wel/niet (schrappen wat niet past) opgenomen worden in de bibliotheek en docserver van de UHasselt.

Datum en handtekening Student(e)	Datum en handtekening promotor(en)	Datum en handtekening Co-promotor(en)
06/06/2022		