

BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com



Promoting Physical Activity in Regional and Remote Cancer Survivors (PPARCS) using Wearables and health-coaching: Randomised Controlled Trial protocol

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-028369
Article Type:	Protocol
Date Submitted by the Author:	05-Dec-2018
Complete List of Authors:	Hardcastle, Sarah; Curtin University, Psychology Hince, Dana; University of Notre Dame Jimenez-Castuera, Ruth; University of Extremadura Boyle, Terry; University of South Australia Cavalheri, Vinicius; Curtin University, Psychology Makin, Greg; St John of God Hospital Murdoch Tan, Patrick; St John of God Hospital Subiaco Barwood, Nigel; St John of God Hospital Murdoch Salfinger, Stuart; St John of God Hospital Subiaco Tan, Jason; St John of God Hospital Subiaco Mohan, Raj Ganendra; Hollywood Private Hospital Levitt, Michael; St John of God Hospital Subiaco Cohen, Paul; St John of God Hospital Subiaco Saunders, Christobel; The University of Western Australia, School of Surgery Platell, Cameron; University of Western Australia; St John of God Hospital Subiaco
Keywords:	ONCOLOGY, wearable technology, physical activity, health coaching, intervention

SCHOLARONE™
Manuscripts

PPARCS TRIAL PROTOCOL

1

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
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 Promoting Physical Activity in Regional and Remote Cancer Survivors (PPARCS)
2 using Wearables and health-coaching: Randomised Controlled Trial protocol

3
4 Sarah J. Hardcastle^{a,b*}, Dana Hince^c, Ruth Jiménez-Castuera^d, Terry Boyle^e, Vinicius
5 Cavalheri^f, Greg Makin^g, Patrick Tan^h, Nigel Barwood^g, Stuart Salfinger^h, Jason Tan^h,
6 Ganendra Raj Mohanⁱ, Michael Levitt^h, Paul A. Cohen^{b, h}, Christobel Saunders^{b, h},
7 Cameron Platell^{b, h}

8
9 ^a School of Psychology, Curtin University, Bentley, Western Australia, Australia

10 ^b School of Medicine, University of Western Australia, Crawley, Western Australia,
11 Australia

12 ^c Institute for Health Research, University of Notre Dame, Fremantle, Western Australia

13 ^d Faculty of Sport Sciences, University of Extremadura, Spain

14 ^e School of Health Sciences, University of South Australia, Australia

15 ^f School of Physiotherapy and Exercise Science, Western Australia, Australia

16 ^g St John of God Hospital, Murdoch, Western Australia, Australia

17 ^h St John of God Hospital, Subiaco, Western Australia, Australia

18 ⁱ Hollywood Private Hospital, Nedlands, Western Australia, Australia

19
20 *Sarah Hardcastle

21 Telephone: +61 439 226 015

22 Email: sarah.hardcastle@curtin.edu.au

23 School of Psychology, Curtin University, PO Box U1987, Perth, Western Australia

24 Word Count: 3998

ABSTRACT

Introduction: Physically active cancer survivors have significantly less cancer recurrence and improved survival compared to those who are inactive. However, the majority of survivors are insufficiently active. There are also significant geographic inequalities in cancer survival with poorer survival rates for the third of Australians who live in non-metropolitan areas compared to those living in major cities. The objective of the trial is to increase physical activity (PA), improve quality of life and reduce sedentary behaviour among cancer survivors living in regional and remote WA.

Methods and analysis: Ninety-four cancer survivors will be randomized intervention and control groups. Intervention group participants will receive: a Fitbit and up to six telephone health coaching sessions. PA, waist-circumference, quality of life and psychological variables will be assessed at baseline, 12-weeks and 24-weeks. A General Linear Mixed Model will be used to assess the effectiveness of the intervention. **Ethics**

and dissemination: Ethics approval has been obtained from St John of God Hospital Subiaco (HREC/#1201). We plan to submit a manuscript of the results to a peer-reviewed journal. Results will be presented at conferences, community and consumer forums and hospital research conferences. Trial registration number: ACTRN12618001743257, prospectively registered. Universal Trial Number: U1111-1222-5698. Protocol version: 1.0.

Keywords: oncology; wearable technology; physical activity; health coaching; intervention.

1 Strengths and limitations of this study

- 2 • The intervention has the potential to be a low-cost and scalable and hence,
3 integrated into existing health-care pathways.
- 4 • An objective measure of PA is used to provide accurate assessment of PA.
- 5 • Due to the postal nature of recruitment, the responders may not be a representative
6 sample of regional and remote cancer survivors.
- 7 • The relatively short follow-up period limits our assessment of the extended
8 acceptance of wearable technology in this population.

10 INTRODUCTION

11 Compared to the general population, cancer survivors are at an increased risk of
12 the development of secondary cancers, cardiovascular disease (CVD) and functional
13 decline[1, 2]. There are several possible explanations for the increased risk, one of which
14 is shared lifestyle risk factors[3]. Insufficient PA, low fruit and vegetable intake, smoking
15 and alcohol consumption make individuals susceptible to both cancer, CVD and other
16 chronic diseases[3].

17 The American Cancer Society PA guidelines for survivors are to participate in
18 150-minutes of moderate-intensity PA per week[4]. However, the majority of Australian
19 cancer survivors (~70-90%) do not meet the PA recommendations[5].

20 PA is associated with lower CVD-related comorbidity in survivors[2]. Physically
21 active survivors have significantly less cancer recurrence and improved survival
22 compared to those who are inactive, and these findings have been found across multiple
23 cancer types[6, 7]. Many survivors suffer additional comorbidities that put them at risk
24 of developing CVD[8]. As a result, insufficiently active survivors who fail to make

1 healthy lifestyle changes post-treatment are likely to have substantially higher risk of
2 developing CVD.

3 Together, colorectal, breast, prostate and uterine cancer account for 41% of all
4 cancer incidence in Western Australia (WA)[9]. Our rationale for targeting survivors of
5 these cancers is based on established risk or comorbid cardio-metabolic disease, and a
6 high prevalence of physical inactivity[10].

7 There are also significant geographic inequalities in cancer survival[8, 11].
8 Survival rates for Australians who live in non-metropolitan areas are poorer than for those
9 living in major cities[12]. Those living in remote areas of Australia are often
10 disadvantaged in relation to access to services, education, employment and income.
11 Mortality rates for all cancers combined are 1.4 times higher in remote areas compared
12 to major cities[12].

13 Existing PA programs for cancer survivors tend to be based in major cities but
14 rarely operate beyond the inner regional areas. Further, facility-based programs that are
15 offered for free initially, eventually incur a cost that may present a barrier to long-term
16 exercise adherence. Previous work with survivors has identified cost, and availability of
17 and access to exercise programs to be significant barriers to participation[13-15].
18 Survivors have also expressed a preference for home-based PA[13, 15, 16].

19 Home-based interventions are advantageous because they mitigate access and
20 transport issues, and are less expensive than supervised, facility-based programs that
21 require participants to attend classes or maintain a health club membership[17]. There is
22 a current gap in the literature on less intensive home-based interventions that employ
23 resource deployment according to patient need, and could more easily translate into
24 practice.

1
2
3
4 1 Furthermore, interventions that meet support needs and offer opportunities for
5
6 2 self-monitoring have been found to be effective in improving PA in survivors[18-20].
7
8 3 Wearable technology holds great potential as a low-cost self-monitoring tool to increase
9
10 4 PA in cancer survivors. Lyons et al.[21] recently reviewed 13 different wearables and
11
12 5 their associated mobile apps, and concluded that they use many of the same techniques
13
14 6 employed in typical PA behaviour change interventions (i.e. self-monitoring, feedback,
15
16 7 goal-setting, social support). Wearables are perceived as useful and acceptable to
17
18 8 individuals with chronic conditions[22]. Wearable activity trackers are acceptable to
19
20 9 older cancer survivors in metropolitan areas[23] and those living in regional and remote
21
22 10 areas of WA (Under revisions). Thus, wearables may represent a relatively low-cost,
23
24 11 feasible and scalable approach for widespread PA promotion.

25
26
27
28
29 12 The overriding aim of the study is to increase PA in adult cancer survivors residing
30
31 13 in regional and remote areas in Australia. Our primary objective is to investigate the
32
33 14 effectiveness of the intervention to increase PA, improve quality of life and reduce
34
35 15 sedentary behaviour among cancer survivors living in regional and remote WA.
36
37
38

39 16 **METHODS AND ANALYSIS**

40 41 17 **Study design**

42
43 18 A randomised controlled parallel group design will be employed. Participants
44
45 19 will be randomised into one of 2 arms: control vs. intervention, and assessments will be
46
47 20 made at baseline (T1), end of intervention (12-weeks) (T2) and at 24-weeks (T3). The
48
49 21 outcome (dependent) measures will include an objective measure of PA, Quality of life
50
51 22 (QoL), waist circumference, plus measures that indicate constructs from the Health
52
53 23 Action Process Approach Model (HAPA)[24] such as attitudes, action self-efficacy,
54
55 24 outcome expectancies, action planning, intentions and maintenance self-efficacy upon
56
57
58
59
60

1 which the intervention is designed. We will also measure a number of covariates that may
2 influence effects of the intervention including: age, gender, socio-economic status, cancer
3 type, months since diagnosis, disease stage, adjuvant treatment, and CVD risk factors.
4 Ethics approval was obtained from the St. John of God Hospital Human Research Ethics
5 Committee (#1201), and reciprocal approval will be approved from other participating
6 hospitals and sites. The trial will comply with CONSolidated Standards of Reporting
7 Trials (CONSORT) and Standard Protocol Items: Recommendations for Interventional
8 Trials (SPIRIT)[25, 26]. A completed SPIRIT checklist for the trial can be found in
9 Supporting Information.

10 Patient and public involvement

11 We have published several papers[13-16] from qualitative work with consumers. Such
12 consumer engagement and feedback has informed the content and type of intervention
13 that will be tested. For example, this work has identified motivation including ‘poor self-
14 discipline’ and ‘not the sporty type’ as the main PA barriers. Some participants held the
15 perception that they were already ‘doing sufficient PA’. Participants also referred to the
16 need for monitoring, support and accountability to help them in their behaviour change
17 efforts. These findings have fed into the design of the intervention in the following ways:
18 the promotion of lifestyle-related exercise such as walking takes away the ‘sporty type’
19 barrier; the use of activity trackers to provide objective feedback on PA can be helpful
20 for those who erroneously think they are undertaking sufficient PA; and the use of activity
21 trackers and health-coaching provides the self-monitoring, goal setting and support that
22 consumers have identified as important. Consumers that have trialled the wearable
23 trackers have reported the intervention to be acceptable and not burdensome (under

1
2
3
4 1 revisions). Study participants will be asked whether they wish to receive a report of the
5
6 2 results, and asked to provide an email address for dissemination of study results.
7
8

9 3 Setting and Participants

10 4 Participants will be cancer survivors diagnosed with cancer and completed active
11
12 5 treatment in the previous 5-years. Participants will reside in Australia and will have been
13
14 6 treated for either breast, prostate, colorectal or uterine cancer. Participants will be
15
16 7 recruited on the basis of (1) remoteness, and (2) low levels of PA. Remoteness will be
17
18 8 measured according to the Accessibility/Remoteness index of Australia and the
19
20 9 Australian Statistical Geography Standard which define five major areas: *major cities*,
21
22 10 *inner regional*, *outer regional*, *remote* and *very remote*[27]. Participants will be recruited
23
24 11 on the basis that they reside in either a regional or remote area. Eligible participants must
25
26 12 also be 1) insufficiently physically active (i.e., engaging in less than 150-minutes of
27
28 13 moderate-intensity or 75-minutes of vigorous-intensity PA per week)[4, 28]; 2) aged
29
30 14 between 18 and 80 years; 3) proficient in English-reading and speaking; 4) have no known
31
32 15 presence of cancer at the time of recruitment; 5) have internet access at home. Exclusion
33
34 16 criteria include individuals who 1) are still undergoing treatment for cancer except for
35
36 17 maintenance therapy such as tamoxifen; 2) have known cardiac abnormalities including
37
38 18 unstable angina or recent myocardial infarction; 3) have any severe disability that may
39
40 19 affect physical function including severe arthritis; 4) have a current diagnosis of a severe
41
42 20 psychiatric illness (those with minor psychiatric diagnoses will be eligible if they are well
43
44 21 enough to participate; 5) are currently enrolled in a health behaviour trial or program.
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 **Recruitment**

2 Participants will be recruited using purposive sampling methods, involving
3 screening the hospital records of participating oncologists, to collate a pool of eligible
4 survivors. The preliminary participating oncologists are based at St John of God Subiaco
5 and Murdoch Hospitals, Hollywood Private Hospital, the Women Centre in West
6 Leederville. Oncologists in South Australia, Victoria and New South Wales may also
7 participate in the trial depending upon recruitment uptake. Eligible individuals will be
8 mailed an invitation letter and information sheet from their treating oncologist.

9 **Measures**

10 Primary outcomes

11 The primary outcome will be minutes of moderate-to-vigorous PA (MVPA) and
12 sedentary behaviour ascertained from the Actigraph GT9X (Actigraph, LLC, Pensacola,
13 Florida, USA). Participants will wear the accelerometer on their right hip for all waking
14 hours for one week. Wear time must exceed 10-hours per day to be considered valid for
15 analysis. Non-wear periods will be defined as intervals of at least 60-consecutive minutes
16 of zero counts will be excluded from analyses. Activity counts will be categorised as:
17 sedentary (<100cpm), light-intensity (100-1951cpm), moderate-intensity (1952-
18 5724cpm) and vigorous-intensity (>5725cpm), using data recorded in 60-s epochs,
19 according to Freedson cut points[29]. MVPA will be examined as both weekly time
20 accumulated (minutes/week), and time in bouts of 10-consecutive minutes
21 (minutes/week).

22 *Sedentary behaviour*

23 Sedentary behaviour will be defined by accelerometer activity counts of <100cpm, for 20
24 consecutive minutes or more, which corresponds to clinical changes in cardio-metabolic

1
2
3
4 1 biomarkers[30]. The accelerometer log completed by participants will assist in
5
6 2 differentiating sedentary time from non-wear time.

8
9 3 *Quality of life*

10 4 Quality of life will be measured using the Medical Outcomes Study Short-Form survey
11
12
13 5 [31]. This instrument is considered reliable across both mental and physical components
14
15
16 6 (Cronbach's alpha of 0.87 and 0.84, respectively), and valid when compared to the 36-
17
18 7 item version[31, 32].

19
20 8 *Physical activity attitudes*

21
22 9 PA attitudes will be assessed using previously validated items, with Cronbach's
23
24
25 10 alpha scores for the subscales below ranging from 0.73 to 0.87[33]. Some items have
26
27 11 been amended, based on previous formative work in survivors[13, 16, 34, 35], and PA
28
29 12 recommendations[4]. The following constructs will be assessed:

30
31 13 *Outcome expectations.* Twelve items will assess outcome expectations. Five items
32
33 14 are derived from the validated exercise pros subscale[36] and 7-items are based on
34
35 15 formative research with survivors[14, 34, 35]. The items measure magnitude of
36
37 16 agreement (1=disagree very strongly to 6=agree very strongly) that regular PA will help
38
39 17 to: reduce tension or stress; feel more confident about my own health; sleep better; have
40
41 18 a positive outlook; control my weight; regain lost strength; prevent cancer recurrence;
42
43 19 increase fatigue; increase joint pain; weaken my immune system; feel better about my
44
45 20 body, and increase my longevity.

46
47 21 *Action self-efficacy.* Four items will assess action self-efficacy, based on previous
48
49 22 research with survivors[37]. Items assess participants' confidence to complete 150-
50
51 23 minutes of MVPA per week (on a six-point Likert scale), with the item stems: 'I believe
52
53
54
55
56
57
58
59
60

1 I have the ability to...'; 'I am confident I can do...'; 'If I wanted to I could...' and 'For
2 me to do...?'.
3

4 *Maintenance self-efficacy.* Thirteen items will assess maintenance self-efficacy,
5 based on formative research using a six-point Likert scale[14, 35]. Items assess
6 confidence to participate in regular MVPA over the next 12-weeks when, for example: I
7 lack discipline, and I am feeling tired.

8 *Action planning.* Four items using a six-point Likert scale will assess action
9 planning for the next 3-weeks[38]. Participants will be asked to respond about whether
10 they have made plan concerning *what, when, where, and how* they will engage in regular
11 PA.

12 *Intention.* Two items, using a six-point Likert scale, will measure intention to
13 engage in moderate-intensity PA for at least 150-minutes per week in the next 12-weeks,
14 based on previously established measures[39]. Items are 'I intend to participate...' and 'I
15 will try to participate...?'.
16

17 Covariates

18 Sociodemographic information and CVD risk factors will be self-reported via the
19 written questionnaire posted to participants at T1. The following variables will be
20 assessed: marital status; educational attainment; gross household income; smoking status;
21 alcohol intake; and chronic disease comorbidities.

22 Procedure

23 Participants will be sent an invitation letter, information sheet, consent form and a reply-
24 paid envelope from their treating surgical, medical or radiation Oncologist. Upon receipt
25 of written consent, participants will be telephoned and an initial screening questionnaire
26 (including the Active Australia Survey; AAS)[40] to assess PA status) administered to
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4 1 determine eligibility. The AAS has demonstrated acceptable convergent validity for
5
6 2 community-dwelling older adults[41]. Only those that report participating in less than
7
8 3 150-minutes of MVPA per week will be eligible to participate in the trial.

10
11 4 If the criteria are met, participants will be sent the study questionnaire, an
12
13 5 Actigraph GTX9 accelerometer, written accelerometer instructions, a tape measure,
14
15 6 graphic instructions to measure waist circumference, and a reply-paid envelope.
16
17 7 Participants will be asked to complete the questionnaire and wear the accelerometer on
18
19 8 their right hip for 7-days during waking hours, and then return the questionnaire and
20
21 9 accelerometer in the reply-paid envelope. Figure 1 represents the flow of research
22
23 10 participants through the trial.

24
25
26
27 11 The statistician will generate the randomisation sequence using STATA v15 with
28
29 12 a 1:1 allocation using random block sizes of 4 and 6 to support allocation concealment.
30
31 13 Participant allocation will be implemented using sequentially numbered, opaque sealed
32
33 14 envelopes, and the researchers involved in assessing and enrolling participants will not
34
35 15 be involved in the generation of the randomisation sequence. Following consent and
36
37 16 baseline assessment, the trial coordinator will choose the next envelope in the sequence
38
39 17 and write the participant study number onto the envelope prior to allocating the
40
41 18 participant to that group. Carbon paper inside the envelope will transfer the number onto
42
43 19 the card containing the details of allocation.
44
45
46
47

48 20 The trial coordinator will post the accelerometers to participants with clear
49
50 21 instructions on how to use them, and will contact participants after the 7-days to remind
51
52 22 them to post them back to the researchers. Participants will also complete questionnaires
53
54 23 that measure socio-demographic variables, QoL, and constructs from the Health Action
55
56 24 Process Approach model[24]which informs the basis of the intervention.
57
58
59
60

1 Both the control and intervention group will receive a mailed booklet designed to
2 educate and motivate improvements in PA. Materials will be based on the current
3 guidelines for PA[28] and also evidence-based behavior change techniques such as action
4 planning, problem solving and self-monitoring[42]. The intervention group will also
5 receive a mailed Fitbit tracker to self-monitor physical activity. The control group will
6 receive minimal intervention to mimic usual care so that we are able to compare the
7 effects of the intervention to usual care. Any adverse events emanating from the trial will
8 be reported to, and managed by the ethics committee alongside the principal investigator
9 (SH). The principal investigator will keep an audit trail and maintain responsibility for
10 the trial including conduct and management of the trial.

11 Power Calculations and Sample size

12 The primary outcome is change in MVPA. A sample size of 94 participants (47
13 in each arm) is required in order to achieve 80% power to detect a difference of 70 ± 120
14 minutes of MVPA per week between the arms at 0.05 level. Our calculations are based
15 on a previous wearable technology trial in survivors using Actigraphs to assess MVPA
16 (WATAAP trial) [43] where the observed net increase was 70 ± 120 minutes of MVPA
17 at 12-weeks. We aim to recruit 104 participants, ensuring that if 10% are lost to follow-
18 up, the intervention will still be adequately powered at 80% to detect a meaningful
19 change.

20 Intervention

21 The 12-week intervention includes two components: 1) a Fitbit Charge 2 activity
22 tracker™ providing real-time monitoring and feedback on PA; 2) Up to six sessions of
23 health coaching (4 fixed sessions) via skype/facetime/etc. or phone depending on
24 participant preferences.

1
2
3
4 1 *WAT tracker*: Participants will be provided with a Fitbit Charge 2™ activity
5
6 2 tracker, and encouraged to wear for the duration of the trial. This is a slim, wrist-worn
7
8 3 device that displays steps, distance, active minutes (MVPA), heart rate and caloric
9
10 4 expenditure. The Fitbit Charge 2™ was chosen because previous work demonstrates its
11
12 5 usefulness and acceptance amongst cancer survivors[23] and older adults (>70)[44]. The
13
14 6 Fitbit Charge 2™ also alerts users to sedentary behaviour and progress towards PA goals.
15
16 7 Data from the device can be uploaded to the Fitbit™ application via Bluetooth.
17
18 8 Participants will receive clear and simple written instructions guiding the installation of
19
20 9 apps and device usage. Technical support will also be provided through follow-up calls
21
22 10 to maximize uptake.
23
24
25
26
27
28
29

30 12 *Health Coaching*: The purpose of the health coaching is to motivate and support increased
31
32 13 PA through supporting self-efficacy, action planning and problem solving, based on the
33
34 14 principles of the HAPA. The health coaching is important to help guide action planning
35
36 15 and problem solving since these behaviour change techniques are absent from the Apps
37
38 16 associated with wearable devices[21]. Telephone health coaching has been successfully
39
40 17 used in Australian and US survivors to increase PA[5, 45]. The first session (wk 1; ~ 60
41
42 18 minutes) will cover technical issues and the features of the Fitbit, including the
43
44 19 importance of MVPA. It will also foster positive outcome expectancies and confidence
45
46 20 towards PA and guide the participant to create PA action plans for the following three
47
48 21 weeks and self-monitor their activity. The purpose of the three follow-up health coaching
49
50 22 sessions (wk 2, 4, and 8; ~30 minutes each) will be to provide support, problem solving
51
52 23 and help the participant to update goals and action plans as they progress. We will adopt
53
54 24 a patient-centred and stepped-care approach by providing additional health coaching
55
56
57
58
59
60

1 sessions (i.e., at wk 6, and 10) to those who may need them in order to achieve meaningful
2 sustained PA change. The weekly exercise target will be at least 180-minutes of
3 moderate-intensity PA, based on research demonstrating better survival in patients who
4 engaged in 3-5 hrs of moderate activity per week[7, 18]. A web-based API (Application
5 programming interface) to collect user's activity data from the Fitbit server will be
6 developed. Upon user consent via Fitbit authentication page, we will be able to collect
7 participants' daily activity (step count, active minutes, duration, heart rate, stair, sleep).
8 The health coach will review daily activity and engagement via the Fitbit app prior to
9 each health coaching session to provide feedback, encouragement and technical support
10 if needed. API monitoring will cease at the end of the trial (after 24-weeks) and a de-
11 authorization email sent to participants to confirm the end of API participation.

12 Quality Assurance

13 The Health coach employed to deliver the intervention will be required to have a
14 background in Psychology or allied health discipline (at least to degree level). The health
15 coach will undertake training including the theoretical bases of the intervention, PA
16 messaging, and implementation of behaviour change techniques. Training will include
17 role-plays with supervised feedback. Health coaching consistency will be achieved by
18 following a semi-structured script with a clear structure of questions, and behaviour
19 change techniques to be covered in each call. Competency and quality control will be
20 monitored by direct observation and/or audio-recordings, (with feedback to the health
21 coach) and will continue until consistent and adequate health coaching performance is
22 confirmed. All telephone calls to participants will be audiotaped.

23 After 12-weeks, participants in both groups will complete a questionnaire that
24 measures variables from the HAPA, QoL and psycho-social variables again for a second

1 time and wear an accelerometer for a 7-day period. The trial coordinator will post out the
2 accelerometers and questionnaires. Between 12-weeks and 24-weeks, participants will
3 keep the Fitbit but there will be no further health coaching. At 24-weeks, all participants
4 will complete the questionnaires for a third time and will receive an accelerometer to wear
5 for a 7-day period. The health coach will work flexible hours so that they can offer early
6 morning and/or evening calls to fit in with participants' schedules. Following trial
7 completion (T3), participants in the control group will be offered the opportunity to trial
8 a Fitbit™ for 12-weeks.

9 Process evaluation

10 Acceptability and feasibility of the intervention will form the process evaluation.
11 Feasibility of the intervention will be evaluated by comparing intervention costs
12 (intervention equipment, staff time) with uptake rates, adherence (to wearing the wearable
13 tracker, receipt of health coaching sessions), and completion. Acceptability and utility of
14 the intervention, and an understanding of the active ingredients will be examined using
15 semi-structured telephone or skype interviews.

16 Data Management

17 All personal data collected will be dealt with and stored in accordance with the Data
18 Protection Act. All data will be stored securely to maintain confidentiality. To preserve
19 participant anonymity, only their allocated trial number will be recorded on trial
20 documentation or computer software except for the consent form and contact details.
21 Documents with identifiable information will be stored separately to other study
22 documents. Pseudonyms will be used when reporting findings from the process
23 evaluation. The use of the data from the study will be controlled by the principal
24 investigator. All data and documentation related to the trial will be stored in accordance

1
2
3
4 1 with applicable regulatory requirements and access to de-identified data will be made
5
6 2 available on request.
7

3 Data Monitoring and Timeline

4 Due to the low risk nature of the intervention, we do not expect any harm or adverse
5 events and therefore there will be no data monitoring committee or trial cessation. The
6 trial will be overseen by the trial management team, consisting the principal investigator,
7 co-chief investigators, the trial coordinator and health coach. Recruitment is expected to
8 commence in January 2019 and the project completed by September 2020. The final
9 follow-up assessment is anticipated to be completed by March 2020 with analysis and
10 report completed by the September.

11 Data analysis

12 The effectiveness of the intervention vs. control on MVPA/week will be assessed using
13 a linear mixed model, with group (intervention vs. control), time (T1 vs. T2 and T3) and
14 their interaction as fixed effects, and with a random effect for participant included to
15 account for the correlations in observations inherent in a repeated measures design. Age,
16 gender, baseline PA level, adjuvant therapy, cancer type, months since diagnosis, and
17 intervention dose will be considered as covariates in the model. Groups will also be
18 compared on secondary outcomes (waist circumference, quality of life) and HAPA
19 constructs using mixed models, including adjustment for confounding where appropriate.
20 Missing data will be investigated for patterns in terms of observed study
21 variables. Multiple imputation will be considered if data are arguably missing at random
22 and less than 20% of the data are missing. We will impute 25 data sets based on all
23 relevant observed variables, including the interaction term and outcome measure of
24 interest for each specific analysis. Sensitivity analyses will be conducted to consider the

1 effect of potential missing not at random mechanisms on parameter estimates from
2 imputed data sets. Intention-to-treat analysis will be conducted where there is participant
3 attrition. Appropriate longitudinal mediation models will be used to investigate whether
4 a) intervention associated changes in MVPA are mediated (at least partially) via the
5 HAPA model and b) changes in QoL/ waist circumference are partially mediated via
6 changes in MVPA. All data will be analysed with $p < 0.05$ considered significant.

7 DISCUSSION

8 The trial will assess the effectiveness of an intervention that combines wearable
9 technology with behaviour change techniques (action-planning, goal-setting, and coping
10 planning, feedback) to increase MVPA and reduce sedentary behaviour in cancer
11 survivors living in non-metropolitan areas of Australia. This protocol describes one of the
12 first trials using wearable technology to promote PA in regional and remote survivors,
13 contributing to research on the effectiveness of distance-based interventions to promote
14 PA.

15 Despite increasing evidence that PA reduces the risk of CVD and cancer
16 recurrence[6, 46], few survivors meet the PA guidelines[4]. Furthermore, there are
17 significant geographic inequalities in cancer survival that urgently need to be addressed,
18 with significantly poorer survival in remote areas compared to major cities.

19 Existing PA programs for cancer survivors tend to be based in major cities with
20 scarce provision outside of major cities. Limited access to exercise facilities due to access,
21 provision or financial barriers disadvantage non-metropolitan survivors[15, 17]. Less
22 intensive home-based interventions could be more acceptable to consumers, scalable and
23 more cost-effective.

24

Conclusion

The trial is pragmatic and primarily concerned with evaluating whether a low-intensity, distance-based intervention is effective for increasing MVPA and reducing sedentary behaviour in survivors compared to usual care. If effective, the intervention, that employs resource deployment according to patient need, has the potential to be a low cost and scalable intervention that could be integrated into existing health care pathways (e.g., telehealth programs) or delivered by oncology nurses, or allied professionals.

REFERENCES

1. Baade PD, Frischi L, & Eakin E. Non-cancer mortality among people diagnosed with cancer. *Cancer Causes Control* 2006;17:287-297.doi:10.1007/s10552-005-053-0.
2. Keats MR, Cui Y, Grandy SA, et al. Cardiovascular disease and physical activity in adult cancer survivors: A nested, retrospective study from the Atlantic PATH cohort. *J Cancer Surviv* 2017;11:264-273.doi: 10.1007/s11764-016-0584-x.
3. Doyle C, Kushi L, Byers T, et al. Nutrition and physical during and after cancer treatment: an American Cancer Society guide for informed choices. *CA Cancer J Clin* 2006;56:323-53.
4. Rock CL, Doyle C, Demark-Wahnefried W, et al. Nutrition and physical activity guidelines for cancer survivors. *CA Cancer J Clin* 2012;62:242-274.doi:10.3322/caac.21142.
5. Hawkes A, Chambers S, Pakenham K, et al. Effects of a telephone-delivered multiple health behavior change intervention (CanChange) on health and behavioral outcomes in survivors of colorectal cancer: a randomized controlled trial. *J Clin Oncol* 2013;31:2313-2321.doi: 10.1200/JCO.2012.45.5873.
6. Friedenreich CM, Neilson HK, Farris MS, et al. Physical activity and cancer outcomes: A precision medicine approach. *Clin Cancer Res* 2016;22: 4766-4775. doi:10.1158/1078-0432.CCR-16-0067.
7. Li T, Wei S, Shi Y, et al. The dose-response effects of physical activity on cancer mortality: findings from 71 cohort studies. *British Journal of Sports Medicine* 2016;50:339-345. doi: 10.1136/bjsports-2015-094927.

- 1
2
3
4 1 8. Weaver K, Foraker R, Alfano C, et al. Cardiovascular risk factors among long-
5 2 term survivors of breast, prostate, colorectal and gynaecologic cancers: a gap in
6 3 survivorship care? *J Cancer Surviv* 2013;7:253-261.doi: 10.1007/s11764-013-
7 4 0267-9.
8 5
- 9 6 9. Threlfall TJ, & Thompson JR. Cancer incidence and mortality in Western
10 7 Australia, 2014. Department of Health, Western Australia, Perth. Statistical Series
11 8 Number 103. Perth, WA: Department of Health 2015.
12 9
- 13 10 10. Leach CR, Weaver KE, Aziz NM, et al. The complex health profile of long-term
14 11 cancer survivors: Prevalence and predictors of comorbid conditions. *J Cancer*
15 12 *Surviv* 2015;9:239-251. doi: 10.1007/s11764-014-040301.
16 13
- 17 14 11. Tervonen HE, Aranda S, Roder D, et al. Cancer survival disparities worsening by
18 15 socio-economic disadvantage over the last 3 decades in New South Wales,
19 16 Australia. *BMC Public Health* 2017;17:691-702. doi:10.1186/s12889-016-4692-
20 17 y.
21 18
- 22 19 12. Australian Institute of Health and Welfare. *Australians' health*. Canberra: AIHW
23 20 2014.
24 21
25 22
- 26 23 13. Hardcastle SJ, Glassey R, Salfinger S, et al. Factors influencing participation in
27 24 health behaviors in endometrial cancer survivors. *Psycho-oncology*
28 25 2017;26:1099-1104. doi:10.1002/pon.4288.
29 26
- 30 27 14. Hardcastle SJ, Maxwell-Smith C, Zeps N, et al. A qualitative study exploring
31 28 health perceptions and factors influencing participation in health behaviors in
32 29 colorectal cancer survivors. *Psycho-oncology* 2017;26:199-205.
33 30 doi:10.1002/pon.4111.
34 31
- 35 32 15. Hardcastle SJ, Maxwell-Smith C, Kamarova S, et al. Factors influencing non-
36 33 participation in an exercise program and attitudes towards physical activity
37 34 amongst cancer survivors. *Support Care Cancer* 2018;26:1289-1295.
38 35 doi:10.1007/s00520-017-3952-9.
39 36
- 40 37 16. Maxwell-Smith C, Zeps N, Hagger MS, et al. Barriers to physical activity
41 38 participation in colorectal cancer survivors at high risk of cardiovascular disease.
42 39 *Psycho-oncology* 2017;26:808-814. doi:10.1002/pon.4234.
43 40
- 44 41 17. Hardcastle SJ, & Cohen PA. Effective physical activity promotion to survivors of
45 42 cancer is likely to be home based and to require oncologist participation. *J Clin*
46 43 *Oncol* 2017;35:3635-3637. doi: 10.1200/JCO.2017.74.6032.
47 44
- 48 45 18. Lahart I, Metsios G, Nevill AM, et al. Randomised controlled trial of a home-
49 46 based physical activity intervention in breast cancer survivors. *BMC Cancer*
50 47 2016; 16:234-247. doi: 10.1186/s12885-016-2258-5.
51 48
52
53
54
55
56
57
58
59
60

19. James E, Stacey F, Chapman K, et al. Impact of a nutrition and physical activity intervention (ENRICH) on health behaviours of cancer survivors and carers: a pragmatic randomized controlled trial. *BMC Cancer* 2015;15:710-725. doi: 10.1186/s12885-015-1775-y.
20. Rogers LQ, Courneya KS, Anton PM, et al. Social cognitive constructs did not mediate the cancer intervention effects on objective physical activity behaviour based on multivariate path analysis. *Ann Beh Med* 2017;51:321-326. doi:10.1007/s12160-016-9840-6.
21. Lyons EJ, Lewis ZH, Mayrsohn BG, et al. Behaviour change techniques implemented in electronic lifestyle activity monitors: A systematic content analysis. *Journal Med Internet Res* 2014;16:e192-e206. doi:10.2196/jmir.3469.
22. Mercer K, Giangregorio L, Schneider E, et al. Acceptance of commercially available wearable activity trackers among adults aged over 50 and with chronic illness: a mixed-methods evaluation. *JMIR Mhealth Uhealth* 2016;4: e7. doi:10.2196/mhealth.4225.
23. Nguyen NH, Hadgraft NT, Moore MM, et al. A qualitative evaluation of breast cancer survivors' acceptance of and preferences for consumer wearable technology activity trackers. *Support Care Cancer* 2017;25:3375-3384. doi:10.1007/s00520-01703756-y.
24. Schwarzer R. Self-efficacy in the adoption and maintenance of health behaviours: Theoretical approaches and a new model. In Schwarzer R, Ed. *Self-efficacy: Thought control of action*. Washington, DC; Hemisphere 1992:217-242.
25. Begg C, Cho M, Eastwood S, et al. Improving the quality of reporting randomized controlled trials: The CONSORT statement. *JAMA* 1996;276:637-639.
26. Chan A, Tetzlaff JM, Altman DG, et al. SPIRIT 2013 statement: Defining standard protocol items for clinical trials. *Annals of Internal Medicine* 2013;158:200-207.
27. Australian Statistical Geography Standard. Volume 5- Remoteness structure. Canberra: Australian Bureau of Statistics 2016.
28. Department of Health. *Australia's physical activity and sedentary behavior guidelines*. Canberra: Department of Health 2014.
29. Freedson PS, Melanson E, & Sirard J. Calibration of the Computer Science and Applications, Inc. accelerometer. *Med Sci Sports Exerc* 1998;30:777-781.
30. Lynch BM, Boyle T, Winkler E, et al. Patterns and correlates of accelerometer-assessed physical activity and sedentary time among colon cancer survivors. *Cancer Causes Control* 2016;27:59-68. doi:10.1007/s10552-015-0683-4.

- 1
2
3
4 1 31. Ware JE, Kosinski M, & Keller SD. A 12-Item short-form health survey:
5 2 Construction of scales and preliminary tests of reliability and validity. *Medical*
6 3 *Care* 1996;34:220-233.
7 4
8 5
9 6 32. Dritsaki M, Petrou S, Williams M, et al. An empirical evaluation of the SF-12,
10 7 SF-6D, EQ-5D and Michigan Hand Outcome Questionnaire in patients with
11 8 rheumatoid arthritis of the hand. *Health Qual Life Outcomes* 2017;15:20-30.
12 9 doi:10.1186/s12955-016-0584-6.
13 10
14 11 33. Parschau L, Barz M, Richert J, et al. Physical activity among adults with obesity:
15 12 Testing the health action process approach. *Rehabil Psychol* 2014;59:42-49.
16 13 doi:10.1037/a0035290.
17 14
18 15 34. Bennett JA, Lyons KS, Winters-Stone K, et al. Motivational interviewing to
19 16 increase physical activity in long-term cancer survivors: a randomized controlled
20 17 trial. *Nurs Res* 2007;56:18-27.
21 18
22 19 35. Short CE, James EL, Girgis A, et al. Move more for life: The protocol for a
23 20 randomised efficacy trial of a tailored-print physical activity intervention for post-
24 21 treatment breast cancer survivors. *BMC Cancer* 2012;12:172-181.
25 22 doi:10.1186/1471-2407-12-172.
26 23
27 24 36. Plotnikoff RC, Blanchard CM, Hotz SB, et al. Validation of the decisional balance
28 25 scales in the exercise domain from the transtheoretical model: A longitudinal test.
29 26 *Meas Phys Educ Exerc Sci* 2001;5:191-206.
30 27 doi:10.1207/S15327841MPEE0504_01.
31 28
32 29 37. Rogers LQ, Shah P, Dunnington G, et al. Social cognitive theory and physical
33 30 activity during breast cancer treatment. *Oncol Nurs Forum* 2005;32:807-815.
34 31
35 32 38. Rhodes RE, Blanchard CM, Matheson DH, et al. Disentangling motivation,
36 33 intention, and planning in the physical activity domain. *Psychol Sport Exerc*
37 34 2006;7:15-27. doi:10.1016/j.psychsport.2005.08.011.
38 35
39 36 39. Ajzen I, Brown TC, & Carvajal F. Explaining the discrepancy between intentions
40 37 and actions: The case of hypothetical bias in contingent valuation. *Pers Soc*
41 38 *Psychol Bull* 2004;30:1108-1121. doi:10.1177/0146167204264079.
42 39
43 40 40. Brown WJ, Burton NW, Marshall AL, et al. Reliability and validity of a modified
44 41 self-administered version of the Active Australia physical activity survey in a
45 42 sample of mid-age women. *Aust N Z J Public Health* 2008;32:535-541.
46 43 doi:10.1111/j.1753-6405-2008-00405.x.
47 44
48 45 41. Heesch KC, Hill RL, Van-Uffelen JG, et al. Are active Australia physical activity
49 46 questions valid for older adults? *J Sci Med Sport* 2011;14:233-237. doi:
50 47 10.1016/j.jsams.2010.11.004.
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4 1 42. Michie S, Abraham C, Whittington C, et al. Effective techniques in healthy eating
5 2 and physical activity interventions: a meta-regression. *Health Psychol*
6 3 2009;28:690–701. doi: 10.1037/a0016136.
7 4
8 5
9 6 43. Maxwell-Smith C, Cohen PA, Platell C, et al. Wearable Activity Technology and
10 7 Action-planning (WATAAP) to promote physical activity to cancer survivors:
11 8 Randomised controlled trial protocol. *Int J Clin Health Psychol* 2018;18:124-132.
12 9 doi: 10.1016/j.ijchp.2018.03.003.
13 10
14 11 44. McMahon SK, Lewis B, Oakes M, et al. Older adults' experiences using a
15 12 commercially available monitor to self-track their physical activity. *J Med*
16 13 *Internet Res* 2016;4:e35. doi:10.2196/mhealth.5120.
17 14
18 15 45. Ligibel JA, Meyerhardt J, Pierce JP, et al. Impact of a telephone-based physical
19 16 activity intervention upon exercise behaviors and fitness in cancer survivors
20 17 enrolled in a cooperative group setting. *Breast Cancer Res Treat* 2012;132:205-
21 18 213. doi:10.1007/s10549-011-11882-7.
22 19
23 20 46. Hamer J, & Warner E. Lifestyle modifications for patients with breast cancer to
24 21 improve prognosis and optimize overall health. *Can Med Assoc J* 2017;189:E268-
25 22 E274. doi:10.1503/cmaj.160464.
26 23
27 24
28 25
29 26
30 27

31 28 **Figure Legends**

32 29 Figure 1. Flow diagram of trial design
33 30
34 31
35 32

36 33 **Acknowledgements:** We thank the consumers that have kindly given their time to
37 34 participate in our previous projects that have contributed to the design of the prospective
38 35 intervention.
39 36
40 37
41 38
42 39
43 40
44 41
45 42
46 43
47 44
48 45
49 46
50 47
51 48
52 49
53 50
54 51
55 52
56 53
57 54
58 55
59 56
60 57

32 58 **Contributors:** SH led the study conceptualisation, development of intervention content
33 59 and writing of the protocol. GM, PT, NB, SS, JT, GRM, ML, PC, CS and CP contributed
34 60 to study conceptualisation and will recruit patients for the trial. RJ edited the protocol and
35 will assist in the process evaluation. TB and VC contributed to physical activity
36 measurement protocol and will be responsible for Actigraph data cleaning and analysis.
37

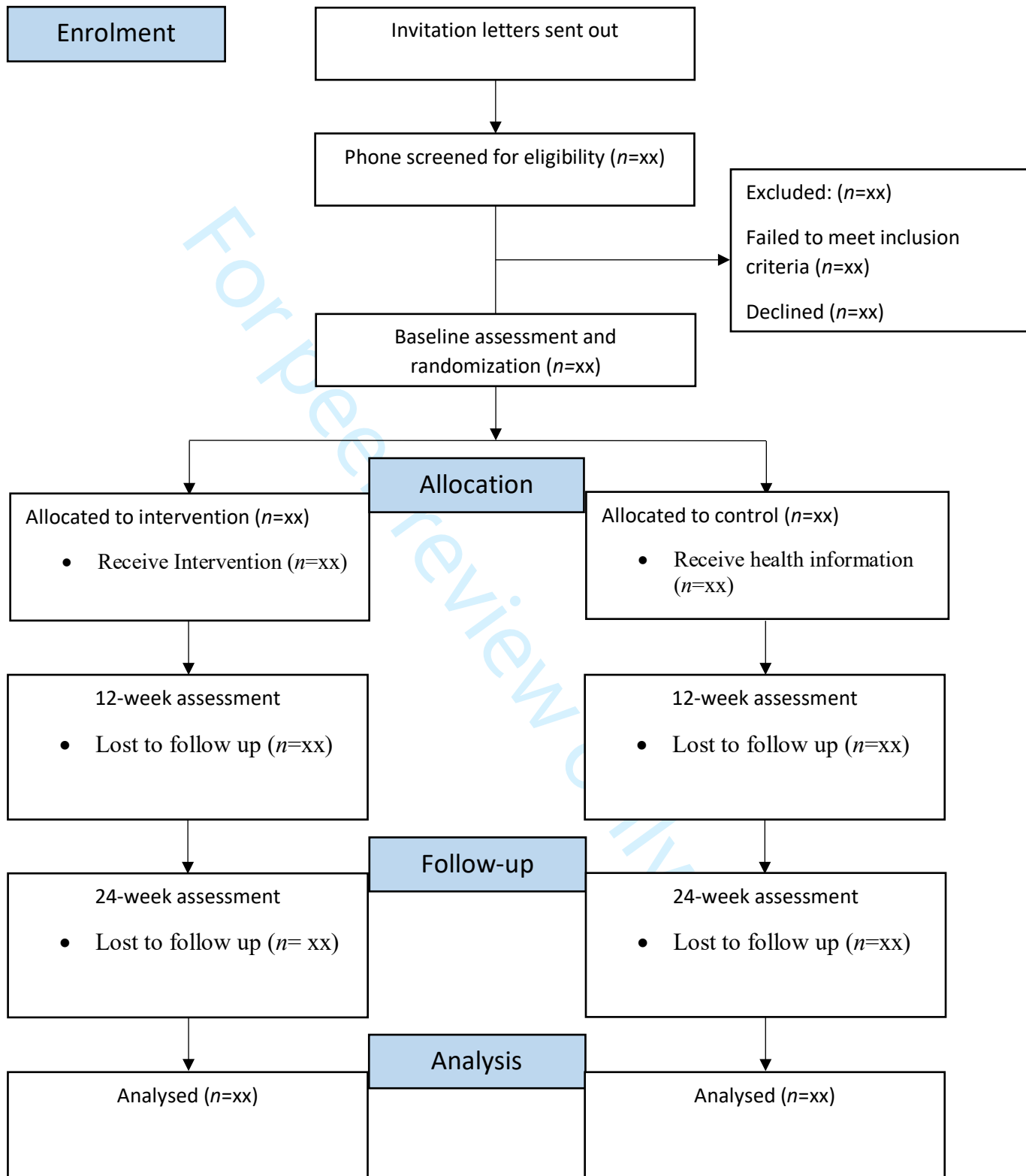
1
2
3
4 1 DH contributed to statistical analysis and the process for randomisation and data
5
6 2 management and will undertake data analysis. All authors edited the manuscript.
7
8

9 3

10
11 4 **Funding:** This work was supported by a grant from The Tonkinson Colorectal Cancer
12
13 5 Research Foundation (Grant reference #59395).
14
15

16 6 **Competing interests:** None declared
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Figure 1. Flow diagram of trial design





Consent form

Title	The promotion of physical activity to adult cancer survivors in regional and remote areas of Western Australia using Fitbit technology and telephone health coaching
Principal investigator	Sarah Hardcastle

Note: All parties signing the consent section must date their own signature.

Declaration by participant

- I have read, or have had read to me, and I understand the participant information and consent form.
- I have had an opportunity to ask questions and I am satisfied with the answers I have received.
- I understand the purposes, procedures and risks of the research described in this research study.
- I intend to adhere to the study requirements to the best of my ability.
- I understand that I will be given a signed copy of this document to keep.

Signature _____ Date _____

Name of participant (please print) _____

Declaration by trial doctor/senior researcher[†]

I have given a verbal explanation of this study, its procedures and risks and I believe that the participant has understood that explanation.

Signature _____ Date _____

Name of trial doctor/ researcher[†] (please print) _____

[†] A senior member of the research team must provide the explanation of, and information concerning, the research study.



STANDARD PROTOCOL ITEMS: RECOMMENDATIONS FOR INTERVENTIONAL TRIALS

SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description
Administrative information		
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym (Page 1)
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry (Page 1)
	2b	All items from the World Health Organization Trial Registration Data Set (UTN and ACTN numbers are on Page 1)
Protocol version	3	Date and version identifier (Page 1)
Funding	4	Sources and types of financial, material, and other support (Page 20)
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors (Title page and Page 20)
	5b	Name and contact information for the trial sponsor (Page 20)
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities (Page 20)
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee) (Page 20)
Introduction		
Background and rationale	6a	Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention (Pages 2-4)
	6b	Explanation for choice of comparators (Page 11)
Objectives	7	Specific objectives or hypotheses (Page 4)

1
2 Trial design 8 Description of trial design including type of trial (eg, parallel group,
3 crossover, factorial, single group), allocation ratio, and framework (eg,
4 superiority, equivalence, noninferiority, exploratory) **(Page 4)**
5
6
7

8 **Methods: Participants, interventions, and outcomes**
9

10 Study setting 9 Description of study settings (eg, community clinic, academic hospital)
11 (and list of countries where data will be collected. Reference to where
12 list of study sites can be obtained **(Page 7)**
13

14 Eligibility criteria 10 Inclusion and exclusion criteria for participants. If applicable, eligibility
15 criteria for study centres and individuals who will perform the
16 interventions (eg, surgeons, psychotherapists) **(Page 6 & 13)**
17
18

19 Interventions 11a Interventions for each group with sufficient detail to allow replication,
20 including how and when they will be administered **(Page 11-13)**
21

22 11b Criteria for discontinuing or modifying allocated interventions for a
23 given trial participant (eg, drug dose change in response to harms,
24 participant request, or improving/worsening disease) **(N/A)**
25

26 11c Strategies to improve adherence to intervention protocols, and any
27 procedures for monitoring adherence (eg, drug tablet return,
28 laboratory tests) **(Page 11-13)**
29
30

31 11d Relevant concomitant care and interventions that are permitted or
32 prohibited during the trial **(Page 6)**
33

34 Outcomes 12 Primary, secondary, and other outcomes, including the specific
35 measurement variable (eg, systolic blood pressure), analysis metric
36 (eg, change from baseline, final value, time to event), method of
37 aggregation (eg, median, proportion), and time point for each
38 outcome. Explanation of the clinical relevance of chosen efficacy and
39 harm outcomes is strongly recommended **(Page 7)**
40
41

42 Participant 13 Time schedule of enrolment, interventions (including any run-ins and
43 timeline washouts), assessments, and visits for participants. A schematic
44 diagram is highly recommended (see Figure) **(Figure 1)**
45

46 Sample size 14 Estimated number of participants needed to achieve study objectives
47 and how it was determined, including clinical and statistical
48 assumptions supporting any sample size calculations **(Page 11)**
49
50

51 Recruitment 15 Strategies for achieving adequate participant enrolment to reach
52 target sample size **(Page 7)**
53

54 **Methods: Assignment of interventions (for controlled trials)**
55

56 Allocation:
57
58
59
60

1			
2	Sequence	16a	Method of generating the allocation sequence (eg, computer-
3	generation		generated random numbers), and list of any factors for stratification.
4			(To reduce predictability of a random sequence, details of any
5			planned restriction (eg, blocking) should be provided in a separate
6			document that is unavailable to those who enrol participants or assign
7			interventions (Page 10)
8			
9			
10	Allocation	16b	Mechanism of implementing the allocation sequence (eg, central
11	concealment		telephone; sequentially numbered, opaque, sealed envelopes),
12	mechanism		describing any steps to conceal the sequence until interventions are
13			assigned (Page 10)
14			
15	Implementation	16c	Who will generate the allocation sequence, who will enrol participants,
16			and who will assign participants to interventions (Page 10)
17			
18			
19	Blinding	17a	Who will be blinded after assignment to interventions (eg, trial
20	(masking)		participants, care providers, outcome assessors, data analysts), and
21			how (Page 10)
22			
23		17b	If blinded, circumstances under which unblinding is permissible, and
24			procedure for revealing a participant's allocated intervention during
25			the trial (N/A)
26			
27			

Methods: Data collection, management, and analysis

28			
29			
30	Data collection	18a	Plans for assessment and collection of outcome, baseline, and other
31	methods		trial data, including any related processes to promote data quality (eg,
32			duplicate measurements, training of assessors) and a description of
33			study instruments (eg, questionnaires, laboratory tests) along with
34			their reliability and validity, if known. Reference to where data
35			collection forms can be found, if not in the protocol (Page 7-11)
36			
37			
38		18b	Plans to promote participant retention and complete follow-up,
39			including list of any outcome data to be collected for participants who
40			discontinue or deviate from intervention protocols (Page 12-14)
41			
42	Data	19	Plans for data entry, coding, security, and storage, including any
43	management		related processes to promote data quality (eg, double data entry;
44			range checks for data values). Reference to where details of data
45			management procedures can be found, if not in the protocol (Page
46			14)
47			
48			
49	Statistical	20a	Statistical methods for analysing primary and secondary outcomes.
50	methods		Reference to where other details of the statistical analysis plan can be
51			found, if not in the protocol (Page 14)
52			
53		20b	Methods for any additional analyses (eg, subgroup and adjusted
54			analyses) (Page 14 & 15)
55			
56			
57		20c	Definition of analysis population relating to protocol non-adherence
58			(eg, as randomised analysis), and any statistical methods to handle
59			missing data (eg, multiple imputation) (Page 14)
60			

Methods: Monitoring

- 1
2
3
4 Data monitoring 21a Composition of data monitoring committee (DMC); summary of its role
5 and reporting structure; statement of whether it is independent from
6 the sponsor and competing interests; and reference to where further
7 details about its charter can be found, if not in the protocol.
8 Alternatively, an explanation of why a DMC is not needed **(Page 15)**
9
10
11 21b Description of any interim analyses and stopping guidelines, including
12 who will have access to these interim results and make the final
13 decision to terminate the trial **(Page 15)**
14
15 Harms 22 Plans for collecting, assessing, reporting, and managing solicited and
16 spontaneously reported adverse events and other unintended effects
17 of trial interventions or trial conduct **(Page 11)**
18
19 Auditing 23 Frequency and procedures for auditing trial conduct, if any, and
20 whether the process will be independent from investigators and the
21 sponsor **(Page 11)**
22
23

Ethics and dissemination

- 24
25
26 Research ethics 24 Plans for seeking research ethics committee/institutional review board
27 approval (REC/IRB) approval **(Page 1 & 5)**
28
29 Protocol 25 Plans for communicating important protocol modifications (eg,
30 amendments changes to eligibility criteria, outcomes, analyses) to relevant parties
31 (eg, investigators, REC/IRBs, trial participants, trial registries, journals,
32 regulators) **(Page 11)**
33
34
35 Consent or assent 26a Who will obtain informed consent or assent from potential trial
36 participants or authorised surrogates, and how (see Item 32) **(Page 9)**
37
38 26b Additional consent provisions for collection and use of participant data
39 and biological specimens in ancillary studies, if applicable **(N/A)**
40
41 Confidentiality 27 How personal information about potential and enrolled participants will
42 be collected, shared, and maintained in order to protect confidentiality
43 before, during, and after the trial **(Page 14)**
44
45
46 Declaration of 28 Financial and other competing interests for principal investigators for
47 interests the overall trial and each study site **(Page 20)**
48
49 Access to data 29 Statement of who will have access to the final trial dataset, and
50 disclosure of contractual agreements that limit such access for
51 investigators **(Page 15)**
52
53 Ancillary and 30 Provisions, if any, for ancillary and post-trial care, and for
54 post-trial care compensation to those who suffer harm from trial participation **(N/A)**
55
56
57
58
59
60

- 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
- | | | |
|----------------------|-----|---|
| Dissemination policy | 31a | Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions (Page 1) |
| | 31b | Authorship eligibility guidelines and any intended use of professional writers (Page 20) |
| | 31c | Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code (Page 1) |

16 Appendices

- 17
18
19
20
21
22
23
24
- | | | |
|----------------------------|----|---|
| Informed consent materials | 32 | Model consent form and other related documentation given to participants and authorised surrogates (Appendix A) |
| Biological specimens | 33 | Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable (N/A) |

25 *It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013
26 Explanation & Elaboration for important clarification on the items. Amendments to the
27 protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT
28 Group under the Creative Commons "[Attribution-NonCommercial-NoDerivs 3.0 Unported](https://creativecommons.org/licenses/by-nc-nd/3.0/)"
29 license.
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

BMJ Open

Promoting Physical Activity in Regional and Remote Cancer Survivors (PPARCS) using Wearables and health-coaching: Randomised Controlled Trial protocol

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-028369.R1
Article Type:	Protocol
Date Submitted by the Author:	11-Feb-2019
Complete List of Authors:	Hardcastle, Sarah; Curtin University, Psychology Hince, Dana; University of Notre Dame Jimenez-Castuera, Ruth; University of Extremadura Boyle, Terry; University of South Australia Cavalheri, Vinicius; Curtin University, Psychology Makin, Greg; St John of God Hospital Murdoch Tan, Patrick; St John of God Hospital Subiaco Salfinger, Stuart; St John of God Hospital Subiaco Tan, Jason; St John of God Hospital Subiaco Mohan, Raj Ganendra; Hollywood Private Hospital Levitt, Michael; St John of God Hospital Subiaco Cohen, Paul; St John of God Hospital Subiaco Saunders, Christobel; The University of Western Australia, School of Surgery Platell, Cameron; University of Western Australia; St John of God Hospital Subiaco
Primary Subject Heading:	Oncology
Secondary Subject Heading:	Sports and exercise medicine, Patient-centred medicine
Keywords:	ONCOLOGY, wearable technology, physical activity, health coaching, intervention

SCHOLARONE™
Manuscripts

PPARCS TRIAL PROTOCOL

1

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
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 Promoting Physical Activity in Regional and Remote Cancer Survivors (PPARCS)
2 using Wearables and health-coaching: Randomised Controlled Trial protocol

3
4 Sarah J. Hardcastle^{a,b*}, Dana Hince^c, Ruth Jiménez-Castuera^d, Terry Boyle^e, Vinicius
5 Cavalheri^f, Greg Makin^g, Patrick Tan^h, Stuart Salfinger^h, Jason Tan^h, Ganendra Raj
6 Mohaniⁱ, Michael Levitt^h, Paul A. Cohen^{b,h}, Christobel Saunders^{b,h}, Cameron Platell^{b,h}

7
8 ^a School of Psychology, Curtin University, Bentley, Western Australia, Australia

9 ^b School of Medicine, University of Western Australia, Crawley, Australia

10 ^c Institute for Health Research, University of Notre Dame, Fremantle, Western Australia

11 ^d Faculty of Sport Sciences, University of Extremadura, Spain

12 ^e School of Health Sciences, University of South Australia, Australia

13 ^f School of Physiotherapy and Exercise Science, Western Australia, Australia

14 ^g St John of God Hospital, Murdoch, Western Australia, Australia

15 ^h St John of God Hospital, Subiaco, Western Australia, Australia

16 ⁱ Hollywood Private Hospital, Nedlands, Western Australia, Australia

17

18 *Sarah Hardcastle

19 Telephone: +61 439 226 015

20 Email: sarah.hardcastle@curtin.edu.au

21 School of Psychology, Curtin University, PO Box U1987, Perth, Western Australia

22 Word Count: 3996

23

24

ABSTRACT

Introduction: Physically active cancer survivors have substantially less cancer recurrence and improved survival compared to those who are inactive. However, the majority of survivors (70-90%) are not meeting the physical activity (PA) guidelines. There are also significant geographic inequalities in cancer survival with poorer survival rates for the third of Australians who live in non-metropolitan areas compared to those living in major cities. The primary objective of the trial is to increase moderate-to-vigorous PA (MVPA) among cancer survivors living in regional and remote Western Australia (WA). Secondary objectives are to reduce sedentary behaviour and in conjunction with increased PA, improve quality of life in non-metropolitan survivors. Tertiary objectives are to assess the effectiveness of the Health Action Process Approach Model (HAPA) variables, upon which the intervention is based, to predict change in MVPA. **Methods and analysis:** Eighty-six cancer survivors will be randomized into either the intervention or control group. Intervention group participants will receive: a Fitbit and up to six telephone health coaching sessions. MVPA (using Actigraphs), quality of life and psychological variables (based on the HAPA model via questionnaire) will be assessed at baseline, 12-weeks (end of intervention) and 24-weeks (end of follow-up). A General Linear Mixed Model will be used to assess the effectiveness of the intervention. **Ethics and dissemination:** Ethics approval has been obtained from St John of God Hospital Subiaco (HREC/#1201). We plan to submit a manuscript of the results to a peer-reviewed journal. Results will be presented at conferences, community and consumer forums and hospital research conferences. Trial registration number: ACTRN12618001743257, prospectively registered. Universal Trial Number: U1111-1222-5698. Protocol version: 2.0.

1
2
3
4 1 Keywords: oncology; wearable technology; physical activity; health coaching;
5
6 2 intervention.

7
8
9 3 Strengths and limitations of this study

- 10
11 4 • The intervention has the potential to be a low-cost and scalable and hence,
12 integrated into existing health-care pathways.
13
14 5
15
16 6 • An objective measure of PA is used to provide accurate assessment of PA.
17
18 7 • Due to the postal nature of recruitment, the responders may not be a representative
19 sample of regional and remote cancer survivors.
20
21 8
22 9 • The relatively short follow-up period limits our assessment of the extended
23 acceptance of wearable technology in this population.
24
25
26
27
28
29

30 12 INTRODUCTION

31
32 13 Compared to the general population, cancer survivors are at an increased risk of
33 the development of secondary cancers, cardiovascular disease (CVD) and functional
34 decline[1, 2]. There are several possible explanations for the increased risk, one of which
35 is shared lifestyle risk factors[3]. Insufficient PA, low fruit and vegetable intake, smoking
36 and alcohol consumption make individuals susceptible to cancer recurrence, CVD and
37 other chronic diseases[3].
38
39
40
41
42
43
44
45

46 19 The American Cancer Society PA guidelines for survivors are to participate in
47 150-minutes of moderate-to-vigorous intensity PA per week[4]. However, the majority
48 of Australian survivors (~70-90%) do not meet the PA recommendations[5].
49
50
51

52 22 PA is associated with lower CVD-related comorbidity in survivors[2]. Physically
53 active survivors have significantly less cancer recurrence and improved survival
54 compared to those who are inactive, and these findings have been found across multiple
55
56
57
58
59
60

1 cancer types[6, 7]. Many survivors suffer additional comorbidities that put them at risk
2 of developing CVD[8]. As a result, insufficiently active survivors (i.e., those not meeting
3 the PA guidelines) who fail to make healthy lifestyle changes post-treatment are likely to
4 have substantially higher risk of developing CVD.

5 Together, colorectal, breast, prostate and uterine cancer account for 41% of all
6 cancer incidence in Western Australia (WA)[9]. Our rationale for targeting survivors of
7 these cancers is based on established risk or comorbid cardio-metabolic disease, and a
8 high prevalence of physical inactivity[10].

9 There are also substantial geographic inequalities in cancer survival[8, 11].
10 Survival rates for Australians who live in non-metropolitan areas are poorer than for those
11 living in major cities[12]. Those living in remote areas of Australia are often
12 disadvantaged in relation to access to services, education, employment and income.
13 Mortality rates for all cancers combined are 1.4 times higher in remote areas compared
14 to major cities[12].

15 Existing PA programs for survivors tend to be based in major cities but rarely
16 operate beyond the inner regional areas. Further, facility-based programs that are offered
17 for free initially, eventually incur a cost that may present a barrier to long-term exercise
18 adherence. Previous work with survivors has identified cost, and availability of and access
19 to exercise programs to be significant barriers to participation[13-15]. Survivors have also
20 expressed a preference for home-based PA[13, 15, 16].

21 Home-based interventions are advantageous because they mitigate access and transport
22 issues, and are less expensive than facility-based programs that require participants to
23 attend classes or maintain a health-club membership[17]. There is a current gap in the
24 literature on the effectiveness of less intensive home-based interventions that could more

1 easily translate into practice. A further novel component of the present study is the
2 specific targeting of underserved regional and remote survivors with a home-based
3 intervention. If effective, the intervention would be low cost and has the potential to be
4 scalable and could be integrated into existing health care pathways.

5 Notwithstanding the obvious advantages of home-based interventions, a recent
6 review and meta-analysis revealed only a small effect (standardized mean difference)
7 0.21 for distance-based PA interventions [18]. However, most of the studies included in
8 the review relied on self-reported PA. Further, most interventions predominantly utilized
9 print and telephone modes of delivery. Few interventions used electronic health platforms
10 or smart technology such as wearables. Distance-based interventions in survivors that
11 utilize wearables show promise with a recent trial revealing a between group difference
12 in MVPA of 103-minutes/week favoring the intervention group [19].

13 Interventions that meet support needs and offer opportunities for self-monitoring
14 have been found to be effective in improving PA in survivors[20-22]. Wearable
15 technology holds great potential as a low-cost self-monitoring tool to increase PA in
16 cancer survivors. Lyons et al.[23] recently reviewed 13 different wearables and their
17 associated mobile apps, and concluded that they use many of the same techniques
18 employed in typical PA interventions (i.e. self-monitoring, feedback, goal-setting, social
19 support). Wearables are perceived as useful and acceptable to individuals with chronic
20 conditions[24]. Wearables are acceptable to older cancer survivors in metropolitan
21 areas[25] and those living in regional and remote areas[26]. Thus, wearables may
22 represent a relatively low-cost, feasible and scalable approach for widespread PA
23 promotion.

Setting and Participants

Participants will be cancer survivors diagnosed with cancer and completed active treatment in the previous 5-years. Participants will reside in Australia and will have been treated for either breast, prostate, colorectal or uterine cancer. Participants will be recruited on the basis of (1) remoteness, and (2) low levels of PA. Remoteness will be measured according to the Accessibility/Remoteness index of Australia and the Australian Statistical Geography Standard which define five major areas: *major cities*, *inner regional*, *outer regional*, *remote* and *very remote*[30]. Participants will be recruited on the basis that they reside in either a regional or remote area. Eligible participants must also be 1) insufficiently physically active (i.e., engaging in less than 150-minutes of moderate-intensity or 75-minutes of vigorous-intensity PA per week)[4, 31]; 2) aged between 18 and 80 years; 3) proficient in English-reading and speaking; 4) have no known presence of cancer at the time of recruitment; 5) have internet access at home. Exclusion criteria include individuals who 1) are still undergoing treatment for cancer except for maintenance therapy such as tamoxifen; 2) have known cardiac abnormalities including unstable angina or recent myocardial infarction; 3) have any severe disability that may affect physical function including severe arthritis; 4) have a current diagnosis of a severe psychiatric illness (those with minor psychiatric diagnoses will be eligible if they are well enough to participate; 5) are currently enrolled in a health behaviour trial or program.

Recruitment

Participants will be recruited using purposive sampling methods, involving screening the hospital records of participating oncologists, to collate a pool of eligible survivors. The preliminary participating oncologists are based at St John of God Subiaco

1 and Murdoch Hospitals, Hollywood Private Hospital, the Women Centre in West
2 Leederville. Oncologists in South Australia, Victoria and New South Wales may also
3 participate in the trial depending upon recruitment uptake. Eligible individuals will be
4 mailed an invitation letter and information sheet from their treating oncologist.

5 Intervention

6 The 12-week intervention includes two components: 1) a Fitbit Charge 2 activity
7 tracker™ providing real-time monitoring and feedback on PA; 2) Up to six sessions of
8 health coaching (4 fixed sessions) via skype/facetime/etc. or phone depending on
9 participant preferences.

10 *WAT tracker:* Participants will be provided with a Fitbit Charge 2™ activity
11 tracker. This is a slim, wrist-worn device that displays steps, distance, heart rate, active
12 minutes (MVPA), and, provides automated prompts which nudge participants to
13 accumulate at least 250 steps/hour. The Fitbit Charge 2™ was chosen because previous
14 work demonstrates its usefulness and acceptance amongst survivors[25-26] and older
15 adults (>70)[32]. Data from the device can be uploaded to the Fitbit™ application via
16 Bluetooth. Participants will receive clear and simple written instructions guiding the
17 installation of apps and device usage. Technical support will also be provided through
18 follow-up calls to maximize uptake.

19
20 *Health Coaching:* The purpose of the health coaching is to motivate and support increased
21 PA (i.e., deliberate bouts of MVPA) and reduced sedentary behaviour through supporting
22 self-efficacy, action planning and problem solving, based on the principles of the HAPA.
23 The health coaching is important to help guide action planning and problem solving since
24 these behaviour change techniques are absent from the Apps associated with wearable

1 devices[23]. Telephone health coaching has been successfully used in Australian and US
2 survivors to increase PA[5, 33]. The first session (wk 1; ~ 60 minutes) will cover technical
3 issues and the features of the Fitbit, including the importance of MVPA. It will also foster
4 positive outcome expectancies and confidence towards PA and guide the participant to
5 create PA action plans for the following three weeks and self-monitor their activity. The
6 purpose of the three follow-up health coaching sessions (wk 2, 4, and 8; ~30 minutes
7 each) will be to provide support, problem solving and help the participant to update goals
8 and action plans as they progress. We will adopt a patient-centred and stepped-care
9 approach by providing additional health coaching sessions (i.e., at wk 6, and 10) to those
10 who may need them in order to achieve meaningful sustained PA change. Additional
11 health coaching sessions will be negotiated between the health coach and the participant,
12 and will be based on both data from the Fitbit dashboard concerning progress, and,
13 participants' perceptions concerning support needs. Additional sessions will be
14 negotiated during the previous follow-up call. The weekly exercise target will be at least
15 180-minutes of moderate-intensity PA, based on research demonstrating better survival
16 in patients who engaged in 3-5 hrs of moderate activity per week[7, 20]. A web-based
17 API (Application programming interface) to collect user's activity data from the Fitbit
18 server will be developed. Upon user consent via Fitbit authentication page, we will be
19 able to collect participants' daily activity (step count, active minutes, hourly activity, heart
20 rate, stairs climbed). The health coach will log hourly activity (accumulation of 250 steps
21 per hour), step count, active minutes (MVPA bouts of at least 10-minutes) for each
22 participant on a weekly basis. The health coach will also review weekly activity and
23 engagement via the Fitbit app prior to each health coaching session to provide feedback,
24 encouragement and technical support if needed. API monitoring will cease at the end of

1 the trial (after 24-weeks) and a de-authorization email sent to participants to confirm the
2 end of API participation.

3 Quality Assurance

4 The Health coach employed to deliver the intervention will be required to have a
5 background in Psychology or allied health discipline (at least to degree level). The health
6 coach will undertake training including the theoretical bases of the intervention, PA
7 messaging, and implementation of behaviour change techniques. Training will include
8 role-plays with supervised feedback. Health coaching consistency will be achieved by
9 following a semi-structured script with a clear structure of questions, and behaviour
10 change techniques to be covered in each call. Competency and quality control will be
11 monitored by direct observation and/or audio-recordings, (with feedback to the health
12 coach) and will continue until consistent and adequate health coaching performance is
13 confirmed. All telephone calls to participants will be audiotaped.

15 Procedure

16 Participants will be sent an invitation letter, information sheet, consent form
17 (Supplementary file, Appendix A) and a reply-paid envelope from their treating surgical,
18 medical or radiation Oncologist. Upon receipt of written consent, participants will be
19 telephoned and an initial screening questionnaire (including the Active Australia Survey;
20 AAS)[34] to assess PA status) administered to determine eligibility. The AAS has
21 demonstrated acceptable convergent validity for community-dwelling older adults[35].
22 Only those that report participating in less than 150-minutes of MVPA per week will be
23 eligible to participate in the trial.

1
2
3
4 1 If the criteria are met, participants will be mailed the study questionnaire, an
5
6 2 Actigraph GTX9 accelerometer, written accelerometer instructions, and a reply-paid
7
8
9 3 envelope. Participants will be asked to complete the questionnaire and wear the
10
11 4 accelerometer on their right hip for 7-days during waking hours, and then return the
12
13 5 questionnaire and accelerometer in the reply-paid envelope. Figure 1 represents the flow
14
15
16 6 of research participants through the trial.

17
18 7 The statistician will generate the randomisation sequence using STATA v15 with
19
20 8 a 1:1 allocation using random block sizes of 4 and 6 to support allocation concealment.
21
22 9 Participant allocation will be implemented using sequentially numbered, opaque sealed
23
24 10 envelopes, and the researchers involved in assessing and enrolling participants will not
25
26 11 be involved in the generation of the randomisation sequence. Following consent and
27
28 12 baseline assessment, the trial-coordinator will choose the next envelope in the sequence
29
30 13 and write the participant study number onto the envelope prior to allocating the
31
32 14 participant to that group. Carbon paper inside the envelope will transfer the number onto
33
34 15 the card containing the details of allocation.
35
36
37
38

39 16 The trial-coordinator will post the accelerometers to participants with clear
40
41 17 instructions on how to use them, and will contact participants after the 7-days to remind
42
43 18 them to post them back to the researchers. Participants will also complete questionnaires
44
45 19 that measure socio-demographic variables, QoL, and HAPA model constructs[27].
46
47

48 20 Both the control and intervention group will receive a mailed booklet designed to
49
50 21 educate and motivate improvements in PA. Materials will be based on the current
51
52 22 guidelines for PA[31] and include examples of home-based strength exercises and a guide
53
54 23 to exercise intensity. The control group will receive minimal intervention to mimic usual
55
56 24 care so that we are able to compare the effects of the intervention to usual care. The
57
58
59
60

1 booklet provided: 'Exercise for people living with cancer' is freely available from Cancer
2 Council Australia and may be found in oncology reception areas, and as such, may be
3 considered to represent usual care.

4 After 12-weeks, participants in both groups will complete a questionnaire that
5 measures variables from the HAPA, QoL and psycho-social variables again for a second
6 time and wear an accelerometer for a 7-day period. The trial-coordinator will post out the
7 accelerometers and questionnaires. Between 12-weeks and 24-weeks, participants will
8 keep the Fitbit but there will be no further health coaching. At 24-weeks, all participants
9 will complete the questionnaires for a third time and will receive an accelerometer to wear
10 for a 7-day period. All Fitbits will be returned after the 24-week assessment alongside the
11 accelerometer. Following trial completion (T3), participants in the control group will be
12 offered the opportunity to trial a Fitbit™ for 12-weeks.

13 Measures

14 Primary outcomes

15 The primary outcome will be minutes of moderate-to-vigorous PA (MVPA) and
16 sedentary behaviour ascertained from the Actigraph GT9X (Actigraph, LLC, Pensacola,
17 Florida, USA). Participants will be mailed the accelerometer and instructed to wear on
18 their right hip for all waking hours for one week at baseline, 12-weeks and 24-weeks.
19 Wear time must exceed 10-hours per day to be considered valid for analysis. Non-wear
20 periods will be defined as intervals of at least 60-consecutive minutes of zero counts will
21 be excluded from analyses. Activity counts will be categorised as: sedentary (<100cpm),
22 light-intensity (100-1951cpm), moderate-intensity (1952-5724cpm) and vigorous-
23 intensity (>5725cpm), using data recorded in 60-s epochs, according to Freedson cut

1 points[36]. MVPA will be examined as both weekly time accumulated (minutes/week),
2 and time in bouts of 10-consecutive minutes (minutes/week).

3 *Sedentary behaviour*

4 Sedentary behaviour will be defined by accelerometer activity counts of <100cpm, for 20
5 consecutive minutes or more, which corresponds to clinical changes in cardio-metabolic
6 biomarkers[37]. The accelerometer log completed will assist in differentiating sedentary
7 time from non-wear time.

8 *Quality of life*

9 Quality of life will be measured using the European Organization for Research and
10 Treatment of Cancer, QoL Core Questionnaire (EORTC QLQ-C30) [38] The QLQ-C30
11 is a feasible, reliable and a valid questionnaire and is used in clinical trials of cancer
12 worldwide [38-40]. It includes five function domains (physical, emotional, social, role,
13 cognitive), eight symptoms (e.g., fatigue, pain) in addition to global health/quality of life.

14 *Physical activity attitudes*

15 PA attitudes will be assessed using previously validated items, with Cronbach's
16 alpha scores for the subscales below ranging from 0.73 to 0.87[41]. Some items have
17 been amended, based on previous formative work in survivors[13, 16, 42, 43], and PA
18 recommendations[4]. All items are assessed using a six-point Likert scale. The following
19 constructs will be assessed:

20 *Outcome expectations.* Twelve-items will assess outcome expectations. Five-
21 items are derived from the validated exercise pros subscale[44] and 7-items are based on
22 formative research with survivors[14, 42, 43]. The items measure magnitude that regular
23 PA will help to: reduce tension or stress; feel more confident about my own health; sleep
24 better; have a positive outlook; control my weight; regain lost strength; prevent cancer

1 recurrence; increase fatigue; increase joint pain; weaken my immune system; feel better
2 about my body, and increase my longevity.

3 *Action self-efficacy.* Four-items will assess action self-efficacy, based on previous
4 research with survivors[45]. Items assess participants' confidence to complete 150-
5 minutes of MVPA per week, with the item stems: 'I believe I have the ability to...'; 'I
6 am confident I can do...'; 'If I wanted to I could...' and 'For me to do...'.
7

8 *Maintenance self-efficacy.* Thirteen-items will assess maintenance self-efficacy,
9 based on formative research [14, 43]. Items assess confidence to participate in regular
10 MVPA over the next 12-weeks when, for example: I lack discipline, and I am feeling
11 tired.

12 *Action planning.* Four-items will assess action planning for the next 3-weeks[46].
13 Participants will be asked to respond about whether they have made plan concerning
14 *what, when, where, and how* they will engage in regular PA.

15 *Intention.* Two-items will measure intention to engage in MVPA for at least 150-
16 minutes per week in the next 12-weeks, based on previously established measures[47].
17 Items are 'I intend to participate...' and 'I will try to participate...'.
18

19 **Covariates**

20 Sociodemographic information and CVD risk factors will be self-reported. The following
21 variables will be assessed: marital status; educational attainment; gross household
22 income; and smoking status. Comorbidity will be assessed using the self-administered
23 comorbidity questionnaire [48].
24

25 **Power Calculations and Sample size**
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4 1 The primary outcome is change in MVPA at T2. A sample size of 86 participants (43 in
5
6 2 each arm) is required in order to achieve 80% power to detect a group (control v
7
8 3 intervention) by time (T1 v T2) interaction at 0.05 level. Our calculations are based on
9
10 4 the covariance matrix from a previous wearable-technology trial in survivors using
11
12 5 accelerometers to assess MVPA [49] assuming a 70-minute increase in MVPA at T2 in
13
14 6 the intervention group, but no change in the control arm. We aim to recruit 100
15
16 7 participants, ensuring that if 15% are lost to follow-up, the intervention will still be
17
18 8 adequately powered at 80% to detect a meaningful change.
19
20
21
22

23 9 Patient and public involvement

24
25 10 We have published several papers[13-16] from qualitative work with consumers. Such
26
27 11 consumer engagement has informed the present intervention. For example, this work has
28
29 12 identified 'poor self-discipline' and 'not the sporty type' as the main PA barriers. Some
30
31 13 participants held the perception that they were already 'doing sufficient PA'. Participants
32
33 14 also referred to the need for monitoring, support and accountability to help them in their
34
35 15 behaviour change efforts. These findings have fed into the design of the intervention in
36
37 16 the following ways: the promotion of lifestyle-related exercise such as walking takes
38
39 17 away the 'sporty type' barrier; the use of wearables to provide objective feedback on PA
40
41 18 can be helpful for those who erroneously think they are undertaking sufficient PA; and
42
43 19 the use of wearables and health-coaching provides the self-monitoring, and support that
44
45 20 consumers have identified as important. Consumers that have trialled the wearable
46
47 21 trackers have reported the intervention to be acceptable and not burdensome [26]. Study
48
49 22 participants will be asked whether they wish to receive a report of the results, and asked
50
51 23 to provide an email address for dissemination of study results.
52
53
54
55
56
57
58
59
60

1 Data Management

2 All personal data collected will be stored in accordance with the Data Protection Act and
3 applicable regulatory requirements and access to de-identified data will be available on
4 request. Data will be stored securely to maintain confidentiality. To preserve participant
5 anonymity, only allocated trial numbers will be recorded on trial documentation or
6 computer software except for the consent form and contact details. Documents with
7 identifiable information will be stored separately to other study documents. Pseudonyms
8 will be used when reporting findings from the process evaluation.

9 Data Monitoring and Timeline

10 The trial will be overseen by the trial management group, consisting the principal
11 investigator, the trial-coordinator and health coach. The trial management group will
12 oversee all aspects of the conduct of the trial including performing safety oversight
13 activities and will meet every 4-weeks. Any significant adverse events will be reported to
14 the HREC within 72-hours, and managed by the HREC alongside the principal
15 investigator (SH). The principal investigator will keep an audit trail and maintain
16 responsibility for the trial including conduct and management of the trial. Recruitment is
17 expected to commence in February-2019 and the project completed by December-2020.

18

19 Data analysis

20 The effectiveness of the intervention vs. control on MVPA/week will be assessed using
21 a linear mixed model, with group (intervention vs. control), time (T1 vs. T2) and their
22 interaction as fixed effects, and with a random effect for participant included to account
23 for the correlations in observations inherent in a repeated measures design. Secondary
24 adjusted models will include age, gender, baseline PA level, adjuvant therapy, cancer

1
2
3
4 1 type, months since diagnosis, and intervention dose (number of health coaching sessions
5
6 2 received) as covariates. Between-group comparisons will be performed for all secondary
7
8 3 outcomes (sedentary behaviour, other PA and psychological variables, quality of life) and
9
10 4 HAPA constructs using mixed models, including adjustment for confounding where
11
12 5 appropriate. Missing data will be investigated for patterns in terms of observed study
13
14 6 variables. Multiple imputation will be considered if data are arguably missing at random
15
16 7 and less than 20% of the data are missing. We will impute 25 data sets based on all
17
18 8 relevant observed variables, including the interaction term and outcome measure of
19
20 9 interest for each specific analysis. Sensitivity analyses will be conducted to consider the
21
22 10 effect of potential missing not at random mechanisms on parameter estimates from
23
24 11 imputed data sets. Intention-to-treat analysis will be conducted where there is participant
25
26 12 attrition. Appropriate longitudinal mediation models will be used to investigate whether
27
28 13 a) intervention associated changes in MVPA are mediated (at least partially) via the
29
30 14 HAPA model and b) changes in QoL are partially mediated via changes in MVPA. All
31
32 15 data will be analysed with $p < 0.05$ considered significant.
33
34
35
36
37
38

39 Process evaluation

40
41 17 Acceptability and feasibility of the intervention will form the process evaluation.
42
43 18 Feasibility of the intervention will be evaluated by comparing intervention costs
44
45 19 (intervention equipment, staff time) with uptake rates, adherence (to wearing the wearable
46
47 20 tracker, receipt of health coaching sessions), and completion. Acceptability and utility of
48
49 21 the intervention, and an understanding of the active ingredients will be examined using
50
51 22 semi-structured interviews.
52
53
54
55
56

57 DISCUSSION

58
59
60

1 The trial will assess the effectiveness of an intervention that combines wearable
2 technology with behaviour change techniques (action-planning, goal-setting, and coping
3 planning, feedback) to increase MVPA and reduce sedentary behaviour in cancer
4 survivors living in non-metropolitan areas of Australia. This protocol describes one of the
5 first trials using wearable technology to promote PA in non-metropolitan survivors,
6 contributing to research on the effectiveness of distance-based interventions to promote
7 PA.

8 Despite increasing evidence that PA reduces the risk of CVD and cancer
9 recurrence[6, 50], few survivors meet the PA guidelines[4]. Furthermore, there are
10 significant geographic inequalities in cancer survival that urgently need to be addressed,
11 with significantly poorer survival in rural areas compared to major-cities. Existing PA
12 programs for survivors tend to be based in major cities with scarce provision outside of
13 major-cities. Less intensive home-based interventions could be more acceptable to
14 consumers, scalable and more cost-effective.

16 **Conclusion**

17 The trial is pragmatic and primarily concerned with evaluating whether a low-
18 intensity, distance-based intervention is effective for increasing MVPA and reducing
19 sedentary behaviour in survivors. If effective, the intervention, that employs resource
20 deployment according to patient need, would be low-cost and scalable, and could be
21 integrated into existing health care pathways.

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
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4

REFERENCES

1. Baade PD, Frischi L, & Eakin E. Non-cancer mortality among people diagnosed with cancer. *Cancer Causes Control* 2006;17:287-297.doi:10.1007/s10552-005-053-0.
2. Keats MR, Cui Y, Grandy SA, et al. Cardiovascular disease and physical activity in adult cancer survivors: A nested, retrospective study from the Atlantic PATH cohort. *J Cancer Surviv* 2017;11:264-273.doi: 10.1007/s11764-016-0584-x.
3. Doyle C, Kushi L, Byers T, et al. Nutrition and physical during and after cancer treatment: an American Cancer Society guide for informed choices. *CA Cancer J Clin* 2006;56:323-53.
4. Rock CL, Doyle C, Demark-Wahnefried W, et al. Nutrition and physical activity guidelines for cancer survivors. *CA Cancer J Clin* 2012;62:242-274.doi:10.3322/caac.21142.
5. Hawkes A, Chambers S, Pakenham K, et al. Effects of a telephone-delivered multiple health behavior change intervention (CanChange) on health and behavioral outcomes in survivors of colorectal cancer: a randomized controlled trial. *J Clin Oncol* 2013;31:2313-2321.doi: 10.1200/JCO.2012.45.5873.
6. Friedenreich CM, Neilson HK, Farris MS, et al. Physical activity and cancer outcomes: A precision medicine approach. *Clin Cancer Res* 2016;22: 4766-4775. doi:10.1158/1078-0432.CCR-16-0067.
7. Li T, Wei S, Shi Y, et al. The dose-response effects of physical activity on cancer mortality: findings from 71 cohort studies. *British Journal of Sports Medicine* 2016;50:339-345. doi: 10.1136/bjsports-2015-094927.
8. Weaver K, Foraker R, Alfano C, et al. Cardiovascular risk factors among long-term survivors of breast, prostate, colorectal and gynaecologic cancers: a gap in survivorship care? *J Cancer Surviv* 2013;7:253-261.doi: 10.1007/s11764-013-0267-9.
9. Threlfall TJ, & Thompson JR. Cancer incidence and mortality in Western Australia, 2014. Department of Health, Western Australia, Perth. Statistical Series Number 103. Perth, WA: Department of Health 2015.

10. Leach CR, Weaver KE, Aziz NM, et al. The complex health profile of long-term cancer survivors: Prevalence and predictors of comorbid conditions. *J Cancer Surviv* 2015;9:239-251. doi: 10.1007/s11764-014-040301.
11. Tervonen HE, Aranda S, Roder D, et al. Cancer survival disparities worsening by socio-economic disadvantage over the last 3 decades in New South Wales, Australia. *BMC Public Health* 2017;17:691-702. doi:10.1186/s12889-016-4692-y.
12. Australian Institute of Health and Welfare. *Australians' health*. Canberra: AIHW 2014.
13. Hardcastle SJ, Glassey R, Salfinger S, et al. Factors influencing participation in health behaviors in endometrial cancer survivors. *Psycho-oncology* 2017;26:1099-1104. doi:10.1002/pon.4288.
14. Hardcastle SJ, Maxwell-Smith C, Zeps N, et al. A qualitative study exploring health perceptions and factors influencing participation in health behaviors in colorectal cancer survivors. *Psycho-oncology* 2017;26:199-205. doi:10.1002/pon.4111.
15. Hardcastle SJ, Maxwell-Smith C, Kamarova S, et al. Factors influencing non-participation in an exercise program and attitudes towards physical activity amongst cancer survivors. *Support Care Cancer* 2018;26:1289-1295. doi:10.1007/s00520-017-3952-9.
16. Maxwell-Smith C, Zeps N, Hagger MS, et al. Barriers to physical activity participation in colorectal cancer survivors at high risk of cardiovascular disease. *Psycho-oncology* 2017;26:808-814. doi:10.1002/pon.4234.
17. Hardcastle SJ, & Cohen PA. Effective physical activity promotion to survivors of cancer is likely to be home based and to require oncologist participation. *J Clin Oncol* 2017;35:3635-3637. doi: 10.1200/JCO.2017.74.6032.
18. Groen WG, Van Harten WH, Vallance JK. Systematic review and meta-analysis of distance-based physical activity intervention for cancer survivors (2013-2018): We still haven't found what we're looking for. *Cancer Treatment Reviews* 2018; 69:188-203.
19. Hartman S, Nelson SH, Myers E, et al. Randomized controlled trial of increasing physical activity on objectively measured and self-reported cognitive functioning among breast cancer survivors: The memory & motion study. *Cancer* 2018; 124:192-202.
20. Lahart I, Metsios G, Nevill AM, et al. Randomised controlled trial of a home-based physical activity intervention in breast cancer survivors. *BMC Cancer* 2016; 16:234-247. doi: 10.1186/s12885-016-2258-5.

- 1
2
3
4 1 21. James E, Stacey F, Chapman K, et al. Impact of a nutrition and physical activity
5 2 intervention (ENRICH) on health behaviours of cancer survivors and carers: a
6 3 pragmatic randomized controlled trial. *BMC Cancer* 2015;15:710-725. doi:
7 4 10.1186/s12885-015-1775-y.
8 5
- 9 6
10 7 22. Rogers LQ, Courneya KS, Anton PM, et al. Social cognitive constructs did not
11 8 mediate the cancer intervention effects on objective physical activity behaviour
12 9 based on multivariate path analysis. *Ann Beh Med* 2017;51:321-326.
13 10 doi:10.1007/s12160-016-9840-6.
14 11
- 15 12 23. Lyons EJ, Lewis ZH, Mayrsohn BG, et al. Behaviour change techniques
16 13 implemented in electronic lifestyle activity monitors: A systematic content
17 14 analysis. *Journal Med Internet Res* 2014;16:e192-e206. doi:10.2196/jmir.3469.
18 15
- 19 16 24. Mercer K, Giangregorio L, Schneider E, et al. Acceptance of commercially
20 17 available wearable activity trackers among adults aged over 50 and with chronic
21 18 illness: a mixed-methods evaluation. *JMIR Mhealth Uhealth* 2016;4: e7.
22 19 doi:10.2196/mhealth.4225.
23 20
- 24 21 25. Nguyen NH, Hadgraft NT, Moore MM, et al. A qualitative evaluation of breast
25 22 cancer survivors' acceptance of and preferences for consumer wearable
26 23 technology activity trackers. *Support Care Cancer* 2017;25:3375-3384.
27 24 doi:10.1007/s00520-01703756-y.
28 25
- 29 26 26. Hardcastle SJ, Galliot M, Lynch BM, et al. Acceptability and utility of, and
30 27 preference for wearable activity trackers amongst nonmetropolitan cancer
31 28 survivors. *PLoS ONE* 2018;13(12):e0210039.
32 29 <https://doi.org/10.1371/journal.pone.0210039>
33 30
- 34 31 27. Schwarzer R. Self-efficacy in the adoption and maintenance of health behaviours:
35 32 Theoretical approaches and a new model. In Schwarzer R, Ed. *Self-efficacy:
36 33 Thought control of action*. Washington, DC; Hemisphere 1992:217-242.
37 34
- 38 35 28. Begg C, Cho M, Eastwood S, et al. Improving the quality of reporting randomized
39 36 controlled trials: The CONSORT statement. *JAMA* 1996;276:637-639.
40 37
- 41 38 29. Chan A, Tetzlaff JM, Altman DG, et al. SPIRIT 2013 statement: Defining
42 39 standard protocol items for clinical trials. *Annals of Internal Medicine*
43 40 2013;158:200-207.
44 41
- 45 42 30. Australian Statistical Geography Standard. Volume 5- Remoteness structure.
46 43 Canberra: Australian Bureau of Statistics 2016.
47 44
- 48 45 31. Department of Health. *Australia's physical activity and sedentary behavior
49 46 guidelines*. Canberra: Department of Health 2014.
50 47
51 48
52 49
53 50
54 51
55 52
56 53
57 54
58 55
59 56
60 57

- 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
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
- 1 32. McMahon SK, Lewis B, Oakes M, et al. Older adults' experiences using a
2 commercially available monitor to self-track their physical activity. *J Med*
3 *Internet Res* 2016;4:e35. doi:10.2196/mhealth.5120.
4
5 33. Ligibel JA, Meyerhardt J, Pierce JP, et al. Impact of a telephone-based physical
6 activity intervention upon exercise behaviors and fitness in cancer survivors
7 enrolled in a cooperative group setting. *Breast Cancer Res Treat* 2012;132:205-
8 213. doi:10.1007/s10549-011-11882-7.
9
10 34. Brown WJ, Burton NW, Marshall AL, et al. Reliability and validity of a
11 modified self-administered version of the Active Australia physical activity
12 survey in a sample of mid-age women. *Aust N Z J Public Health* 2008;32:535-
13 541. doi:10.1111/j.1753-6405-2008-00405.x.
14
15 35. Heesch KC, Hill RL, Van-Uffelen JG, et al. Are active Australia physical
16 activity questions valid for older adults? *J Sci Med Sport* 2011;14:233-237. doi:
17 10.1016/j.jsams.2010.11.004.
18
19 36. Freedson PS, Melanson E, & Sirard J. Calibration of the Computer Science and
20 Applications, Inc. accelerometer. *Med Sci Sports Exerc* 1998;30:777-781.
21
22 37. Lynch BM, Boyle T, Winkler E, et al. Patterns and correlates of accelerometer-
23 assessed physical activity and sedentary time among colon cancer survivors.
24 *Cancer Causes Control* 2016;27:59-68. doi:10.1007/s10552-015-0683-4.
25
26 38. Aaronson NK, Ahmedzai S, Bergman B, et al. The European Organization for
27 Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use
28 in international clinical trials in oncology. *Journal of the National Cancer Institute*
29 1993;85:365-376.
30
31 39. Guzelant A, Goksel T, Ozkok S et al. The European organization for research and
32 treatment of cancer QLQ-C30: an examination into the cultural validity and
33 reliability of the EORTC QLQ-C30. *European Journal of Cancer Care*
34 2004;13:135-144.
35
36 40. Ozturk A, Sariham S, Ercan I, et al. Evaluating quality of life and pulmonary
37 function in long-term survivors of non-small cell lung cancer with radical or
38 postoperative radiotherapy. *Am J Clin Oncol* 2009;32:65-72.
39
40 41. Parschau L, Barz M, Richert J, et al. Physical activity among adults with obesity:
41 Testing the health action process approach. *Rehabil Psychol* 2014;59:42-49.
42 doi:10.1037/a0035290.
43
44 42. Bennett JA, Lyons KS, Winters-Stone K, et al. Motivational interviewing to
45 increase physical activity in long-term cancer survivors: a randomized controlled
46 trial. *Nurs Res* 2007;56:18-27.
47

- 1
2
3
4 1 43. Short CE, James EL, Girgis A, et al. Move more for life: The protocol for a
5 2 randomised efficacy trial of a tailored-print physical activity intervention for post-
6 3 treatment breast cancer survivors. *BMC Cancer* 2012;12:172-181.
7 4 doi:10.1186/1471-2407-12-172.
8 5
9 6
10 7 44. Plotnikoff RC, Blanchard CM, Hotz SB, et al. Validation of the decisional balance
11 8 scales in the exercise domain from the transtheoretical model: A longitudinal test.
12 9 *Meas Phys Educ Exerc Sci* 2001;5:191-206.
13 10 doi:10.1207/S15327841MPEE0504_01.
14 11
15 12 45. Rogers LQ, Shah P, Dunnington G, et al. Social cognitive theory and physical
16 13 activity during breast cancer treatment. *Oncol Nurs Forum* 2005;32:807-815.
17 14
18 15 46. Rhodes RE, Blanchard CM, Matheson DH, et al. Disentangling motivation,
19 16 intention, and planning in the physical activity domain. *Psychol Sport Exerc*
20 17 2006;7:15-27. doi:10.1016/j.psychsport.2005.08.011.
21 18
22 19 47. Ajzen I, Brown TC, & Carvajal F. Explaining the discrepancy between intentions
23 20 and actions: The case of hypothetical bias in contingent valuation. *Pers Soc*
24 21 *Psychol Bull* 2004;30:1108-1121. doi:10.1177/0146167204264079.
25 22
26 23 48. Sangha O, Stucki G, Liang MH, et al. The self-administered comorbidity
27 24 questionnaire: A new method to assess comorbidity for clinical and health
28 25 services research. *Arthritis & Rheumatism* 2003;49:156-163.
29 26
30 27 49. Maxwell-Smith C, Cohen PA, Platell C, et al. Wearable Activity Technology and
31 28 Action-planning (WATAAP) to promote physical activity to cancer survivors:
32 29 Randomised controlled trial protocol. *Int J Clin Health Psychol* 2018;18:124-132.
33 30 doi: 10.1016/j.ijchp.2018.03.003
34 31
35 32 50. Hamer J, & Warner E. Lifestyle modifications for patients with breast cancer to
36 33 improve prognosis and optimize overall health. *Can Med Assoc J* 2017;189:E268-
37 34 E274. doi:10.1503/cmaj.160464.
38 35
39 36
40 37
41 38
42 39
43 40
44 41
45 42
46 43
47 44
48 45
49 46
50 47
51 48
52 49
53 50
54 51
55 52
56 53
57 54
58 55
59 56
60 57

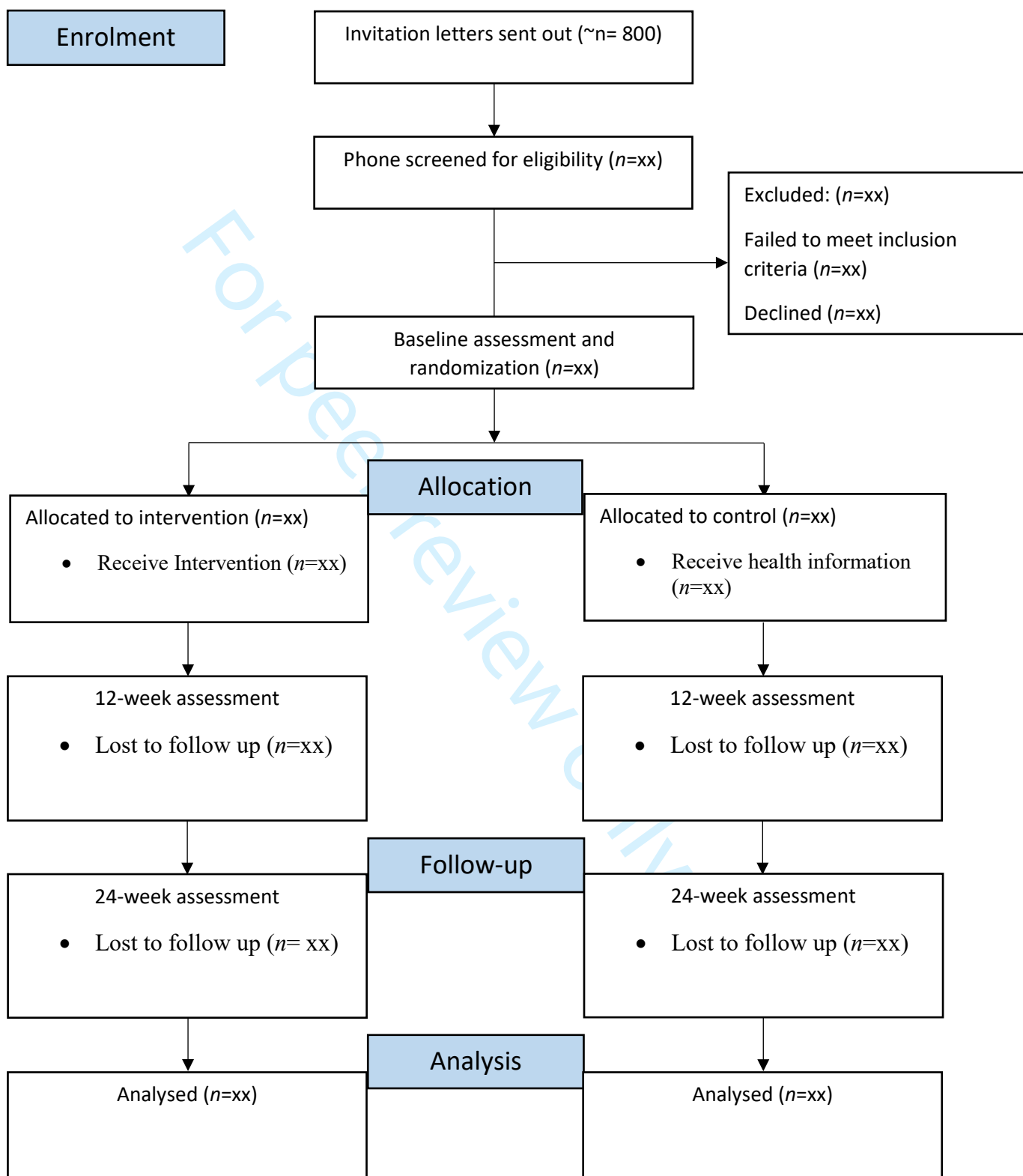
Figure Legends

Figure 1. Flow diagram of trial design

Acknowledgements: We thank the consumers that have kindly given their time to participate in our previous projects that have contributed to the design of the prospective intervention.

- 1
2
3
4 1 **Contributors:** SH led the study conceptualisation, development of intervention content
5
6 2 and writing of the protocol. GM, PT, SS, JT, GRM, ML, PC, CS and CP contributed to
7
8 3 study conceptualisation and will recruit patients for the trial. RJ edited the protocol and
9
10 4 will assist in the process evaluation. TB and VC contributed to physical activity
11
12 5 measurement protocol and will be responsible for Actigraph data cleaning and analysis.
13
14 6 DH contributed to statistical analysis and the process for randomisation and data
15
16 7 management and will undertake data analysis. All authors edited the manuscript.
17
18 8
19
20 9 **Funding:** This work was supported by a grant from The Tonkinson Colorectal Cancer
21
22 10 Research Foundation (Grant reference #59395).
23
24
25
26 11 **Competing interests:** None declared
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Figure 1. Flow diagram of trial design





Supplementary File, Appendix A: Consent form

Title	The promotion of physical activity to adult cancer survivors in regional and remote areas of Western Australia using Fitbit technology and telephone health coaching
Principal investigator	Sarah Hardcastle

Note: All parties signing the consent section must date their own signature.

Declaration by participant

- I have read, or have had read to me, and I understand the participant information and consent form.
- I have had an opportunity to ask questions and I am satisfied with the answers I have received.
- I understand the purposes, procedures and risks of the research described in this research study.
- I intend to adhere to the study requirements to the best of my ability.
- I understand that I will be given a signed copy of this document to keep.

Signature _____ Date _____

Name of participant (please print) _____

Declaration by trial doctor/senior researcher[†]

I have given a verbal explanation of this study, its procedures and risks and I believe that the participant has understood that explanation.

Signature _____ Date _____

Name of trial doctor/ researcher[†] (please print) _____

[†] A senior member of the research team must provide the explanation of, and information concerning, the research study.



SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description
Administrative information		
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym (Page 1)
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry (Page 1)
	2b	All items from the World Health Organization Trial Registration Data Set (UTN and ACTN numbers are on Page 1)
Protocol version	3	Date and version identifier (Page 1)
Funding	4	Sources and types of financial, material, and other support (Page 24)
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors (Title page and Page 23)
	5b	Name and contact information for the trial sponsor (Page 24)
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities (Page 24)
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee) (Page 23)
Introduction		
Background and rationale	6a	Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention (Pages 3-6)
	6b	Explanation for choice of comparators (Page 11)
Objectives	7	Specific objectives or hypotheses (Page 6)

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
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Trial design	8	Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory) (Page 6)
--------------	---	---

Methods: Participants, interventions, and outcomes

Study setting	9	Description of study settings (eg, community clinic, academic hospital) (and list of countries where data will be collected. Reference to where list of study sites can be obtained (Page 7)
---------------	---	--

Eligibility criteria	10	Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists) (Page 7-10)
----------------------	----	---

Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered (Page 8-10)
---------------	-----	---

	11b	Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease) (N/A)
--	-----	---

	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests) (Page 8-10)
--	-----	--

	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial (Page 7)
--	-----	---

Outcomes	12	Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended (Page 6, & Page 12-14)
----------	----	--

Participant timeline	13	Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure) (Figure 1)
----------------------	----	--

Sample size	14	Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations (Page 14)
-------------	----	--

Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size (Page 7)
-------------	----	---

Methods: Assignment of interventions (for controlled trials)

Allocation:

1			
2	Sequence	16a	Method of generating the allocation sequence (eg, computer-
3	generation		generated random numbers), and list of any factors for stratification.
4			(To reduce predictability of a random sequence, details of any
5			planned restriction (eg, blocking) should be provided in a separate
6			document that is unavailable to those who enrol participants or assign
7			interventions (Page 11)
8			
9			
10	Allocation	16b	Mechanism of implementing the allocation sequence (eg, central
11	concealment		telephone; sequentially numbered, opaque, sealed envelopes),
12	mechanism		describing any steps to conceal the sequence until interventions are
13			assigned (Page 11)
14			
15	Implementation	16c	Who will generate the allocation sequence, who will enrol participants,
16			and who will assign participants to interventions (Page 11)
17			
18			
19	Blinding	17a	Who will be blinded after assignment to interventions (eg, trial
20	(masking)		participants, care providers, outcome assessors, data analysts), and
21			how (Page 11)
22			
23		17b	If blinded, circumstances under which unblinding is permissible, and
24			procedure for revealing a participant's allocated intervention during
25			the trial (N/A)
26			
27			

Methods: Data collection, management, and analysis

28			
29			
30	Data collection	18a	Plans for assessment and collection of outcome, baseline, and other
31	methods		trial data, including any related processes to promote data quality (eg,
32			duplicate measurements, training of assessors) and a description of
33			study instruments (eg, questionnaires, laboratory tests) along with
34			their reliability and validity, if known. Reference to where data
35			collection forms can be found, if not in the protocol (Page 7-11)
36			
37			
38		18b	Plans to promote participant retention and complete follow-up,
39			including list of any outcome data to be collected for participants who
40			discontinue or deviate from intervention protocols (Page 8)
41			
42	Data	19	Plans for data entry, coding, security, and storage, including any
43	management		related processes to promote data quality (eg, double data entry;
44			range checks for data values). Reference to where details of data
45			management procedures can be found, if not in the protocol (Page
46			15-16)
47			
48			
49	Statistical	20a	Statistical methods for analysing primary and secondary outcomes.
50	methods		Reference to where other details of the statistical analysis plan can be
51			found, if not in the protocol (Page 16-17)
52			
53			
54		20b	Methods for any additional analyses (eg, subgroup and adjusted
55			analyses) (Page 16-17)
56			
57		20c	Definition of analysis population relating to protocol non-adherence
58			(eg, as randomised analysis), and any statistical methods to handle
59			missing data (eg, multiple imputation) (Page 17)
60			

Methods: Monitoring

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed (Page 16)
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60	Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct (Page 16)
	Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor (Page 16)

Ethics and dissemination

26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60	Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval (Page 1 & 6)
	Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators) (Page 16)
	Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32) (Page 10)
		26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable (N/A)
	Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial (Page 15-16)
	Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site (Page 24)
	Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators (Page 24)
	Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation (N/A)

- 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
- | | | |
|-------------------------|-----|---|
| Dissemination
policy | 31a | Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions (Page 1) |
| | 31b | Authorship eligibility guidelines and any intended use of professional writers (Page 23-24) |
| | 31c | Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code (Page 1) |

16 Appendices

- 17
18
19
20
21
22
23
24
- | | | |
|-------------------------------|----|---|
| Informed consent
materials | 32 | Model consent form and other related documentation given to participants and authorised surrogates (Appendix A) |
| Biological
specimens | 33 | Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable (N/A) |

25 *It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013
26 Explanation & Elaboration for important clarification on the items. Amendments to the
27 protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT
28 Group under the Creative Commons "[Attribution-NonCommercial-NoDerivs 3.0 Unported](https://creativecommons.org/licenses/by-nc-nd/3.0/)"
29 license.
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60