Process evaluation of the 'Singapore physical activity and nutrition study'

Elaine Yee-Sing Wong, Andy H. Lee, Anthony P. James, Jonine Jancey

PII: S0149-7189(20)30151-8

DOI: https://doi.org/10.1016/j.evalprogplan.2020.101847

Reference: EPP 101847

To appear in: *Evaluation and Program Planning*

Received Date: 23 April 2019

Revised Date: 20 March 2020

Accepted Date: 26 June 2020

Please cite this article as: Wong EY-Sing, Lee AH, James AP, Jancey J, Process evaluation of the 'Singapore physical activity and nutrition study', *Evaluation and Program Planning* (2020), doi: https://doi.org/10.1016/j.evalprogplan.2020.101847

Process Evaluation of the 'Singapore Physical Activity and Nutrition Study'

1. Elaine Yee-Sing Wong*
PhD candidate (Pub H), M. Health Sci (Edu), P. Dip. in Health Promotion, B. Nut & Food Sci, School of Public Health, Curtin University, Perth, WA, Australia, GPO Box U1987, Perth, Western Australia, 6845, Tel: +65 81387834, yee-sing.wong@postgrad.curtin.edu.au

2. Professor Andy H. Lee
PhD (Statistics), Master of Maths (statistics), B. Maths (Hons), School of Public Health, Curtin University, Perth, WA, Australia, GPO Box U1987, Perth, Western Australia, 6845, Tel: +618 9266 4180, Andy.Lee@curtin.edu.au

3.Dr Anthony P. James
PhD (Sci), B. Sci (Hons) School of Public Health, Curtin University, Perth, WA, Australia, GPO Box U1987, Perth, Western Australia, 6845, Tel: +618 9266 2962, T.P.James@curtin.edu.au

4. Associate Professor Jonine Jancey
PhD (Public Health), B. Sci with Honours in Health Promotion, Collaboration for Evidence, Research and Impact in Public Health, (CERIPH), School of Public Health, Curtin University, Perth, WA, Australia, GPO Box U1987, Perth
Western Australia, 6845, Tel: +618 9266 3807, Fax: +618 9266 2958, J.Jancey@curtin.edu.au

*****Corresponding author.

Highlights

- This is the first physical activity and nutrition program for women aged 50 years and over to be implemented and comprehensively evaluated in Singapore recreational centres.
- Singapore recreational centres offer an appropriate venue to implement lifestyle programs to reach older women.
- Practical educational resources, tailored education sessions and motivational support from trained program ambassadors, supported physical activity and dietary behaviour change.

- Telephone dietary counselling recorded the highest participation rate, emphasising the suitability of this strategy for this target group.
- Ongoing feedback and recommendations from participants and program ambassadors, such as flexibility in program scheduling, can assist in the development of more suitable programs.

ABSTRACT

Introduction: The Singapore Physical Activity and Nutrition Study (SPANS) aimed to improve the physical activity (PA) and nutrition behaviours of Singaporean women aged 50 years and over. The SPANS program consisted of PA classes, nutrition workshops, telephone dietary counselling, health booklets, a health calendar and program ambassadors. This study aimed to assess and understand the implementation of the program strategies and gain insight into process evaluation components to inform future programs.

Methods: The evaluation was guided by a process evaluation framework and collected data via questionnaires (n = 209), program ambassador documentation and exit interviews with program completers (n = 13) and non-completers (n = 12).

Results: In total, 295 participants completed the program (response rate = 84%). Participants reported high levels of satisfaction with the overall program (99.5%) and program activities (96.7%), and rated program ambassadors highly. Participation rates were highest for telephone dietary counselling sessions. The main reason for not attending program activities was having a 'busy schedule' (n = 158). Participants cited a need for improved recreational centre facilities and increased flexibility around program delivery.

Conclusions: The process evaluation showed that the program strategies were implemented as planned and were deemed suitable for supporting behaviour change among Singaporean women aged 50 years and over. The program reached and involved the majority of participants

throughout the six-month program. The combination of practical education resources and supportive program ambassadors were key strategies that facilitated positive PA and dietary behaviours. However, there needs to be some flexibility in the delivery of programs. The findings of this research may inform other programs in the region.

Keywords: behaviour change; community-based program; physical activity; non-communicable diseases; nutrition; program evaluation.

INTRODUCTION

The rising level of non-communicable diseases (NCDs) is a worldwide phenomenon. The World Health Organization (WHO) has called upon its 194 global members to intensify their physical activity (PA) and nutrition programs to reduce the rates of NCDs (World Health Organisation, 2017). The effectiveness of community-based PA and dietary programs aimed at combating NCDs is well-supported by evidence-based research (Blackford, et al., 2017; Ding, et al., 2016; Hyseni, et al., 2016; Jancey, et al., 2019).

In Singapore, NCDs account for 60% of deaths (Dans, et al., 2011), with a very high incidence of cancer, heart disease and type 2 diabetes (Epidemiology & Disease Control Division, 2019). Singaporean women aged 50 years and over are particularly at risk due to their unhealthy diet and insufficient levels of PA. The majority of women in this 'at risk' group exceed the recommended intake for energy (58%) and fat (57%), do not meet the recommended dietary fibre requirements (62%) (Health Promotion Board, 2013) and report high levels of leisure-time physical inactivity (72%) (Ministry of Health, 2011).

In response to this, the Singapore Physical Activity and Nutrition Study (SPANS) was implemented to improve PA and dietary behaviours of Singaporean women aged 50 and over attending their neighbourhood recreational centres (RCs). RCs are public facilities supporting social leisure activities located below high-rise public housing and represent conveniently located hubs to implement lifestyle programs and facilitate lifestyle practices for older Singaporean women (Wong, Lee, James, & Jancey, 2019).

The SPANS program comprised of (1) educational resources that included PA and nutrition booklets, a health calendar based on Singapore's PA and nutrition guidelines (Health Promotion Board 2015a, 2015b); (2) 12 PA classes (weeks 2–24); three nutrition education workshops (weeks 1, 12 and 24); and three telephone dietary counselling sessions (weeks 4, 12 and 20). These strategies supported lifestyle behaviour change as evidenced by previous PA and nutrition studies (Blackford, et al., 2017; Burke, Jancey, Howat, Lee, & Shilton, 2013; Chee, et al., 2017; Jancey, et al., 2017; Jung, Lee, Lee, Kwon, & Song, 2012; Tran, et al., 2017).

Trained program ambassadors (i.e., final-year nutrition, sports and wellness students (n = 13), qualified nutritionists (n = 2) and a certified fitness instructor (n = 1)) organised and conducted the program strategies. They were responsible for the baseline and post-program data collection, as well as the fitting of accelerometers. Accelerometers measured PA levels objectively and were worn by the participants on their right hip for seven consecutive days (pre- and post-program) and removed when showering, swimming and sleeping (Aguilar-Farías, Brown, & Peeters, 2014). A detailed overview of the accelerometer can be found in the published protocol paper (Wong, Lee, James, & Jancey, 2018). The control group participants received a falls-prevention booklet and were blinded to the nature of the program. The outcome evaluation results currently under review elsewhere (Wong, Lee, James, & Jancey, 2019), have shown

statistically significant improvements in moderate and vigorous-intensity PA and dietary behaviours in the intervention group compared to the control group.

This study provides the first report on a comprehensive process evaluation of the SPANS in Singaporean RCs. Previous research has argued that it is necessary to carry out a mixed-methods process evaluation to identify program characteristics and opportunities for improvements (Haynes, et al., 2014; Liu, et al., 2016; Moore, et al., 2014). Process evaluation is widely used to determine if a program has been implemented as intended, investigates reasons for attrition, identifies acceptability of a program and provides insights into program outcomes (Lavinghouze & Snyder, 2013; Saunders, Evans, & Joshi, 2005; Shimazaki & Takenaka, 2015; Sranacharoenpong, Hanning, Sirichakwal, & Chittchang, 2009; Tran, et al., 2017).

Involvement of participants and program ambassadors during process evaluation helps ensure timely feedback to improve program quality (Schijndel- Speet, Evenhuis, Wijck, & Echteld, 2014). Despite the many advantages of conducting process evaluation, the majority of lifestyle programs often neglect this form of evaluation, instead choosing to focus on impact and outcome evaluation (Olstad, et al., 2016; Saunders, Wilcox, Baruth, & Dowda, 2014; Viester, Verhagen, Bongers, & Van Der Beek, 2014). Bauman and Nutbeam (2013) advised that process evaluation enables the researcher to determine if a program has been implemented as intended, identifying conditions that are needed to achieve successful program outcomes, which can then inform future programs. They concluded that if process evaluation is not conducted, researchers may not have an understanding of why a program was successful or unsuccessful. Therefore, this study aimed to assess and understand the implementation of the

program strategies and gain insight into process evaluation components to inform future programs.

METHODS

Setting and theory

This study describes the process evaluation of the larger SPANS program, a six-month randomised, controlled trial (RCT) targeting community-dwelling Singaporean women aged 50 and over attending RCs across three Singaporean districts. The trial was registered with the Australian and New Zealand Clinical Trials Registry (trial no: ACTRN12617001022358), and details of recruitment and screening have been reported elsewhere (Wong, et al., 2018).

Social Cognitive Theory underpinned the SPANS and was supported by several psychosocial constructs (Glanz, Rimer, & Viswanath, 2008). These constructs were: (a) self-efficacy – participants were educated on the benefits of healthy eating and regular PA, (b) skill development – participants were encouraged to adopt and practice health-enhancing habits, and (c) positive reinforcement and observational learning through regular feedback and shared health experiences with other participants (Bandura, 2004; White, Wójcicki, & McAuley, 2012). Moreover, motivational interviewing strategies were implemented to positively influence PA and dietary behaviours (Cummings, Cooper, & Cassie, 2009; Rollnick, 2010).

Process evaluation design

The SPANS program adapted the process evaluation framework developed by Saunders et al. (2005) for assessing program implementation. This framework has been effectively used in comparable six-month PA and nutrition programs with older adults to pinpoint preferred strategies in facilitating behaviour change (Blackford, et al., 2017; Tran, et al., 2017). Process

evaluation components based on Saunders and colleague's (2005) framework assessed (a) ways to attract participants and maintain their engagement (recruitment), (b) the number of active program participants (reach), (c) factors that affect implementation and outcomes (context), (d) the extent to which program implementation occurred as planned (fidelity), (e) the number of intended program strategies conducted (dose delivered-completeness), (f) the extent to which participants used resources as recommended (dose received-exposure), and (g) the satisfaction of participants with the program and staff (dose received-satisfaction). Table 1 is based on the Saunders et al. (2005) framework and summarises the process evaluation components and the corresponding data collection instruments.

Table 1. Process evaluation components and data collection instruments

Process evaluation components	**Data collection instruments**		
	Self-completed questionnaires	Semi-structured exit interviews	Program ambassadors' documentation
Who participated and withdrew, and for what reasons? **Recruitment** – attract participants and maintain engagement			X
Reach – number of active program participants			X
Context – factors that impact program implementation and outcomes	X	X	X
Was the intervention implemented as planned? **Fidelity** – extent to which program implementation occurred as planned			X
Dose delivered – number of intended program strategies conducted			X

Dose received (exposure) – extent to which participants used resources as recommended		X	X
What were the perceptions and recommendations for improvements? **Dose received** (satisfaction) – satisfaction of participants with the program and staff	X	X	X

Data collection procedure

The questionnaire and exit interview were adapted from previous instruments used in process evaluation studies (Blackford, et al., 2017; Tran, et al., 2017). Two trained program ambassadors pilot-tested the bilingual (English and Chinese) questionnaire (n = 10) and exit interviews (n = 5) with other peer-aged female RC patrons to improve clarity and comprehension before administration to the target group. The measurement instruments were modified according to the respondents' suggestions (e.g., reduce the number of questions and simplify the structure of the questions). Conversely, the RC patrons commented that no changes were required for the exit interviews.

An information sheet with the researchers' contact details was provided to the participants. Program ambassadors informed participants of the study's purpose, objectives and procedure. A signed, informed consent form outlining the study's protocols and confidentiality was obtained from the participants prior to data collection. All program participants were invited to complete the questionnaire, and those participating in the interviews were purposefully selected. Both qualitative and quantitative data were collected.

Data collection instruments

Self-completed questionnaire

At the final PA session (session 12, week 24), participants completed a questionnaire that assessed the program and program ambassadors (i.e., clarity or presentations, delivery skills, approachability and knowledge) (see Supplementary file 1) and satisfaction with the program (i.e., activities, pace, sustainability and program overall). A five-point Likert scale (1 – poor, 2 – fair, 3 – satisfactory, 4 – good and 5 – excellent) was adopted to establish satisfaction with the program (i.e., pace and sustainability of interest) and program ambassadors (i.e., clarity of presentation, delivery skills, knowledge and approachability). Open-ended questions were included for participants to provide commentary on what they liked and did not like, as well as recommendations for program improvements.

Semi-structured exit interview

On completion of the program, exit interviews were conducted with program completers (n = 13) and non-completers (n = 12). The interview consisted of a 10-point Likert scale to assess the program ambassadors (1 = poor to 10 = excellent) and open-ended questions to determine (a) program engagement, (b) perception of program strategies, (c) support and guidance provided by the program ambassadors, (d) changes in attitudes and behaviours towards PA and dietary habits, and (e) suggestions for program improvements (see Supplementary file 2). Respondents opted for non-audio-recorded interviews. Therefore, the trained interviewers recorded participants' responses by hand. Recorded responses were then reviewed by the participants. Each interview lasted approximately 45–60 minutes and conducted in English or Chinese.

Program ambassadors' documentation

At the end of each PA class and nutrition workshop throughout the six-month program, a 15-minute group discussion was undertaken by program ambassadors. This process collected feedback relating to the program and its strategies, and identified any issues that might impact attendance and acceptability of program strategies, together with recommendations for improvements. Recruitment and data collection challenges were documented throughout the program. Program ambassadors recorded participants' feedback after each session in their logbooks and reported these to the principal investigator (PI), who monitored the feedback and responded to the need for any program modifications. Program ambassadors recorded participants' attendance at PA classes (n = 12), nutrition workshops (n = 3) and dietary counselling sessions (n = 3). Follow-up telephone calls were made to participants to identify reasons for their absence from any program sessions.

Analysis of data

Thematic analysis

Data collected via the self-completed questionnaires, exit interviews and program ambassadors' documentation was translated from the Mandarin or Chinese dialects into English. Thematic analysis of the transcribed qualitative data was conducted by two trained researchers. As guided by Braun and Clarke (2006), they familiarised themselves with the data, reviewed and coded the data, and established themes. Identified themes were supported by direct quotes from participants. Qualitative data from the questionnaire, exit interviews and program ambassadors' documentation were organised, sorted and managed using the NVivo 11 software (QSR International, 2017). The two trained researchers reviewed the data, and reached a consensus.

Statistical analysis

Descriptive statistics were used to summarise participants' demographic profiles. For the self-completed questionnaire, responses to the five-point Likert scales (1 = poor to 5 = excellent) for the program and program ambassadors were recoded into dichotomous variables (unsatisfactory (1–2) and satisfactory (3–5)). Percentages of dichotomous variables and attendance at sessions and workshops were calculated using the Statistical Package for Social Science software version 25 (IBM Corporation, 2017). Mean scores for the Likert scale rating (scale 1–10) for program ambassadors (i.e., nutritionists and the fitness trainer) were also calculated for the exit interviews.

RESULTS

Participant demographics

In total, 295 Singaporean female residents aged 50 years and over completed the program, the majority of whom (mean age 64, SD 7.9 years) were of Chinese descent (96%) and married (76%) with high school education (54%). About one-third (32%) lived in four-room government flats (see Table 2).

Table 2. Characteristics of female participants (n = 295)

	n	%
Age mean (SD) years	64 (7.9)	
Chinese	282	95.7%
Malay	7	2.4%
Indian	6	1.9%
Education level		
Primary or no education	71	23.9%
High/secondary school	160	54.1%
College	32	11%
University/tertiary education	32	11%
Marital status		
With partner	223	75.6%

Without partner (widowed, single or divorced)	72	24.4%
Housing Type		
Government		
Two-room flat	14	4.8%
Three-room flat	58	19.6%
Four-room flat	95	32.1%
Five-room flat	54	18.2%
Private property	60	20.4%
Others (1 room, executive flats, maisonette)	14	4.9%

SD- standard deviation

SPANS Program

Program withdrawal

Of the 351 participants who initially commenced the six-month SPANS, 295 completed the program (retention rate of 84%). Reasons nominated by participants (n = 56) for withdrawing from the program included being busy with family, work and volunteer commitments (n = 38), relocating overseas (n = 4), fear of blood tests (n = 4), uncontactable (n = 4), health issues (e.g., cataract, immobility and dizziness) (n = 3), relocation (n = 1), forgetfulness (n = 1) and death of spouse (n = 1). Non-completers reported that they participated for a period ranging from two to five months.

Program participation

The majority of participants (78%) attended at least half of the PA classes and nutrition workshops, while 66% attended at least three-quarters of the sessions. The highest participation rates were for telephone dietary counselling (72%), followed by nutrition workshops (65%) and PA classes (60%) (see Table 3).

Table 3. Participation in program activities

Telephone dietary counselling sessions (n = 3)	**n**	**%**
Session 1	212	89
Session 2	181	76
Session 3	182	76
Attendance level ≥ 75%	172	72
Nutrition workshops (n = 3)		
Workshop 1	189	79
Workshop 2	208	87
Workshop 3	172	72
Attendance level ≥ 75%	155	65
Physical activity classes (n = 12)		
Class 1	233	97
Class 2	171	72
Class 3	169	71
Class 4	183	77
Class 5	172	72
Class 6	188	79
Class 7	172	72
Class 8	172	72
Class 9	163	68
Class 10	168	70
Class 11	181	76
Class 12	163	68
Attendance level ≥ 75%	143	60
Attendance across all activities		
Attendance level ≥ 75%	157	66
Attendance level ≥ 50%	186	78

Participants (n = 295) reported several reasons that prevented them from achieving full participation at all sessions listed in Table 3. These were busy schedules (n = 158), time clashes with family activities, caretaking, working and volunteering (n = 32), overseas holidays

(n = 17), health issues (n = 13), forgetfulness (n = 3), preference for PA to be conducted indoors (n = 3), fear of falling during wet weather (n = 3) and the belief that PA classes were tiring (n = 2).

The identified program themes were (a) program satisfaction, (b) program outcomes, (c) program improvements, (d) program resources and (e) program ambassadors (reported below).

Program satisfaction

Of the 295 participants, 209 (71%) completed the questionnaire. The majority of participants reported high satisfaction rates for the overall program (99.5%), program activities (96.7%), program pace (96.7%) and sustainability of program interest (96.2%). The participants enjoyed the program, which increased their desire to improve their health. For example, *"I enjoyed the nutrition and fitness sessions, including the dietary counselling sessions, which motivated me to enhance my health" (questionnaire 86).* Almost all participants (99%) reported that they would recommend the program to friends, family or other people: "*I will recommend the program to people who have the time to take part in it, as it is a good program to learn about healthy living" (questionnaire 156).* Even non-completers were satisfied and complimented the relevance of learning more about a healthy lifestyle. *"It was a good program to learn about healthy living. I would recommend it to people who have the time to take part in it (interview 10)."* The program also provided opportunities for social support and time to bond with friends and family: "… *allows bonding with my sister and cousin that motivates me to change my diet" (questionnaire 171) and "The fitness program pushed me to exercise and was also a good platform from which to get to know people" (questionnaire 201).*

Program outcomes

A sub-sample of participants were interviewed (n = 13) and reported that the SPANS had motivated them to increase their PA levels. More than half (n = 8) participated in PA sessions such as yoga, aerobics and dance classes (Flamenco, Performance, Bollywood, Zumba and Bokwa) offered elsewhere. Nine completers made dietary changes: eating less fried foods, fatty meat, sugary foods, meat, salt and oil; eating more whole-grains, dairy products, vegetables and fruits; and dining out less often. Some completers became motivated to search online for nutritional information on functional foods, calorie intake and food labels, with comments such as "*I seek knowledge online on reading labels, calories and functional foods" (interview 10)* and *"when buying products in the supermarket, I look out for the healthier choice symbol" (interview 11).*

Program improvements

Participants recommended promoting the program via 'word of mouth' to friends and family members and emphasised sharing program benefits: *"… seniors can explain how healthy living has positively impacted their life" (questionnaire 78).* In addition, they suggested more frequent nutrition workshops (bi-weekly), bilingual language instructors and provision of refreshments and rewards (e.g., supermarket vouchers). Suggested future education topics included mental wellness and women's health issues.

Recommendations for PA classes included multiple timeslots and longer class durations (> 1 hour): *"There could be more fitness classes per week for those who are busy on other days" (interview 9).* There were requests for more yoga and dance classes with guidance in posture correction, larger RC facilities for PA classes, slower pace for inactive adults and videos of PA

classes to take home. The need to eliminate participants' negative perceptions about wearing the accelerometer device (i.e., inconvenient, uncomfortable and visually unappealing) was highlighted. Participants suggested that program ambassadors educate on the importance of the accelerometers in measuring PA levels and provide them with a personalised report of their accelerometer data to improve their acceptance of wearing the device. The participants also perceived that dietary counselling was best conducted face-to-face rather than by telephone as a means of increasing rapport between the participant and the program ambassador.

Program resources

Overall, participants commented that program resources were valuable and that they used the educational resources as recommended: "*Good stretching exercises and visual resources provided in the nutrition sessions facilitate understanding and were useful to learn about healthy living" (interview 9).* The information was found to be age-appropriate: *"I learned more about exercise and nutrition messages in this holistic program suited to my age group" (interview 3).* Participants found the resources to be easy to read, appealing and provided simple messages. For instance, "*The instructions in the health and recipe booklets are simple to follow (interview 13). They are colourful, attractive and easy to read" (interview 11) and "The recipes in the booklet were easy to cook yet tasted good … practical and helpful" (interview 5).*

Program ambassadors

Program ambassadors were reported to be excellent educators with regards to their clarity during presentation (99%), delivery skills (99%), approachability (98.6%) and knowledge (98.6%). Participants stated that they were highly suited to their roles with supporting quotes such as *"their energy level and passion in teaching are commendable" (questionnaire 112).*

Program ambassadors (i.e., nutritionists and the fitness instructor) scored highly on the 10-point Likert scale (mean = 8.4) in their teaching of PA and dietary information. They provided clear, simple and useful health information, with supportive quotes such as: "*It was helpful, and the presentation was short and sweet. Yet I gained good knowledge, and I am more aware of my health" (interview 13).* The ambassadors were also friendly, approachable and knowledgeable, with supporting quotes such as: "*Moves demonstrated by the fitness instructors are very good, professional and look very easy" (questionnaire 89). "I felt that the trainers were encouraging … gained lots of knowledge that I found very beneficial for my blood circulation" (questionnaire 210) and "the nutritionists were approachable and knowledgeable" (interview 9).*

DISCUSSION

The process evaluation of the SPANS was conducted to assess and understand the implementation of the program strategies and gain insight into process evaluation components to inform future programs. The results demonstrated that the program was delivered as intended with appropriate program strategies and resources, supporting and motivating participants to change their PA and dietary behaviours.

The high retention rate (84%) for the SPANS indicated good participant reach, adherence and acceptance of the program. Of those who withdrew from the program, the main reason was 'busy with family, work and volunteer commitments', which was consistent with comparable process evaluation studies of community-based PA and nutrition RCTs (Blackford, et al., 2017; Burke, et al., 2013; Jancey, et al., 2018; Tran, et al., 2017). This is a challenging issue to address, as individuals do have competing life priorities. There may be a need for more flexible approaches, such as encouraging home-based activities and resources. Home-based programs

have been successfully used with older adults in other countries (Blackford, et al., 2017; Burke, et al., 2013) but not trialled in Singapore, and this is something to investigate in the future.

An average attendance of 66% was achieved across the program activities (i.e., PA classes, nutrition workshops and dietary counselling sessions), showing these to be reasonably suitable outreach strategies for this target group. Nearly all participants were satisfied with the program activities, enjoyed the activities and were motivated to improve their health. Health benefits and social bonding with family and friends were key reasons that attracted the participants to maintain program engagement. Telephone dietary counselling achieved the highest participation rate, which makes it a priority strategy for future lifestyle programs. The motivational interviewing techniques used in the telephone discussions were well received and supportive of increasing positive behaviour change. Advantages of telephone counselling include convenience and the ability to provide prompt personalised feedback and reinforcement of positive behaviour change (Kim, et al., 2013). This strategy also assists in counteracting the main nominated barrier to attendance at the sessions and workshops, which was a busy schedule. Beyond this, some participants suggested face-to-face delivery for dietary counselling sessions as a means of strengthening rapport between participants and program ambassadors. Prior research into Asian lifestyle programs has found face-to-face, personalised nutrition education increased program adherence and enhanced dietary changes (Chaiyasoot, et al., 2018; Charunee, et al., 2018).

The role of program ambassadors and the printed resources were also integral to the program. The program ambassadors played a crucial role in educating and motivating the participants to make positive behaviour changes, and the participants found the printed resources to be

attractive, age-appropriate and easy to understand. The role of program ambassadors and the use of printed resources have been shown to be effective strategies in previous PA and nutrition studies with older adults (Blackford, et al., 2017; Burke, et al., 2013; Jancey, et al., 2018; Tran, et al., 2017) and appear to be a suitable strategy for this target group of older Singaporean women.

The conveniently located RCs were an attractive venue, acting as a community hub to promote and increase leisure-time PA and healthy eating. RCs are a venue that can increase social connectedness with other peer-aged participants by engaging them in health programs within their communities (Wong, et al., 2019). However, the participants did identify the need to increase the size of RCs, as space constraints in the centres made implementing indoor health programs challenging. RCs are unique venues synonymous with Singapore, and they are popular and accessible (Heath, et al., 2012; Wong, et al., 2019). Therefore, more opportunities for increased investment in RCs to support healthy ageing is warranted.

One component of the program that was not well received were the accelerometers, with many participants refusing to wear the device. This challenge has been documented in previous studies, with participants refusing to wear device due to discomfort, inconvenience, unappealing appearance and restriction in clothing choice (Huberty, Ehlers, Jonathan Kurkarbara, & Buman, 2015; O'Brien, et al., 2017). As suggested by Tedesco, Barton and O'Flynn (2017), functional (i.e., unobtrusive, comfortable and effortless) accelerometers need to be designed to increase participants' acceptance and enthusiasm for wearing them. Those participants who did wear an accelerometer (n = 65) suggested leveraging off the accelerometer data through the provision of personalised reports on PA levels. This approach

would provide feedback to the participants and potentially make the wearing of accelerometers more appealing.

Overall, the SPANS program was well received by the participants, and the program ambassadors' post-session feedback assisted in modifying the program to suit the participants' preferences and needs. For example, PA classes, nutrition workshops and telephone counselling were offered at alternative times to cater to busy participants. It is recognised that regular post-session reviews contribute to modifications to support the relevance and acceptability of the program to the target group (Lobo, Petrich, & Burns, 2014).

Strength and limitations

The main strength of this study was the multiple sources from which data were collected using both qualitative and quantitative methods, providing a comprehensive view of the implementation and acceptance of program strategies. However, social desirability and researcher bias might have affected the findings. Moreover, the participants might have been more motivated than those who chose not to participate in the program. Future research could explore whether these process evaluation components were sufficiently objective and adequately documented.

CONCLUSION

This study represents the first comprehensive process evaluation conducted on a program targeting older women in Singapore's Recreational Centres. The process evaluation demonstrated that the SPANS program was implemented as intended and engaged the majority of participants throughout the six-month program. The participants were satisfied with the program, resources and the program ambassadors, indicating the appropriateness of

these strategies for this target group, particularly with regard to the use of the telephone for dietary counselling. The combination of practical educational resources and supportive program ambassadors were key strategies that facilitated positive PA and dietary behaviours. Participants' suggestions for program modification will be beneficial to the implementation of future programs, potentially increasing the relevance and suitability for older community-dwelling Singaporean women at risk of NCDs.

LESSONS LEARNED

Process evaluation is an essential part of program implementation. This evaluation should be undertaken to determine if the program was implemented as intended and establish what worked and what did not work to understand why the program was successful or unsuccessful. Record keeping and participant involvement in process evaluation should occur at all stages of the process evaluation, and a variety of data collection tools should be used. Those implementing programs should keep communication channels with participants open and respond to participant feedback in a timely manner to improve program acceptability and maintain engagement. Data gathered at the end of each workshop and class over the course of the program supported timely feedback and program modification.

Author Statement

- Ms Elaine Wong Yee Sing conceptualised, designed and pilot-tested the methodology and intervention, undertook recruitment, implemented the intervention program and was involved in managing and interpretation of the data collection, management and analysis.

- **Associate Professor Jonine Jancey** provided close supervision and monitoring of the research development, implementation and evaluation. She actively participated in the study, read drafts critically and suggested improvements for all the publications and thesis.

- **Professor Andy Lee** provided statistical support and advice. He also participated in the study design and research process, read drafts critically and suggested improvements for all the publications and thesis.

- **Doctor Tony James** provided advice, ongoing support and was involved in all stages of the research study and process. He read drafts critically and suggested improvements for all the publications and thesis.

Authors' contributors

EYSW co-ordinated the study and drafted the manuscript. EYSW, JJ, AHL and APJ designed the study and revised the manuscript. All authors have contributed to the conception and design and/or the analysis and interpretation of data; draft the article or revise it critically for intellectual content; read and approved the final version for publication.

Availability of data and materials

Data and intervention materials are available from the first author upon request. Curtin University of Technology will have access to the final trial dataset, and there is no contractual agreements that limit its access for the investigators. Individual information will not be released owing to confidentiality agreements signed by the study participants.

Ethics approval, dissemination and consent to participate

The research protocol was approved by the Curtin University Human Research Ethics Committee (approval number: HRE2016-0366). The results of the study will be disseminated through reports, publications and conference presentations. Written informed consent was sought from all participants prior to entry into the study.

Trial registration

Australian and New Zealand Clinical Trials Registry, ACTRN12617001022358. Registered on 14 July 2017

Conflicting interests

The authors declare that they have no conflicting interests.

Funding source

This study was financially supported by the researcher' institution only.

Acknowledgments

The authors are grateful to Singapore Polytechnic, Temasek Polytechnic and participants for their kind support and contribution to the study. The first author would like to acknowledge the contribution of an Australian Government Research Training Program Scholarship in supporting this research.

REFERENCES

Aguilar-Farías, N., Brown, W.J., & Peeters, G.M.E.E. (2014). ActiGraph GT3X+ cut-points for identifying sedentary behaviour in older adults in free-living environments. *Journal of Science and Medicine in Sport, 17*, 293-299.

Bandura, A. (2004). Health Promotion by Social Cognitive Means. *Health Education and Behavior, 31*, 143-164.

Bauman, A. & Nutbeam, D. (2013). *Evaluation in a nutshell: a practical guide to the evaluation of health promotion programs*. Sydney: Mc-Graw Hill.

Blackford, K., Lee, A., James, A.P., Waddell, T., Hills, A.P., Anderson, A.S., Howat, P., & Jancey, J. (2017). Process evaluation of the Albany Physical Activity and Nutrition (APAN) program, a home-based intervention for metabolic syndrome and associated chronic disease risk in rural Australian adults. *Health Promotion Journal of Australia, 28*, 8-14.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3(2), 77-101.*

Burke, L., Jancey, J.M., Howat, P., Lee, A.H., & Shilton, T. (2013). Physical Activity and Nutrition Program for Seniors (PANS): Process Evaluation. *Health Promotion Practice, 14*, 543-551.

Burke, L., Lee, A.H., Jancey, J., Xiang, L., Kerr, D.A., Howat, P.A., Hills, A.P., & Anderson, A.S. (2013). Physical activity and nutrition behavioural outcomes of a home-based intervention program for

seniors: a randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity, 10*, 14.

Chaiyasoot, K., Sarasak, R., Pheungruang, B., Dawilai, S., Pramyothin, P., Boonyasiri, A., Supapueng, O., Jassil, F.C., Yamwong, P., & Batterham, R.L. (2018). Evaluation of a 12-week lifestyle education intervention with or without partial meal replacement in Thai adults with obesity and metabolic syndrome: a randomised trial. *Nutrition & Diabetes, 8*, 23.

Charunee, T., Supranee, C., Ngamphol, S., Bencha, Y.-A., Patcharaporn, T., Pattharawan, N., & Karunee, K. (2018). Intensive lifestyle modification program on weight loss and metabolic syndrome risk reduction among obese women in rural areas of Thailand. *Journal of Health Research, 32*, 203-216.

Chee, W.S.S., Gilcharan Singh, H.K., Hamdy, O., Mechanick, J.I., Lee, V.K.M., Barua, A., Mohd Ali, S.Z., & Hussein, Z. (2017). Structured lifestyle intervention based on a trans-cultural diabetes-specific nutrition algorithm (tDNA) in individuals with type 2 diabetes: a supports controlled trial. *BMJ Open Diabetes Research & Care,* 5, (1), e000384.

Cummings, S., Cooper, R., & Cassie, K. (2009). Motivational Interviewing to Affect Behavioral Change in Older Adults. *Research on Social Work Practice, 19*, 195-204.

Dans, A., Ng, N., Varghese, C., Tai, E.S., Firestone, R., & Bonita, R. (2011). The rise of chronic non-communicable diseases in southeast Asia: time for action. *Lancet, 377*, 680-689.

Ding, D., Lawson, K.D., Kolbe-Alexander, T.L., Finkelstein, E.A., Katzmarzyk, P.T., van Mechelen, W., & Pratt, M. (2016). The economic burden of physical inactivity: a global analysis of major non-communicable diseases. *Lancet, 388*, 1311-1324.

Epidemiology & Disease Control Division, (2019). The Burden of Disease in Singapore, 1990-2017. (last accessed on 12 August 2019). Retrieved from https://www.moh.gov.sg/resources-statistics/singapore-burden-of-disease-report-2017

Glanz, K., Rimer, B., & Viswanath, K. (2008). *Health behaviour and health education: theory, research and practice*. San Francisco: Wiley.

Haynes, A., Brennan, S., Carter, S., O'Connor, D., Schneider, C.H., Turner, T., & Gallego, G. (2014). Protocol for the process evaluation of a complex intervention designed to increase the use of research in health policy and program organisations (the SPIRIT study). *Implementation Science, 9*, 113.

Health Promotion Board, (2013). National Nutrition Survey 2010. (last accessed on 23 April 2019). Retrieved from https://www.hpb.gov.sg/workplace/workplace-programmes/useful-information-for-organisations/national-reports-and-surveys

Health Promotion Board, (2015a). Dietary Guidelines for Older Adults. (last accessed on 23 April 2019). Retrieved from: https://www.healthhub.sg/live-healthy/456/Dietary%20Guidelines%20for%20Older%20Adults

Health Promotion Board, (2015b). National Physical Activity Guidelines: Summary Guide for Professionals. (last accessed on 12 August 2019). Retrieved from: https://www.hpb.gov.sg/article/health-promotion-board-launches-national-physical-activity-guidelines

Heath, G.W., Parra, D.C., Sarmiento, O.L., Andersen, L.B., Owen, N., Goenka, S., Montes, F., Brownson, R.C., & Lancet Physical Activity Series Working, G. (2012). Evidence-based intervention in physical activity: lessons from around the world. *Lancet, 380*, 272-281.

Huberty, J., Ehlers, D.K., Jonathan Kurkarbara, A., & Buman, M. (2015). Feasibility of three wearable sensors for 24 hour monitoring in middle-aged women. *BMC Women's Health, 15*.

Hyseni, L., Atkinson, M., Bromley, H., Orton, L., Lloyd-Williams, F., McGill, R., & Capewell, S. (2016). The effects of policy actions to improve population dietary patterns and prevent diet-related non-communicable diseases: scoping review. *European Journal of Clinical Nutrition, 71*, 694.

IBM Corporation. (2017). SPSS Statistics for Windows (Version 25) [Computer software]. Armonk, New York.

Jancey, J., Holt, A.-M., Lee, A., Kerr, D., Robinson, S., Tang, L., Anderson, A.S., Hills, A., & Howat, P. (2017). Effects of a physical activity and nutrition program in retirement villages: a cluster randomised controlled trial. *The International Journal of Behavioral Nutrition and Physical Activity, 14*, 92.

Jancey, J., Holt, A.-M., Lee, A.H., Kerr, D.A., Hart, E., Robinson, S., Anderson, A.S., Hills, A.P., & Howat, P. (2018). Retirement village physical activity and nutrition intervention process evaluation: Informing practice. *Australasian Journal on Ageing, 37*, E144-E149.

Jancey, J., James, A., Lee, A., Howat, P., Hills, A.P., Anderson, A.S., Bordin, C., & Blackford, K. (2019). Metabolic syndrome in rural Australia: An opportunity for primary health care. *Australian Journal of Rural Health, 27*, 210-215.

Jung, H., Lee, B., Lee, J.-E., Kwon, Y.-H., & Song, H. (2012). Efficacy of a programme for workers with metabolic syndrome based on an e-health system in the workplace: a pilot study. *Journal of Telemedicine and Telecare, 18*, 339-343.

Lavinghouze, S.R. & Snyder, K. (2013). Developing Your Evaluation Plans: A Critical Component of Public Health Program Infrastructure. *American Journal of Health Education, 44*, 237-243.

Liu, H., Muhunthan, J., Hayek, A., Hackett, M., Laba, T.-L., Peiris, D., & Jan, S. (2016). Examining the use of process evaluations of randomised controlled trials of complex interventions addressing chronic disease in primary health care—a systematic review protocol. *Systematic Reviews, 5*, 138.

Kim, J., Bea, W., Lee, K., Han, J., Kim, S., Kim, M., Na, W., & Sohn, C. (2013). Effect of the telephone-delivered nutrition education on dietary intake and biochemical parameters in subjects with metabolic syndrome. *Clinical nutrition research*, 2, 115-124.

Lobo, R., Petrich, M., & Burns, S.K. (2014). Supporting health promotion practitioners to undertake evaluation for program development. *BMC Public Health, 14*, 1315.

Ministry of Health. (2011). National Health Survey 2010. (last accessed on 23 April 2019). Retrieved from https://www.moh.gov.sg/resources-statistics/reports/national-health-survey-2010

Moore, G., Audrey, S., Barker, M., Bond, L., Bonell, C., Cooper, C., Hardeman, W., Moore, L., Cathain, A., Tinati, T., Wight, D., & Baird, J. (2014). Process evaluation in complex public health intervention studies: the need for guidance. *Journal of Epidemiology and Community Health, 68*, 101.

O'Brien, W.J., Shultz, S.P., Firestone, R.T., George, L., Breier, B.H., & Kruger, R. (2017). Exploring the challenges in obtaining physical activity data from women using hip-worn accelerometers. *European Journal of Sport Science, 17*, 922-930.

Olstad, D.L., Ball, K., Abbott, G., McNaughton, S.A., Le, H.N.D., Ni Mhurchu, C., Pollard, C., & Crawford, D.A. (2016). A process evaluation of the Supermarket Healthy Eating for Life (SHELf) randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity, 13*, 27.

QSR International. (2017). NVivo Qualitative Data Analysis (Version 11) [Computer software]. Melbourne, Australia.

Rollnick, S. (2010). Motivational interviewing. *British Medical Journal, 34*, 1242-1245.

Saunders, R.P., Evans, M.H., & Joshi, P. (2005). Developing a Process-Evaluation Plan for Assessing Health Promotion Program Implementation: A How-To Guide. *Health Promotion Practice, 6*, 134-147.

Saunders, R.P., Wilcox, S., Baruth, M., & Dowda, M. (2014). Process evaluation methods, implementation fidelity results and relationship to physical activity and healthy eating in the Faith, Activity, and Nutrition (FAN) study. *Evaluation and Program Planning, 43*, 93-102.

Schijndel-Speet, M., Evenhuis, H.M., Wijck, R., & Echteld, M.A. (2014). Implementation of a group-based physical activity programme for ageing adults with ID: a process evaluation. *Journal of Evaluation in Clinical Practice, 20*, 401-407.

Shimazaki, T. & Takenaka, K. (2015). Evaluation of Intervention Reach on a Citywide Health Behavior Change Campaign: Cross-Sectional Study Results. *Health Education and Behavior, 42*, 793-804.

Sranacharoenpong, K., Hanning, R., Sirichakwal, P., & Chittchang, U. (2009). Process and Outcome Evaluation of a Diabetes Prevention Education Program for Community Healthcare Workers in Thailand. *Education for Health, 22*, 335-335.

Tedesco, S., Barton, J., & O'Flynn, B. (2017). A Review of Activity Trackers for Senior Citizens: Research Perspectives, Commercial Landscape and the Role of the Insurance Industry. *Sensors, 17*.

Tran, V.D., Jancey, J., Lee, A., James, A., Howat, P., & Thi Phuong Mai, L. (2017). Physical activity and nutrition program for adults with metabolic syndrome: Process evaluation. *Evaluation and Program Planning, 61*, 128-133.

Viester, M.L., Verhagen, M.E.A.L., Bongers, J.P., & Van Der Beek, J.A. (2014). Process Evaluation of a Multifaceted Health Program Aiming to Improve Physical Activity Levels and Dietary Patterns Among Construction Workers. *Journal of Occupational and Environmental Medicine, 56*, 1210-1217.

White, S.M., Wójcicki, T.R., & McAuley, E. (2012). Social Cognitive Influences on Physical Activity Behavior in Middle-Aged and Older Adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 67B*, 18-26.

Wong, E.Y.-S., Lee, A.H., James, A.P., & Jancey, J. (2018). Physical activity and nutrition intervention for Singaporean women aged 50 years and above: study protocol for a randomised controlled trial. *Trials, 19*, 257.

Wong, E.Y.-S., Lee, A.H., James, A.P., & Jancey, J. (2019). Recreational Centres' Facilities and Activities to Support Healthy Ageing in Singapore. *International Journal of Environmental Research and Public Health, 16*, 3343.

World Health Organisation, (2017). WHO launches new NCDs Progress Monitor. (last accessed on 23 April 2019). Retrieved from https://www.who.int/nmh/publications/ncd-progress-monitor-2017/en/

Authors' biography

1. Elaine Yee-Sing Wong

Ms Elaine Wong is a PhD Candidate (School of Public Health), Postgraduate Diploma in Health Promotion and a Bachelor in Nutrition and Food Science from Curtin University of Western Australia. She also holds a Masters in Health Science (Education) from University of Sydney. She has more than 20 years of working experience in the area of development, implementation and evaluation of health promotion initiatives to the community, government, and private sectors; writing articles for magazines; provision of nutritional counselling and consultancy; conducting health seminars, talks, supermarket tours, radio interview, cooking demonstrations, and workshops for more than 3000 organizations.

2. Professor Andy H. Lee

Professor Andy Lee is the chair professor of Biostatistics at the School of Public Health. He has published over 200 publications starting from 1976 till present and provided supervision to over 30 successful PhD and Master of Philosophy Students till present. He has been the recipient of a number of awards: 2001 Best poster presentation award at Mixtures 2001 - Recent Developments in Mixture Modelling; 2002/2004/2006 Curtin University- Division of Health Sciences: Researcher of the Year award; 2010 R&D Award for Highest Research Performance Index (Publications); 2012/2013 Faculty of Health Sciences Publications Award (Highest impact factor papers).

3. Dr Anthony P. James

Dr Anthony James is a senior lecturer and a unit coordinator for both postgraduate and undergraduate teaching on food chemistry, principles of biochemistry, nutritional biochemistry and food laboratory at the School of Public Health. He has over 60 publications in the area of public health, food science and chemistry; with vast research interests in insulin resistance, dietary and lifestyle modifications, lipoprotein metabolism and health outcomes of functional food consumption. He heads as the chair of the Nutrition Society of Australia from 2013 till present and supervises numerous Masters and PhD students in the school of Public Health.

4. Associate Professor Jonine Jancey

Associate Professor Jonine Jancey is the Director of Graduate Research and the Research Development Lead at CERIPH. She has published over 90 peer-reviewed articles, 40 reports and securing research funding close to $4.5million. She supervises Doctoral, Master, Honours students and have received awards that include: 2016 Leadership in Health Promotion Award; 2015 New Independent Research Award; 2011 Early Career Researcher of the Year; 2009 Curtin Early Career Research Fellowship; 2008 Public Health Association of Australia Postgraduate Student Excellence Award. She widely published in specialty areas on older adults and physical activity/nutrition, metabolic syndrome, worksite health, food and nutrition and E-cigarettes.