

Full Title: The impact of lay volunteers on community health screening program outcomes for older adults: A mixed-methods evaluation
Short Title: Impact of lay volunteers in community health

Ka Shing Yow, Audrey Shu Ting Kwan, Xiaoting Huang, Jie Xin Lim, Meng Han Lim, Lynn Pei Zhen Teo, Juliana Shariq Mujtaba, Muhammad Razzan Razaki, Yihan Khoo, Si Qi Lim, Alicia Shi Yao Chee, Jed Jasman, Jasmine Yee Ru Cheng, Elliott Weizhi Sim, Thaddeus Chi En Cheong, Nerice Heng Wen Ngiam, Angeline Jie-Yin Tey, Chee Hsiang Liow, Lian Leng Low, Kennedy Yao Yi Ng

Submitted to: Journal of Medical Internet Research
on: April 20, 2025

Disclaimer: © The authors. All rights reserved. This is a privileged document currently under peer-review/community review. Authors have provided JMIR Publications with an exclusive license to publish this preprint on its website for review purposes only. While the final peer-reviewed paper may be licensed under a CC BY license on publication, at this stage authors and publisher expressly prohibit redistribution of this draft paper other than for review purposes.

Table of Contents

Original Manuscript..... 5

Supplementary Files..... 40

 Figures 41

 Figure 1..... 42

 Figure 2..... 43

Full Title: The impact of lay volunteers on community health screening program outcomes for older adults: A mixed-methods evaluation

Short Title: Impact of lay volunteers in community health

Ka Shing Yow¹ MBBS, MRCS, MRCP, MMed; Audrey Shu Ting Kwan² BSc (Hons), MPH; Xiaoting Huang² MBBS, MRCP, MMed; Jie Xin Lim² PhD; Meng Han Lim³ BSocSci (Hons); Lynn Pei Zhen Teo² BSc; Juliana Shariq Mujtaba² BSc, MSc; Muhammad Razzan Razaki² BSc; Yihan Khoo⁴ MBBS, DWD; Si Qi Lim² M Ger; Alicia Shi Yao Chee² GCE A Lvl; Jed Jasman² BSc (Hons); Jasmine Yee Ru Cheng² BPsychSc(Hons); Elliott Weizhi Sim² Dip; Thaddeus Chi En Cheong² MBBS; Nerice Heng Wen Ngiam² MBBS, MRCP, MMed; Angeline Jie-Yin Tey⁵ MBBS, MRCP, MMed; Chee Hsiang Liow⁶ MMed; Lian Leng Low² MBBS, MMed, MCI, FCFP; Kennedy Yao Yi Ng² MBBS, MRCP, MMed

¹ National University Health System Singapore SG

² Singapore General Hospital Singapore SG

³ Ministry of Health Singapore SG

⁴ Sengkang General Hospital Singapore SG

⁵ Tan Tock Seng Hospital Singapore SG

⁶ National University of Singapore Singapore SG

Corresponding Author:

Kennedy Yao Yi Ng MBBS, MRCP, MMed

Singapore General Hospital
10 Hospital Blvd
Singapore
SG

Abstract

Objectives: Community health screening programs frequently report inconsistent follow-up rates and barriers to sustained lifestyle changes. This study evaluated the HealthStart program, a layperson-led intergenerational health coaching program that aims to improve health screening follow-up, chronic disease understanding and ownership, digital health application adoption and sustained lifestyle changes.

Methods: HealthStart is a self-determination theory-based intervention that aims to increase the autonomy and competence of participants via volunteer engagement, health coaching, and post-health screening follow-up. Lay volunteers (LVs) were taught principles of motivational interviewing, health coaching and social determinants of health via a training model anchored on principles of intergenerational and service learning. LVs act as health advocates through the participants' journeys under the guidance of healthcare volunteers.

Convergent parallel mixed-methods analysis was employed. A total of 192 participants' quantitative data were collected through pre- and post-program surveys. Qualitative data were obtained from 36 semi-structured interviews analyzed through thematic analysis.

Results: The follow-up rate among primary care providers increased significantly from 42.7% to 84.5% ($\chi^2=43$, $p<0.001$). A total of 66.2% (92/139) of the participants achieved their health goals, and 81.3% (113/139) reported satisfaction with the program. There was a statistically significant correlation ($Z=2.44$, $p=0.015$) between participant health goal attainment and the number of follow-up visits and between post-cycle participant eHealth literacy scale (eHEALS) scores and the number of follow-up visits ($F(2,130)=6.06$, $p=0.003$).

The qualitative findings highlighted LVs' crucial role in facilitating health conversations, promoting lifestyle changes, and building meaningful connections in catalyzing lifestyle changes in the participants. While the training adequately prepared LVs for these tasks, some encountered challenges with participants resistant to change or with complex needs.

Conclusion: HealthStart demonstrated the feasibility and impact of using laypersons in the community to increase follow-up

rates and promote healthier lifestyles among older adults.

(JMIR Preprints 20/04/2025:75699)

DOI: <https://doi.org/10.2196/preprints.75699>

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**

Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.

Only make the preprint title and abstract visible.

No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**

Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain visible.

Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <https://preprints.jmir.org/preprint/75699>

No. Please do not make my accepted manuscript PDF available to anyone. I understand that if I later pay to participate in <https://preprints.jmir.org/preprint/75699>

Original Manuscript

Full Title: The impact of lay volunteers on community health screening program outcomes for older adults: A mixed-methods evaluation

Ka Shing Yow^{1,2†}, Audrey Shu Ting Kwan^{1,3,4†}, Xiaoting Huang^{1,5}, Jie Xin Lim¹, Meng Han Lim^{1,6}, Lynn Pei Zhen Teo¹, Juliana Shariq Mujtaba^{1,7}, Razzan Razaki^{1,8}, Yihan Khoo^{1,9}, Si Qi Lim^{1,4}, Alicia Shi Yao Chee¹, Jed Jasman^{1,3}, Jasmine Yee Ru Cheng^{1,3}, Elliott Weizhi Sim¹, Thaddeus Chi En Cheong^{1,10}, Nerice Heng Wen Ngiam^{1,11}, Angeline Jie-Yin Tey^{1,12}, Chee Hsiang Liow¹³, Lian Leng Low^{3,14&}, Kennedy Yao Yi Ng^{1,3,15&}

1. TriGen, Singapore
2. Department of Internal Medicine, National University Health System, Singapore
3. Division of Population Health and Integrated Care, Singapore General Hospital, Singapore
4. Department of Physiotherapy, Singapore General Hospital, Singapore
5. Department of Geriatric Medicine, Singapore General Hospital, Singapore
6. Primary and Community Care Division, Ministry of Health, Singapore
7. Medical Informatics Branch, Ministry of Defence, Singapore
8. Department of Nursing, Singapore General Hospital, Singapore
9. Department of Transitional Care and Community Medicine, Sengkang General Hospital, Singapore
10. Department of Internal Medicine, Singapore General Hospital, Singapore
11. Department of Infectious Diseases, Singapore General Hospital, Singapore
12. Department of Respiratory and Critical Care Medicine, Tan Tock Seng Hospital, Singapore
13. Saw Swee Hock School of Public Health, National University of Singapore, Singapore
14. Department of Family Medicine and Continuing Care, Singapore General Hospital, Singapore
15. Division of Medical Oncology, National Cancer Centre, Singapore

[†]co-first authors

[&]co-last authors

Corresponding Author:

Kennedy Yao Yi Ng

Division of Population Health and Integrated Care, Singapore General Hospital, Singapore

10 Hospital Blvd, Singapore 168582

kennedy.ng.y.y@singhealth.com.sg

Abstract

Objectives: Community health screening programs frequently report inconsistent follow-up rates and barriers to sustained lifestyle changes. This study evaluated the HealthStart program, a layperson-led intergenerational health coaching program that aims to improve health screening follow-up, chronic disease understanding and ownership, digital health application adoption and sustained lifestyle changes.

Methods: HealthStart is a self-determination theory-based intervention that aims to increase the autonomy and competence of participants via volunteer engagement, health coaching, and post-health screening follow-up. Lay volunteers (LVs) were taught principles of motivational interviewing, health coaching and social determinants of health via a training model anchored on principles of intergenerational and service learning. LVs act as health advocates through the participants' journeys under the guidance of healthcare volunteers.

Convergent parallel mixed-methods analysis was employed. A total of 192 participants' quantitative data were collected through pre- and post-program surveys. Qualitative data were obtained from 36 semi-structured interviews analyzed through thematic analysis.

Results: The follow-up rate among primary care providers increased significantly from 42.7% to 84.5% ($\chi^2=43$, $p<0.001$). A total of 66.2% (92/139) of the participants achieved their health goals, and 81.3% (113/139) reported satisfaction with the program. There was a statistically significant correlation ($Z=2.44$, $p=0.015$) between participant health goal attainment and the number of follow-up visits and between post-cycle participant eHealth literacy scale (eHEALS) scores and the number of follow-up visits ($F(2,130)=6.06$, $p=0.003$).

The qualitative findings highlighted LVs' crucial role in facilitating health conversations, promoting lifestyle changes, and building meaningful connections in catalyzing lifestyle changes in the participants. While the training adequately prepared LVs for these tasks, some encountered challenges with participants resistant to change or with complex needs.

Conclusion: HealthStart demonstrated the feasibility and impact of using laypersons in the community to increase follow-up rates and promote healthier lifestyles among older adults.

Background

Introduction

Many countries are facing an aging population^[1], with a rising prevalence of chronic diseases^[2]. Community health screenings are key preventive health programs aimed at screening, detecting, and managing these conditions. However, these screening programs report inconsistent follow-up rates^[3,4], and many patients experience barriers to sustained lifestyle changes, including a lack of knowledge and community support^[5]. In the United States, many cancer screening programs involve fewer than 75% of patients receiving some form of follow-up care^[6]. In 2016, SingHealth, Singapore's largest public healthcare cluster, reported that one in four individuals screened via community-based health screenings had not returned for a doctor's follow-up after a year^[7]. Loss to follow-up has significant physical and socioeconomic implications, including untreated chronic conditions, physical complications, reduced healthcare system efficiency, and increased financial costs^[8].

While lay volunteers (LVs) have been effectively utilized in specific screening programs for screening follow-up, such as the blood cholesterol screening, counseling, and referral (SCORE) system under the Pawtucket Heart Health Program (PHHP) in the 1990s^[9] and the Baltimore eye screening program in the early 2000s^[10], their role in broader screening programs addressing major cardiovascular risk factors and health coaching has not been thoroughly investigated.

With appropriate training, LVs can be empowered to guide health screening participants in navigating the health system, increasing follow-up rates, setting specific health-related

lifestyle goals, and adhering to them. Previous qualitative studies have shown benefits of this approach, including improved person-focused coordinated care^[11], more seamless referrals to appropriate services^[12], and the promotion of healthy practices^[13]. Experts recommend measuring indicators that predict the success of lay counselors^[14] and exploring their effectiveness in more complex tasks, such as diagnosis and counseling^[15]. When designed and implemented appropriately, community-based health coaching has the potential to be a significant nonclinical intervention for individual and population health^[16], simultaneously improving the health literacy of health coaches undergoing training and the general public and facilitating the adoption of healthy practices across generations^[17].

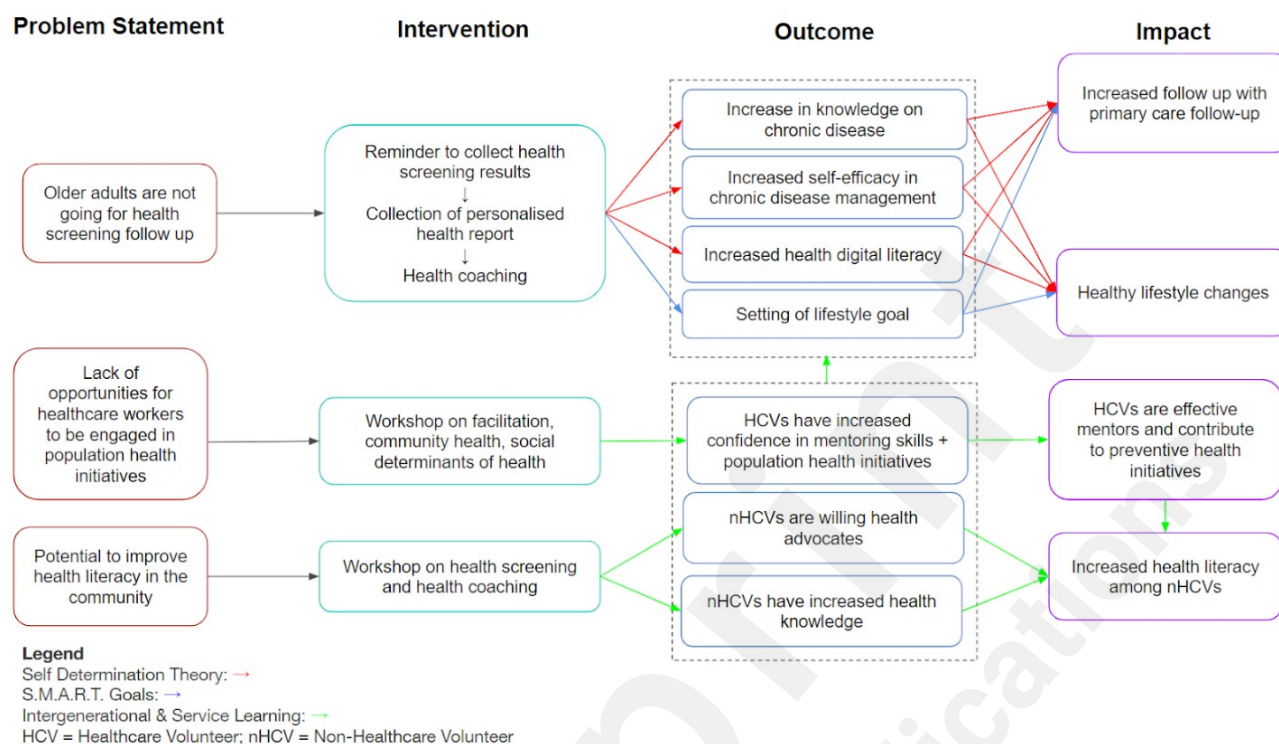
Conceptual Framework

HealthStart is a self-determination theory (SDT)-based intervention built to support the Healthier SG (HSG) initiative, the local government's policy to promote healthier aging by reshaping the population's health-seeking behaviors and lifestyle through collaborative community-based care^[18]. It aims to increase the engagement and follow-up rates of participants attending a chronic disease community health screening by developing, training, and empowering LVs to be health advocates that accompany participants in their postscreening journey over a three-month period.

SDT proposes that personally relevant goals are more internally motivated and are thus more likely to be obtained than goals set due to some external pressure^[19]. It specifies three basic psychological needs (i.e., autonomy, competence, and relatedness) that provide the basis for motivation and development and are the contextual conditions that facilitate internal motivation and help people integrate their behavior into their everyday lives and sense of self. Autonomy refers to the sense that one's actions are the result of their own

volition, competence is the belief in one's ability to affect change and achieve desired outcomes, and relatedness is the extent to which one feels a connection with others. Self-integration of behaviors occurs when externally motivated behaviors (i.e., behaviors regulated by an external force) become integrated into one's 'sense of self'; that is, they contribute to one's overall evaluation of the self.

HealthStart aims to increase the autonomy and competence of the participants through the SDT framework via volunteer engagement, health coaching, and posthealth screening follow-up, relating that to the participants' lifestyle to increase knowledge, confidence, and digital health literacy and set and achieve lifestyle goals. The SMART (Specific, Measurable, Achievable, Realistic, and Timely) framework is used to assist participants in setting lifestyle-related goals and achieving sustained lifestyle change^[20]. LVs are taught health knowledge and health coaching skills, which they applied through their interaction with participants under the guidance of healthcare volunteers (HCVs) who underwent a preprogram facilitation workshop. The program's theory of change is reflected in Figure 1.

Figure 1: HealthStart Theory of Change

Volunteer training in HealthStart is delivered via a blended learning approach^[21] and anchored on principles of intergenerational and service learning, combining learning objectives with community service to create a meaningful learning experience while meeting the community needs of older adults^[22]. Youths with no prior healthcare experience are recruited as LVs. On an individual level, lifelong health habits are best cultivated at a young age, and there is potential to improve health literacy among youths^[23]. At the community level, having imparted LVs with a service learning experience in HealthStart, there is potential for intergenerational transfer of health knowledge when LVs bring the knowledge and experience gained from the program back to their families and communities^[24]. The concept of service learning emphasizes volunteers' learning through critical reflection by having them participate in community service experiences in real-world settings; this aspect is grounded in Kolb's experiential learning theory, which states that

effective learning is based on concrete experience, reflective observation, abstract conceptualization and active experimentation^[25]. The HealthStart program is intentionally designed to achieve reciprocity by valuing both volunteer learning experiences and the benefits for the recipient^[26].

Contact theory was used to guide intergenerational program development and study^[27]. There are four main tenets that, when present in the contact setting, increase the likelihood that people will experience positive contact: the support of governing bodies, equal group status, intergroup cooperation, and common goals. In the design of the HealthStart program, we built upon lessons learned in a previous intergenerational program that was demonstrated to increase health literacy and reduce ageist attitudes^[28]. The program emphasized the concept of equal group status, where all the volunteers attended the training day together and were collectively held accountable for the participants whom they were assigned. Intergroup cooperation and common goals were also built into the interactions between the LVs and the participants, where they devised a plan together and fulfilled the goals set out at the start of the program. Throughout the journey, HCVs, comprising doctors and nurses, act as clinicians who teach healthcare knowledge and skills to LVs and as mentors who provide supervision to LVs as they engage with the participants.

The primary outcome of the program was residents' enrollment with a family physician. Each resident had to additionally complete a local health promotion board (HPB) booklet^[29] detailing their newly diagnosed condition, learn a digital health application, and set a healthy lifestyle goal and achieve it. The secondary outcomes include increases in health knowledge, health ownership and digital health literacy among residents, as well as the acceptability of the program among stakeholders.

Methods

Program Implementation

For the participants, the program consists of a personal review of their health screening results, health goal setting with their assigned LVs, follow-up with their PCPs, and completion of their health goals over a three-month duration. Throughout the process, HCVs oversee the operations and provide avenues for content clarification and professional support as necessary. Each HealthStart group consists of one HCV and four LVs. Each LV is assigned two participants. LVs are expected to follow up with participants over a period of three months through either physical or virtual visits.

To complete the HealthStart program, participants will need to fulfill the following criteria:

1. Learn about their chronic disease(s) with the aid of the Health Promotion Board (HPB) booklets^[29]
2. Learn at least one digital health application such as HealthHub^[30,31]
3. Enrollment with a PCP
4. Set a lifestyle goal and achieve it

The participants will first meet their LVs at a community event where health screening reports are distributed and explained by a community nurse. The LVs will conduct their first session of health coaching with the participants and build rapport via questions that cover sociodemographic factors and lifestyle aspects (exercise, smoking, alcohol intake, dietary habits), utilizing tools such as a time wheel and a healthy plate (Appendix 1) to aid them. The time wheel provides the participants and LVs with a clearer picture of their time allocation within a 24-hour period to identify pockets of time for purposeful healthy lifestyle

changes (e.g., brisk walking, meal planning). The Healthy Plate acts as a guide for participants and LVs to review the current dietary content of their meals and in conjunction with the time wheel to find time for either healthy cooking or to travel for healthier food options.

LVs subsequently teach participants about their newly diagnosed chronic disease via HPB educational materials, guide them in the use of digital health applications^[30,31], assist in setting up an appointment to a PCP through the use of the digital health application HealthHub and support the participants in setting a lifestyle goal. LVs follow up with their participants one-to-one longitudinally over a period of 3 months through in-person or virtual visits (i.e., video calls) every fortnight, where they check the participants' progress, motivate them to achieve their goals, and ensure the fulfillment of the program's four goals.

LVs are required to fill out a follow-up visit form after each visit and a final visit form at the last visit to track the participant's progress through HealthStart and have monthly meetings with LVs to reflect on their intergenerational and service-learning experience. This provides a chance for LVs to practice the mentoring skills learned and is an extension of Kolb's experiential learning within small groups^[25].

Volunteer Training

The HealthStart training adopts a blended learning approach^[21]. Volunteers are divided into teams from the outset to facilitate team building. This early introduction fostered bonding within the team throughout the training process. All volunteers are provided with an overview of the program and the operational aspects of HealthStart for baseline understanding. LVs are trained to be health coaches by watching prerecorded lectures on the following topics: Singapore's healthcare system, chronic diseases and principles of

management, social determinants of health, and vital sign monitoring. Educational materials by the Health Promotion Board Singapore on the following conditions (hypertension, hyperlipidemia, and diabetes mellitus) and a volunteer protocol guidebook (Appendix 2) for operational workflow reference are sent to the volunteers.

LVs are required to take a pretraining quiz to ensure adequate knowledge acquisition prior to in-person training. This is followed by interactive lectures covering topics related to SMART goal setting and the principles of motivational interviewing. HCVs undergo workshops on community healthcare, social determinants of health (SDOH), mentoring and facilitation training. The facilitation workshop aims to equip HCVs with knowledge and basic skills for mentoring LVs and to foster stronger intergenerational relationships through the HealthStart journey. The in-person training session takes place over a day.

The training day ends with HCVs and LVs gathering back in their groups to play the various scenarios they may encounter and provide an opportunity for HCVs to interact with the LVs and put into practice mentoring and facilitation skills. An organizing committee member role plays a role as a participant in these scenarios and acts to monitor the dynamics and provide support and feedback as needed. There are four scenarios simulating the various scenarios in the entire journey that the LVs may encounter (Appendix 3). Each scenario is followed by a debrief session led by the group's HCV and a large group reflection for all volunteers. This structure provides opportunities for reflective observation and encourages volunteers to practice abstract conceptualization, applying what they have learned to subsequent scenarios, in line with Kolb's experiential learning cycle^[25]. HCVs use a standardized evaluation checklist to assess the competency of LVs (Appendix 4). LVs deemed unsuitable for the health coaching role are offered additional training or opportunities to volunteer in other capacities.

Study Design

This study used a convergent parallel mixed-methods design to evaluate the effectiveness of the HealthStart program. This outcome evaluation aimed to determine 1) the health impact on older adults and 2) the acceptability of the program among older adults, HCVs and LVs.

Participants

Older adults aged 40 years and above who participated in the health screening, LVs aged 21--35 years and HCVs who participated in the program were eligible for the study. Individuals with medical comorbidities that affected their ability to communicate (e.g., severe dementia) were excluded from the study. Individuals who could not speak English, Mandarin, Malay, or Tamil were also excluded.

Quantitative Data Collection and Analysis

The quantitative data collection was conducted between September 2022 and June 2023. Data from older adults were collected at the beginning of the health screening and at the end (third month) of each cycle through a digital survey administered by a trained volunteer. The data were collected via FormSG, a secure electronic government-encrypted web-based form with the following designed fields.

1. Sociodemographic variables, including age, sex, race, marital status, highest education level, and residential type
2. Primary outcome: Follow-up with a primary care doctor, measured as 'Yes' or 'No'
3. Secondary outcomes
 - a. Knowledge Questionnaire: a 12-item true/false questionnaire on chronic

conditions that is an abbreviated version of the 15-minute chronic disease questionnaire^[32] adapted to the local context using information from the Health Promotion Board (HPB) brochures

- b. Patient Activation Measure (PAM-13): a 13-item questionnaire measuring individuals' ability to self-manage chronic disease through self-reported knowledge, skills, and confidence^[33].
- c. eHealth Literacy Scale (eHEALS): an 8-item questionnaire assessing respondents' perceived skills in using information technology for health^[34].
- d. SMART (Specific, Measurable, Attainable, Relevant, Time-based)^[20] health goal attainment: self-rated achievement of lifestyle goals, measured as a 'Yes' or 'No'
- e. Program satisfaction: "To what extent are you satisfied with the program?" with 4-level Likert scale response options (not at all satisfied, slightly unsatisfied, slightly satisfied, very satisfied).

Descriptive statistics were computed for the study population. The program implementation fidelity was tracked via the number of follow-up visits and the number of final assessments conducted. McNemar's test was used to examine differences in the proportion of primary care follow-up before and after the program. Pre- and postintervention differences in secondary outcomes were compared via paired t tests. One-way ANOVA and linear trend tests were employed in the subgroup analysis to evaluate the relationships between the secondary outcomes and the number of follow-up visits the residents received. A binomial logistic regression was performed with primary care follow-up as the outcome variable and demographics and baseline questionnaire scores as the predictor variables. All the statistical analyses were performed via Stata Version 15 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC.) Statistical significance was set

at $p < 0.05$.

Qualitative Data Collection and Analysis

Qualitative data were collected through one-to-one, semistructured interviews with older adults, LVs, and HCVs who participated in the program. Purposive sampling was used to recruit older adults on the basis of the following criteria to ensure the representability of each group: age, sex, race, education level, number of follow-up visits within the program and postprogram primary care follow-up status. Convenience sampling was used for LVs and HCVs. The interview guides were formulated on the basis of the reconstructed theory of change to elicit perceptions of the program, the health advocacy process with older adults, and the volunteer training program (Annex 1).

The interviews were conducted between November 2023 and January 2024 face-to-face or via Zoom Web Conferencing (Zoom Video Communications, Inc., San Jose, California) by four project team members trained and supervised by the qualitative lead coinvestigator. Each interviewer was trained in qualitative data collection techniques. All interviews were audio-recorded and transcribed via an automated transcription software service and later checked by a project member, ensuring verbatim accuracy and redacting identifiable information. Four team members coded the transcripts via a deductive-abductive approach, focusing on perceptions toward the program, the health advocacy process, and volunteer training while allowing new themes to emerge. Thematic analysis, following the framework of Braun and Clarke^[35], was used by four coders to analyze the transcripts. After independently coding the transcripts, a secondary coder reviewed them to address discrepancies and finalize the coding. QSR NVivo 14 software was employed for data management and analysis. Data triangulation was used to identify areas where qualitative

themes explained quantitative data findings on program implementation fidelity and program outcomes.



Results

Quantitative

HealthStart reached out to 192 older adults via 30 healthcare workers and 115 lay volunteers over two health screening cycles conducted in 2022 and 2023, respectively.

A total of 424 participants underwent the community health screening program, 192 of whom were eligible and recruited for the study. Figure 2 illustrates the flowchart of the program participants. Among the 192 study participants, 139 completed the study. The demographics of the study participants are summarized in Table 1. The mean age of the study participants was 67 years, and the sex distribution was approximately equal. Most of the participants were of Chinese ethnicity, had completed primary or secondary school, and resided in self-owned flats.

Figure 2: Flowchart of Program Participants

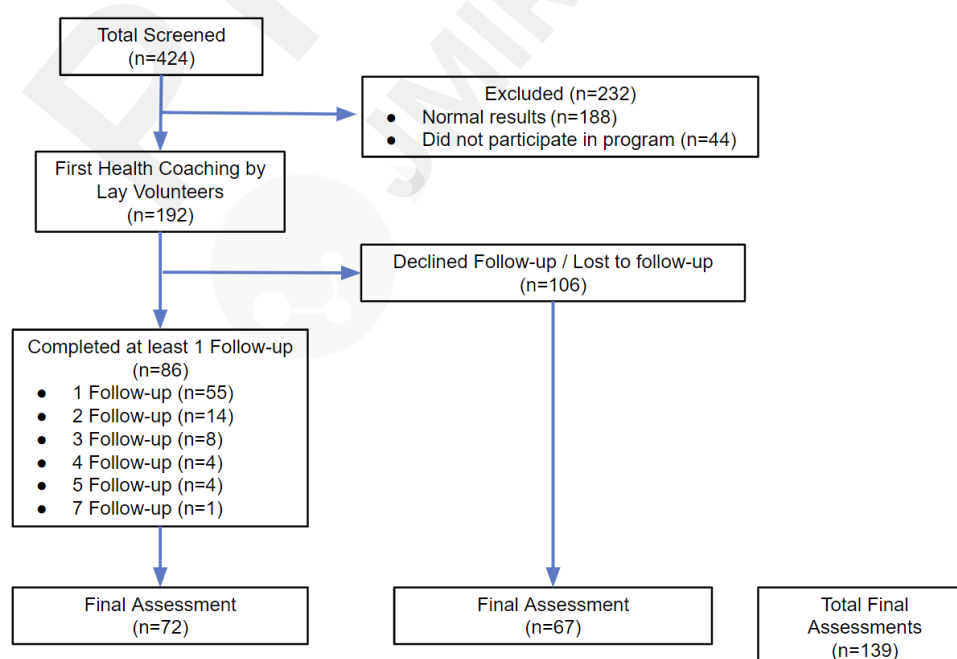


Table 1: Demographics of the Study Participants

	HealthStart Participants (n=192)
Mean age, years (SD)	66.9 (9.60)
Gender (%)	
Male	92 (48.0)
Female	100 (52.1)
Race (%)	
Chinese	170 (88.5)
Others	22 (11.5)
Marital Status (%)	
Single	58 (30.3)
Married	133 (70.0)
Highest Education Level (%)	
No formal education	18 (9.38)
Primary education	52 (27.1)
Secondary education	79 (41.2)
Tertiary education	43 (22.4)
Status of residential/living status (%)	
Rent/Lodge	27 (14.1)
Own	165 (85.9)
Resident Questionnaires (SD)	
Knowledge	8.81 (1.58)
PAM-13	68.7 (17.9)
eHEALs	24.5 (10.6)

The primary outcome of the study, the follow-up rate with primary care, increased from 42.7% (82/148) preprogram to 84.5% (125/148) postprogram. McNemar's test revealed a statistically significant difference in the proportion of individuals who followed up with primary care before and after intervention ($\chi^2 = 43$, $p < 0.001$).

The secondary outcomes of the study included a knowledge questionnaire on chronic conditions, the PAM-13, eHEALs, SMART goal attainment, and program satisfaction. There was no statistically significant change in the scores before and after the intervention for knowledge ($t=0.418$, $p = 0.677$), the PAM-13 ($t=-1.99$, $p=0.05$), or the eHEALs ($t=1.52$, $p=0.13$). Health goal attainment was achieved by 66.2% (92/139) of the residents. A total of 81.3% (113/139) of the residents reported feeling 'Satisfied' or 'Very Satisfied' with the

program. A summary of the above outcomes can be found in Annex 2.

When stratified by the number of LV follow-ups in the program, participants who received more sessions of follow-up with volunteers demonstrated improvement in selected secondary outcomes. There was a statistically significant increase in eHEAL scores in the groups that experienced more follow-up sessions, as determined by one-way ANOVA ($F(2,130) = 6.06$, $p = 0.003$). A Tukey post hoc test revealed a statistically significant increase in eHEAL scores in those with more than one LV follow-up (30.4 ± 8.4 , $p = 0.002$) compared with those with no follow-up (23.5 ± 8.4) and no significant difference between those with more than one LV follow-up and those with only one LV follow-up (26.3 ± 8.7 , $p = 0.147$). There was a statistically significant linear-by-linear trend ($Z=2.44$, $p=0.015$) between health goal achievement and those with none (58.46%), one (65.91%), or two or more (87.50%) LV follow-up visits. No statistically significant changes in knowledge ($F(2,130) = 0.61$, $p = 0.544$) or PAM-13 scores ($F(2,130) = 2.07$, $p = 0.131$) were noted via one-way ANOVA between groups stratified by the number of LV follow-up visits received.

Binomial logistic regression was conducted with primary care follow-up as the outcome variable and demographics and baseline questionnaire scores as the predictor variables, as depicted in Annex 3. The results revealed that older adults and minority race groups were significantly correlated with a higher rate of follow-up with a primary care provider. Baseline knowledge, the PAM-13 score, the eHEALs score, sex, marital status, residential status, and education level were not significantly associated with the primary outcome.

Qualitative

Thirty-six semi-structured interviews were conducted with older adults, LVs, and HCVs, achieving thematic saturation. The characteristics of the subjects can be found in Annex 4.

Representative quotes from the following three themes are displayed in Table 2.

Lay volunteers play a key role in facilitating health conversations and assisting older adults in understanding, planning for and achieving healthy lifestyle changes.

Many older adults reported gaining valuable health knowledge from LVs, particularly regarding their health conditions and the importance of lifestyle habits in achieving better health. As a result of LV education and support, some residents initiated follow-up visits with primary care providers. Two examples of health goals were 'to attend Wednesday Zumba class for seniors listed on the national health app' and 'reducing fried fish consumption for dinner to twice per week, substituting with steamed fish and increased vegetable intake within one month'. The participants mentioned achieving various lifestyle changes, including reducing the intake of unhealthy foods, increasing the consumption of healthier dietary options, and engaging in more physical activity, and reported additional health benefits that were not captured in the quantitative outcomes, such as weight loss, improvements in health markers, and an overall sense of well-being. While some older adults were unable to articulate specific facts on chronic diseases, this did not hinder their understanding of the importance of adopting healthier lifestyle choices.

The interviews revealed that LVs prioritized building relationships and employed motivational interviewing principles, such as partnership and compassion, with older adults. The participants expressed that these personable methods of setting health goals and encouraging behavioral change were effective in helping them achieve their health objectives. As a result, many developed self-efficacy in managing their health conditions through lifestyle habits and reported sustaining these habits without the need for ongoing LV support.

With respect to the adoption of health-related digital applications, some older adults reported that they already possessed these skills prior to the program. Additionally, some participants indicated that LVs do not emphasize this component in health conversations. A handful of older adults with limited digital literacy indicated that additional follow-up sessions were necessary to master these skills.

Training was adequate in preparing lay volunteers to facilitate behavioral change for motivated older adults but less so for those who were not ready or faced biopsychosocial challenges.

LVs reported that the training content and resources provided were sufficient to teach them about chronic diseases and lifestyle management. In particular, almost all the volunteers reported that learning motivational interviewing techniques and practicing these skills through role-playing case scenarios were the most beneficial aspects of their training. These techniques enable them to apply their knowledge, practice communication skills, and help HCVs identify LVs who may need additional guidance. Many older adults who successfully adopted lifestyle changes cited various intrinsic motivations, including their families and life goals, and recognized their individual responsibility in maintaining a healthy lifestyle. These older adults were receptive to the LV's advice, built meaningful connections with them, and experienced positive lifestyle changes.

However, LVs encountered difficulties engaging with participants who resisted change or were unwilling to engage. Some older adult participants also noted that it was ultimately up to each individual to take ownership and improve their health. Additionally, LVs felt limited when older adults shared complex needs, such as mental health or financial issues. In such situations, HCVs play a critical role in guiding LVs.

Older adults and volunteers valued the program's focus on healthy living and building meaningful connections.

Older adults appreciated the program for several reasons, including the health knowledge and benefits gained, the support from LVs in achieving their health goals, the meaningful connections formed, the opportunity to participate free of charge, and the promotion of healthier lifestyles for both younger and older Singaporeans. The majority of LVs expressed that being a lay health volunteer was fulfilling and enriching. Many valued the meaningful connections formed with older adults, the ability to positively impact their health, and the opportunity to learn health knowledge and people's skills. Most LVs reported that they were keen to volunteer again in the program and would encourage their peers to participate. HCVs are also encouraged by LVs to positively impact older adults' health and to have the opportunity to mentor them as effective health advocates.

Table 2: Representative Quotations from Qualitative Themes

Qualitative Themes	Representative Quotes
Lay volunteers played a key role in facilitating health conversations and assisting older adults in understanding, planning for and achieving healthy lifestyle changes	This (December) was the second time (seeing the General Practitioner). The first time I (saw the GP after the program), think it is somewhere around April. Yah she saw some improvement in the (cholesterol) report... Last time I like to eat fried things like crackers. Then, now I truly cut down lah. Fried chicken all these very rare also... So that one (community exercise group) is every day. So yah I feel happy, at least I stick to something and do it everyday. <i>(OA07, Female, 50-60 years)</i> She (LV) got say. She is actually very good, she just said, need to exercise. At that time, I am quite fat, quite heavy, she said to cut down on eating these things. I listened to her, keep cutting down and loss a few kilograms... Last time, I think- exercise very little lah and then also, she said don't eat too much of these and that... from then on, I have

been eating oats. Previously, I would go and buy take out for breakfast, and they are oily ah... I tried to start- whenever I cook dishes and etc., I don't use/consume oil. Keep making soup, and pair it with rice. For vegetables, **use blanching to cook**, ah, I try not to use any oil.
(OA05, Female, 60-70 years)

(LV) say ah, because my cholesterol and my sugar, together high a little bit lah. Asked me to cut down lah.. **before that I do not know**. Then, they give the (Health Promotion) book lah,.. **I follow the book lah... Black coffee, no sugar** every morning. Last time no, last time every day I put milk ah. Then, I take the **brown rice**, now I also take. Last time, I do not like brown rice. **Last time, I cannot breathe ah**. Like very tired. Eat already, must sleep. Now, no ah, because I eat already I go walk outside, **now very light.. Last year I 70 kg, then after I go for this, I 62 kg**. Because I see the book, all I cut down already ah, then I exercise.. I must take care lah, if not who else to see my (bedbound) husband..
(OA13, Female, 60-70 years)

Eating **vadai** (savory Indian fried snack) ah, also my favorite. That also I cut down, I miss ah. Wah, I cut down a lot. One day **Roti Prata** (fried Indian flatbread) I also cut down eh... Always all oily food, so I cut down, cut more. So I just forget it lah, just everything. **I think I changed a lot... What they told me I just listen, just keep in mind what they told me, just try my best lah** — Therefore, now I good lah! For me, (LV) told me those uh food ah , what do you call that? Low-sodium ah? I feel that consulting with (LV), **I feel learn something lah**.

(OA02, Male, 60-70 years)

I think (the SMART goal)- she always like go out and eat and she like to eat **Char Kway Teow** (stir-fried rice noodles) or something. So one of the SMART goals was like, why not you opt for like those healthier option? Like those healthier logo? The sign like eat the meals based on that? The reason why she eat food that has very high cholesterol is because is like *Hawker center* (local food center). Then, the nice food is usually like the Char Kway Teow or that kind? **So I say why not you just cook at home instead. In addition, you can control what you cook, how much oil you want. You can still replicate the same recipe, but make it healthier.**

(LV08, Female, <21 years old)

Training was adequate in preparing lay volunteers to facilitate behavioral change for motivated older adults but less so for those who were not ready or faced biopsychosocial challenges	I did get to learn a lot and apply the hands-on skills from the training. The goal-setting part, was something that was like a skill that we role-played a lot during the training itself. In addition, we actually got to apply the framework that was given to us, which I thought was actually quite impressive... Along the way we could branch out to like different conversations, to get to know their lifestyle and get to know, like their habits and stuff, so that we could you know, try to set more realistic goals and get a holistic understanding of them. (LV11, Male, <21 years) Case scenarios were the most helpful (part of the training) for me, I would say. So during the case scenario we need to act out as the resident, and that allows me to basically make an assessment about the LV, whether they are capable or whether they are competent enough to tackle trick questions or also handle difficult situations. Therefore, one of the scenarios was about a difficult resident and I was quite impressed to see the LV able to overcome the scenario and they did pretty well. (HCV02, Male, 31-40 years) We did not truly complete that part (goal setting). Because while they know about their condition, the uncle was quite pessimistic, and he kept saying that he was going to pass eventually. So like, there was no point doing this. Therefore, during the first meeting, it was more navigating through that conversation. I struggled quite a bit, and I have to keep looking at (HCV) for help, because I did not know what to say... During the training session, I feel like the, the role-playing we did truly helped me quite a lot in preparing for this actual scenario, because I think without the training, I think I will be a lot more lost. (LV12, Female, <21 years old)
Older adults and volunteers value the program's focus on healthy living and building meaningful connections	Actually, for example this group of people (volunteers) come to you ah, it's strangers what, but you're helping us you know, so it's truly good to have this program. In addition, then you only tap on all this ah because we have our own goals to achieve right? (OA08, Female, 60-70 years) I like it that I can make a meaningful impact to someone else's life, and cause volunteers are the ones that actually go down to the client's home, build rapport with them, and to understand them, do motivational interviewing and draft out HealthStart goals, and to continue up the

follow-up sessions.... So nearing the end, they always like to feed us tea, and we could tell that like—**we were very attached, and we could tell that they truly enjoyed the sessions a lot**, and they also said that they truly enjoyed the time. Because, while it is one thing about drafting out HealthStart goals and working toward them, **it's also like making a friend, like allowing them to pass down their generation information to us.**

(LV07, Female, 21-35 years)

Therefore, honestly, I had quite a **fulfilling experience with HealthStart** because I **learned a lot of things**, like, one of the things that I truly found very useful is **how we can package our words to, like, persuade the elderly to like, stick to their goals.**

(LV13, Female, <21 years)

They (the LV) are very good, you know. I think they're better than me [laughs]. Actually, (the older adults) truly do lose weight. In addition, then they truly change some of their, erm, eating habits, which you know is very personal to tell them. If they're willing to take, take in your advice, and you see results, it's very fulfilling, you see? And yeah,, it is very fulfilling... Then, you're truly getting Singaporeans with everyone healthier. It is truly HealthierSG (preventive health reforms)... In addition, you know this is a very good organization and initiative that you know you're with the government and all, to truly do this.

(HCV03, Female, 31-40 years)

The (LVs) that I worked **were quite open-minded and the willingness to learn uh, helped to drive this volunteerism**, and to work together with the (older adults). Can say the first few times when they met the (older adults) they were quite shy, they're not so confident. However, uh, **slowly they managed to improve in their talking to (the older adult).** We can see that they are **very passionate and slowly become more and more confident and comfortable** to talk, and eventually they will become, like their own, like part of a family.

(HCV02, Male, 31-40 years)

Discussion

The postprogram primary care provider follow-up rate was 84.5%, which was higher than previously reported rates in health screening programs^[6,7]. The binomial logistic regression revealed that older adults and minority races were significantly correlated with a higher primary care provider follow-up rate. A 2019 study in Taiwan revealed that elderly people were more likely to participate in preventive health screening than younger people were^[36], similar to the findings of this study. Minority race groups have been shown to have lower screening follow-up rates than majority race groups in previous studies^[37]. HealthStart was offered freely to all residents regardless of race; deliberately linked LVs with older adults who spoke the same mother tongue; and provided an educational booklet in the older adult's mother tongue language to facilitate accessibility, communication, and understanding, which likely helped reduce racial inequity^[38].

The health goal attainment rate was 66.2%, with individuals being more likely to achieve them if they had more LV follow-ups. The majority of goals centered on improving one's diet or physical activity. A total of 54.5% of a group of 33 participants achieved their set health goal in a previous community outreach health coaching program conducted by certified health coaches in Missouri^[39]. This study revealed equivalent rates of health goal attainment in older adults receiving abnormal health screening results, with their postscreening journey facilitated by lay volunteers. The qualitative findings highlighted a key takeaway of the program being understanding, planning for, and achieving healthy lifestyle changes, facilitated by health coaching. The initial shock of receiving abnormal health screening results from older adults may have formed an additional impetus for the high health-related goal attainment rate^[40]. Building on residents' autonomy and competence through the SDT framework^[19] helped improve awareness of healthy practices and achieve health-related

lifestyle changes in the HealthStart program.

The participants in this study were noted to have high baseline knowledge (8.81/12, SD = 1.58) and high PAM-13 scores (68.8/100, SD = 1.56), reflecting readiness to adopt new behaviors but potentially having difficulty sustaining change^[41], and relatively low eHEL scores (24.5/40, SD = 0.92). There was no statistically significant change in knowledge of chronic diseases, the PAM-13, or eHEALS between pre- and postintervention. Qualitative interviews revealed that most older adults did not recall specific facts about chronic diseases or adopt specific digital skills but learned more about the importance of health and achieving health-related lifestyle changes through the program.

Despite a thorough training program, LVs faced challenges when interacting with participants who were less keen or were not ready or motivated to make lifestyle changes or those with complex psychosocial issues. In adapting to a new and often unfamiliar role, dealing with different levels of individual receptivity and health system-level challenges are among some of the key challenges faced by health coaches in the literature that were similarly described in HealthStart^[42]. Qualitative interviews revealed the importance of having professional support and guidance from HCVs. To address varying levels of individual receptivity and health system-level challenges, incorporating the transtheoretical model of change and a social prescription model with community resources for financial or psychosocial support into the training program is planned in future iterations of the program^[43]. The reflection process on such challenges in an effort to learn and adapt to their role formed a critical aspect of the LVs' learning journey as part of Kolb's experiential learning theory^[25].

High satisfaction scores were reported by older adults of the program (81.3%), and qualitative reports demonstrated acceptability and appreciation for the program from both

volunteers and older adults. LVs felt it was a rich experience and expressed interest in volunteering in similar programs again. Older adults valued the new health insights gained and reported improvements in their health and lifestyles. A qualitative study in Canada that integrated community volunteers as extensions of the primary care team to support older adults yielded similar findings. These community volunteers deepened the primary care team's understanding of their patients and facilitated the delivery of person-centered care, demonstrating the possibility of integrating community volunteers into the primary care setting^[11]. A separate study conducted in Canada revealed that community volunteers can play a role in increasing older adults' understanding of community resources and system navigation^[12]. LVs are potentially untapped resources capable of effectively engaging in and promoting healthier living among older adults.

This study suggests that laypersons may be capable of improving primary care follow-up rates and promoting healthier living among older adults when equipped with chronic disease knowledge and health coaching skills. The high acceptability and positive feedback among all stakeholders suggest that laypersons can be valuable assets in population-level preventive health initiatives, especially when supported by professional guidance. Given the effectiveness, acceptability, potential reach and adoption of HealthStart, the evaluation demonstrates the potential to scale community programs involving laypersons in population health initiatives^[44]. Program sustainability is further strengthened by collaborative work with local grassroots organizations and alignment with the national strategic context of healthier aging^[45].

Strengths and Limitations

There are several limitations to this study. First, the observed improvements could not be

attributed to the program due to the absence of a control group, and the majority of the studies' quantitative outcomes were based on self-reported scales. Nevertheless, the qualitative data collected substantiate the study's findings. Future studies could employ more rigorous designs, such as quasiexperimental trials, to establish causality. Additionally, participant attrition resulted in missing data, which introduces the potential for nonresponse bias. The strengths of the study include the mixed methods evaluation, which allows for the triangulation of data and the inclusion of significant numbers of traditionally underserved populations, such as ethnic minorities and individuals of low socioeconomic status.

Conclusion

This study demonstrated the feasibility of utilizing laypersons to improve follow-up rates and promote healthier lifestyles among older adults participating in community health screening. The high acceptability of this model among stakeholders highlights the potential of harnessing the community, an untapped valuable resource, in population health initiatives.

Declarations

Ethics approval and consent to participate

This project received approval from the SingHealth Centralised Institutional Review Board [CIRB Reference Number: 2022/2700]. All participants provided informed consent and were given a participant information sheet. All quantitative and qualitative data collected were de-identified and stored on a set of electronic devices that were only accessible by the evaluation team. All evaluation team members were under the Division of Population Health and Integrated Care at Singapore General Hospital and were public health researchers or

researchers in training and had no formal interactions with the participants before the study.

Consent for publication

No individual person's data in any form is contained in this publication.

Acknowledgments

We would like to acknowledge the contributions of members of the Singapore General Hospital Division of Population Health and Integrated Care, community partners, as well as Sou Kalon and Mustafa Chechatwala, public health researchers who helped refine the manuscript.

This research project was funded by SingHealth's Regional Health System (RHS): Population-based, Unified, Learning System for Enhanced and Sustainable Health (PULSES) grant.

Authors' contributions

KSY, ASTK, XH, JXL, MHL, LPZT, NHWN, AJYT, LLL and KYYN were involved in the conceptualisation and design of the implementation framework. ASTK, XH, MHL, LPZT, JSM, RR, YK, SQL, ASYC, JJ, JYRC, EWS and TCEC were involved in the methodology, investigation, project administration and data curation. KSY, ASTK and JXL performed formal analysis in the quantitative section. KSY, ASTK, ASYC, JJ, JYRC, EWS, TCEC and CHL conducted formal thematic analysis in the qualitative section. KSY and ASTK prepared and wrote the original draft of the manuscript, and all authors were involved in reviewing and editing the manuscript. KSY, XH, JXL, MHL, LPZT, NHWN, AJYT and KYYN were involved in funding acquisition. KSY, NHWN, AJYT, LLL and KYYN supervised the project

administration. LLL and KYYN supervised the overall direction of the research.

Conflicts of interest

The authors declare they have no competing interests.

Availability of data and materials

The datasets of the study are available from the corresponding author on reasonable request.

References

1. World social report 2023: Leaving no one behind in an ageing world [Internet]. United Nations Department of Economic and Social Affairs; 2023. Available from: https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2023/01/WSR_2023_Chapter_Key_Messages.pdf
2. World Health Organization. Ageing and health [Internet]. World Health Organization. 2024. Available from: <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>
3. AshaRani PV, Devi F, Wang P, Abdin E, Zhang Y, Roystonn K, et al. Factors influencing uptake of diabetes health screening: a mixed methods study in Asian population. BMC Public Health [Internet]. 2022 Aug 9;22(1); doi:10.1186/s12889-022-13914-2
4. Gutiérrez J, Chima S, Boyd L, Sherwani A, Drosdowsky A, Napin Karnchanachari, et al. Failure to follow up abnormal test results associated with cervical cancer in primary and ambulatory care: a systematic review. BMC Cancer. 2023 Jul 12;23(1); doi:10.1186/s12885-023-11082-z
5. Subramaniam M, Devi F, AshaRani PV, Zhang Y, Wang P, Jeyagurunathan A, et al. Barriers and facilitators for adopting a healthy lifestyle in a multi-ethnic population: A qualitative study. Carraça E, editor. PLOS ONE. 2022 Nov 2;17(11):e0277106; doi:10.1371/journal.pone.0277106
6. Yabroff KR, Washington KS, Leader A, Neilson E, Mandelblatt J. Is the Promise of Cancer-Screening Programs Being Compromised? Quality of Follow-Up Care after Abnormal Screening Results. Medical Care Research and Review. 2003 Sep;60(3):294–331; doi:10.1177/1077558703254698
7. Many not Following up After Health Screening [Internet]. www.sgh.com.sg. 2017. Available from: <https://www.sgh.com.sg/news/others/many-not-following-up-after-health-screening>
8. Griffin SJ. Lost to follow-up: the problem of defaulters from diabetes clinics. Diabetic Medicine. 1998 Nov;15(S3):S14–24; doi:10.1002/(sici)1096-9136(1998110)15:3+3.3.co;2-9
9. Linnan LA, Gans KM, Hixson ML, Mendes E, Longpre H, Carleton RA. Training health professionals and lay volunteers to deliver cholesterol screening and education programs. PubMed. 1990 Nov 1;105(6):589–98.
10. Quigley HA, Kee Park C, Tracey PA, Pollack IP. Community screening for eye disease by laypersons: the Hoffberger program. American Journal of Ophthalmology. 2002 Mar;133(3):386–92; doi:10.1016/s0002-9394(01)01380-0
11. Gaber J, Oliver D, Valaitis R, Cleghorn L, Lamarche L, Avilla E, et al. Experiences of integrating community volunteers as extensions of the primary care team to help support older adults at home: a qualitative study. BMC Family Practice. 2020 May 16;21(1); doi:10.1186/s12875-020-01165-2
12. Gaber J, Stephanie Di Pelino, Datta J, Samina Talat, Browne T, Marentette-Brown S,

- et al. Community Volunteers and Primary Care Providers Supporting Older Adults in System Navigation: A Mixed Methods Study. *International Journal of Integrated Care*. 2022 Jan 1;22(1); doi:10.5334/ijic.5978
13. Lewin S, Munabi-Babigumira S, Glenton C, Daniels K, Bosch-Capblanch X, van Wyk BE, et al. Lay health workers in primary and community health care for maternal and child health and the management of infectious diseases. *The Cochrane Database of Systematic Reviews*. 2010 Mar 17;2010(3); doi:10.1002/14651858.CD004015.pub3
 14. Kagee A. Training lay counsellors in public health: Considerations for social workers, professional counsellors and psychologists. *Global Public Health*. 2020 Feb 21;15(6):1–7; doi:10.1080/17441692.2020.1730931
 15. Woldie M, Feyissa GT, Admasu B, Hassen K, Mitchell K, Mayhew S, et al. Community health volunteers could help improve access to and use of essential health services by communities in LMICs: an umbrella review. *Health Policy and Planning*. 2018 Dec 1;33(10):1128–43; doi:10.1093/heapol/czy094
 16. Towards a Healthier, Happier Britain: The Case for Health Coaching [Internet]. UK & International Health Coaching Association; 2023 [cited 2024 Oct 16]. Available from: https://www.gmactive.co.uk/wp-content/uploads/2024/01/FINAL_V8_TOWARDS_A_HEALTHIER_HAPPIER_BRITAIN.pdf
 17. Maini A, Fyfe M, Kumar S. Medical students as health coaches: adding value for patients and students. *BMC Medical Education*. 2020 Jun 3;20(1); doi:10.1186/s12909-020-02096-3
 18. Huang X, Yow KS, Shu A, Yeo JY, Lim HA, Lim JX, et al. Healthstart: A Layperson-Led Community Health Coaching Programme. SSRN.
 19. Ryan RM, Deci EL. Self-determination Theory and the Facilitation of Intrinsic motivation, Social development, and well-being. *American Psychologist*. 2000 Jan;55(1):68–78 *Am Psychol*. 2000;55(1):68-78; doi:10.1037//0003-066x.55.1.68
 20. Bailey R. Goal Setting and Action Planning for Health Behavior Change. *American Journal of Lifestyle Medicine*. 2019;13(6):615–8; doi:10.1177/1559827617729634
 21. Hoic-Bozic N, Mornar V, Boticki I. A Blended Learning Approach to Course Design and Implementation. *IEEE Transactions on Education*. 2009 Feb;52(1):19–30; doi:10.1109/TE.2007.914945
 22. Deeley SJ. Service-learning: Thinking outside the box. *Active Learning in Higher Education*. 2010 Mar;11(1):43–53; doi:10.1177/1469787409355870
 23. Woods-Townsend K, Hardy-Johnson P, Bagust L, Barker M, Davey H, Griffiths J, et al. A cluster-randomised controlled trial of the LifeLab education intervention to improve health literacy in adolescents. Doran CM, editor. *PLOS ONE*. 2021 May 5;16(5):e0250545; doi:10.1371/journal.pone.0250545
 24. Vaughan C, Gack J, Solorazano H, Ray R. The Effect of Environmental Education on Schoolchildren, Their Parents, and Community Members: A Study of

Intergenerational and Intercommunity Learning. The Journal of Environmental Education. 2003 Jan;34(3):12–21; doi:10.1080/00958960309603489

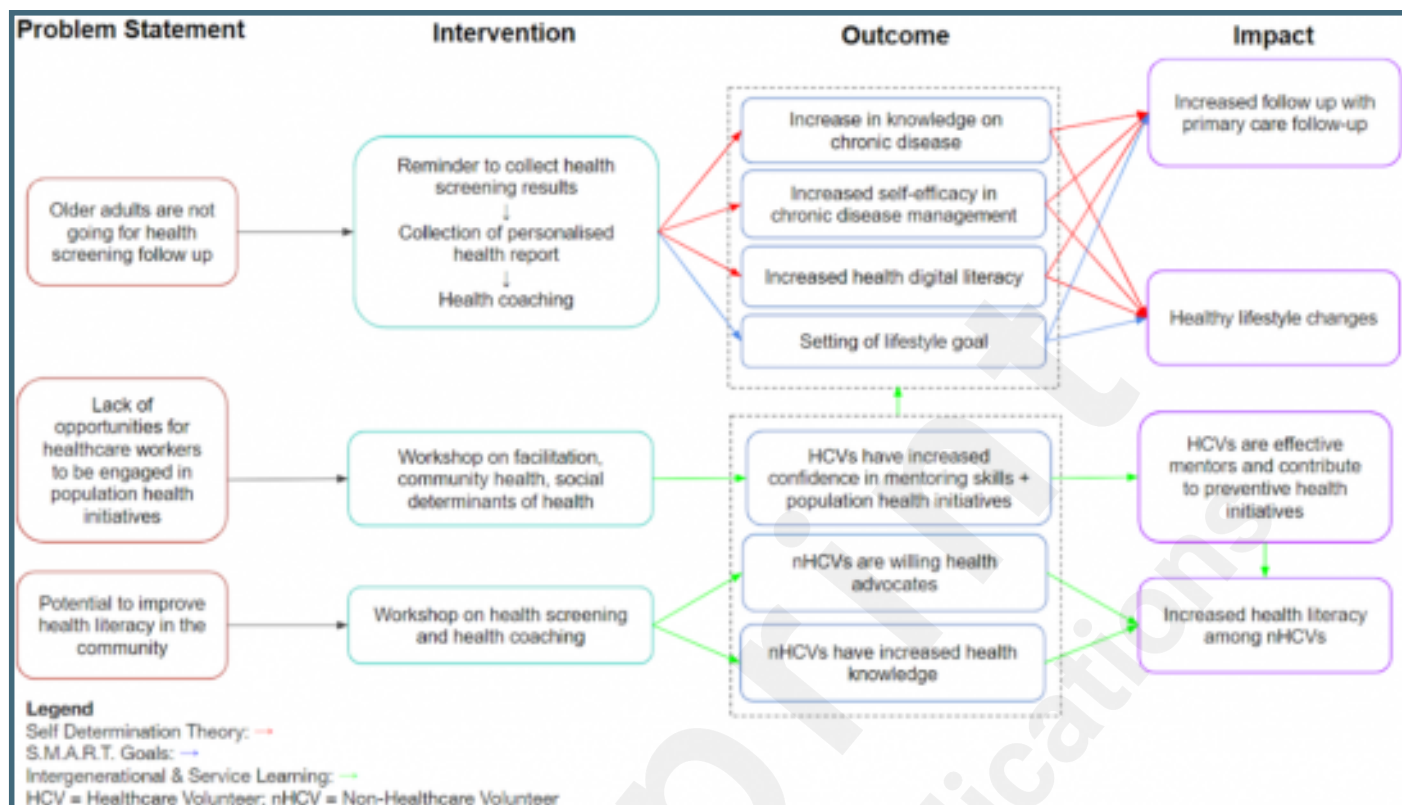
25. Jacoby B. Service-Learning in Higher Education. Jossey-Bass; 1996
26. Furco A. Service-Learning: A Balanced Approach to Experiential Education. Service Learning, General [Internet]. 1996 Jan 1; Available from: <https://digitalcommons.unomaha.edu/slceslgen/128>
27. Health Promotion Board Resources [Internet]. Health Promotion Board; Available from: <https://www.hpb.gov.sg/resources>
28. Martins T, Midão L, Martínez Veiga S, Dequech L, Busse G, Bertram M, et al. Intergenerational Programs Review: Study Design and Characteristics of Intervention, Outcomes, and Effectiveness. Journal of Intergenerational Relationships. 2018 Dec 16;17(1):93–109; doi:10.1080/15350770.2018.1500333
29. Ng KYY, Leung GYC, Tey AJY, Chaung JQ, Lee SM, Soundararajan A, et al. Bridging the intergenerational gap: the outcomes of a student-initiated, longitudinal, inter-professional, inter-generational home visit program. BMC Medical Education. 2020 May 11;20(1); doi:10.1186/s12909-020-02064-x
30. Ngiam NHW, Yee WQ, Teo N, Yow KS, Soundararajan A, Lim JX, et al. Building Digital Literacy in Older Adults of Low Socioeconomic Status in Singapore (Project Wire Up): Nonrandomized Controlled Trial. Journal of Medical Internet Research. 2022 Dec 2;24(12):e40341; doi: 10.2196/40341
31. Lim HA, Lee JSW, Lim MH, Teo LPZ, Sin NSW, Lim RW, et al. Bridging Connectivity Issues in Digital Access and Literacy: Reflections on Empowering Vulnerable Older Adults in Singapore. JMIR Aging. 2022 May 3;5(2):e34764; doi:10.2196/34764
32. Baker DW, Williams MV, Parker RM, Gazmararian JA, Nurss J. Development of a brief test to measure functional health literacy. Patient Education and Counseling. 1999 Sep 1;38(1):33–42; doi:10.1016/s0738-3991(98)00116-5
33. Hibbard JH, Stockard J, Mahoney ER, Tusler M. Development of the Patient Activation Measure (PAM): Conceptualizing and Measuring Activation in Patients and Consumers. Health Services Research [Internet]. 2004 Jun 28;39(4p1):1005–26; doi:10.1111/j.1475-6773.2004.00269.x
34. Norman CD, Skinner HA. eHEALS: The eHealth Literacy Scale. Journal of medical internet research. 2006;8(4):e27; doi:10.2196/jmir.8.4.e27
35. Braun V, Clarke V. Using Thematic Analysis in Psychology. Qualitative Research in Psychology [Internet]. 2006;3(2):77–101; doi: 10.4236/psych.2020.113033
36. Chien SY, Chuang MC, Chen I-Ping. Why People Do Not Attend Health Screenings: Factors That Influence Willingness to Participate in Health Screenings for Chronic Diseases. International Journal of Environmental Research and Public Health. 2020 May 17;17(10); doi:10.3390/ijerph17103495
37. Javed Z, Haisum Maqsood M, Yahya T, Amin Z, Acquah I, Valero-Elizondo J, et al. Race, racism, and cardiovascular health: Applying a social determinants of health framework to racial/ethnic disparities in cardiovascular disease. Circulation:

- Cardiovascular Quality and Outcomes [Internet]. 2022;15(1); doi:10.1161/CIRCOUTCOMES.121.007917
38. Fiscella K, Humiston S, Hendren S, Winters P, Jean-Pierre P, Idris A, et al. Eliminating Disparities in Cancer Screening and Follow-up of Abnormal Results: What Will It Take? *Journal of Health Care for the Poor and Underserved*. 2011 Feb [cited 2023 May 8];22(1):83–100; doi:10.1353/hpu.2011.0023
 39. Beemer R, Mosier E. THE USE OF GOAL ATTAINMENT SCALING IN A COMMUNITY OUTREACH HEALTH COACHING PROGRAM [Internet]. 2019. Available from: <https://digitalcommons.wku.edu/ijesab/vol11/iss7/83/>
 40. Boudreaux ED, Bock B, O’Hea E. When an Event Sparks Behavior Change: An Introduction to the Sentinel Event Method of Dynamic Model Building and Its Application to Emergency Medicine. *Academic Emergency Medicine*. 2012 Mar;19(3):329–35; doi:10.1111/j.1553-2712.2012.01291.x
 41. Ge L, Kaur P, Chun Wei Yap, Bee Hoon Heng. Psychometric Properties of the Patient Activation Measure in Community-Dwelling Adults in Singapore. *Inquiry*. 2022 Jan 1;59(59):004695802211007-004695802211007; doi:10.1177/00469580221100781
 42. Thom DH, Wolf J, Gardner H, DeVore D, Lin M, Ma A, et al. A Qualitative Study of How Health Coaches Support Patients in Making Health-Related Decisions and Behavioral Changes. *The Annals of Family Medicine*. 2016 Nov 1;14(6):509–16; doi:10.1370/afm.1988
 43. Neuner-Jehle S, Schmid M, Grüniger U. The “Health Coaching” programme: a new patient-centred and visually supported approach for health behaviour change in primary care. *BMC Family Practice*. 2013 Jul 17;14(1); doi:10.1186/1471-2296-14-100
 44. Milat A, Newson R, King L, Rissel C, Wolfenden L, Bauman A, et al. A guide to scaling up population health interventions. *Public Health Research & Practice*. 2016 Jan 28;26(1); doi:10.17061/phrp2611604
 45. Crane M, Nathan N, McKay H, Lee K, Wiggers J, Bauman A. Understanding the sustainment of population health programmes from a whole-of-system approach. *Health Research Policy and Systems*. 2022 Apr 7;20(1); doi:10.1186/s12961-022-00843-0

Supplementary Files

Figures

HealthStart theory of change.



Flowchart of program participants.

