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Reducing noncommunicable disease risk in midlife adults using eHealth: The GroWell for Health Program feasibility study ☆

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ABSTRACT

Background: Midlife adults are at increased risk of noncommunicable disease due to the lifetime cumulative effect of unhealthy behaviours and increased prevalence of overweight and obesity.
Aim: This study evaluates preliminary effectiveness and feasibility of an eHealth intervention (GroWell for Health Program) designed for primary prevention of modifiable risk factors in midlife adults.
Methods: The sample comprised community dwelling adults 40 to 59 years, able to read English with access to a personal computer/tablet. Following consent, participants were randomly allocated to a structured 8-week intervention including an eBook (Arm A) or an eBook plus nurse coaching (Arm B). Outcome measures include self-report physical activity, diet, stage of change; anthropometric measures; and feasibility.
Findings: Overall 40 people consented to participate in the study. The majority were female (89.2%) with a mean age of 50.6 (SD = 6.3) years. Significant within groups change over time was observed in Arm A for physical activity, fruit, vegetable intake and exercise stage of change; and daily vegetable and fruit intake, fruit, and exercise stage of change than in Arm B.
Discussion: The direction of change in outcomes suggests the intervention content and structure is likely to be effective in supporting behaviour change in midlife adults. Health coaching from nurses improved retention, although for motivated participants completing the program independently using the eBook is a cost-effective option.
Conclusion: Promising results suggest the nurse delivered eHealth intervention is feasible and likely be effective in addressing modifiable risk factors for NCD in midlife adults.

Summary of relevance

Problem or issue

- Noncommunicable diseases (NCD) which are responsible for many premature deaths in midlife adults are largely preventable, being related to modifiable lifestyle risk factors.

What is already known

- While complex interventions targeting multiple health behaviours are effective and use of eHealth improves reach, there is a paucity of nurse-led eHealth interventions for primary prevention of NCDs.

What this paper adds

- A novel eHealth behaviour change intervention, that includes health coaching delivered by nurses, has enormous potential to support behaviour change and reduce NCD risk in midlife adults.

☆ **Trial registration:** ACTRN12618001641280.

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1. Introduction

Middle aged (midlife) adults are at increased risk of developing noncommunicable chronic diseases (NCD) including cardiovascular disease (CVD), cancer, respiratory disease and type 2 diabetes that are responsible for the majority of premature deaths in adults between the ages of 30 and 70 years (Dagenais et al., 2020). These diseases are preventable being largely attributable to modifiable lifestyle factors including lack of physical activity, unhealthy diet, tobacco smoking and alcohol consumption that all contribute to increase cardiometabolic risk (Naghavi et al., 2017). The GroWell for Health Program (GWHP) is a novel multiple health behaviour change intervention designed for primary prevention of behavioural risk factors in midlife adults that includes health coaching by nurses. This paper reports results of a recent feasibility study that aimed to evaluate the utility and acceptability of the intervention and to undertake preliminary efficacy testing of the intervention delivered in two different modes.

2. Literature review

In Australia, and worldwide, there is an epidemic of lifestyle-related NCDs with efforts to reduce risk factor prevalence imperative to improve individual and community health, reduce the burden of disease and address health inequities. Upstream health behaviours, especially unhealthy diet, lack of physical activity, tobacco smoking and alcohol consumption (SNAP risk factors) are well known to adversely impact on blood lipid profile, glucose regulation, cardiovascular health and weight gain (Yusuf et al., 2020). There is evidence that the majority of middle-aged Australian adults are not meeting current evidence-based recommendations for fruit and vegetable intake, physical activity, alcohol consumption and healthy body weight, with an alarming 83.6% of men and 72.2% of women aged 45-54 years old classified as overweight or obese in 2017-18 (Australian Institute of Health and Welfare, 2020). Thus, many adults have a cluster of unhealthy lifestyle risk factors and habitual behaviours that not only compound risk but make behaviour change very challenging.

'Middle age' or 'midlife' is not a clearly defined term in the scientific literature. For the purposes of this study, the age range 40 to 59 years was chosen for several reasons. Most females have finished child bearing by the age of 40 with the average age of menopause in Australia around 51 years (Davis et al., 2015). The prevalence of NCD's and cardiometabolic risk rises with age, for example, the proportion of people with hypertension triples from 4.2% in people age 35- 44 years to 12.9% of 45-54 years old; and approximately 75% of adults aged 55-64 years old have a waist circumference that puts them at increased risk of metabolic complications (AIHW, 2020). In contemporary times, from a psycho-social perspective, midlife is a busy stage of life with both males and females usually still in the workforce and experiencing similar barriers to health behaviour change such as lack of time, work and family responsibilities (McGuire, Seib, & Anderson, 2016). When lifestyle factors such as unhealthy diet and lack of physical activity start having an adverse impact at this time of life, this may be a stimulus for change to reduce risk factors and improve health and wellbeing.

There is evidence that complex health behaviour change interventions that target multiple risk factors simultaneously are effective with the inclusion of goal setting, self-monitoring, person centred and autonomy supportive counselling approaches likely to improve intervention outcomes over time (Samdal, Eide, Barth, Williams, & Meland, 2017). While eHealth, mHealth and telehealth interventions are increasingly being used, especially in the context of the current Covid-19 pandemic, there is a paucity of nurse-led eHealth interventions delivered remotely in home or primary care settings, aimed at primary prevention of multiple behavioural risk factors in adults without a chronic condition (Patnode, Evans, Senger, Redmond, & Lin, 2017). With the shift from acute to community care and growth in primary care nursing workforce there is also evidence nurses are underutilised and would like to spend more time on health promotion, client education and client assessment (Halcomb & Ashley, 2019). In this context and given that nurses are now eligible to use telehealth, eHealth interventions delivered by nurses have enormous potential to support individual behaviour change, improve health and prevent the onset of debilitating chronic disease.

3. Current study

This study evaluates the feasibility of a novel nurse-led complex eHealth behaviour change program (GWHP) for primary prevention of NCD modifiable lifestyle risk factors in midlife adults. The GWHP includes a structured interactive eBook/Journal that provides detailed evidence-based health information, self-monitoring activities, goal setting and scripted first-person narrative stories. The intervention also includes an optional video consultation component (Arm B), with a personalised health assessment and motivational interviewing provided by registered nurses.

4. Methods

4.1. Trial design and objectives

A two-arm parallel group feasibility study was designed according to the CONSORT 2010 statement: extension to randomised pilot and feasibility trials (Eldridge et al., 2016), with participants randomly allocated to either Arm A (GWHP eBook) or Arm B (GWHP eBook + health coaching). The study had two objectives:

1) Undertake preliminary analysis of the effect of two different modes of delivery on physical activity level, fruit and vegetable intake, alcohol frequency, BMI, waist circumference and readiness for change;
2) Assess feasibility of recruitment, retention, intervention delivery, data collection tools and methods, actual time and cost of administration, data collection and intervention delivery.

4.2. Theoretical basis

Motivation to change is well recognised as an important part of individual behaviour change process that influences action and goal attainment (Heckhausen & Heckhausen, 2010). The transtheoretical model of health behaviour change (TTM) posits that the likelihood of change in any behaviour depends on an individual's motivation and readiness for change (Prochaska & Velicer, 1997). The TTM describes the 'stages of change' of precontemplation, contemplation, preparation, action and maintenance as being a cyclical process, with individuals likely to be at different stages for discrete health behaviours.

While TTM is a theory, Motivational Interviewing (MI) is an effective behavioural counselling technique widely used by a range of health professionals in many healthcare contexts and with many behaviours including tobacco smoking, diet, physical activity, weight loss, alcohol and substance use behaviours (Frost et al., 2018). In MI, the clinician works in partnership with an individual using person-centred empathic communication and a clearly identified change goal, with the aim of evoking and strengthening a client's own motivations for change (Rollnick, Butler, & Miller, 2008).

4.3. Setting and participants

The study setting was a university research centre, with private video consultations conducted for data collection and intervention delivery in participants' homes or location of choice. Eligible adults were: (i) 40 to 59 years of age; (ii) able to speak and read Level 10 English; (iii) had access to a mobile, tablet or eReader device. Exclusion criteria were: (i) having an existing diagnosis of cardiovascular disease, type 2 diabetes or cancer in the past 12 months; (ii) any clinical, cognitive or psychiatric contraindication identified by clinical staff, and; (iii) being at higher risk of an adverse event scored on the Adult Pre-Exercise Screening Tool (Brickwood, Williams, Ahuja, & Fell, 2012).

4.4. Sample size and recruitment

For the purposes of this feasibility study, our aim was to enrol sufficient numbers to generate useful data for future planning with a minimum threshold of 25 participants per treatment arm for medium (0.5) standardised effect sizes (Whitehead, Julious, Cooper, & Campbell, 2016). Anticipating attrition of 20% we aimed to enrol 60 participants. Following television media publicity, social media publicity and distribution of study fliers in a range of community settings, prospective participants registered interest online through the study website. On completion of registration, screening and recruitment were undertaken by Research Assistant 1 (RA1). Detailed written information was provided about study processes and potential risks and benefits with all participants completing and signing a written consent form. Following consent, RA1 notified Research Assistant 2 (RA2) who randomly assigned participants to either Arm 1 or Arm 2. Random assignment was via a computer generated permuted randomised block sequence with equal cases randomised to each group. Permuted block randomisation was performed within strata defined by sex (male/female) with random variation in block of sizes of two and four. Participant blinding was not possible because participants were aware of the trial's conditions and differences.

4.5. Intervention

The GroWell for Health Program is a structured 8-week program designed to enhance motivation and promote positive changes in physical activity, healthy eating and healthy weight management, stress management and sleep, strength and balance, alcohol consumption, tobacco smoking and health screening behaviours. Maintenance of behaviour change is supported by emphasising positive outcomes of new behaviour, providing options that are enjoyable and encouraging self-monitoring and goal setting. Recommendations incorporated into the program are adapted from the latest evidence based guidelines for physical activity, healthy diet, and alcohol consumption (Australian Government Department of Health, 2014; National Health & Medical Research, 2013).

There are two components to the intervention: (i) an interactive eBook, and (ii) nurse consultations via video with registered nurses trained to deliver the intervention. Participants in this feasibility study were allocated to one of two study arms: (i) Arm A received the interactive eBook and undertook the program independently, and (ii) Arm B received the interactive eBook plus video consultations with a registered nurse at baseline, 4 weeks and 8 weeks.

The Program eBook is published in an editable PDF format produced by a professional graphic designer with high quality images, colours and fonts used. The program/eBook incorporates principles from the TTM and MI and aims to move participants from contemplation to action by evoking their motivation for change. It has 8-steps/sections and includes evidence-based information, self-reflection, goal setting, action planning and strategies to overcome barriers to change and prevent relapse for each of the target behaviours. The book also contains scripted first-person narrative stories from a fictional female and male participant, that further aim to enhance participant engagement using content that addresses process, experience, benefits, barriers and outcomes of the program (Shaffer & Zikmund-Fisher, 2013). The book is also a resource that people can continue to use as a reference or use to re-start the program at a later date.

In addition to the eBook, participants in Arm B received video consultations with a registered nurse in week 1 (60 minutes), week 4 (30 minutes) and week 8 (30 minutes). The nurse delivering the consultation component of the intervention was an experienced clinical nurse with community nursing competencies and supportive counselling skills. Training about the structure and content of the GWHP, motivational interviewing and goal setting was provided before intervention delivery. Intervention fidelity was assured with use of a consultation checklist, and one of the clinical investigators auditing case notes and regularly observing consultations. In this study intervention fidelity was easily maintained with only one nurse delivering the intervention to Arm B participants. Table 1 describes components of the GWHP intervention.

4.6. Data collection and measurement

To evaluate the feasibility of the intervention before conducting a fully powered randomised controlled trial, data were collected from three sources: (i) a self-report online questionnaire, (ii) anthropometric measures, (iii) descriptive data about registrations, eligibility, recruitment, retention rates and intervention delivery methods, and workload hours.

4.6.1. Online questionnaire

Participants completed online surveys before commencing the program (baseline) and at completion of the 8-week intervention (endpoint). The questionnaire included: socio-demographic information (baseline only); self-reported weight and height, daily fruit and vegetable intake, physical activity; weekly alcohol consumption, daily tobacco use, and; stage of change for exercise, fruit, and vegetable consumption.

The primary outcome was self-report physical activity measured using the International Physical Activity Questionnaire Short Form (IPAQ-SF) (Ekelund et al., 2006). The IPAQ-SF is a 10-item instrument used to assess 7-day recall of physical activity including vigorous and moderate intensity activity, walking and sitting behaviour in four domains of leisure time, work, transport and domestic and gardening activities. Total scores are calculated by summing the duration (in minutes) and frequency (days) of vigorous intensity, moderate intensity and walking activities. All scores are then converted to Metabolic Equivalent (MET) minutes per week with four continuous scores obtained for walking, moderate, vigorous and total physical activity MET-minutes per week. Physical activity is also categorised into low (<600 MET-minutes/week), moderate (600-1499 MET-minutes/week) or high (> 1500 MET-minutes/week). There is also a question about time spent sitting, converted to total minutes per week. The IPAQ-SF has proven reliability, being a widely used questionnaire to measure physical activity, with lower participant burden than the IPAQ-Long form (Lee, Macfarlane, Lam, & Stewart, 2011) and inexpensive to administer.

Secondary outcomes including daily fruit and vegetable intake, daily tobacco smoking and weekly frequency of alcohol consumption were measured using items from the National Nutrition and Physical Activity Questionnaire (ABS, 2011). Readiness for change

Table 1
Components of the GroWell for Health Program©.

Component	Delivery strategies/content
Program book/eBook arm A and B timing: weeks 1-8	GWHP Book is a written, structured resource to guide participants week by week through the Program. Provided as an editable PDF eBook or hard copy on request. Content includes structured step-by-step evidence-based health information, goal setting and self-monitoring activities each week. Step 1: Motivation and preparation for change Step 2: Physical activity/exercise Step 3: Healthy eating and healthy weight Step 4: Stress, sleep and mental well-being Step 5: Muscle strength and balance Step 6: Smoking and alcohol consumption Step 7: CVD risk factors and cancer prevention in midlife Step 8: Maintaining motivation Book includes short first person scripted narratives by 'Helen' and 'Greg' who share their motivation or change and their experience and outcomes as they progress through the Program. These are included at the end of each step and relate to the specific topic.
Nurse consultation via video Arm B only Timing: Week 1-60 minutes Week 4-30 minutes Week 8-30 minutes	Consultation via video link on phone/tablet/PC at flexible time and place to suit participant. Detailed health assessment of: Biophysical measures – height, weight, waist circumference, blood pressure Health and lifestyle factors Readiness and perceived barriers to change Person centred discussion to engage, focus and evoke motivation for change. Specific, Measurable, Achievable, Realistic, Time-bound (SMART) goal setting.

for weekly moderate-vigorous intensity physical activity, daily consumption of 2 serves of fruit 5 serves of vegetables were measured using three questions with five response categories corresponding with maintenance, action, preparation, contemplation and precontemplation stages (Marcus, Selby, Niaura, & Rossi, 1992). For example the question, *Do you currently exercise for 150 minutes each week at a moderate to vigorous exercise level?* has the following response options: Yes, I have been for more than 6 months; Yes, I have been for less than 6 months; No, but I am planning to start in the next 30 days; No, but I am planning to start in the next 6 months, and; No, and I don't plan to start in the next 6 months.

4.6.2. Anthropometric measures

Measures including height, weight, waist circumference and hip circumference were collected by participants with direct supervision from research assistants and research nurses during video consultation, according to standardised procedures. Participants were given detailed written instructions before appointments and visualised by the research assistant/nurse while measurements were collected and immediately recorded. Body mass index and waist-to-hip ratio were then calculated using standard formulas (World Health Organization WHO, 2000).

4.6.3. Feasibility evaluation

During all phases of the study, descriptive data were collected about registration, eligibility, recruitment and retention. Feasibility outcomes were defined a priori as: Registered interest 50% male and female; Eligibility $\geq$75% of those screened will be eligible; Recruitment $\geq$70% of eligible participants will agree to enrol; Retention $\leq$30% of participants lost to follow-up. To further evaluate feasibility about data collection methods, use of the interactive eBook, appointment scheduling and research nurse and administrative staff workload, a real time log of issues was recorded by research staff.

4.7. Statistical analysis

Analyses of survey and anthropometric data were performed using Statistical Package for Social Sciences, Version 27.0.1. (2020). Descriptive data are expressed as count (percentage), mean (SD) and median (interquartile range/IQR). Due to the small sample size and attrition rate, a modified intent to treat approach was taken where missing data was imputed using last value carried forward (Little, Long, & Lin, 2009). Comparison between groups at baseline and those lost to follow up (LTFU) were analysed using *t*-test, chi square and nonparametric equivalents. Change over time within groups were analysed using paired *t*-test, chi-square and Wilcoxin signed ranks tests for median data.

4.8. Ethical clearance

In accordance with the NHMRC National Statement on Ethical Conduct in Human Research, ethical clearance was obtained from the relevant institutional Human Research and Ethics Committee (Approval number: 2018/259). All participants provided written consent and no monetary incentives were provided for participation.

5. Results

Seventy people registered interest in participating in the study, with 40 consenting and being randomized to Arm A (eBook) or Arm B (eBook + health coaching). Of those randomized, three withdrew before commencing the intervention and fourteen participants were lost to follow up (35%). Attrition was slightly higher from Arm A (eBook) group and in both groups was higher in those with low levels of physical activity reported at baseline. No harm or adverse events were reported or observed during the study. A Consort diagram detailing recruitment and flow through the study is illustrated in Fig. 1.

5.1. Baseline characteristics

Baseline characteristics of participants who provided data including those in Arm A (n = 18), Arm B (n = 19) and those lost to follow up (LTFU) are presented in Table 2. There was a significant difference noted between the groups for marital status, with a higher proportion in Arm A being married (χ^2 (3) = 12.2, $p <$

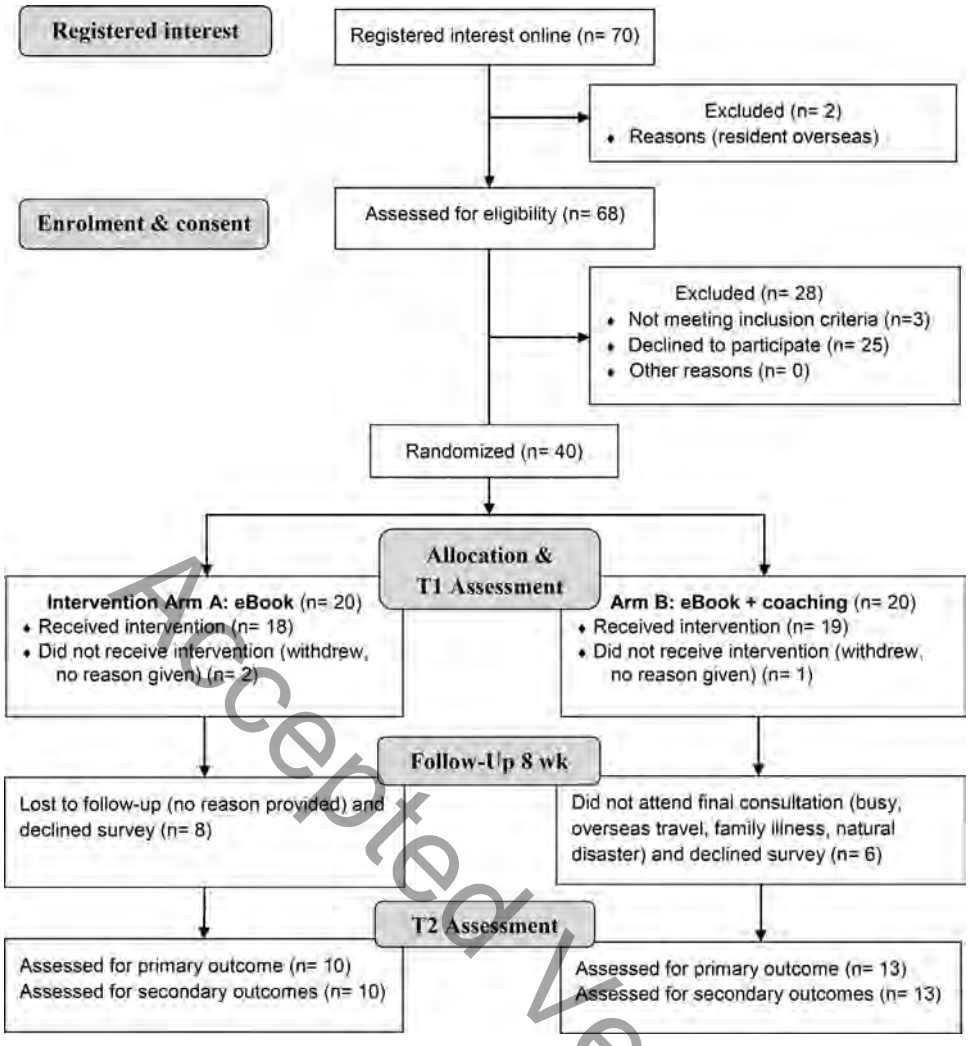

Fig. 1. Study consort diagram.

0.05). For the total sample, most participants were female (89.2%) and the mean age was 50.6 (SD = 6.3) years old. Most were married (75.7%) employed either full-time (51.4%) or part-time (37.8%) with around half having attained tertiary education (51.3%).

Most participants were overweight (43.2%) or obese (32.4%), with low (27.0%) to moderate levels (62.2%) of physical activity. Nearly half of participants (48.6%) were not meeting the recommended daily two serves of fruit with 75.7% not eating recommended five or more daily serves of vegetables. There was only one current smoker and average frequency of alcohol consumption was 2.3 (2.3) days per week. About half of participants (48.6%) were in the pre/contemplation stage of change for exercise (150 minutes mod/hard per week) and fruit consumption (2 serves daily), with 67.6% in pre/contemplation stage for vegetable consumption (5 serves daily).

5.2. Within groups change over time

Table 3 presents within groups change over time for median physical activity (MET-minutes/per week), sitting time (minutes/week), mean daily serves of fruit, vegetables, weekly alcohol frequency (days/week), BMI, waist circumference and waist-hip ratio. Positive trends were noted in both groups for increased physical activity, daily serves of fruit and vegetables, BMI and waist circumference. Statistically significant changes were observed in Arm A for walking and total physical activity, and in Arm B for daily serves of vegetables ($p < 0.05$).

Physical activity (low, medium and high MET-minutes) by category results; proportion of participants meeting recommended guidelines for daily fruit, vegetables and stage of change results are presented in Table 4. Within Arm A statistically significant differences were detected pre and post intervention for meeting daily recommendations for fruit and vegetable intake, and exercise stage of change; in Arm B significant differences for fruit intake, fruit stage of change and exercise stage of change ($p < 0.05$).

5.3. Feasibility evaluation

Online recruitment of study participants was used with 70 potential participants registering interest in enrolling in the study via email or via the 'Register interest' field on the study website. Of those who registered interest in the initial four weeks following publicity, the majority (88%) were female. Of those registering interest, two were excluded before screening with one resident overseas and one outside the target age group. Sixty-eight adults were eligible to participate (97%) although only 40 people (57%) then progressed to provide written consent and were randomised. In terms of the feasibility criteria, online recruitment was successful in recruiting women but not men, and while most people who registered interest were eligible, less than 70% of eligible participants agreed to enrol.

Table 2
Sociodemographic and health characteristics of participants at baseline.

Variable	Arm A (n = 18) M (SD) or n (%)	Arm B (n = 19) M (SD) or n (%)
Mean age (SD)	49.7 (6.7)	51.5 (6.0)
People (%)		
Male	2 (11.1)	2 (10.5)
Female	16 (88.9)	17 (89.5)
Country of birth (%)		
Australia	13 (72.2)	27 (73.7)
Other	5 (27.8)	5 (26.3)
Language other than English (%)		
No	17 (94.4)	19 (100.0)
Yes	1 (5.6)	0
Marital status (%)		
Married	17 (94.4)	11 (57.9)
Divorced/separated	1 (5.6)	3 (15.8)
Single/never married	0 (0.0)	5 (26.3)
Educational attainment (%)		
Junior school	3 (16.6)	3 (15.8)
Senior school	1 (5.6)	2 (5.3)
Trade/diploma	5 (27.8)	10 (26.3)
University/college	1 (5.6)	7 (18.9)
Post-graduate studies	8 (44.4)	12 (32.4)
Employment status (%)		
Full-time employment	6 (33.3)	13 (68.4)
Part-time employment	9 (50.0)	5 (26.3)
Unemployed	1 (5.6)	1 (5.3)
Part-time student	1 (5.6)	0
Ill/unable to work	1 (5.6)	0
Annual household income (%)		
Less than $20,000 AUD	1 (5.6)	0
$20,000-$60,000 AUD	3 (16.7)	3 (15.8)
$60,000-$100,000 AUD	2 (11.2)	8 (42.1)
More than $100,000 AUD	11 (61.1)	7 (36.8)
Don't know	1 (5.6)	1 (5.3)
PA MET minutes/week (%)		
Low <600	8 (44.4)	2 (10.5)
Moderate 600 - 2999	9 (50.0)	14 (73.7)
High >3000	1 (5.6)	3 (15.8)
Mean BMI (SD)	29.3 (5.3)	28.1 (5.0)
BMI categories (%)		
Normal (< 25 kg/m²)	3.0 (16.7)	6.0 (31.6)
Overweight (25 - 29.9 kg/m²)	9.0 (50.0)	7.0 (36.8)
Obese (≥ 30 kg/m²)	6.0 (33.3)	6.0 (31.6)

Note. Arm A, eBook; Arm B, eBook + coaching; AUD, Australian dollars; PA Met min/week, Physical Activity, Metabolic Equivalent minutes per week.

Overall, attrition from the study was 42%. Of those who consented to participate in the study, 93% of participants (n = 37) completing the baseline survey and a further 14 (35%) were lost to follow up and did not complete the data collection appointment and online survey at completion of the intervention. Attrition from the study was higher in Arm A (50%) than Arm B (35%). Among those who were lost to follow up, it was noted that nearly three quarters (%) were in precontemplation/contemplation stage of change for exercise at baseline (See Supplementary Table). A range of reasons were provided for withdrawal from the study including work and family commitments, overseas travel, family illness and natural disaster (flood) with a few participants not providing a reason and not completing the final survey. Feasibility criterion of ≤30% attrition was not met for Arm A, although was closer to being met for Arm B.

Data collection using an online survey system was easy to administer with no participants reporting issues accessing the survey platform. Email reminders to participants were easily generated at intervals of 1, 2 and 3 weeks with responses captured on a secure server. While there were no missing data within the online surveys due to participants not being able to skip responses, 42% of enrolled participants did not complete the final survey (8 weeks) on completion of the intervention. Anthropometric measures including weight and waist circumference were collected by participants

Table 3
Change over time within groups for physical activity MET minutes/week, sitting time, fruit and vegetable intake, alcohol frequency, and anthropometric measures.

Variable	Arm A (n = 18)				Arm B (n = 19)			
	Pre M (SD) or Md [IQR][a]	Post M (SD) or Md [IQR][a]	z/r[b]	p	Pre M (SD) or Md [IQR][a]	Post M (SD) or Md [IQR][a]	z/r[b]	p
Physical activity[c]								
Median vigorous [IQR]	0.0 [0.0-870.0]	0.0 [0.0-1080.0]	-0.9	0.35	480.0 [0.0-1440.0]	1200.0 [120.0-1440.0]	-1.0	0.31
Median moderate [IQR]	120.0 [0.0-390.0]	240.0 [0.0-390.0]	-0.7	0.50	480.0 [240.0-720.0]	480.0 [240.0-840.0]	-0.8	0.40
Median walking [IQR]	297.0 [173.2-495.0]	453.0 [198.0-1039.0]	-1.9	0.04	495.0 [198.0-924.0]	924.0 [198.0-1188.0]	-1.6	0.09
Median total PA [IQR]	834.0 [415.1-1389.0]	1,481.0 [495.0-2870.0]	-2.7	0.01	1935.0 [1306.5-2430.0]	2,226.0 [1464.0-3212.0]	-1.2	0.22
Median sitting min/wk [IQR]	330.0 [210.0-450.0]	300.0 [240.0-450.0]	-0.7	0.49	300.0 [150.0-600.0]	300.0 [180.0-360.0]	-1.7	0.09
Diet[d]								
Mean fruit serves/day (SD)	1.7 (1.0)	2.1 (1.0)	-1.3	0.22	2.4 (1.3)	2.1 (0.9)	1.2	0.26
Mean veg serves/day (SD)	3.2 (1.4)	3.9 (1.0)	-1.7	0.11	3.5 (1.0)	4.6 (1.0)	-3.6	<0.01
Mean alcohol days/wk (SD)	1.9 (2.0)	1.8 (2.5)	0.5	0.65	2.7 (2.7)	2.5 (2.4)	0.5	0.62
Adiposity								
Mean BMI (SD)	29.3 (5.3)	29.1 (5.4)	1.4	0.18	28.1 (5.0)	27.7 (4.8)	1.9	0.06
Mean waist circumference (SD)[e]	91.8 (12.2)	90.2 (10.9)	1.1	0.29	95.1 (11.6)	92.5 (12.2)	1.9	0.08
Mean waist-hip ratio (SD)	0.8 (0.1)	0.8 (0.1)	-0.2	0.83	0.8 (0.1)	0.8 (0.1)	1.1	0.30

Note.
[a] Interquartile range, first and third quartiles.
[b] Wilcoxin signed ranks test for median data/Paired sample t-tests for mean data.
[c] Median Metabolic Equivalent (MET) minutes per week.
[d] Mean daily serves.
[e] Measured in centimetres (cm); Arm A, eBook; Arm B, eBook + coaching.

Table 4
Change over time within groups in physical activity total MET minutes category, serves of fruit and vegetables, and stage of change.

Variable	Arm A (n = 18)				Arm B (n = 19)			
	Pre n (%)	Post n (%)	z/r[a]	p	Pre n (%)	Post n (%)	z/r[a]	p
Physical activity								
Low <600 MET-mins	8 (44.4)	6 (33.3)	-1.9	0.06	2 (10.5)	1 (5.3)	-1.3	0.18
Medium 600-2,999 MET-mins	9 (50.0)	8 (44.4)			14 (73.7)	13 (68.4)		
High >3000 MET-mins	1 (5.6)	4 (22.2)			3 (15.8)	5 (26.3)		
Fruit 2 serves/day								
Yes	10 (55.6)	11 (61.1)	10.8	<0.05	9 (47.4)	10 (52.6)	9.0	<0.05
No	8 (44.4)	7 (38.9)			10 (52.6)	9 (47.4)		
Vegetables 5 serves/day								
Yes	5 (27.8)	7 (38.9)	10.9	<0.05	4 (21.1)	11 (57.9)	3.7	0.10
No	13 (72.2)	11 (61.1)			15 (78.9)	8 (42.1)		
Stage of change								
Exercise – 150 mins mod/hard								
Contemplation	12 (66.7)	11 (61.1)	14 1	<0.01	6 (31.6)	6 (31.6)	3.7	0.04
Action	6 (33.3)	7 (38.9)			13 (68.4)	13 (68.4)		
Fruit 2 serves/day								
Contemplation	8 (44.4)	7 (38.9)	14.3	<0.01	10 (52.6)	9 (47.4)	9.1	<0.05
Action	10 (55.6)	11 (61.1)			9 (47.4)	10 (52.6)		
Vegetables 5 serves/day								
Contemplation	13 (72.2)	9 (50.0)	6.9	0.03	12 (63.2)	4 (21.1)	2.9	0.24
Action	5 (27.8)	9 (50.0)			7 (36.8)	15 (78.9)		

Note.
[a] Wilcoxin signed ranks test/Pearson chi-square/Fisher's exact test; Arm A, eBook; Arm B, eBook + coaching.

during online appointments, guided by a research assistant using standardised instructions. Some participants reported finding this difficult and had not read the instruction sheet before the appointment.

Most participants were able to successfully download and use the interactive PDF eBook that was emailed to them. A small number of people requested a hard copy of the book, with a printed and bound version being supplied via mail. This suggests that giving participants the option of either eBook or hard copy may assist with participant engagement in the intervention, especially for those who preferred hard copy books. Online appointments with the research nurse were scheduled to suit the participant with strong positive feedback reported about the ease of scheduling by both participants and nurses.

In this study, nurses delivering the intervention were experienced community health nurses with prior experience in health coaching for health behaviour change. As such, they needed limited training to effectively deliver the intervention. In a future trial, nurses not familiar with the intervention and motivational interviewing would need additional workplace training and supervised practice to develop skills and confidence to deliver the intervention.

This feasibility study was conducted with a modest budget, with most expenses related to direct staffing costs of the experienced research nurse and research assistant. Time required for data collection by the research assistant was 4 hours per participant including: appointment time of 1.5 hours, administrative time to organise appointments, email participants and undertake study documentation. After including other research related activities such as survey set up and deployment, recruitment and consent approximately 8 hours total research assistant time was required per participant enrolled into the study. For Arm B (eBook + nurse coaching), a total of 8 hours research nurse time per participant was required including: 2 hours direct consultation time, administrative time required to organise appointments, email participants, complete study documentation, with training time also included in this allocated 8 hours.

6. Discussion

This feasibility trial of the 8-week GroWell for Health Program eHealth behavioural intervention designed for midlife adults shows promising emerging results suggesting the content and structure is likely to be effective in supporting participants to increase physical activity and meet dietary recommendations for fruit and vegetable intake. Change in outcomes for alcohol frequency, BMI, waist circumference and readiness for change also showed positive trends. This is consistent with the literature (Patnode et al., 2017) and our previous research that found a 12-week multiple health behaviour change intervention tailored specifically for midlife women, was effective in promoting increased physical activity and a healthier lifestyle (McGuire, Seib, Porter-Steele, & Anderson, 2019).

Many participants registering interest and enrolling in study were females, with only two male participants completing final data collection. Demographic characteristics of participants in this study are consistent with the literature and our previous research, whereas most volunteers to eHealth intervention trials tend to be female and well educated (Spring et al., 2018). In terms of feasibility, it suggests that other strategies rather than online recruitment are needed to engage men's interest and motivation to participate. Recruitment through a health service, community centre or workplaces where men attend may be more effective recruitment strategy.

In this study, participants were randomly allocated to one of two arms, with Arm A receiving the program in an eBook and Arm B the eBook with nurse coaching including motivational interviewing provided via video consultation. It was encouraging that participants in both study arms reported positive changes in health behaviours over time, although meaningful comparisons between groups was limited by small sample size and differing baseline characteristics where those in Arm B had significantly higher physical activity levels and higher proportion in action stage of change for exercise at baseline. Although a cost-effective option, results suggest that offering the program as a stand-alone self-directed eBook is feasible only in participants who are motivated and ready

for change. It was noted that some participants requested a hard copy of the program book, suggesting this option needs to be available in a future trial.

Attrition from the study after enrolment was high, particularly from Arm A where participants undertook the intervention independently. In some cases, where participants did not formally withdraw from the study, it was unclear whether they had adhered to part or all of the program and then chose not to complete the final survey. Engaging and retaining participants with low motivation in a health behaviour change intervention is always challenging, with readiness to change linked to self-efficacy (Marcus et al., 1992). So, although participants may be contemplating making change and enrol in a health program/intervention, moving to action and maintaining change is a complex process with individuals requiring tailored support. Consistent with our previous research, lower attrition in Arm B suggests that health coaching provided in nurse consultations is an effective means of supporting participant retention and health behaviour change (McGuire et al., 2019).

In regard to data collection processes, while online survey tools were cost-effective and easy to deploy, the number of participants who declined completion of the final survey suggests that participant burden was too high and that the length of survey and time needed to complete needs review. In measuring physical activity, the IPAQ-SF is a commonly used as a subjective measure, however, as with most self-report physical activity questionnaires, it tends to overestimate physical activity compared to objective accelerometry measures (Lee et al., 2011). While measuring PA with objective accelerometry is a more reliable method, it will be a much more costly method to employ in a fully powered trial. Measurement of weight, height, waist and hip circumference was undertaken where participants were given instructions and observed via video during online appointments was an innovative solution that worked quite well, although reliability needs to be evaluated.

This feasibility study also provides information about the time and cost of delivery of the intervention that will inform budget development for a larger trial, with costs relating not only to direct consultation time and administrative recruitment and data collection time, but also staff training to deliver the intervention. Future budgets will also need to include printing costs for those participants who prefer a hard copy of the GWHP Book.

In considering the context of practice to conduct a fully powered efficacy trial, there are several options being explored including in primary care, workplace and correctional facility settings. With evidence that General Practice Nurses (GPNs) are underutilised (Halcomb & Ashley, 2019) and with the Commonwealth Department of Health funded health assessment for people aged 45 to 49 years at risk of developing chronic disease (Australian Government Department of Health, 2014), this non-pharmacological intervention could potentially be delivered by GPNs in partnership with GPs to assist clients to make necessary lifestyle changes to reduce modifiable risk factors. With the COVID-19 pandemic forcing increased use of telehealth, this also provides opportunities for trial and implementation of remotely delivered preventive health interventions such as GWHP in primary care settings, workplaces or correctional facilities. In a future definitive trial, an effectiveness-implementation hybrid design will allow concurrent evaluation of effectiveness and implementation to facilitate the translation of research findings into practice (Curran, Bauer, Mittman, Pyne, & Stetler, 2012).

6.1. Limitations

Results of this feasibility study suggest that while the direction of change in health behaviours is encouraging, further planning is needed to improve recruitment, data collection and retention of participants in the intervention. This includes strategies to attract more men, reduce the burden of survey completion and data collection, more objectively assess physical activity, and to improve participant engagement to reduce attrition. The study was conducted on a small budget and was time limited, which meant that the initial recruitment target of 30 participants in each arm was not met. However, as this was a feasibility study, being underpowered is not a largely impacting limitation as results are being used to inform future study design.

7. Conclusion

With many midlife adults having multiple risk factors and at increased risk of noncommunicable diseases such as CVD and type 2 diabetes, targeted preventive health programs are essential to better support individuals to improve health literacy and promote health behaviour change. As the largest group in the health workforce, nurses are well placed to take the lead in design, testing and implementation of novel behaviour change interventions. Encouraging results in this feasibility study provide an important starting point in preparation for full evaluation of the GWHP in a larger trial.

Credit authorship contribution statement

Amanda McGuire: Conceptualisation, Methodology, Project administration, Funding acquisition, Investigation, Formal Analysis, Writing – Original Draft; **Janine Porter-Steele**: Conceptualisation, Methodology, Investigation, Writing – Review and Editing; **Nicole McDonald**: Conceptualisation, Methodology, Project administration, Writing – Review and Editing; **Siobhan Colfer-Burgess**: Investigation, Writing – Review and Editing; **Debra Anderson**: Mentorship, Writing – review and editing; **Charrlotte Seib**: Mentorship, Formal analysis, Writing – Review and Editing.

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Ethical statement

This study involved human research. Ethical approval was obtained from the Griffith University Human Research and Ethics Committee on 28/03/2018 (GU Ref No: 2018/259). No recruitment or data collection activities commenced until full ethical clearance was obtained. All participants signed a written consent form and were free to withdraw from the study at any time.

Declaration of competing interests

The authors have no actual or potential conflicts of interest to declare.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.colegn.2021.09.003.

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