Supplemental file 1.

To:

Sedentary behaviour IntervenTion as a personaLisEd Secondary prevention Strategy (SIT LESS) for coronary artery disease patients participating in cardiac rehabilitation: rationale and design of the SIT LESS randomised clinical trial

B.M.A. van Bakel, MD[1]; S.H. Kroesen, MSc[1]; A. Günal, MD[2]; A. Scheepmaker, MD[2]; W.R.M. Aengevaeren, MD, PhD[3]; F.F. Willems, MD, PhD[3]; R. Wondergem, PhD[4,5,6]; M.F. Pisters, PhD[4,5,6]; J. Dam, MSc[7]; A.M. Janssen, MSc[7]; M. de Bruin, PhD[7]; M.T.E. Hopman, MD, PhD[1]; D.H.J. Thijssen, PhD[1,8]; T.M.H. Eijsvogels, PhD[1]

Affiliations:

1. Radboud university medical center, Radboud Institute for Health Sciences, Department of Physiology, Nijmegen, The Netherlands
2. Bernhoven hospital, Department of Cardiology, Uden, The Netherlands
3. Rijnstate hospital, Department of Cardiology, Arnhem, The Netherlands
4. Utrecht University, University Medical Center Utrecht Brain Center, Department of Rehabilitation, Physical Therapy Science and Sport, Utrecht, The Netherlands
5. Research Group Empowering Healthy Behaviour, Department of Health Innovations and Technology, Fontys University of Applied Sciences, Eindhoven, The Netherlands
6. Center for Physical Therapy Research and Innovation in Primary Care, Julius Health Care Centers, Utrecht, the Netherlands
7. Radboud university medical center, Radboud Institute for Health Sciences, Department of IQ healthcare, Nijmegen, The Netherlands
8. Research Institute for Sports and Exercise Sciences, Liverpool John Moores University, United Kingdom

Corresponding author:

Thijs M.H. Eijsvogels, PhD, Radboud university medical center, Dept. of Physiology, P.O. Box 9101, 6500 HB, Nijmegen, The Netherlands. E-mail: Thijs.Eijsvogels@radboudumc.nl Telephone: (+31) (0)24 36 14273 Fax: (+31) (0)24 3668340

Literature review to identify determinants of physical activity and sedentary behaviour

To identify the most important determinants of physical activity and sedentary behaviour in coronary artery disease patients a systematic literature review was conducted. On 31-07-2019, the following search string was used to identify eligible studies in the PubMed/MEDLINE, PsycINFO and EMBASE databases:

((myocardial infarction or ST elevation myocardial infarction or non ST elevation myocardial infarction or acute coronary syndrome or ischemic heart disease or ischaemic heart disease or coronary artery disease) ***and*** *(sedentary behavior or sedentary behaviour or sedentary lifestyle or sedentary time or sitting time or sitting behaviour or sitting behavior or inactivity or inactive or inactive lifestyle)* ***and*** *(determinant* or barrier* or facilitator* or facilitating factor or belief* or skill* or intention* or self-efficacy or attitude or risk perception or social influence or social norm)).af (all fields)*

Articles were included if adults (≥18 years old) with coronary artery disease or cardiovascular risk factors were studied, including at least one psychological determinant (e.g. self-efficacy, beliefs, motivation) in relation to physical activity and / or sedentary behaviour. We only included articles published in English and available as full-text. For efficiency purposes, we first selected review articles that covered previously published quantitative studies. Subsequently, qualitative articles were examined for in-depth understanding of beliefs, barriers and facilitators towards physical activity and sedentary behaviour. Therefore, the following search string was used to identify qualitative studies in the PubMed/MEDLINE, PsycINFO and EMBASE databases on 21-01-2020:

((cardiac rehab or myocardial infarction or ST elevation myocardial infarction or non ST elevation myocardial infarction or acute coronary syndrome or ischemic heart disease or ischaemic heart disease or coronary artery disease)* ***and*** *(sedentary behavior* or sedentary behaviour* or sedentary lifestyle or sedentary time or sitting time or sitting behaviour or sitting behavior or inactivity or inactive or inactive lifestyle)* ***and*** *(determinant* or barrier* or facilitator* or facilitating factor or belief* or skill* or intention* or self-efficacy or attitude or risk perception or social influence or social norm) and (qualitative or focusgroup* or interview*)).af (all fields)*

After achieving saturation regarding determinants no further articles were processed. The results of the literature review are summarised in the **Supplemental Table S1** below.

Supplemental Table S1. Determinants of physical activity and sedentary behaviour

		Reference number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
		Type^	R	R	R	R	R	R	R	R	R	B	B	C	C	C	C	C	C	C	C	C	Q	Q	Q	Q	Q	Q	Q	Q	Q
Determinants	**Effect***	**Quotes#**																													
A. Sociodemographic characteristics																															
Low education level	-			x																			x								
Low socioeconomic status	-			x		x						x											x	x	x						
Health literacy	+													x								x								
Older age	-	1, 2, 3				x																	x								
Greater household size	+																	x												
Depression	-	4, 5, 6				x					x	x												x					x		
Psychological wellbeing	+	7, 8														x								x	x						
Smoking	-					x																									
Poor health status	-	9																					x						x		
B. Subjective norm																															
Physician counselling	+	1, 2	x	x	x	x	x																x	x					x		
Social norms	-	3, 4																					x						x		
Family responsibilities	-																				x		x						x	x	
C. Attitude / behavioural intention																															
Lack of interest / motivation	-	1, 2, 3, 4, 5, 6	x	x		x																	x	x	x	x			x	x	
Pleasure	+		x																							x					

Expected functional gains	+		x																											
Long term health benefits	+			x				x								x				x										
Risk awareness	+																			x										
Lifelong active lifestyle	+																					x								
Comorbidities	-	7, 8, 9, 10, 11																				x		x	x		x	x		
Competing demands	-																												x	
Acceptance being sedentary	-	12																										x		
Low self-efficacy	-	13, 14	x	x		x								x						x		x		x				x		
Feelings of embarrassment	-																					x		x						
D. Self-regulatory processes																														
Lack of self-discipline	-																				x									
(Self-)monitoring tools	+	1	x	x			x						x												x	x	x	x		
Goal setting	+	2, 3																						x		x		x		
Regular contact / reminders	+		x										x																	
E. Facilitating factors																														
Written exercise prescription	+		x																											
Regular prompting	+												x														x			
Information by physician	+										x														x					
Social support	+	1, 2, 3	x	x	x							x	x			x		x				x	x	x		x		x		x
Access to facilities	+			x								x							x											
Tailored counselling	+			x					x		x																x			

Use of monitoring devices	+				x		x			x																	x				
Health maintenance	+	4, 5, 6																				x	x	x	x			x		
Positive role model	+	7																					x							
F. Intrapersonal barriers																														
Concerns functional capacity	-	1, 2	x	x		x																x	x					x	x	
Competing demands	-	3	x					x														x			x				x	
Work-related barriers	-	4																			x	x						x	x	
G. Interpersonal barriers																														
Social obligations	-																				x	x							x	
H. Environmental barriers																														
Inclement weather	-	1		x																		x	x		x				x	
Distance to exercise facility	-		x	x		x															x								x	
Remote controllers / elevators	-				x																									
I. Knowledge																														
Lack of knowledge	-	1, 2, 3, 4		x																		x	x	x						

^Study type: C: cohort study; Q: qualitative study; R: review.
*: effect of determinant: positive (+) = increase physical activity / reduce sedentary behaviour; negative (–) = decrease physical activity / increase sedentary behaviour.
#: quotes from qualitative articles:

A1. “Exercise is just too much for an older person”[21]
A2. “Exercise at my age. . . . I mean I’ll be 81 and I’m in pretty good shape and I’m not gonna change and do something that might mess things up”[21]
A3. “[I don’t exercise] because of my old age”[21]
A4. “It’s not the physical side that stopped me from getting up and walking around the block, it’s more the mental side of things”[22]
A5. “When I am feeling down, I can hardly even get myself out of bed, let alone do exercise”.[22]
A6. “I’ve gone through a divorce and it really affected me. I went through a phase where I said I don’t have to do it anymore and I just stopped. So I did the opposite. I just stopped being motivated to be active. I just sat.”[27]
A7. “Exercise was like a therapy for your mind and body”[22]

A8. “Exercise makes you feel good within yourself and gives you a mental uplift”[22]
A9. “I have a lot of other health issues I have to deal with before I think about my sitting time”[27]

B1. “Well, I think exercising is very important because my doctor has absolutely insisted and he was the one who got me started here and I’m still doing it three times a week.”[21]
B2. “The time I spent at the [cardiac] rehab was fabulous because we had people there who were checking how we were feeling and our levels”[22]
B3. “I think it wasn’t the ‘thing’ to do when I was younger, which is a long time ago”[21]
B4. “So, this week, one day I was standing and watching TV…. I did it for half an hour, and then afterwards, I sat down again. My wife found it strange. She was uncomfortable and found it strange so I did that for only one day and after that I didn’t do it again”[27]

C1. “I just don’t feel like it, I can’t be bothered”[22]
C2. “I find it all a waste of time, jogging about in the gym”[23]
C3. “Exercise is just never, never a thing in front of my mind. I guess because I was always so active”[21]
C4. “I ought to exercise but I don’t want to”[21]
C5. “I know it is good for me and I should be doing it. I should, but I don’t”[21]
C6. “I guess I am too lazy to exercise”[21]
C7. “Arthritis is one reason I don’t exercise”[21]
C8. “Right now I don’t have the lung capacity to swim. I really can’t do it anymore” [21]
C9. “Doing exercise to me is something painful”[21]
C10. “My back bothers me real bad when I try to walk. I get short of breath”[21]
C11. “My legs will bother me. It’s just too painful.”[21]
C12. “I read up to 2:00 AM sometimes. I know it’s bad for me but it’s what I enjoy and nor do I think I would want to change it.”[27]
C13. “I thought I was on the downward slide after having my heart attack and thinking like this made it harder to exercise”[22]
C14. “It was a bit of a shock when I had this heart attack. I really thought I was bullet-proof. I realise I’m not, and this has slowed me down. Up until the heart attack I felt quite fit, but since then I feel older and slower”[22]

D1. Using a self-monitoring tool for developing awareness of how sedentary their lifestyle was: “I really liked being able to see what I had done. And I can say, not exercising at all is a condition of extreme unconsciousness. And so, it just brings some form of exercise into consciousness. To be able to see how little or how much I did and how was I feeling and why did those things occur and how did I feel about it. It was just an awesome wakeup.”[25]
D2. “It’s important to always have goals in front of you”[22]
D3. “The journal I’m doing as part of the program has helped a lot. I can see how I’ve improved, and how I can improve more”[27]

E1. “Without my wife’s support to exercise, there is no way I would’ve got to the level I am now”[22]
E2. “My wife comes out 2 or 3 times per week, so she’s been very supportive that way”[22]
E3. “Being part of something like this program and going through something together in a group like we do at the moment in rehab would be really helpful”[27]
E4. “I don’t want another stroke. I am willing to follow any advice that will make me healthy”[27]
E5. “It helps me maintain my body, myself . . . because I like living and exercise is part of maintaining and being able to be productive”[21]
E6. “I want to enjoy watching my grandsons grow up”[22]
E7. “I met this guy at rehab who had not exercised much in the past, but had started, little by little, and now exercises every day. I thought, “if he can do it, surely I can too”[22]

F1. “You don’t have the same stamina and the same reserves within your body. Your energies are all totally depleted after heart surgery”[22]
F2. “Some of my sitting time is moving from pain to less pain. With the heat and the medications, I don’t think you can do much”[27]
F3. “By the time I got in from work, by the time I cooked supper and did the chores I had to do, there wouldn’t be any time left”[21]
F4. “I wouldn’t consider it [reducing sedentary behavior at work]. I don’t know where to incorporate it at work. I can’t be on my computer and walk at the same time and give it the same degree

of focus"[27]

H1. "Weather's a big thing, if it's cold and wet no one wants to go out and do exercise"[22]

I1. "I just don't know how much I can do now, especially when I get out of breath. But I am not sure I get anything from my walks if I don't get out of breath"[22]
I2. "I can walk very slowly for a fair distance, but that's not much good"[22]
I3. "What benefit can I get out of it?"[22]
I4. "If you could demonstrate to me what would happen if I reduced my sitting time and what the health benefits were, that would motivate me"[27]

REFERENCES

1. Allen J, Morelli V. Aging and exercise. *Clinics in geriatric medicine* 2011;27(4):661-71. doi: https://dx.doi.org/10.1016/j.cger.2011.07.010
2. Hui EKH, Rubenstein LZ. Promoting Physical Activity and Exercise in Older Adults. *Journal of the American Medical Directors Association* 2006;7(5):310-14. doi: http://dx.doi.org/10.1016/j.jamda.2006.03.006
3. Sallis R, Franklin B, Joy L, et al. Strategies for promoting physical activity in clinical practice. *Progress in cardiovascular diseases* 2015;57(4):375-86. doi: https://dx.doi.org/10.1016/j.pcad.2014.10.003
4. Resurreccion DM, Moreno-Peral P, Gomez-Herranz M, et al. Factors associated with non-participation in and dropout from cardiac rehabilitation programmes: a systematic review of prospective cohort studies. *European Journal of Cardiovascular Nursing* 2019;18(1):38-47. doi: http://dx.doi.org/10.1177/1474515118783157
5. Crookham J. A Guide to Exercise Prescription. *Primary Care - Clinics in Office Practice* 2013;40(4):801-20. doi: http://dx.doi.org/10.1016/j.pop.2013.08.002
6. Lewis SF, Hennekens CH. Regular Physical Activity: A 'Magic Bullet' for the Pandemics of Obesity and Cardiovascular Disease. *Cardiology (Switzerland)* 2016;134(3):360-63.
7. Lawlor ER, Bradley DT, Cupples ME, et al. The effect of community-based interventions for cardiovascular disease secondary prevention on behavioural risk factors. *Preventive Medicine: An International Journal Devoted to Practice and Theory* 2018;114:24-38.
8. McEwan D, Harden SM, Zumbo BD, et al. The effectiveness of multi-component goal setting interventions for changing physical activity behaviour: A systematic review and meta-analysis. *Health Psychology Review* 2016;10(1):67-88.
9. Piepoli MF, Villani GQ. Lifestyle modification in secondary prevention. *European Journal of Preventive Cardiology* 2017;24(3):101-07.
10. Myers V, Gerber Y. Physical activity and recovery from cardiovascular disease: A psychological perspective. New York, NY: Springer Science + Business Media; US 2016.
11. Oldenburg B, Baptista S, Cocker F, et al. Changing lifestyle behaviors to improve the prevention and management of cardiovascular disease. Handbook of psychocardiology , Vols. New York, NY: Springer Science + Business Media; US 2016:1-2 (pp. 1077-94). xxvi, 156.
12. Aaby A, Friis K, Christensen B, et al. Health literacy is associated with health behaviour and self-reported health: A large population-based study in individuals with cardiovascular disease. *European Journal of Preventive Cardiology* 2017;24(17):1880-88.
13. Bachmann JM, Mayberry LS, Wallston KA, et al. Relation of Perceived Health Competence to Physical Activity in Patients With Coronary Heart Disease. *American Journal of Cardiology* 2018;121(9):1032-38.
14. Kahkonen O, Kankkunen P, Miettinen H, et al. Perceived social support following percutaneous coronary intervention is a crucial factor in patients with coronary heart disease. *Journal of Clinical Nursing* 2017;26(9):1264-80.
15. Kim ES, Kubzansky LD, Soo J, et al. Maintaining healthy behavior: A prospective study of psychological well-being and physical activity. *Annals of Behavioral Medicine* 2017;51(3):337-47. doi: http://dx.doi.org/10.1007/s12160-016-9856-y
16. Loprinzi PD, Crush EA. Source and size of social support network on sedentary behavior among older adults. *American Journal of Health Promotion* 2018;32(1):28-31.
17. Perez A, Fleury J, Belyea M. Environmental resources in maintenance of physical activity 6 months following cardiac rehabilitation. *Clinical Nursing Research* 2016;25(4):391-409.

18. Platter M, Hofer M, Holzl C, et al. Supporting cardiac patient physical activity: a brief health psychological intervention. *Wiener Klinische Wochenschrift* 2016;128(5):175-81.
19. Ramirez FD, Chen Y, Di Santo P, et al. Association Between Self-Reported Potentially Modifiable Cardiac Risk Factors and Perceived Need to Improve Physical Health: A Population-Based Study. *Journal of the American Heart Association* 2017;6(5):03.
20. Won MH, Son Y-J. Perceived social support and physical activity among patients with coronary artery disease. *Western Journal of Nursing Research* 2017;39(12):1606-23. doi: http://dx.doi.org/10.1177/0193945916678374
21. Traywick LS, Schoenberg NE. Determinants of exercise among older female heart attack survivors. *Journal of Applied Gerontology* 2008;27(1):52-77.
22. Rogerson MC, Murphy BM, Bird S, et al. " I don't have the heart" : A qualitative study of barriers to and facilitators of physical activity for people with coronary heart disease and depressive symptoms. *International Journal of Behavioral Nutrition and Physical Activity* 2012;9 (no pagination)(140)
23. Clayton J, Ruston A. Exercising for a healthy heart: A qualitative study of women's beliefs. *Health Education Journal* 2003;62(1):29-40.
24. Korkiakangas EE, Alahuhta MA, Husman PM, et al. Motivators and barriers to exercise among adults with a high risk of type 2 diabetes-A qualitative study. *Scandinavian Journal of Caring Sciences* 2011;25(1):62-69.
25. Fukuoka Y, Lindgren T, Jong S. Qualitative exploration of the acceptability of a mobile phone and pedometer-based physical activity program in a diverse sample of sedentary women. *Public Health Nursing* 2012;29(3):232-40.
26. Ayotte BJ, Margrett JA, Hicks-Patrick J. Physical activity in middle-aged and young-old adults: The roles of self-efficacy, barriers, outcome expectancies, self-regulatory behaviors and social support. *Journal of Health Psychology* 2010;15(2):173-85.
27. Biswas A, Faulkner GE, Oh PI, et al. Patient and practitioner perspectives on reducing sedentary behavior at an exercise-based cardiac rehabilitation program. *Disability and rehabilitation* 2018;40(19):2267-74. doi: http://dx.doi.org/10.1080/09638288.2017.1334232
28. Fleury J, Lee SM, Matteson B, et al. Barriers to physical activity maintenance after cardiac rehabilitation. *Journal of Cardiopulmonary Rehabilitation* 2004;24(5):296-307. doi: http://dx.doi.org/10.1097/00008483-200409000-00002
29. Wong EM, Zhong XB, Sit JW, et al. Attitude toward the out-patient cardiac rehabilitation program and facilitators for maintenance of exercise behavior. *Psychology, Health & Medicine* 2016;21(6):724-34.