

A review on healthy ageing interventions addressing physical, mental and social health of independent community-dwelling older adults

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Abstract

Healthy ageing is a multi-dimensional concept which appertains to all older adults. This study reviewed the intervention characteristics, intervention content and effectiveness of multi-dimensional healthy ageing interventions (MHAI) addressing physical, mental and social health among independent community-dwelling older adults. A search was conducted in PubMed, CINAHL, Embase, Scopus, and PsycINFO for studies published from Jan 2007 to October 2016. 18 publications were included, accounting for 15 studies. The review reflects the complexity, variations and methodological considerations of developing a comprehensive MHAI. It demonstrates the possibility of integrating person-focused to environment-focused content topics in future MHAI, beyond the physical, mental and social health dimensions. Among the reviewed studies, health education programs reported improvements in quality of life and life satisfaction while health assessment and education programs promoted positive health behaviors. Future MHAI studies need to employ more robust research methods and greater contextual information reports to build stronger evidence base.

Keywords: Healthy Ageing, Quality of Life, Health, Home and Community Based Care

Introduction

The global population of older adults aged ≥ 60 years is predicted to increase from 901 million in 2015 to 2.1 billion in 2050.¹ As longevity prevails predominately, the pursuit of good health during these extended years of life becomes rudimentary and pertinent. Older adults perceived health as being independent in daily activities, free from illness or able to manage symptoms, having a positive acceptive attitude towards ageing, and staying connected with their surrounding people, community, and environment.² Such views denote the complexity of good health being multi-facet, encompassing, and closely intertwined with daily independence and adaptation at old age. Thus, healthy ageing is *'a lifelong process of optimising opportunities for improving and preserving health and physical, social, and mental wellness, independence, quality of life, and enhancing successful life-course transitions.'*³ Although healthy aging is a multi-dimensional concept, there are mixed descriptions of what its specific dimensions entails.^{4,5} This study takes on the three widely accepted health dimensions identified by World Health Organisation (WHO) : physical, mental, and social well-being.⁶ Among older adults, examples of physical health components include chronic disease prevention and/or management, fall prevention, physical activity and nutrition. Mental well-being aspects comprise stress management, coping with positive negative affect, self-concept, mood or cognitive function. Social health of older adults can vary from size and quality of social network and support, social interaction, community participation, social functioning and intergenerational activities. As such, components of healthy ageing interventions vary broadly and they influence the quality of life (QoL), health-related outcomes and health behavior of older adults.⁷ Healthy aging is a concept that appertains to all older adults and it would be erroneous to assume that independent well-looking older adults

living in the community are ageing well. Understanding the existing literature on multi-dimensional healthy ageing interventions (MHAIs) for these older adults is essential to assess further research needs and set direction for future comprehensive community-based programs. Thus, the purpose of this review paper was to describe the intervention characteristics, intervention content and effectiveness of MHAIs on QoL, health-related outcomes (e.g., physical functioning, mental well-being and social functioning) and health behavior among community-dwelling independent older adults.

Methods

This review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.⁸ Literature search was conducted across the electronic databases PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, Scopus, and PsycINFO for English-language studies published from January 2007 to October 2016. The keywords “aged”, “healthy ageing”, “health promotion”, “risk prevention”, “social participation”, and “community” and their index terms were exploded and searched in combinations. Duplicated records were removed using Endnote and subsequent articles were screened through their titles and abstracts using the eligibility criteria. Full-texts of the remaining articles were reviewed for further eligibility. Reference lists of included studies were reviewed for eligible studies. Although study protocols were excluded, the authors were emailed to follow-up on the study findings.

Table 1 showed the specific eligibility criteria of the included studies. MHAIs, which promoted independent living in homes and communities, encouraged social participation, or addressed ageing issues were considered. Eligible studies included structured healthy aging

interventions addressing on all three aspects of physical, mental, and social health in community-dwelling older adults. These older adults must be living independently in their homes, capable of performing activities of daily living (ADLs) on their own. Studies that explicitly recruited older adults with specific diseases or conditions (e.g., pre-frail/frail, at risk of depression) were excluded as their interventions would likely target disease- or condition-specific management, instead of promoting overall well-being. Only peer-reviewed experimental studies with control groups were included in this review.

After screening the full-texts of eligible studies, the Cochrane Collaboration tool was used to appraise the quality of experimental studies by assessing their risk of bias as low, high or unclear.⁹ This was performed independently by two registered nurses with post-graduate research training (SB and JY) using the indicators: random sequence generation (selection bias based on method of generating group allocation for participants), allocation concealment (selection bias based on participants knowing their group allocations prior to assignment), binding of participants and personnel (performance bias) and outcome assessors (detection bias), incomplete outcome data (attrition bias), and selective outcome reporting (reporting bias). Any appraisal disagreements were discussed between the two reviewers or resolved with the third reviewer (WW).

Study characteristics on setting, country, design, population, intervention description and content, control group, use of theoretical framework, instruments, outcome measures, and results were extracted from the selected studies and their study protocols (if any). Data from a single study but reported in more than one publication was extracted as one study.

Narrative synthesis¹⁰ was used to systematise the analysis process (Supplement 1). It comprised of four stages: theory development, preliminary synthesis, exploring relationships

within and between studies and lastly, assessing the robustness of synthesis. Theory development was conducted at the early phase of the review process when identifying review questions and eligibility criteria. This stage is related to how the intervention works, why, and for whom. This review focused on MHAI that addressed issues related to promoting one's capacity to manage physical, psychological, and social health at old age. As most interventions were educational programs, the overall underpinning implicit theory is that education related to health promotion can broaden one's knowledge to bring about behavioral change and improve one's well-being. The use of preliminary synthesis helped to describe and organise findings. An initial textual description of all studies was generated from data extraction to identify patterns across studies. Studies were subsequently grouped according to the nature of interventions (health education, health assessment, and goal-setting). Vote counting was used to tabulate statistically significant and non-significant findings to evaluate the effectiveness of interventions. Content analysis was used to identify themes across the content of interventions and quantify data according to frequency of occurrence. The stage on exploring relationships within and between studies involved identifying factors to account for differences in direction and magnitude of effects across studies. Patterns emerged from tabulation of textual description and vote counting allowed for further analysis. Attention was given to heterogeneity of studies, particularly the characteristics of intervention, study population, outcomes, and methodological considerations. To assess the robustness of synthesis, critical reflection was examined under the limitations section of this paper to evaluate the quality of data introspectively.

Results

Study Characteristics

Figure 1 described the selection process for 32,033 potential records identified across the database searches. After removing duplicate and ineligible records, 18 publications, accounting for 15 studies, were included. There were 12 randomised controlled trials (RCTs) and 3 quasi-experimental studies. The studies' details are summarised in Table 2.

Sample Characteristics

These studies involved 9,152 older adults. Sample sizes varied from 30 to 2,580 participants. Approximately half of them (n=8) adopted convenience sampling. Participants were primarily recruited either from community activity centres or through healthcare professionals. Most studies (n=13) reported more female participants compared to males, contributing to an overall female population of 5,363 (59.6%). Seven studies targeted older adults who were ≥ 65 years old, while six studies included younger older adults (50 to 64 years old).

Risk Of Bias

Most studies had moderate to high risk of bias. Eight out of 15 studies performed random sequence generation. Allocation concealment was ensured in four studies. One study performed the blinding of participants and personnel while seven studies conducted the blinding of outcomes. Nine studies addressed adequate management of incomplete data and three studies had minimal risk for selective reporting. Supplement 2 shows the risk of bias summary table.

Intervention Characteristics

The studies were categorised accordingly to the nature of interventions: health education, health assessment and education, and goal-setting programs. Seven studies focused on health education. These interventions provided older adults with health-related information and exposure

to positive health behaviors to improve on their knowledge and capacity to use them. Six studies included both health assessment and education in their interventions. They provided individual assessment of older adults' health conditions, lifestyles, or behavioral-related risk factors and subsequently provided feedback to enhance their health. Two studies included goal-setting in their interventions. While Clare *et al.*¹¹ solely involved setting health goals with participants, Mountain and colleagues¹² combined both goal-setting and health education in their intervention.

Only six studies reported using theoretical frameworks to underpin their interventions. These frameworks included social cognitive theories on behavioral change, self-regulation, and behavioral learning,¹¹ Rowe and Kahn's ageing model,¹³ model of occupational adaption,¹⁴ wheel of wellness model,¹⁵ model of self-care for health promotion in ageing,¹⁶ and the Salutogenesis theory.¹⁷

Various modes of intervention delivery were observed across the studies: 4 group-based interventions, 8 individual interventions, and 5 mixed-modality interventions (consisted of both individual and group-based programs.) Among the interventions that incorporated group-based programs, only 5 studies reported group size number, with 4 to 18 participants per group.^{14, 17-20, 21} Little can be concluded on the recommended group size for group-based interventions. Individuals who delivered the interventions were diverse; they included general practitioners, nurses, occupational therapists, university lecturers, a team of multi-disciplinary healthcare professionals, and even senior citizen volunteers.

Intervention Content

Although the focus of interventions included in this review was on addressing physical, mental and social well-being of older adults, the content covered were wide-ranging beyond the three health dimensions. Thus intervention contents were categorised into themes from a person-focused to environment-focused perspective: (1) ageing, attitudes and beliefs, (2) managing individual's health, (3) physical environment, (4) socio-cultural interaction and commitment, and (5) socio-structural health. Figure 3 portrays the various specific content topics under each theme, as well as the frequency counts of each content topic. For example, the content topic on psychological resources was mentioned in four studies, while the topic on physical activity was mentioned in 11 studies.

All 15 studies included content topics under the theme “managing individual’s health”. It included popular topics such as encouraging physical activity, assessing and promoting cognitive health and healthy eating. The next common theme was “socio-cultural interaction and commitment” (n=13), followed by “ageing, attitudes, and beliefs” (n=8), “physical environment” (n=6), and “socio-structural health” (n=5). Only three studies encompassed content topics from all five themes.^{14, 17, 18}

Effectiveness Of Interventions

In the reviewed studies, effectiveness of interventions used was measured by various outcomes broadly. While some studies used generic QoL instruments, e.g., Medical Outcome Study short-form health survey,^{11,12,14,22} WHO-QoL-BREF¹⁷ EQ-5D-3L,¹² Life Satisfaction Index-Z,^{14,19} Satisfaction in Daily Life,¹⁵ others used geriatric-centric QoL instruments e.g., CASP-19,¹¹ and Life Satisfaction for the Third Age-Short Form.¹³ Self-rated health was commonly measured as a single-item, either as a standalone item or thereof a health-related instrument. Varying

instruments were used to assess participants' physical, cognitive, psychological, and social functioning. Several studies combined individual items from various instruments to evaluate health behavior and only few studies used behavioral-specific validated instruments.^{11, 14, 16} All, except two studies,^{12, 23} lacked repeated measures.

Using these outcome measures, effectiveness of intervention studies were analysed and presented according to the respective nature of interventions: health education programs (n=7), health assessment and education programs (n=6) and goal-setting programs (n=2). Summary of the findings are illustrated in Table 3.

Health Education Programs

Among the seven health education programs, four concomitantly reported positive effects on QoL, life satisfaction, and satisfaction towards health in independent older adults.^{13, 15, 17, 24} While Gustafsson *et al*¹⁸ reported short-term improved self-rated health in older adults, the three other studies observed no change in self-rated health. These studies attributed to the study population being community-dwelling individuals with reasonably good baseline health.^{15, 17, 25} Alternatively, variables used for self-rated health items were ordinal and might not be sensitive in detecting changes within the health range category if there were true deviations from baseline self-rated health.

A three-armed RCT tested a multi-disciplinary approach and compared the effectiveness of individual preventive home visit (PHV) versus mixed-modality intervention (senior group meetings and one home visit) with a control group.^{18, 23, 24, 26} Older adults from both intervention groups demonstrated long-term behaviors of physical activity engagement.²⁶ However, older

adults in the mixed-modality intervention fared better in delaying ADL deterioration both short term and long term compared to those who received PHV.^{18,23} This illuminated the potential of using mixed-modality approaches for future studies to encourage health behavioral modifications and decrease rate of functional decline.

Two group-based interventions that distinctively allocated 30 to 45 minutes of physical activity in their weekly education program yielded contrasting psychological outcomes. With the focus of intervention directed at preventing cognitive decline, Kamegaya *et al.*¹⁵ found significant improvement in cognitive function but not in functional capacity, depressive symptoms, and social functioning. Contrastingly, with an all-encompassing aim of promoting physical activity, mental stimulation, social engagement, and learning of new skills, Escolar and de Guzman¹³ reported notable improvement in depressive symptoms for participants receiving the program. Outcomes on physical and social functioning were not evaluated in this study. Note that the latter study did not provide information on participant recruitment process nor account for confounding variables that may influence the results. Also, both studies had small sample sizes and it was unclear how randomisation was performed. Despite these methodological pitfalls, both studies reported improvements in QoL post-intervention.

Two studies focused on promoting self-care in independent community-dwelling older adults. While Tan *et al.*¹⁷ evaluated a 12-week self-care structured group program related to motivation, psychosocial well-being, physical health and activity, Sundsli *et al.*¹⁶ assessed the effectiveness of five 30-minute self-care telephone talk sessions on various health topics. Perhaps owing to the underpinning theory on salutogenesis, which focused on psychological resource and sense of coherence, Tan *et al.*¹⁷ reported improvement only in the QoL psychological domain. No

significant difference was observed in self-care behavior, as well as the QoL physical, social, and environmental domains. Similarly, participants receiving self-care talk sessions demonstrated better mental well-being but no significant change in self-care behavior.¹⁶ Further analysis was limited by the provision of intervention and implementation details.

A university program, consisting of broad-ranging subjects, was conducted for older adults to promote knowledge, personal development, and social participation.²⁵ This quasi-experimental study showed that older adults improved their positive affect and maintained their cognitive function, physical health, and information-seeking behavior after the program, while participants in the control group had a decline in these aspects. Though findings were promising, more robust study designs e.g., RCT are needed. Moreover, such university program would probably appeal to older adults who are literate, higher educated, and able to commit to the three-year program.

Health Assessment And Education Programs

Six health assessment and education programs demonstrated positive impacts on health behavior e.g., increasing physical activity and meaningful activity participation, consuming more vegetables/fibre, decreasing fat and alcohol intake, taking up vaccinations, screening for health conditions, and better stress management.^{14, 21, 22, 27, 28}

Although three studies, conducted in the United Kingdom, Germany, and Switzerland, provided older adults with individualised computer-generated feedback in response to their self-reported health assessment, the method in which how these feedbacks were reinforced varied. This might have led to different health behavioral outcomes. Minimal improvement was observed for Harari *et al.*²⁷ study, where the reinforcement of health feedback was dependent on the efforts of

general practitioners. However, a significant adoption of health-promoting behavior and preventive care was reported in Dapp *et al.*²¹ study where participants were offered reinforcement either through a half-day group session on selected healthy ageing topics or two home visits delivered by a nurse. Stuck *et al.*²⁸ even reported a long-term uptake of positive health behavior and preventive care at a two-year follow-up. The latter intervention involved trained nurses to conduct ≥ 2 home visits, and collectively managed cases with geriatricians and primary care providers.

Sherman *et al.*²⁹ evaluated the effectiveness of PHVs on 75-year-old adults where trained nurses in Sweden used standardised health assessment tool to identify health needs and plan nursing interventions. Contrastingly, this study reported a decrease in physical activity in older adults who received home visits and an increase in alcohol intake for both treatment and control groups. Information on nursing interventions related to participants' assessments of health behavior was unclear in the paper.

Two studies adapted the Well Elderly Lifestyle Redesign® program, which was initiated in United States. While Clark *et al.*¹⁹ expanded the scope of sample population to ethnically diverse older adults in the United States, Johansson and Björklund¹⁴ adapted the program into the Swedish context. Participants in the treatment group underwent weekly group sessions and individual assessment in homes or community settings to manage their well-being, ADLs, and occupational lives. Although the program duration in these two studies differed by two months, both studies reported improvements in the domains vitality and mental health of 36-item Short-Form Survey. Additionally, in Clark *et al.* study¹⁹, participants in the treatment group demonstrated improvements in social function and bodily pain, psychological well-being, and life satisfaction.

Johansson and Björklund¹⁴ found a significant uptake of meaningful activity participation in their treatment group. However, the latter study was methodologically weaker as it had non-equivalent control group and small sample size. Nonetheless, its qualitative evaluation findings revealed similar positive effects. Participation in the program gave older adults a sense of belonging to the community and they found the adaptive strategies learnt during the intervention useful for their daily lives. This demonstrated the beneficial outcomes gained from the Well Elderly Lifestyle Redesign® program.

A 4-weekly individualised counselling program was offered to South Korean seniors to identify and work on wellness issues using the Wellness Evaluation of lifestyle profile.²² With its extensive coverage on aspects e.g., work and leisure, sense of worth, intellectual stimulation, and friendship, participants in the treatment group reported higher perceived wellness, lesser depressive symptoms, and better performance in subscales on nutrition, exercise, self-care, and stress management. However, no statistical significance was observed on the 8-item Short-Form Survey. The author attributed it to the instrument's lack of sensitivity.

Goal-setting Programs

In a pilot three-armed RCT, the authors investigated the effectiveness of a goal-setting intervention, goal-setting with follow-up telephone call intervention, compared to the control group.¹¹ While small positive effect sizes in physical and cognitive activities were reported for participants in both intervention groups, no statistically significant differences on QoL, cognitive functioning, psychological well-being, and health-promoting activities were observed. As participants were given the flexibility to set up to five personal goals related to physical, dietary, cognitive, or social aspects of health behavior, the reported mean \pm SD goals set by participants

from both intervention groups was 2.85 ± 1.2 only. The lack of mandated focus in setting of goals for specific health dimensions might contributed to the insignificant findings. Additionally, the small sample size might not be able to elicit statistical significance. As such, the additional evaluation of using behavioral reinforcement through bi-monthly telephone calls to monitor goal attainment was inconclusive.

Goal-setting And Health Education Program

Only one study adopted both goal-setting and health education approaches in the intervention. Mountain *et al.*¹² evaluated a mixed-modality occupation-based lifestyle intervention to overcome challenges in active engagement and achieve personal goals. However, no benefits were observed in QoL and psychological well-being in the intervention group. The authors attributed it to the ceiling effect of participants being well at baseline. The authors emphasised the importance of identifying individuals with potential health needs for future studies.

In summary, the health education programs in this review reported improvements in QoL and life satisfaction while health assessment and education programs demonstrated positive outcomes in health-promotive behaviors. Evidence on effectiveness of goal-setting programs on QoL, health-related outcomes and positive health-behaviors are limited. Owing to the heterogeneity of interventions and varied use of outcome measures, results on the evaluation of MHAIs on physical functioning, mental well-being, and social functioning were mixed and meaningful interpretations cannot be made.

Discussion And Implications

The focus of this review was to summarise the intervention characteristics, intervention contents, and effectiveness of existing MHAIs for independent community-dwelling older adults, so as to provide methodological insights and directions in developing future community-based multi-dimensional interventions to help older adults to age healthily.

Sample And Intervention characteristics

Across the examined studies included in this review, the overall percentage of gender distribution of participants is proportionally acceptable. However, the tendency for more women to participate was exemplified in studies adopting convenience sampling with smaller sample sizes. Rather than adopting the view of women being more likely to engage and care for their health,³⁰ different strategies could be employed to engage both genders. While male-oriented strategies can focus on problem-solving and information gathering on specific topics, female-orientated approaches can involve social connections and the discussion of feelings.³¹

Studies in this review primarily targeted individuals in their late middle age or younger older adults, engaging them early in health-promoting and risk-preventing behaviors. Only one study targeted older adults aged ≥ 80 years old. It evaluated the effectiveness of intervention by examining participant's deterioration of self-rated health, deterioration of ADL independence, and maintenance/increase in physical activity. This revealed methodological differences in outcome measures for older adults of different age groups. On the other hand, it raised questions on the best time to introduce such interventions to older adults, and the purpose of such interventions on whether they seek to slow down the process of ageing and decline or to enhance health of older adults.

Several methodological considerations related to outcome measures emerged from the review. While generic QoL measures were used in most examined studies, few studies adopted geriatric-centric instruments. Depending on the intent, generic QoL measures give flexibility to compare QoL between participants of various age groups and measure QoL broadly. As QoL is contextual according to individuals' socio-cultural circumstances and values, geriatric-centric QoL measures built upon from older adults' perspectives might be more apt and responsive in studies related to healthy ageing. Some examined studies used individual items to measure health behavior or lacked the use of validated instruments, making comparisons between behavioral-related interventions challenging. Additionally, most studies evaluated their programs only once post-intervention and lacked repeated measures. This is crucial for behavioral-related intervention studies as it takes time for behavioral change and that retention of behavioral change is of interest.³²

The use of theory aids in understanding the phenomenon of interest, identifies determinants crucial for interventions to work, and determines relevant outcomes for evaluation.³³ However, only several interventions were theory-based. Among which, only Tan *et al.*¹⁷ provided an explicit description on the application of theoretical concepts in their study protocol. Future studies need greater clarity in reporting theoretical analysis underlying the development of intervention and their choice of theoretical model.

Intervention Content

This review illustrated that the content components of MHAI are beyond the boundaries of physical, mental, and social health dimensions, covering an extensive scope from personal attitudes and beliefs, management of own health, interaction with physical and social environment and socio-structural influences. They reflected the layers of context through microsystem

(individuals' attitudes and beliefs, and management of own health), mesosystem (social interaction and participation within community), exosystem (socio-cultural factors), macrosystem (national policies, social resources and services), and chronosystem (adaptation to life transitions) described in the Bioecological Systems theory.³⁴ This theory explained how the layers of context interact with each other, shape individual's biopsychosocial functioning over time, and how individuals mould and interpret environmental contexts.³⁵ Themes of intervention content identified from the studies embraced an ecological approach to healthy ageing, from a person-focused to environment-focused content topics. They recognised influential interactions within an older adult, as well as between the older adult and the environmental context that moulds one's functioning and way of life.³⁶

The theme on ageing, attitudes and beliefs was addressed in more than half of the studies. Attitudes towards self-ageing, in aspects of physiological change, psychosocial loss, and psychological enhancement, can partially mediate health satisfaction and QoL in older adults.³⁷ A study reported that attitudes towards ageing influenced both older adults' and their spouses' psychological well-being.³⁸ Older adults need to be aware of their perspectives towards ageing, be encouraged to think positively, and perceive flexible ways of coping strategies³⁹ to adapt to old age. In relation to attitudinal traits in coping with the aging process, promoting psychological resources in older adults is another area of interest recently popularised in ageing studies. Even at very advanced age, psychological assets e.g., self-efficacy and optimism were found to be predictors of well-being in centenarians,⁴⁰ suggesting its share of importance for older adults to cope with functional limitations. Other pertinent psychological resources in ageing studies include but are not limited to resilience, sense of coherence, and locus of control.^{41, 42, 43} This draws on references related to the Salutogenic Umbrella, which houses various psychological resource

concepts, contributing to the conceptualisation of how health is maintained, promoted, or impeded.⁴⁴ Healthcare professionals need to be mindful of older adults' attitudes and beliefs towards ageing, motivate and encourage positive thinking to manage their health. Future research can also focus on effective strategies to enhance older adults' psychological resources that underpin motivation and behaviors of health-promoting actions.

Almost all studies addressed issues related to health management of individual and social interaction at the community level. This is anticipated, given that the eligible studies had to fulfil all three, physical, mental, and social health topics. However, not many of the included studies incorporated environmental-related topics into their healthy aging programs. Environmental conditions e.g., community life, social capital, perception of local safety and security, accessibility to public green space, services, and facilities have influences on older adults' health and activity participation.⁴⁵ Having independence, autonomy, and being able to stay connected with surrounding people and community matter to older people.⁴⁶ As they age, they spend more time at home managing their needs to support their valued roles and activities. Addressing environmental-related concerns through health programs may assist older adults to adapt to growing old and facilitate ageing-in-place. As these factors are contextual and may vary across communities, efforts are required to understand the needs of older adults within each specific community and tailor interventions accordingly.

Among all the included studies, only three of them covered from person-focused to environment-focused topics, embracing all five themes. Such intervention studies are supported by Greenfield³⁵, who advocated for an ecological approach in ageing-in-place initiatives to enhance facilitators and mitigate barriers enmeshed through the interplay of individual and

environmental factors. Researchers and healthcare professionals need to move beyond personal health promotion, recognise and consider the physical environmental, community, and social structural influences to make healthy ageing more attainable. Health assessment of independent community-dwelling older adults can consider the safety of interior and exterior home environment, social capital, ease of mobility, accessibility to health and social services as well as structural facilities available in the neighbourhood. Close collaborations between primary care providers, researchers, and community partners are thus needed to integrate existing health information, social, and community resources and services before reaching out to older adults. Future studies can explore the development of ecological health assessment tools for community-dwelling older adults to identify health needs in individuals and within communities to promote healthy ageing.

Effectiveness Of Interventions

The findings of this review were consistent with a previous review, which reported positive effects on adherence to preventive behaviors, adoption of healthy lifestyle actions, improvement in ADLs, self-perceived physical health, and QoL.⁴⁷ In addition, this review found that health education interventions demonstrated improvements on QoL, life satisfaction, and satisfaction towards health while interventions combining both health assessment and education showed positive effects on health behavior in independent community-dwelling older adults. The reviewed health education interventions focused more on QoL outcomes while health assessment and education interventions had tendency to evaluate behavioral-related outcomes. Thus, outcome comparisons between these two types of interventions could not be determined. An additional health assessment component may provide healthcare professionals the advantage to identify and

tailor care according to individuals' specific needs. Future studies can evaluate the impact on both QoL and health behaviors in older adults in both of such interventions, and even make comparisons between these intervention strategies.

Similarly, with the variability of study characteristics and intervention content, comparisons on the effectiveness of individual, group, and mixed-modality interventions were challenging. Nonetheless, Gustafsson *et al.*²³ found that the combination of senior group meetings and PHV yielded long-term positive effects on physical functioning and health behavior when compared to PHV only. While PHVs provided personalised attention according to each older adult's needs, the additional group-based education created a supportive environment for older adults to act and engage in health-promoting behaviors. They learnt from peers, benefited from role models and through the sharing of problems.⁴⁸ Researchers can consider mixed-modality approaches for future health programs to promote positive health behaviors and older adults' well-being. As this approach is more resource intensive compared to individual interventions, future studies can evaluate both the effectiveness and cost-effectiveness of mixed-modality health programs.

The goal-setting MHAIs included in this review were limited and thus the effectiveness of such interventions in independent community-dwelling older adults were inconclusive. However, it was found that home care older adults who received goal-setting intervention reported higher QoL and performed more individualised activities compared to those who received standardised homecare assessment.⁴⁹ In a preventive care program, life goal-setting strategy further enhanced QoL improvement and delayed frailty decline in frail older adults.⁵⁰ Such approach acts on individual's motivation and cognitive mechanisms, where setting specific goals to obtain an

outcome, together with performance feedback, can result in better behavioral performance.⁵¹ With the paucity of existing studies, future research can determine the effects of goal-setting therapy on QoL, functional well-being, and health behaviors in independent community-dwelling older adults.

Limitations/ Robustness Of Synthesis

The screening of studies using the eligibility criteria was performed by a reviewer, which may be a potential source of bias. The second and third reviewers were consulted when there were concerns related to the eligibility of studies. The search approach of this review was limited to studies published in English language in the past decade. This might have missed relevant older studies, unpublished works, and studies published in other languages, which may provide further insights to the development of intervention content and design for future MHAI. While attempts were made to contact the authors of potential studies to clarify on the eligibility criteria, responses were lukewarm. Many of these studies were excluded because of unclear population, intervention, comparator or outcome measures. Meta-analysis could not be performed due to the broad-based nature of the interventions, their heterogeneity, and use of disparate outcome measures.

Biases and methodological gaps were noted in many of the included studies. Common weaknesses include the use of non-probability samples, small sample sizes, lack of blinding to participants and personnel, non-participant bias, and selective reporting. As a few studies observed the ceiling effect in measuring health-related QoL and self-rated health for independent community-dwelling older adults, researchers need to take caution in selecting outcome measures to measure true effects and to avoid type II error. Alternative considerations can include geriatric-centric QoL scales and continuous variables to measure self-rated health.

The findings of this review lacked generalisability due to the differences in study settings, interventions, and outcomes. This was further hindered by the low-level reporting of contextual information, e.g., characteristics of targeted community, preparation involved by personnel delivering intervention, and description of usual care in control groups.

Conclusion

This review reflects the complexity, variations and methodological considerations of designing a comprehensive multi-dimensional healthy aging intervention, particularly paying attention to the intervention characteristics, content and effectiveness of the programs. Based on the reviewed studies, the contents of MHAIs addressing the physical, mental and social health of older community dwellers were interwoven with individuals' beliefs and attitudes, management of bodily changes, and interactions between physical and social environments within an ecosystem. The review demonstrated the possibility of integrating the above various content in developing future comprehensive healthy aging programs. Healthcare professionals and researchers need to appreciate and embrace a person- to environment-focused care approach in managing older adults' physical, mental and social health, promoting their independence and QoL to help them age well. It also calls for greater integration of health, social and environmental resources through close collaborations between and among healthcare providers, researchers, community partners, and policy-makers. In this review, health education programs were found to improve on older adult's QoL and life satisfaction while health assessment and education programs promote positive health behaviors. Future studies need to employ more robust research methods, include the evaluation of geriatric specific-QoL outcomes and health behaviors, and have greater contextual information

reports to provide stronger evidence base in developing and evaluating the effectiveness of comprehensive multi-dimensional healthy aging programs.

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References

1. United Nations. World Population Ageing 2015. http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Report.pdf; 2015. Accessed 4 January 2017.
2. Song M, Kong EH. Older adults' definitions of health: A metasynthesis. *Int J Nurs Stud*. 2015;52(6):1097-1106. <https://doi.org/10.1016/j.ijnurstu.2015.02.001>
3. Health Canada. Workshop on Healthy ageing. Part I: Ageing and Health Practices. <http://publications.gc.ca/collections/Collection/H39-612-2002-1E.pdf>; 2002. Accessed 4 January 2017.
4. Wilhelmson K, Duner A, Eklund K, Gosman-Hedström G, Blomberg S, Hasson H, Gustafsson H, Landahl S, Dahlin-Ivanoff S. Design of a randomized controlled study of a multi-professional and multidimensional intervention targeting frail elderly people. *BMC Geriatrics*. 2011;11:24. <https://doi.org/10.1186/1471-2318-11-24>
5. Ng TP, Broekman BFP, Niti M, Gwee X, Kua EH. Determinants of Successful Ageing Using a Multidimensional Definition Among Chinese Elderly in Singapore. *The American Journal of Geriatric Psychiatry*. 2009;17(5):407-416. <https://doi.org/10.1097/JGP.0b013e31819a808e>
6. World Health Organisation. Constitution of the World Health Organisation. http://www.who.int/governance/eb/who_constitution_en.pdf; 2006 Accessed 4 January 2017
7. Michel JP, Dreux C, Vacheron A. Healthy ageing: Evidence that improvement is possible at every age. *European Geriatric Medicine*. 2016;7(4):298-305. <https://doi.org/10.1016/j.eurger.2016.04.014>

8. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med.* 2009;6(7):e1000097. <https://doi.org/10.1371/journal.pmed.1000097>
9. Higgins JPT, Green S. *Cochrane Handbook for Systematic Reviews of Interventions. Version 5.1.0.* The Cochrane Collaboration; 2011.
10. Popay J, Roberts H, Sowden A, Petticrew M, Arai L, Rodgers M, Britten N, Roen K, Duffy S. Guidance on the Conduct of Narrative Synthesis in Systematic Reviews: A Product from the ESRC Methods Programme. http://www.lancaster.ac.uk/shm/research/nssr/research/dissemination/publications/NS_Synthesis_Guidance_v1.pdf; 2006. Accessed 4 January 2017.
11. Clare L, Nelis SM, Jones IR, Hindle JV, Thom JM, Nixon JA, Cooney J, Jones CL, Tudor Edwards R, Whitaker CJ. The Agewell trial: a pilot randomised controlled trial of a behavior change intervention to promote healthy ageing and reduce risk of dementia in later life. *BMC Psychiatry.* 2015;15:25. <https://doi.org/10.1186/s12888-015-0402-4>
12. Mountain G, Windle G, Hind D, Walters S, Keertharuth A, Chatters R, Sprange K, Craig C, Cook S, Lee E, Chater T, Woods R, Newbould L, Powell L, Shortland K, Roberts J. A preventative lifestyle intervention for older adults (lifestyle matters): a randomised controlled trial. *Age Ageing.* 2017;46(4):627-634. <https://doi.org/10.1093/ageing/afx021>
13. Escolar Chua RL, de Guzman AB. Effects of Third Age Learning Programs on the Life Satisfaction, Self-Esteem, and Depression Level among a Select Group of Community Dwelling Filipino Elderly. *Educational Gerontology.* 2014;40(2):77-90. <https://doi.org/10.1080/03601277.2012.701157>

14. Johansson A, Björklund A. The impact of occupational therapy and lifestyle interventions on older persons' health, well-being, and occupational adaptation. *Scandinavian Journal of Occupational Therapy*. 2016;23(3):207-219. <https://doi.org/10.3109/11038128.2015.1093544>
15. Kamegaya T, Araki Y, Kigure H, Yamaguchi H. Twelve-week physical and leisure activity programme improved cognitive function in community-dwelling elderly subjects: A randomized controlled trial. *Psychogeriatrics*. 2014;14(1):47-54.
16. Sundsli K, Soderhamn U, Espnes GA, Soderhamn O. Self-care telephone talks as a health-promotion intervention in urban home-living persons 75+ years of age: a randomized controlled study. *Clin Interv Ageing*. 2014;9:95-103. <https://doi.org/10.2147/CIA.S55925>
17. Tan KK, Chan SW, Wang W, Vehvilainen-Julkunen K. A salutogenic program to enhance sense of coherence and quality of life for older people in the community: A feasibility randomized controlled trial and process evaluation. *Patient Education & Counselling*. 2016;99(1):108-116. <https://doi.org/10.1016/j.pec.2015.08.003>
18. Gustafsson S, Wilhelmson K, Eklund K, Gosman-Hedström G, Zidén L, Kronlöf GH, Højgaard B, Slinde F, Rothenberg E, Landahl S, Dahlin-Ivanoff S. Health-promoting interventions for persons aged 80 and older are successful in the short term-results from the randomized and three-armed elderly persons in the risk zone study. *Journal of the American Geriatrics Society*. 2012;60(3):447-454.
19. Clark F, Jackson J, Carlson M, Chou CP, Cherry BJ, Jordan-Marsh M, Knight BG, Mandel D, Blanchard J, Granger DA, Wilcox RR, Lai MY, White B, Hay J, Lam C, Marterella A, Azen SP. Effectiveness of a lifestyle intervention in promoting the well-being of independently living older people: results of the Well Elderly 2 Randomised Controlled

- Trial. *J Epidemiol Community Health*. 2012;66(9):782-790.
<http://dx.doi.org/10.1136/jech.2009.099754>
20. Dapp U, Anders JA, von Renteln-Kruse W, Minder CE, Meier-Baumgartner HP, Swift CG, Gillmann G, Egger M, Beck JC, Stuck AE. A randomized trial of effects of health risk appraisal combined with group sessions or home visits on preventive behaviors in older adults. *The Journals of Gerontology: Series A: Biological Sciences and Medical Sciences*. 2011;66(5):591-598.
21. Dapp U, Anders JA, von Renteln-Kruse W, Minder CE, Meier-Baumgartner HP, Swift CG, Gillmann G, Egger M, Beck JC, Stuck AE. A randomized trial of effects of health risk appraisal combined with group sessions or home visits on preventive behaviors in older adults. *The Journals of Gerontology: Series A: Biological Sciences and Medical Sciences*. 2011;66(5):591-598.
22. Kwon SH. Wheel of Wellness Counseling in Community Dwelling, Korean Elders: A Randomized, Controlled Trial. *J Korean Acad Nurs*. 2015;45(3):459-468.
<https://doi.org/10.4040/jkan.2015.45.3.459>
23. Gustafsson S, Eklund K, Wilhelmson K, Edberg AK, Johansson B, Kronlof GH, Gosman-Hedstrom G, Dahlin-Ivanoff S. Long-term outcome for ADL following the health-promoting RCT-elderly persons in the risk zone. *The Gerontologist*. 2013;53(4):354-663.
24. Behm L, Wilhelmson K, Falk K, Eklund K, Ziden L, Dahlin-Ivanoff S. Positive health outcomes following health-promoting and disease-preventive interventions for independent very old persons: long-term results of the three-armed RCT Elderly Persons in the Risk Zone. *Arch Gerontol Geriatr*. 2014;58(3):376-383.
<https://doi.org/10.1016/j.archger.2013.12.010>

25. Fernandez-Ballesteros R, Molina MA, Schettini R, del Rey AL. Promoting active ageing through university programs for older adults: An evaluation study. *GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry*. 2012;25(3):145-154.
26. Ziden L, Haggblom-Kronlof G, Gustafsson S, Lundin-Olsson L, Dahlin-Ivanoff S. Physical function and fear of falling 2 years after the health-promoting randomized controlled trial: elderly persons in the risk zone. *Gerontologist*. 2014;54(3):387-397. <https://doi.org/10.1093/geront/gnt078>
27. Harari D, Iliffe S, Kharicha K, Egger M, Gillmann G, von Renteln-Kruse W, Beck J, Swift C, Stuck A. Promotion of health in older people: a randomised controlled trial of health risk appraisal in British general practice. *Age Ageing*. 2008;37(5):565-571. <https://doi.org/10.1093/ageing/afn150>
28. Stuck AE, Moser A, Morf U, Wirz U, Wyser J, Gillmann G, Born S, Zwahlen M, Iliffe S, Harari D, Swift C, Beck JC, Egger M. Effect of health risk assessment and counselling on health behavior and survival in older people: a pragmatic randomised trial. *PLoS Med*. 2015;12(10):e1001889. <https://doi.org/10.1371/journal.pmed.1001889>
29. Sherman H, Soderhielm-Blid S, Forsberg C, Karp A, Tornkvist L. Effects of preventive home visits by district nurses on self-reported health of 75-year-olds. *Prim Health Care Res Dev*. 2016;17(1):56-71. <https://doi.org/10.1017/S1463423614000565>
30. Calasanti T. Gender Relations and Applied Research on Ageing. *The Gerontologist*. 2010;50(6):720-734. <https://doi.org/10.1093/geront/gnq085>
31. Kaye L, Crittenden JA, Charland J. Invisible older men What we know about older men's use of healthcare and social services. *Generations*. 2008;32(1):9-14.

32. Jackson N, Waters E. Criteria for the systematic review of health promotion and public health interventions. *Health Promotion International*. 2005;20(4):367-374.
<https://doi.org/10.1093/heapro/dai022>
33. Green J. The role of theory in evidence-based health promotion practice. *Health Education Research*. 2000;15(2):125-129.
34. Bronfenbrenner U, Moen P. The bioecological model of human development. In W. Damon & R. M. Lerner, eds. *Handbook of child psychology, Vol 1: Theoretical models of human development*. New York: John Wiley; 2006:793-828.
35. Greenfield EA. Using Ecological Frameworks to Advance a Field of Research, Practice, and Policy on Ageing-in-Place Initiatives. *The Gerontologist*. 2012;52(1):1-12.
<https://doi.org/10.1093/geront/gnr108>
36. Satariano WA. *Epidemiology of Ageing: An ecological approach*. Sudbury, Massachusetts: Jones and Bartlett Publishers; 2006.
37. Low G, Molzahn AE, Schopflocher D. Attitudes to ageing mediate the relationship between older peoples' subjective health and quality of life in 20 countries. *Health and Quality of Life Outcomes*. 2013;11:146.
38. Momtaz YA, Hamid TA, Masud J, Haron SA, Ibrahim R. Dyadic effects of attitude toward ageing on psychological well-being of older Malaysian couples: an actor-partner interdependence model. *Clinical Interventions in Ageing*. 2013;8:1413.
39. Chang CW, Toh Y, Fan QQ, Chen ASH. Mind over Body: Positive attitude and flexible control beliefs on positive ageing. *BIOPHILIA*. 2015;3:254-261.
<https://doi.org/10.14813/ibra.2015.254>

40. Jopp D, Rott C. Adaptation in very old age: Exploring the role of resources, beliefs, and attitudes for centenarians' happiness. *Psychology and ageing*. 2006;21(2):266-280. <http://dx.doi.org/10.1037/0882-7974.21.2.266>
41. Bjorklof GH, Engedal K, Selbaek G, Maia DB, Coutinho ES, Helvik AS. Locus of control and coping strategies in older persons with and without depression. *Ageing Ment Health*. 2016;20(8):831-839. <https://doi.org/10.1080/13607863.2015.1040722>
42. Lavretsky H. *Resilience and Ageing: Research and Practice*. Baltimore: The John Hopkins University Press; 2014.
43. Silverstein M, Heap J. Sense of coherence changes with ageing over the second half of life. *Advances in Life Course Research*. 2015;23:98-107. <https://doi.org/10.1016/j.alcr.2014.12.002>
44. Lindstrom B, Eriksson M. *The Hitchhiker's guide to Salutogenesis: salutogenic pathways to health promotion*. Helsinki: Folhalsan Research Centre; 2010.
45. Annear M, Keeling S, Wilkinson TIM, Cushman G, Gidlow BOB, Hopkins H. Environmental influences on healthy and active ageing: a systematic review. *Ageing and Society*. 2012;34(4):590-622. <https://doi.org/10.1017/S0144686X1200116X>
46. Wiles JL, Leibing A, Guberman N, Reeve J, Allen RE. The meaning of "ageing in place" to older people. *Gerontologist*. 2012;52(3):357-366. <https://doi.org/10.1093/geront/gnr098>
47. Lima KC, Caldas CP, Veras RP, Correa RF, Bonfada D, de Souza DL, Jerez-Roig J. Health Promotion and Education: A Study of the Effectiveness of Programs Focusing on the Ageing Process. *Int J Health Serv*. 2017;47(3):550-570. <https://doi.org/10.1177/0020731416660965>

48. Behm L, Ziden L, Duner A, Falk K, Dahlin-Ivanoff S. Multi-professional and multi-dimensional group education--a key to action in elderly persons. *Disability and Rehabilitation*. 2013;35(5):427-435. <https://doi.org/10.3109/09638288.2012.697249>
49. Parsons J, Rouse P, Robinson EM, Sheridan N, Connolly MJ. Goal setting as a feature of homecare services for older people: does it make a difference? *Age Ageing*. 2012;41(1):24-29. <https://doi.org/10.1093/ageing/afr118>
50. Yuri Y, Takabatake S, Nishikawa T, Oka M, Fujiwara T. The effects of a life goal-setting technique in a preventive care program for frail community-dwelling older people: a cluster nonrandomized controlled trial. *BMC Geriatrics*. 2016;16:101. <https://doi.org/10.1186/s12877-016-0277-3>
51. Strecher VJ, Seijts GH, Kok GJ, Latham GP, Glasgow R, DeVellis B, Meertens RM, Bulger D. Goal setting as a strategy for health behavior change. *Health Education Quarterly*. 1995;22(2):190-200.

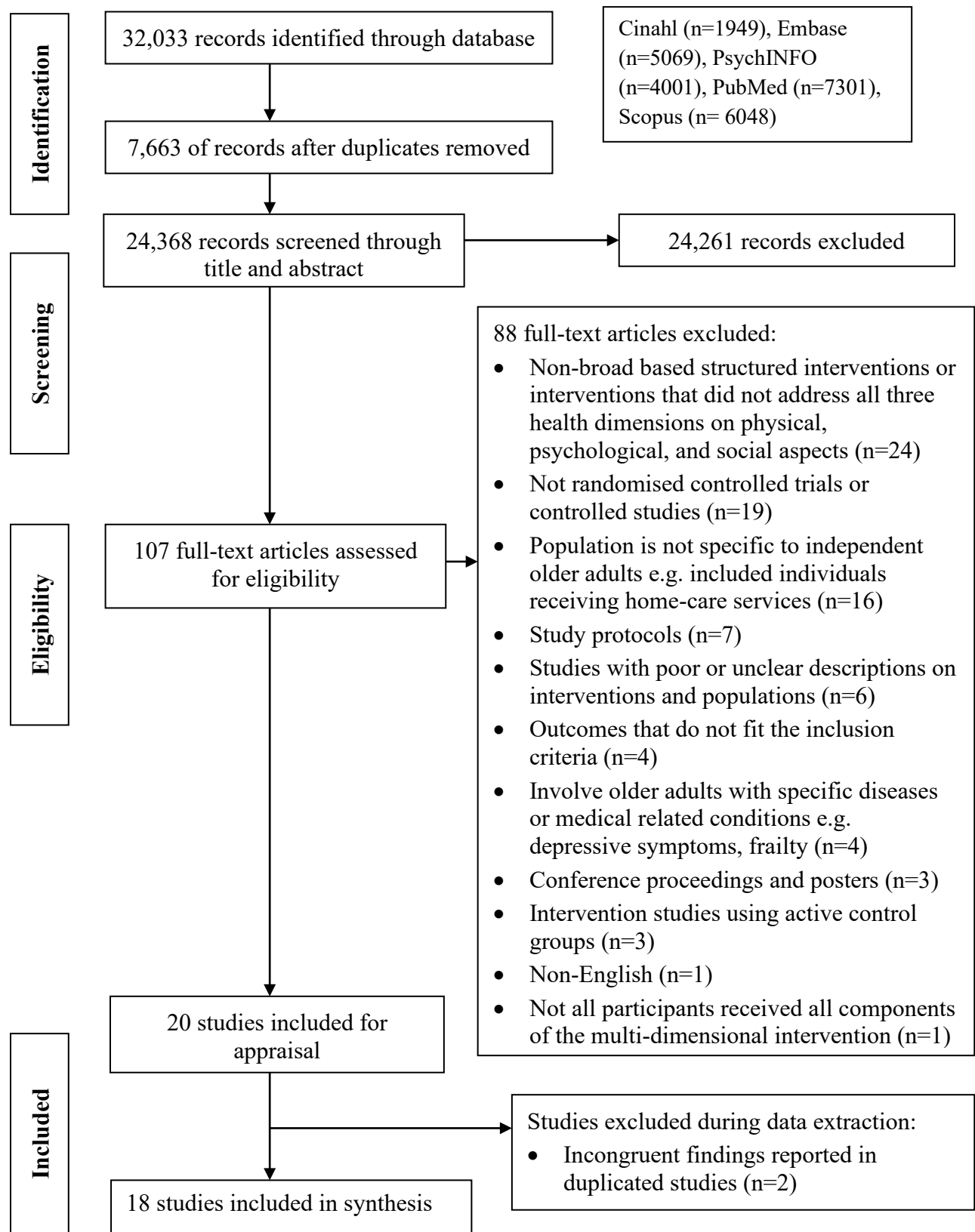


Figure 1: PRISMA

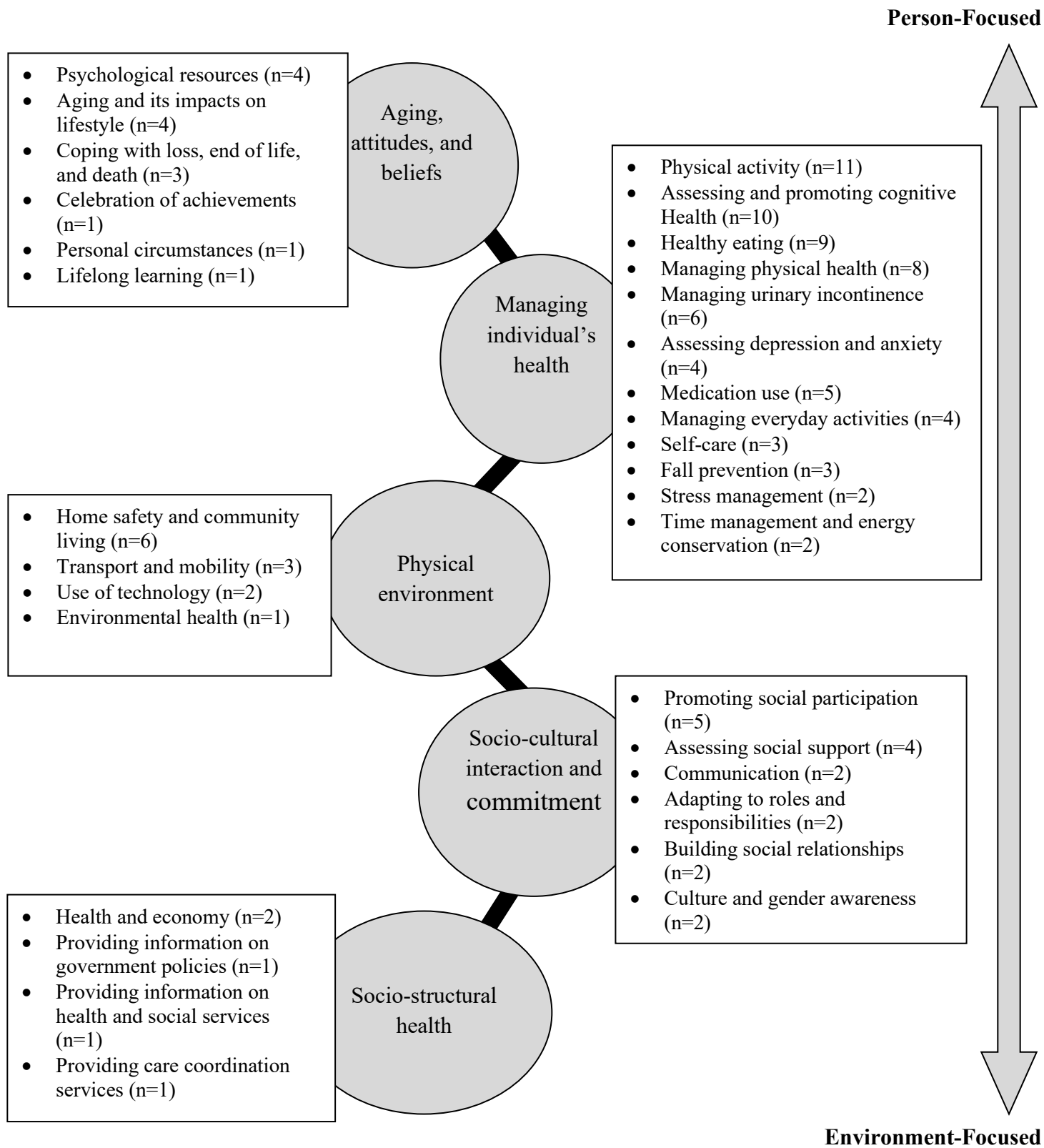


Figure 2: Categorized themes and topics on the intervention content

Table 1: Eligibility Criteria

Inclusion and exclusion criteria	
Population	Individuals who are ≥ 65 years old or those referred to as elderly/older adults/older persons/older people/seniors who live independently in their own homes and do not rely on others to perform their activities of daily living (ADLs).
Intervention	Healthy aging interventions that seek to promote or maintain independent living in homes and communities, encourage social participation, or address aging or ageism-related issues. Studies must include structured healthy aging interventions encompassing all the three following health dimensions: (1) physical health and/or functioning, (2) mental well-being, and (3) social health and engagement.
Comparison	Usual care offered to older adults can include existing community healthcare services or programs, or minimal intervention(s) introduced.
Outcomes	Primary outcomes <ul style="list-style-type: none">• Quality of life, life satisfaction, and self-rated health of older adults Secondary outcomes <ul style="list-style-type: none">• Physical functioning (e.g. ADLs)• Psychological well-being (e.g. depression, anxiety)• Cognitive health (e.g. memory)• Social health (e.g. social network, social participation)• Health behaviour (e.g. physical activity, nutrition, self-care)
Types of study	Peer-reviewed studies using randomised or non-randomised controlled trials as study designs.
Exclusion criteria	<ul style="list-style-type: none">• Non-experimental studies, qualitative articles, study protocols, dissertations, and conference proceedings• Non-English language papers• Study population with older adults who are hospitalised, cognitively impaired, terminally ill, receiving home-care services for assistance, or residing in nursing homes or assisted living environments where healthcare personnel are available within their vicinity to care for them• Studies that included independent and dependent individuals but did not differentiate results between the two groups.• Studies that explicitly recruited older adults with specific diseases or conditions (e.g. metabolic syndrome, depressive symptoms, cognitive complaints, and frailty).• Interventions addressing only one or two of the indicated health dimensions.

Table 2: Summary of Studies arranged according to Type of Interventions

Author (Year) Country	Type	Population	Intervention	Theme addressed in content of intervention
Behm et al (2014) Gustafasson et al (2012) Gustafasson et al (2013) Ziden et al (2014) Sweden	Study design: Three-armed RCT Nature of program: Health education Modality: Individual Setting: Two urban district with a mix of self-owned houses and apartments in Gothenburg	Eligibility criteria: • ≥ 80 years old and community dwelling • Not dependent on municipal home help service or care • Independent from another person in ADLs • Cognitively intact Sample method: Simple random sampling Sample size: Intervention: 174 (PHV) Intervention: 171 (SM) Control: 114	<u>Preventive home visits (PHV)</u> • Provision of information on existing health and social services Delivered by: Either from an occupational therapist, physiotherapist, registered nurse, or social worker Frequency: One 1.5 to 2hr PHV Use of theoretical framework: No	<ul style="list-style-type: none"> • Aging, attitudes, and Beliefs • Managing individuals' health • Physical environment • Socio-cultural interaction and commitment • Socio-structural health

	<p>Nature of program: Health education</p> <p>Modality: Individual and group</p>		<p><u>Senior meetings + follow-up home visit (SM)</u></p> <ul style="list-style-type: none"> • Provision of information on aging related topics and strategies to overcome problems encountered at home. • Group discussion on aging-related issues with peers <p>Delivered by: Collaborative multi-profession (occupational therapist, physiotherapist, registered nurse, and social worker)</p> <p>Frequency: 4 weekly 2-hour group meetings + 1 home visit 2-3 weeks after group Meetings</p>	
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<p>Escolar & de Guzman (2014)</p> <p>Philippines</p>	<p>Study Design: RCT</p> <p>Nature of program: Health education</p> <p>Modality: Group</p> <p>Setting: Suburban community located just outside a large metropolitan city</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • 60 to 80 years old • Able to read and write in Filipino • No mental/cognitive illness • No history of stroke/cardiac arrest or COPD that can impair ability to participate • Have good muscle strength and good motor functioning skill • Not involved in educational programs offered in community • Able to walk independently with or without assistive devices, no fractures <p>Sample method: Unclear</p> <p>Sample size: Intervention: 25 Control: 15</p>	<p><u>Educational programs</u></p> <ul style="list-style-type: none"> • Learning program to promote physical activity, mental stimulation, social engagement, health promotion, and development of new skills. <p>Delivered by:</p> <p><u>Wellness program</u> - Volunteer nurses</p> <p><u>Physical fitness activity</u> - Physical education instructors</p> <p><u>Livelihood program</u> - Food technology instructor</p> <p>Frequency:</p> <p>4-month program</p> <ul style="list-style-type: none"> • Wellness program x6 sessions • Physical fitness activity program weekly for 2 months, 30-40 minutes each session • Livelihood training program x6 sessions <p>Use of theoretical framework: Rowe & Kahn Aging model</p>	<ul style="list-style-type: none"> • Managing individual's health
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<p>Tan, Chan, Wang & Vehviläinen-Julkunen (2016)</p> <p>Singapore</p>	<p>Study design: RCT feasibility study</p> <p>Nature of program: Health education</p> <p>Modality: Group</p> <p>Setting: Senior activity centre</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • ≥ 65 years old • Can communicate in Mandarin and/or English • Without mental illness and/or severe visual/hearing impairment • Can commit for the 12-week program <p>Sample method: Convenience sampling</p> <p>Sample size: Intervention: 32 Control: 32</p>	<p><u>Self-care structured group program</u></p> <ul style="list-style-type: none"> • To promote understanding of external life challenges confronting old people through information sharing • To review internal and external resources of older adults to improve their well-being and QoL <p>Delivered by: Unclear</p> <p>Frequency: 12 weeks, twice per week</p> <p>Use of theoretical Framework: Salutogenesis theory</p>	<ul style="list-style-type: none"> • Aging, attitudes, and beliefs • Managing individuals' health • Physical environment • Socio-cultural interaction and commitment • Socio-structural health
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<p>Sundsil, Soderhamn, Espnes & Soderhamn (2014)</p> <p>Norway</p>	<p>Study Design: Quasi-experimental</p> <p>Nature of program: Health education</p> <p>Modality: Individual</p> <p>Setting: Urban cities in Norway</p>	<p>Eligibility Criteria:</p> <ul style="list-style-type: none"> • ≥ 75 years old • Home dwelling (Recruited from a larger study on self-care and health among home-dwelling people) <p>Sample Method: Random sampling from city A for intervention group. Matched control group according to gender and age from city B.</p> <p>Sample size: Intervention: 15 Control: 15</p>	<p><u>Self-care talk sessions</u></p> <ul style="list-style-type: none"> • To talk, reflect, and develop plans on various topics related to self-care • To evaluate on previous topic/plan <p>Delivered by: 2 occupational therapist and 1 physiotherapist</p> <p>Frequency: 5x 30-minute personal self-care telephone talk sessions</p> <p>Use of theoretical framework: Model of self-care for health promotion on aging</p>	<ul style="list-style-type: none"> • Aging, attitudes, and beliefs • Managing individuals' health • Socio-cultural interaction and commitment
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<p>Fernandez-Ballesteros, Molina, Schettini & del Ray (2012)</p> <p>Spain</p>	<p>Study design: Quasi-experimental</p> <p>Nature of program: Health education</p> <p>Modality: Group</p> <p>Setting: Autonomous University of Madrid</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • No clear description. <p>Experimental: Recruited on a standard basis (after an exam) and registered for a 3-year university program for older adults (PUMA) at the university.</p> <p>Control: Taken from a representative probable sample of population of Madrid.</p> <p>Aged 55 to 70 years.</p> <p>Sample method: Convenience sampling for intervention group and used matched cohort for control group</p> <p>Sample size: Intervention: 82 Control:76</p>	<p><u>University program</u></p> <ul style="list-style-type: none"> • Promote knowledge and new technologies to increase social integration and participation and intergenerational relationships and to promote personal development and well-being. • Include broad ranging subjects from health-related modules to arts and social sciences. <p>Delivered by: Lecturers in the university</p> <p>Frequency: 3 years</p> <p>Use of theoretical framework: No</p>	<ul style="list-style-type: none"> • Aging, attitudes, and beliefs • Managing individuals' health • Socio-cultural interaction and commitment
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<p>Kamegaya, Araki, Kigure & Yamguchi (2014)</p> <p>Japan</p>	<p>Study design: RCT</p> <p>Nature of program: Health education</p> <p>Modality: Group</p> <p>Setting: Municipality of Maebashi</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • ≥ 65 years old • Without dementia • Having no medical condition that made participants unable to engage in physical activity <p>Sample method: Convenience sampling</p> <p>Sample size: Intervention: 26 Control: 26</p>	<p><u>Physical and leisure activity program</u></p> <ul style="list-style-type: none"> • Consists of physical and leisure activities • Promote physical activity and introduce leisure activities to stimulate cognitive function <p>Delivered by: Healthcare professionals (Physiotherapist, occupational therapist and public health nurse) and 3 to 5 senior citizen volunteers</p> <p>Frequency: 12 weekly 2-hour program (include 45minute exercise program)</p> <p>Use of theoretical framework: No</p>	<ul style="list-style-type: none"> • Managing individuals' health • Socio-cultural interaction and commitment
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<p>Harari et al (2008)</p> <p>United Kingdom</p>	<p>Study design: RCT</p> <p>Nature of program: Health assessment and education</p> <p>Modality: Individual</p> <p>Setting: London Group Practices</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • ≥ 65 years old • Non-nursing home resident • Does not need help in basic ADLs • Does not have dementia • No terminal disease • Speaks English <p>Sample method: Cluster sampling</p> <p>Sample size: Intervention: 940 Control: 1066</p>	<p><u>Health risk appraisal for older adults (HRA-O)</u></p> <ul style="list-style-type: none"> • A broad-based screening and assessment of older adults to collect information that identifies risk factors via questionnaire • Provide individualised feedback/report generated by decision support software to older adults • Untrained general practitioners (GPs) encouraged to reinforce preventive health and health behaviour issues (not mandatory) <p>Delivered by: Decision support software and GPs</p> <p>Frequency: HRA-O evaluation, once</p> <p>Use of theoretical framework: No</p>	<ul style="list-style-type: none"> • Managing individuals' health • Socio-cultural interaction and commitment
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<p>Dapp et al (2011)</p> <p>Germany</p>	<p>Study design: RCT</p> <p>Nature of program: Health assessment and education</p> <p>Modality: Individual OR mixed</p> <p>Setting: General practitioners clinics in Hamburg</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • ≥60 years old • Does not need human help in Basic ADL and/or receiving nursing care • No cognitive impairment • No terminal disease • Ability to understand German <p>Sample Method: Cluster sampling from GP list of patients</p> <p>Sample size: Intervention: 878 Control: 1702</p>	<p><u>Health risk appraisal for older adults (HRA-O)</u></p> <ul style="list-style-type: none"> • A broad-based screening and assessment of older adults to collect information that identifies risk factors via questionnaire • Provide individualised feedback/report generated by decision support software to older adults • Trained GPs encouraged to reinforce preventive health and health behaviour issues (not mandatory) • Participants undergo reinforcement sessions (either group or home visits) <p>Delivered by: Decision support software and geriatric team comprising nutritionist, physiotherapist, social worker, and geriatrician for <u>group sessions</u> OR specially trained nurse for <u>home visits</u>. Both nurse and geriatrician provide recommendations.</p> <p>Frequency: HRA-O evaluation followed by 1 half-day group session <u>OR</u> HRA-O evaluation followed by 2 home visits (6 months apart)</p> <p>Use of theoretical framework: No</p>	<ul style="list-style-type: none"> • Managing individuals' health • Physical environment • Socio-cultural interaction and commitment
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<p>Stuck et al (2015)</p> <p>Switzerland</p>	<p>Study design: RCT</p> <p>Nature of program: Health assessment and education</p> <p>Modality: Individual</p> <p>Setting: Primary care physicians (PCPs) serving mixed rural and urban primary care catchment areas in Solothurn</p>	<p>Eligibility Criteria:</p> <ul style="list-style-type: none"> • ≥65 years old individual whom PCP had seen at least once in past 5 years • Without disability (need human assistance for performing ADL, cognitive impairment, terminal disease) • Able to speak German <p>Sample method: Cluster sampling from PCP list of patients</p> <p>Sample size: Intervention: 874 Control: 1410</p>	<p><u>Health risk appraisal for older adults (HRA-O)</u></p> <ul style="list-style-type: none"> • A broad-based screening and assessment of older adults to collect information that identifies risk factors via questionnaire • Provide individualised feedback/report generated by decision support software to older adults • PCPs, who received intervention manual, were encouraged to reinforce preventive health and health behaviour issues (not mandatory) • Participants undergo reinforcement sessions through home visits by nurse counsellors <p>Delivered by: Decision support software and home visits conducted by nurse counsellors. Nurse and PCPs provide recommendations</p> <p>Frequency: HRA-O evaluation, twice + ≥2 home visits and telephone follow-ups (average 5.2 home visits and 2 calls over 2 years)</p> <p>Use of theoretical Framework: No</p>	<ul style="list-style-type: none"> • Managing individuals' health • Socio-cultural interaction and commitment
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<p>Sherman et al (2016)</p> <p>Sweden</p>	<p>Study design: RCT</p> <p>Nature of program: Health assessment and education</p> <p>Modality: Individual and group</p> <p>Setting: Healthcare centres (HCCs) from 5 distinct geographical areas of Stockholm. HCCs must have at least 3 DNs employed</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • 75 year olds • Independent, living at home <p>Sample Method: Random cluster sampling</p> <p>Sample size: Intervention: 220 Control: 303</p>	<p><u>Preventive home visits</u></p> <ul style="list-style-type: none"> • Identify health concerns of older adults, support, and empower their self-care activities, person-centred approach to plan and evaluate nursing interventions, document, using healthcare dialogue. <p>Delivered by: RNs with specialist training (District nurses)</p> <p>Frequency: One 1-Hour preventive home visit</p> <p>Use of theoretical framework: No</p>	<ul style="list-style-type: none"> • Managing individuals' health • Physical environment • Socio-cultural interaction and commitment • Socio-structural health
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<p>Kwon (2015) South Korea</p>	<p>Study design: RCT</p> <p>Nature of program: Health assessment and education</p> <p>Modality: Individual</p> <p>Setting: Senior welfare centre that operates various educational and recreational programs without additional charge in Deagu.</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • 65 years and over • Cognitively intact <p>Sample method: Convenience sampling</p> <p>Sample size: Intervention: 44 Control: 49</p>	<p><u>Wheel of Wellness individual counselling</u></p> <ul style="list-style-type: none"> • Provides individual counselling and education to enhance older adults' wellness based on their wellness profile • Referral to community mental health clinic for depressed seniors and to physical activity and/or social networking programs to enhance specific subtasks of the wheel <p>Delivered by: Registered nurses</p> <p>Frequency: 4 weekly one-hour individual counselling</p> <p>Use of theoretical framework: Wheel of Wellness</p>	<ul style="list-style-type: none"> • Aging, attitudes, and beliefs • Managing individuals' health • Socio-cultural interaction and commitment
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<p>Johansson & Björklund (2016)</p> <p>Sweden</p>	<p>Study design: Quasi-experimental</p> <p>Nature of program: Health assessment and education</p> <p>Modality: Individual and group</p> <p>Setting: Geographical housing area comprising of apartments in urban environment in Sweden</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • ≥ 65 years old • Community-dwelling • No homecare <p>Sample method: Convenience sampling for the intervention group, and the control group is matched according to gender and age from another primary care district</p> <p>Sample size: Intervention: 22 Control: 18</p>	<p><u>Group sessions and home visits</u></p> <ul style="list-style-type: none"> • Provision of information, group discussion, and conduct of activity related to various themes of interests. • Individual assessment of needs to develop program based on individual's need on occupation related activity <p>Delivered by: Occupational therapist</p> <p>Frequency: Group interventions for 2-hour/week for 4 months + Maximum 4-hour home visit</p> <p>Use of theoretical framework: Model of Occupational Adaption</p>	<ul style="list-style-type: none"> • Aging, attitudes, and beliefs • Managing individuals' health • Physical environment • Socio-cultural interaction and commitment • Socio-structural health
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<p>Clark et al (2012)</p> <p>United States</p>	<p>Study design: RCT with cross-over</p> <p>Nature of program: Health assessment and education</p> <p>Modality: Individual and group</p> <p>Setting: Senior activity centres, senior housing residences, graduated care retirement community in Los Angeles</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • 60 to 95 years old • No overt signs of psychosis or dementia • Able to complete study assessment battery <p>Sample Method: Convenience sampling</p> <p>Sample size: Intervention: 232 Control: 228</p>	<p><u>Small group discussions and individual sessions</u></p> <ul style="list-style-type: none"> • Identify and implement feasible, sustainable activity-relevant changes • Develop plans to overcome mundane obstacles to enact activity-relevant changes • Participate in selected activities; rehearsals and repetitions of changes to everyday routine <p>Delivered by: Occupational therapist</p> <p>Frequency: Weekly 2-hour group sessions for 6 months + Up to 10 individual 1-hour sessions in homes or community-settings</p> <p>Use of theoretical framework: Not mentioned. However, this intervention on <i>Well Elderly II</i> is based on <i>Well Elderly I</i>. The underpinning theoretical framework of latter intervention was based on Dynamic systems theory and View of human as an occupational being.</p>	<ul style="list-style-type: none"> • Aging, attitudes, and beliefs • Managing individuals' health • Socio-cultural interaction and commitment
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<p>Clare et al (2015)</p> <p>United Kingdom</p>	<p>Study design: Pilot Three-arm RCT</p> <p>Nature of program: Goal-Setting</p> <p>Modality: Individual</p> <p>Setting: Community Agewell Centre that offers a range of activities and opportunities for social interaction in North Wales</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • ≥ 50 years old living and functioning independently in local community • No dementia or intellectual disability <p>Sample method: Convenience sampling</p> <p>Sample size: Intervention: 24 (Goal-setting) Intervention: 24 (Goal-setting + mentoring) Control: 27</p>	<p><u>Goal-setting group</u></p> <ul style="list-style-type: none"> • Set individual health goals and work towards them <p>Delivered by: Unclear</p> <p>Frequency: One 90-minute interview</p> <p>Use of theoretical framework: Drew upon social cognitive theories of health behavioural change, self-regulation, and behavioural learning.</p>	<ul style="list-style-type: none"> • Managing individuals' health • Socio-cultural interaction and commitment
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	<p>Nature of program: Goal-setting</p> <p>Modality: Individual</p>		<p><u>Goal-setting + mentoring</u></p> <ul style="list-style-type: none"> • Set individual health goals and work towards them • Telephone follow-ups to review progress of goal attainment <p>Delivered by: Unclear</p> <p>Frequency: One 90-minute goal-setting interview + 5 bi-monthly follow-ups mentoring telephone calls</p> <p>Use of theoretical framework: Drew upon social cognitive theories of health behavioural change, self-regulation, and behavioural learning.</p>	
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<p>Mountain et al. (2017)</p> <p>United Kingdom</p>	<p>Study design: RCT</p> <p>Nature of program: Goal-setting and health education</p> <p>Modality: Individual OR mixed</p> <p>Setting: Rural North Wales and a large urban city in Northern England</p>	<p>Eligibility criteria:</p> <ul style="list-style-type: none"> • ≥65 years old • Living independently in their own home or sheltered accommodation, alone or with others • Able to converse in English or Welsh • Displays reasonable cognitive function using 6-item Cognitive Impairment test <p>Sample method: Convenience sampling</p> <p>Sample size: Intervention: 145 Control: 143</p>	<p><u>Group sessions and individual sessions</u></p> <ul style="list-style-type: none"> • To provide information to enhance older adults' knowledge of how to overcome barriers to active engagement. • To set and follow-up on personal goals <p>Delivered by: Facilitated by National Health Service (NHS) staff or social care staff whom underwent training and supervision by qualified occupational therapists.</p> <p>Frequency: 16 weekly group sessions + 4 individual sessions (one approximately every 4 weeks)</p> <p>Use of theoretical framework: No</p>	<ul style="list-style-type: none"> • Aging, attitudes, and beliefs • Managing individuals' Health • Physical environment
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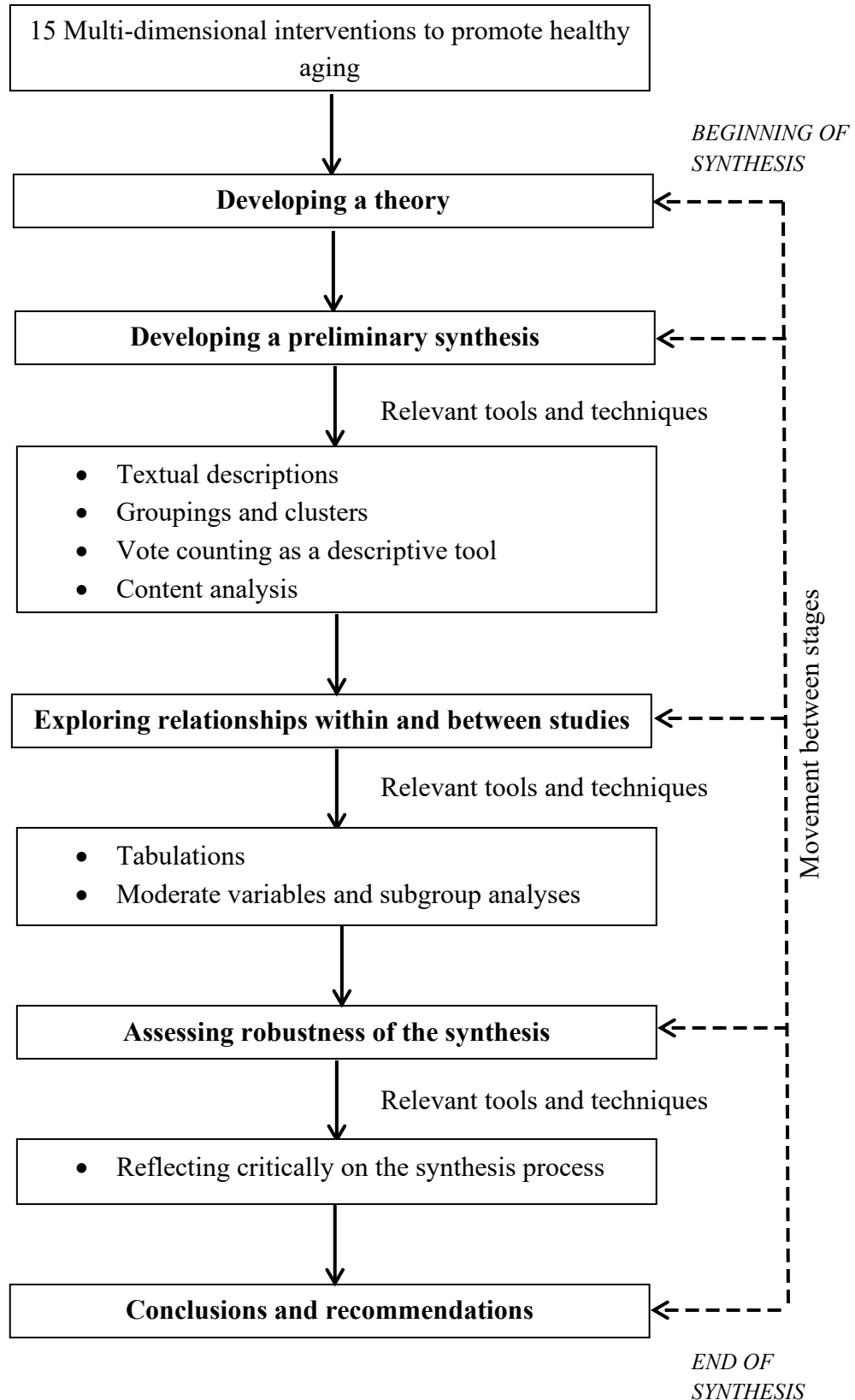
Table 3: Summary of findings on effectiveness of MHAI

Reference	QoL/life satisfaction	Self-rated health	Physical functioning	Mental well-being (Cognitive)	Mental well-Being (Psychological)	Social functioning	Health behaviour
Health education programs							
Behm et al (2014) Gustafasson et al (2012) Gustafasson et al (2013) Ziden et al (2014)	+	+	+				+
Escolar & de Guzman (2014)	+				+		
Tan, Chan, Wang & Vehviläinen-Julkunen (2016)	+	0					0
Sundsil, Soderhamn, Espnes & Soderhamn (2014)					+		0
Fernandez-Ballesteros, Molina, Schettini & del Ray (2012)		0	0	0	0/+	0/+	
Kamegaya, Araki, Kigure & Yamguchi (2014)	+	0	0	+	0	0	
Health assessment and education programs							
Harari et al (2008)							+
Dapp et al (2011)							+
Stuck et al (2015)		0	0				+

Reference	QoL/life satisfaction	Self-rated health	Physical functioning	Mental well-being (Cognitive)	Mental well-Being (Psychological)	Social functioning	Health behaviour
Sherman et al (2016)		0	0				-
Kwon (2015)	0	+			+		+
Johansson & Björklund (2016)	0/+						+
Clark et al (2012)	0/+			0	+		
Goal-setting programs							
Clare et al (2015)	0			0	0		0
Mountain et al (2017)	0	0			0		

+ Statistical significant improvement of outcome $p \leq 0.05$, 0 Statistical insignificant outcome observed, - Statistical significant worsening of outcome, 0/+ Multiple outcomes with both statistical significant and insignificant observations.

Supplement 1: Process of Review Synthesis



Supplement 2: Summary of Risk of Bias Table

Study reference	Random sequence generation	Allocation concealment	Blinding of participants & personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting
Behm et al (2014) Gustafsson et al (2012) Gustafsson et al (2013) Ziden et al (2014)	Unclear	Low	High	Low	Low	High
Clare et al (2015)	Low	Unclear	High	Low	Low	Low
Clark et al (2012)	Low	Unclear	Low	Low	Low	High
Dapp et al (2011)	Low	Low	High	Low	Low	High
Escolar & de Guzman (2014)	Unclear	Unclear	High	Unclear	Unclear	Unclear
Harari et al (2008)	Low	Unclear	High	Low	High	Unclear
Johansson & Björklund (2016)	High	High	High	High	High	Unclear
Kamegaya, Araki, Kigure & Yamguchi (2014)	Unclear	Unclear	High	Unclear	High	Unclear
Kwon (2015)	Low	Low	High	Unclear	Low	Unclear
Sherman et al (2016)	Unclear	High	High	Unclear	High	High
Stuck et al (2015)	Low	Unclear	High	Low	Low	Low
Sundsil, Soderhamn, Espnes & Soderhamn (2014)	High	High	High	Unclear	Low	High
Tan, Chan, Wang & Vehviläinen-Julkunen (2016)	Low	Unclear	High	High	Low	High
Fernandez-Ballesteros, Molina, Schettini & del Ray (2012)	High	High	High	Unclear	Low	Unclear
Mountain et al. (2017)	Low	Low	High	Low	Unclear	Low