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Healthy and active aging exercise program for functional health and wellbeing among rural adults: Implementation and evaluation at primary care in Telangana

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Abstract:

BACKGROUND: Population aging is a global phenomenon associated with challenges of physical and cognitive declines, reduced social interaction, and increased risk of mental health issues. Preventive measures to address potential health needs of aging population are essential to promote healthy aging. Physical exercise interventions designed with age-sensitive approach to enhance functional ability and quality of life are essential through community participatory approach. The study aimed evaluation of a multi-component age sensitive home-based physical exercise "Healthy and Active Aging Exercise Protocol (HAAEP)" intervention program on physical health, functional ability, and social interaction among middle-aged to old-aged adults.

MATERIALS AND METHODS: A randomized control trial was performed applying a 16-week HAAEP program to evaluate functional health (FH) including anthropometric measures and social interaction among 270 community-based adults aged 40-90 years from rural Sangareddy district, Telangana, India.

RESULTS: The Intervention group (IG) and Control group (CG) exhibited differential progress over time, between the group analysis reported significant improvement in TUG (0.0018), 6MWT (0.0292), IPAQ –PA pattern, (0.0194) IPAQ-Sedentary behavior (0.04), BMI (0.0177), Fat percentage (0.0314), Muscle percentage (0.000), Bone and BMR (0.031). Group-based approach in community-friendly settings showed improvement in social interaction, DSSI (0.0120).

CONCLUSION: Age-sensitive HAAEP program on functional health with social wellbeing, have shown significant positive effect among adults of different age groups, and will be an effective holistic strategy for healthy and active aging.

Keywords:

Functional ability, health promotion, healthy aging, physical activity, rural population, social interaction

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Introduction

Aging is a complex yet unique process potentially accompanied with declines in physical, cognitive, and social functional ability. Musculoskeletal loss at a rate of 12-14% after 50 years and physical inactivity (10-40%) leads to physical functional decline during progressive phase of aging, influencing strongly the lifestyle factors.[1] Hence, prioritizing health-promoting interventions starting in middle adulthood to support active aging is essential. Physical activity (PA) interventions focused on exercise enhancement and fostering social connections with a population-based approach can improve physical health, psychosocial well-being, resulting to positive health outcomes and successful aging with better quality of life.[2-4]

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Consistent to the physical activity guidelines, India has taken the physical health promotion initiatives like "Fit India Movement"(2019) with a vision towards healthier nation to inculcate physical activity as part of daily life.[5] National Health Policy initiate health and wellness clinics driven transformation of health with primary health care perspectives enables health-promoting behaviors among populations.[6,7]

Physical inactivity and other behavioral patterns causing lifestyle disorders are seen growingly associated with raising lifestyle disease burden worldwide (IHME, 2016). Implementation of population-based physical activity program at primary care and community level in conjunction with capacity-building training for ground-level health workers can be successful strategies.[8] Critical barriers in integration of physical activity promotion are mostly geographical, gender, and socio-economic based, hence considering these factors will be more suitable while planning such programs at primary health care or community settings and rural areas in specific. A deeper analysis of the health system and physical activity context provide a better understanding of factors affecting healthy ageing among adults in rural communities and the mechanisms to address them.[9] Innovative exercise-based healthy aging programs implemented from middle adulthood at community level, will be sustainable strategies to enhance physical and cognitive functioning, self-confidence, social interactions among people at primary care level enabling to move towards the objectives of decade of healthy aging.[10]

The current demographic scenario of fast-growing aging population insists the need for productively engaged, age-sensitive community-friendly physical activity programs with sustainable and scalable preventive educational approaches in the background of inadequate health care resources from the public health organizations. The present study assessed the physical activity and health behaviors with social dimensions and factors involved in active aging to evaluate the home-based Healthy and Active Aging Exercise Program (HAAEP), a cost effective, multicomponent program developed tailored to the needs of population of varied aging adults and low resource settings. The intervention with a preventive strategy was developed, implemented through a multimodal recreational, health educational and health promotion approach, targeting to improve functional health and social wellbeing among aging adults in rural areas from pre aging phase integrating with primary care system, public health stakeholders and community with a sustainable community participatory approach contributing to the WHO Global Action Plan on Physical Activity (GAPPA).A theoretical framework of the study is represented in Figure 1.

Materials and Methods

Study design and setting

The Healthy and Active Aging Exercise Protocol (HAAEP program) study was two armed, parallel group, randomised control trial, implemented in the purview of ChitkulSubcenter which comes under Patancheru Rural Health center, Sangareddy district, Telangana, India.

Study participant and sampling

A situational analysis covering all four geographically directional zones was done with the help of community healthcare workers to select the population meeting the eligibility criteria. Total 580 participants were screened from the households surveyed by by door-to-door survey method. In total, 335 aging adults (40-90 years) were selected as per eligibility criteria to participate in the study.During the baseline assessment, 270 participated and 65 participants withdrawn from the study due to various reasons. 270 were randomly allocated into experimental group (n = 135) and control group (n = 135) by lottery method. The CONSORT diagram is presented in Figure 2. The recruitment process and the baseline data collection of the participants wereinitiated in July 2022. Before the commencement of the study, institutional ethical clearance was obtained and informed consent was obtained from the participant in the written and/or thumbprint format. Based on previous study sample, size was calculated with an effect size 0.57 and 80% power at an alpha level of 0.01 and a dropout rate of 10%.

Inclusion and exclusion criteria

Participants who were ambulant and with cognitive functioning (>24 Mini Mental State Examination score) in the age group of 40 year to 90 years, residents of village for more than 6 months, mobile, not participated in any exercise intervention program in the recent six months were included. Who were diagnosed with chronic illness and were with active symptoms, non-ambulatory (wheelchair bound), suffering with unstable medical condition (respiratory, metabolic, cardiovascular), with acute illnesses, severe depression or dementia, people with hearing or visual disability were excluded from the study.

Data collection tools and technique

Age, gender, level of education, marital status, and occupation were included for demographic variables.

Primary outcome measure

Functional health is the primary outcome measure. Functional health was evaluated using a validated test battery applicable for various age groups to measure various components of strength, endurance, balance, mobility. Timed up-and-go test (TUG), Full turn test (FT) and Functional Reach Test (FRT), Sit-to-stand test (StS), and Modified Sit And Reach test (MSRT) and

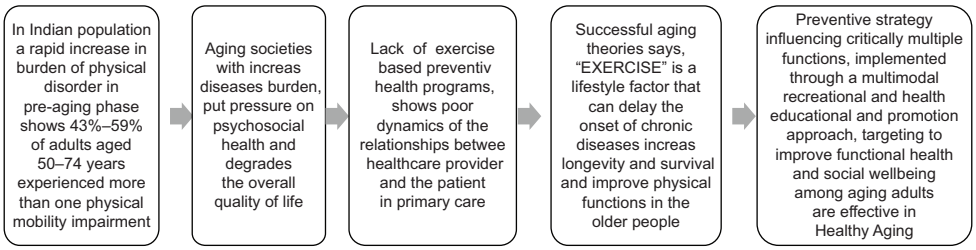

Figure 1: Theoretical Framework for the study

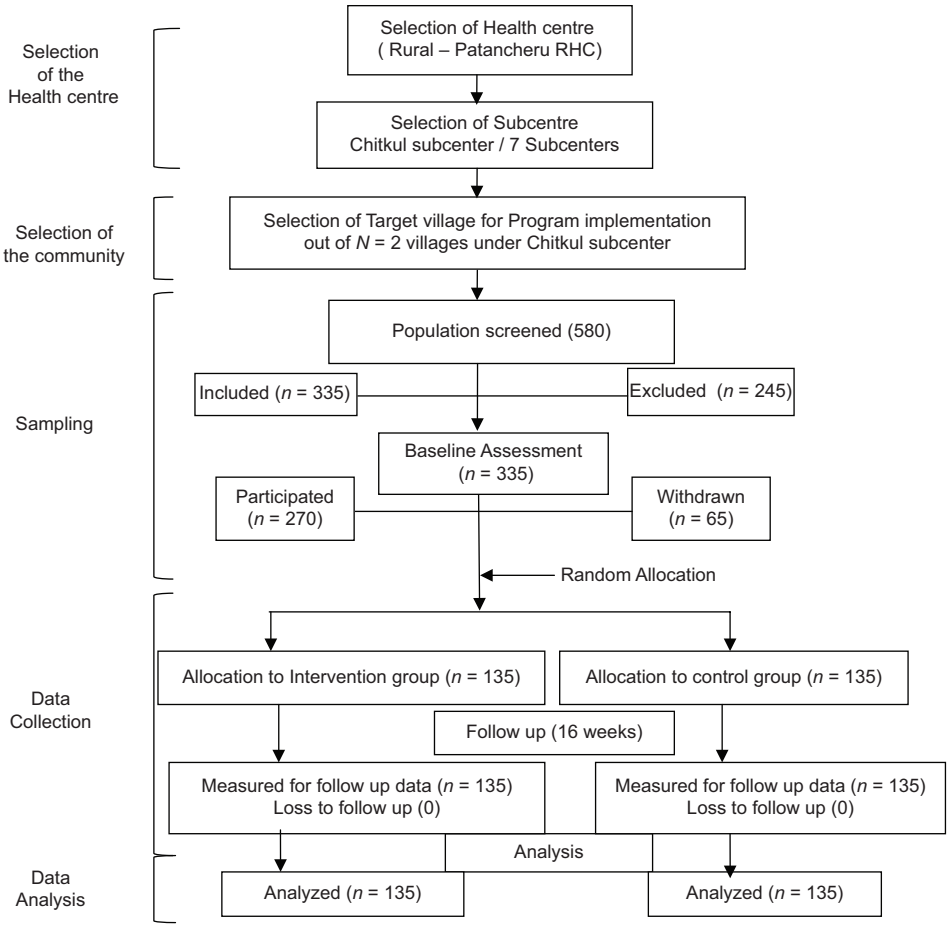

Figure 2: CONSORT Diagram for the study process

Six-Minute Walk Test (6MWT) were used to measure mobility, endurance, balance and lower body strength while hand-held dynamometer was used to assess the hand grip strength.International Physical Activity Questionnaire (IPAQ) was used for physical activity and sedentary pattern. Anthropometric measures such as Body Mass Index (BMI), fat percentage, percentage of skeletal muscle, bone weight, and Basal Metabolic Rate (BMR) measure by Body Composition Analyser (BCA).

Secondary outcome measure

Social networking and participation arethe secondary outcome measures and were evaluated using Duke Social Support Index (DSSI), an 11-item scale, comprising of two subscales focusing on social interaction and subjective support. The scores were summed and categorized into low-fair, high and very high, the very high category is associated with stronger social interaction.

Intervention protocol registration and approval

Prior to implementation of the research study, the approval was taken by Institutional Ethical committee of University of Hyderabad (IEC approval no- UH/IEC/2021/29) and protocol was registered in Clinical Trial Registry, India (CTRI/2022/09/045672). Conduct of research in the rural communities was officially approval by Health Officer, Patancheru Rural Health Centre.

Before the commencement of the study, institutional ethical clearance was obtained and informed consent was obtained from the participant in the written and/or thumbprint format.

Experimental intervention program

Healthy and Active Aging Exercise Protocol (HAAEP program) was a multi-component exercise program included 11simple, yet progressive exercises tailored to the needs of aging adults, developed by the supervisor of the project with the assistance of the research scholar in the Active and Healthy Aging Lab, School of Medical Sciences, University of Hyderabad. Validity was confirmed with external subject experts and pilot research to verify the feasibility. HAAEP protocol, a comprehensive approach for functional health, applicable in diverse community settings, consisted of group walking, breathing exercise, strength-flexibility-endurance training, balance-coordination-mobility activities, and meditation. Simple, feasible, and adaptable to the functional health needs of the population of varied groups (age sensitive), HAAEP was provided as personalized training, group-based activity, and home-based program, schedules 30 min/day for 5 days/week for a period of 16 weeks.

Healthy and Active Aging Exercise Protocol (HAAEP program) was scheduled for sixteen weeks and includes the following exercises.

Warm up followed by 2-3 minutes breathing exercises included free joint movements of the body 5 to 10 times for 1-2 minutes, walking from room to room, a total of 5 minutes. Exercise schedule of the HAAEP, a combination of 10 exercises in tolerable pace, that included, March past, Walking from side to side, Heel raises, Reaching, Sit to stand, Wall push ups, Hip lifts, Leg lift and Climbing stairs. All the exercises were trained under close supervision and observation and safety of the environment was ensured. Those who were using assistive and supportive devises were kept available as required and participants were encouraged to stop exercises any time if they feel giddiness, or any other discomforting symptoms. Exercise program was followed by relaxation (meditation).

HAAEP program education and promotion approach

Strong emphasis was given on health education and promotion approaches for the successful implementation for the sustainable health outcomes among aging population. Simple yet scientific HAAEP intervention-related education and orientation with HAAEP booklet was provided to the ground level health care workers along with the guidance related to recruitment and referral mechanism. Understandable local language announcements and posters, hand outs were used for information dissemination and to encourage participation. Planned and organized meetings were held from the initiation to termination of the program with health care team from rural health centres (district medical officer and the community level health care workers) and community leaders (men and women), political representatives (Sarpanch, Ward Members, etc), *mahila samiti* (women groups) members, head of the family, etc., were involved throughout the project implementation for necessary cooperation and participation. Education on components of healthy aging was provided through innovative videos and demonstrations, during the health education individual and group sessions and discussions by the investigators. Booklet, self-monitoring diaries/calendars, audio-video recording after intervention were regularly monitored after every session. to verify the active engagement of the participants. WhatsApp groups were created to communicate regular exercise reminders, educational videos in relation to the intervention and follow ups. Meeting with family members or care givers and regular follow up through phone calls facilitated keeping the participants actively enagaged throughout the program. Creating social and peer group networks to improve health and reducing social isolation were few highly beneficial strategies adopted while implementing the program.

After baseline assessment, participants were distributed into intervention group (IG) and control group (CG) by random allocation (lottery method done by health care worker who were blinded to the study). Due care has been taken to avoid dissemination of the intervention components between CG and IG by planning the session in different days and areas for meeting. The study was not blinded to the researcher as well as participants, as the intervention include forming groups for intervention, HAAEP booklet use, phone calls, WhatsApp group follow ups, etc. The IG was provided with HAAEP program with community-based health promotion approaches and CG was given health advices for a period of 16 weeks followed by post-test assessment, data analysis, and interpretation.

Statistical analysis

Statistical analysis was conducted using STATA software (version 14). Frequency, percentage, mean and standard deviation were analysed for all the variables. Normality distribution of the data was evaluated using Shaprio-Wilk test. The Paired *t*-test (normally distributed) and Wilcoxon signed rank test (not normally distributed) was performed to determine whether there were significant changes in the outcomes within the groups. *t*-test (normal) and Mann-Whitney U test (non-normal) was used to measure the effect of intervention between the different group (experimental and control group). Statistical

significance level of the *P* value was set at 0.05, 0.01, and 0.001. A quality checking for the missing data was done in the following way, (a) At the data collection level, missing data due to tool or equipment error were crosschecked and recollected, the missing data error was < 0.5%) (b) Checking participant absenteeism from the post intervention evaluation phase, the participants were followed up and the data was collected (<0.2%), (c) During the data entry level, a quality checking of the data entry was done at regular intervals, randomly selected 10th form, in case of any missed data the crosschecking of the questionnaire was done and the data updated. For all the outcomes Intention to treat (ITT) analysis was attempted.

Results

Socio demographic analysis

Among the total 335 participants enrolled in the study, 65 have withdrawn with various personal reasons and 270 adults participated in the intervention. Demographic analysis shows [Table 1] participants (106 men and 164 women) with mean age 51 ± 10.7 years exhibited no significant difference between the groups, age (0.76), gender (0.44), education (0.12), Marital status (0.84), Occupation (0.05), and Physical activity (0.66).

Effect of analysis on the outcome variables

Intention to treat analysis (ITT) showed significant difference between the results. Table 2 shows a mean difference of 1.02 (IG) and -0.25 (CG) in TUG, 1.02 (IG) and -0.25 (CG) in FT, -0.62 (IG) and 0.08 (CG) in FRT, -0.82 (IG) and 0.10 (CG) in STS, -24.6 (IG) and 1.48 (CG) in 6MWT, -0.08 (IG) and -0.01 (CG) in IPAQ, -0.07 (IG) and -0.02 (CG) in HHD. A significant difference between the group was observed at the level of *P* value <0.05, <0.01 and <0.001 in TUG (0.0018), 6MWT (0.0292), IPAQ –PA pattern, (0.0194) IPAQ-Sedentary behavior (0.0444). But the results of STS (0.406), MSRT (0.59), 360 degree

Table 1: Socio demographic characteristics of the participants (*n*=270)

Variables	Overall *n* (%) *n*=270	Intervention group *n* (%) *n*=135	Control group *n* (%) *n*=135	*P*
Age (M±SD)	51±10.7 years			
Age groups				
40-50 yrs	143 (52.9)	72 (53.3)	71 (52.5)	0.76
50-60 yrs	51 (18.8)	25 (18.5)	26 (19.2)	
60-70 yrs	61 (22.5)	30 (22.2)	31 (22.9)	
70-80 yrs	15 (5.5)	8 (5.9)	7 (5.9)	
Gender	Total - 270			
Male	106 (39.26)	42 (31.1)	48 (35.5)	0.44
Female	164 (60.74)	93 (68.8)	87 (64.4)	
Educational Levels				
No formal education	74 (27.4)	34 (25.1)	53 (39.2)	0.12
Elementary	96 (35.5)	52 (38.5)	44 (32.5)	
High school	59 (21.8)	36 (26.7)	20 (14.8)	
College/University	41 (15.1)	13 (9.6)	18 (13.3)	
Marital Status				
Married	243 (90.0)	121 (89.6)	122 (90.3)	0.84
Widower	27 (10.0)	14 (10.3)	13 (9.6)	
Separated	--	---	---	
Never Married	--	---	---	
Occupation				
Farmer	29 (10.74)	12 (8.8)	17 (12.5)	0.05
House wife	132 (48.8)	68 (50.3)	64 (47.4)	
Daily wager	19 (7.04)	5 (3.7)	14 (10.3)	
Construction worker	24 (8.8)	8 (5.9)	16 (11.8)	
Municipal worker	15 (5.5)	6 (4.4)	9 (6.6)	
Factory worker	35 (12.9)	28 (20.7)	7 (5.1)	
Small business	11 (4.07)	4 (2.9)	7 (5.1)	
Other	2 (0.74)	2 (1.4)	1 (0.7)	
Not working	3 (1.1)	2 (1.4)	--	
Physical Activity Level				
>180 min	73 (27.04)	40 (29.6)	33 (24.4)	0.66
150-180 min	125 (46.3)	58 (42.9)	67 (49.6)	
90-150 min	59 (21.8)	32 (23.7)	27 (20.0)	
<150 min	9 (3.3)	3 (2.2)	6 (4.4)	
Rarely perform PA	4 (1.4)	2 (1.4)	2 (1.4)	

Table 2: Functional Health and Physical Activity among adults

Variable	Experimental group Mean (SD)	Comparison of intervention effect within the group	Control group Mean (SD)	Comparison of intervention effect within the group	Comparison of intervention effect between the group
Functional Health Analysis					
TUG					
Pre-test	9.6±2.8		9.4±2.9		
Post-Intervention	8.5±2.8	0.00***	9.6±2.8	0.001***	0.0018***
FT					
Pre-test	2.0±0.64		2.1±0.59		
Post-Intervention	1.9±0.70	0.00***	2.08±0.62	0.014**	0.1506
FRT					
Pre-test	21.5±8.4		21.7±8.2		
Post-Intervention	22.2±8.0	0.001***	21.6±8.1	0.1752	0.5530
STS					
Pre-test	12.8±4.1		13.7±4.4		
Post-Intervention	13.7±4.0	0.000***	13.6±4.5	0.0848	0.406
MSRT					
Pre-test	2.8±0.66		2.7±0.81		
Post-Intervention	2.6±0.63	0.000***	2.7±0.82	0.205	0.05*
HHD					
Pre-test	1.2±0.45		1.2±0.45		
Post-Intervention	1.3±0.48	0.000***	1.2±0.46	0.045	0.3052
6MWT					
Pre-test	318.3±101.4		318.7±99.9		
Post-Intervention	343±101.7	0.001***	317.2±99.5	0.1457	0.0292**
Physical Activity Analysis					
IPAQ-Physical activity					
Pre-test	4.7±0.43		4.7±0.45		
Post-Intervention	4.8±0.37	0.008	4.7±0.47	0.157	0.0194**
IPAQ-Sedentary					
Pre-test	3.7±1.0	0.001***	3.4±1.19	0.0833	0.0444
Post-Intervention	3.5±1.2		3.3±1.19		

P – 0.05*, 0.01**, 0.001***

full turn (FT) (0.1506), FRT (0.5530), and hand held dynamometry (0.3052) did not exhibit significant results.

Regulated walking pattern in IG also influenced the anthropometric measure significantly in comparison to CG. Table 3 showed BMI (0.0177), Fat percentage (0.0314), Muscle percentage (0.000), Bone weight (0.19), BMR (0.031). The results obtained by Wilcoxon signed rank test within the group showed a significant improvement in intervention group in contrast with control group, with a mean difference of 0.47 (IG) and -0.25 (CG) in BMI, 1.32 (IG) and -0.06 (CG) in Fat percentage, -0.08 (IG) and 0.5 (CG) in Muscle percentage, -0.04 (IG) and -0.008 (CG) in Bone weight, 1.02 (IG) and -0.25 (CG) in BMR.

Implementation of the HAAEP with a group-based approach in rural community friendly settings enhanced the social networking and support system which was reported significantly in DSSI Table 4 shows the effect of HAAEP intervention program on social networking between the groups, a significant difference in DSSI (0.0120) reported by Mann Whitney U test. The results obtained by Wilcoxon signed rank test within the group showed a significant improvement in intervention group in contrast with control group, with a mean difference of -2.0 (IG) and 0.11 (CG) in DSSI.

Discussion

In reference to the swift demographic transitions and the need for societal, families, and individual preparedness, action plan was introduced to promote healthy and active aging for the life course (World Health Organization (WHO), 2002), with an agenda to provide long term care with equitable access through structured health promotion and disease prevention programs for successful active aging.[9] Physical activeness throughout life is a strong protective factor against age-related morbidity and mortality, but the effect is slowly and progressively declined from middle age annually by 3%; hence, getting habituated to physically active lifestyle pattern from younger phase of life can contribute to healthy and successful aging.[10,11] Popular model by Rowe and Khan proposed social engagement also as an

Table 3: Analysis of Anthropometric measures

Variable	Experimental group Mean (SD)	Comparison of intervention effect within the group	Control group Mean (SD)	Comparison of intervention effect within the group	Comparison of intervention effect between the group
			Anthropometric Analysis		
Body Mass Index (BMI					
Pre-test	24.7±4.4		25.5±4.74		
Post Intervention	24.2±3.8	0.002**	25.5±4.76	0.426	0.0177**
Fat percentage					
Pre-test	28.1±9.8		31.9±9.3		
Post Intervention	26.8±9.5	0.000***	31.9±9.3	0.995	0.0314*
Muscle Percentage					
Pre-test	37.8±7.5		35.0±7.3		
Post Intervention	38.7±7.6	0.000***	34.5±7.4	0.005***	0.000***
Bone weight					
Pre-test	2.74±0.34		2.7±0.5		
Post Intervention	2.7±0.36	0.001***	2.7±0.57	0.101	0.193
Basal Metabolic Rate					
Pre-test	25.2±7.8		23.6±6.9		
Post Intervention	27.8±8.2	0.01**	23.9±8.7	0.416	0.031*

P – 0.05*, 0.01**, 0.001***

Table 4: Social Connectivity analysis

Variable	Experimental group Mean (SD)	Comparison of intervention effect within the group	Control group Mean (SD)	Comparison of intervention effect within the group	Comparison of intervention effect between the group
			Social networking and participation		
Duke Social Support Index (DSSI)					
Pre-test	24.8±4.3		25.5±4.74		
Post Intervention	26.8±4.8	0.001**	25.5±4.76	0.0143**	0.0120**

important component of successful aging which is more effective if the cultural context of different communities is emphasized during implementation of healthy aging programs.[12,13]

The objective of the study was determining the effectiveness of the novel intervention HAAEP on the improvement of physical activity-related health behavior and social connectivity among aging adults. A comparative analysis of intervention group (IG) and control group (CG) exhibited a high level of statistical significance in most of the components in IG compared to CG, indicating a prospective reversal of health-related functional decline associated with aging. Influence of HAAEP on PA health behaviors with social dimensions and factors were discussed based on the results obtained.

Adherence to structured physical exercise program for functional health

Multicomponent HAAEP program (16 weeks) resulted in improvement of physical functional health in the experimental group compared to the control group in the study, results of between the group analysis did not showed a significant differences in all the variables, but TUG (0.0018) and 6MWT (0.0292) reported significant results. However, the changes were exhibited through mean difference values of IG and CG (within the group analysis).

Aging associated physiological regression progressively affects the musculoskeletal strength, cardiorespiratory fitness, nervous system activation, etc., consequently deteriorating physical capability, balance, coordination, mobility, overall functional health and quality of life,[14] but multicomponent or multimodal exercise interventions had sustained impact on functional strength-based quality of life in community dwelling older adults[15] Incorporation of lower extremity strength, endurance, static-dynamic balance enhancing exercises might have improved functional tests performance (TUG, STS, FRT, FT), evidences reported greater decline in lower limb muscle strength with aging when compared to upper limb, nearly 3.4% annually leading to functional degradation and dynamic balance and mobility impairment.[16]Vast arena of literature emphasized the long-term application of moderate to high intensity resistance and aerobic exercise intervention program a strong contributory factor in prevention of functional health with increasing age, supporting the duration of intervention period (16 weeks) in this study and related improvement in the endurance,

balance, and mobility components. Studies showed multicomponent lifestyle-based interventions with PA and nutritional supplementation decrease in frailty, improved musculoskeletal strength, and enhanced gait speed highly impacting TUG and STS performance after 12 weeks and 24 weeks of high intensity training compared to 10 weeks or lesser intervention period.[17,18] HAAEP program's acceptance by the intervention group in the rural community was accredited to the deliverance of intervention with a comprehensive rural system-oriented tailored approach aligned to meet the needs of the middle age to old age population in consideration with the individual, social, cultural, environmental factors, etc. Studies from developed countries reported that physical health promotion approaches were highly effective in community dwelling aging population.[19,20] Implementation of various complex components of HAAEP was simplified by utilizing multimodal strategies in understandable way considering the social and educational context of the rural participants. HAAEP program-associated life style management and preventive education was followed by individualized home-based and group-based sessions were provided in addition with goal setting and achieving, self-monitoring, feedback-related guidance. Studies reported varied level of success of intervention programs by utilization of remote communication technology based feedback strategies such as video conferencing or direct phone calls for ensuring adherence to regularity of elderly or prompt self regulatory monitoring methods among aging population.[21-23] According to Krishnasamy *et al*., consistent guiding, engaging and motivating participant plays a pivotal role in health promotion.[24] Vivifrail exercise program, a multicomponent, multi-centred RCT on aged population significantly boosted psychosocial aspect along with functional capacity.[25]

Group or individual walking with environmental awareness and breathing exercise clinically strengthened habitual walking speed, slowing down the influence of aging associated physiological decline on functional mobility and considerably improved 6MWT, a prognostic indicator of cardiorespiratory fitness (respiratory muscle strength and lung capacity), musculoskeletal endurance, physical agility, and neuromuscular coordination.[26] Studies supported walking as an universally highly acceptable intervention for the older adults.[27,28]

Physical activity behavior (IPAQ) of the subjects showed that total mean score of metabolic equivalent (MET) was higher with a significant effect. Comparison of between the group analysis showed a highly significant effect in PA behavior, IPAQ–PA pattern, (*P* value 0.0194) and significant effect in sedentary habits, IPAQ-Sedentary behavior (*P* value -0.0444). Within the group analysis of HAAEP group in contrast to CG reported highly significant result as subjects in IG interestedly practiced exercise in a regulated manner, avoiding the prolonged sedentary behavior in their lifestyle and spending time in group walking or leisure-based physical activities in the parks during evening gathering. Review study reported higher impact of PA on healthy middle age adults when compared to the older adults.[29] On the contrary, other studies showed significant effect of PA on older adults with problems like arthritis, diabetes, cardiac problems, etc.[28] while some other studies found no differences in both the age groups.[30]

Physical health, body composition with energy balance

Consistent to existing evidence, comparison between the group exhibited a significant result in variables Body Mass Index (BMI) (*P* value- 0.0177), fat percentage (*P* value- 0.0314), Muscle percentage (*P* value- 0.000), and BMR (*P* value- 0.031) showing the better effect of HAAEP in the IG subjects, whereas CG showed the fat mass and BMI raise towards the negative side.

The rate of adipose and fibrous tissue accumulation in the intra-muscular and inter-muscular area progressively increases with the process of aging associated with reduction in oxidative capacity, leading to higher risk in causation of metabolic syndrome resulting in non-communicable diseases (NCD) and a range of physical disabilities.[31,32] Reduction in the percentage of body fat and improvement in the muscle percentage is probably due to increase in morphological and neuromuscular muscle quality due to the type of exercise (combination of aerobic-resistance and isometric-isokinetic) executed. Interventions with multicomponent PA and other lifestyle modifications can influence the catabolic and anabolic metabolisms reducing sarcopenic factors and improve lean mass.[18] Enhanced neural and morphological adaptation mechanism results in activated neuromuscular coordination, higher muscle density, and improved muscle strength after long-term supervised exercise programs.[33] Loss of accumulated fat in the muscular area and visceral fat loss can be due to combination of resistance and aerobic exercise as reported in few researches.[34] BMR changes impacts fat percentage also, large weight loss was evidenced in few studies after high intensity interval training due to equalization of energy expenditure and fat loss after moderate intensity continuous training, where the energy was not equalized.[35-37] Recent researches recommend incorporation of multiple component-based high interval exercise training increasing metabolic stress component has positive impact on overall body composition and physical fitness along with combatting cardio metabolic risk.[38,39] Recent meta-analysis reported

a high level of correlation between resistance training and lowering of BMI, improvement in lean body mass due to enhanced hormonal regulation and muscle protein synthesis, regression in sarcopenic obesity and related physical frailty in aging population.[40] Potential multicomponent exercise program like HAAEP can be promising in mitigating the decline in muscle function, joint mobility, risk of metabolic abnormalities, etc. and body composition-related functional outcomes followed in a regulated pattern.Studies emphasize on practice of habit formation and progressively building stronger habits with consistency can help in weight controlling behavior in middle age population preventing the occurrence of non-communicable diseases in older age.[24]

Physical exercise program integrated with social component for Psychosocial wellbeing

Social connectivity showed significant positive effect when HAAEP program was applied as a group-based intervention program including the whole community. Itwas highly effective especially in rural communities' building profound social bonding. A significant insight was shed by the results obtained in the intervention group ($P < 0.001$). As per WHO, active aging is a lifelong process where planned health promotion approaches for aging population should be implemented emphasizing social participation, inclusion and community support.[41] National Institute for Health and Clinical Excellence (U.K.) stressed on maximizing local communities engagement for better health and well-being and reduction in health disparities.[42] HAAEP program focused on family centric empowerment for stronger attainment of preventive health behavior by inculcating individual and group based sessions, in person and online sessions for the family members. Research studies are based on Pender's Health Promotion Model construct and family empowerment which lead to enhancement in preventive behavior of the participant.[43] Studies also discussed about the success and failures of community empowerment for health promotion, challenges of community stake holders, underdeveloped health care system, etc., in the developing countries affect the implementation of community-based interventions.[44] Another study emphasizes the importance of crafting effective policies that foster lifelong learning motivation, alongside ensuring robust social security measures and the availability of alternative care options. Additionally, the study emphasizes the need for social support strategies that promote healthy aging among older adults.[45,46] A scoping review emphasized a strongly positive association between functional social support (emotional, instrumental, informational, companionship, and social comparison) and PA, stating that loneliness prevailing from middle age is a high risk cause of physical and psychosocial functional decline where community group PA interventions can impact highly the PA, social companionship, and connectedness among aging population.[47] Longitudinal studies in European countries observed PA interventions practiced with partners from community improved peer-based social support, while family supported PA or leisure walking improved overall functions of Brazilian aging population.[48]

Success of our program is highly contributed to the active approach and participation by community stake holders like, health care workers (ASHA workers, etc), ward members, family members holistic association, participant's social engagement like volunteering for the program holistically improved social connectedness and community driven success component of the HAAEP program, as well-structured orientation and educational sessions were consistently provided with regular follow ups. Community-based group intervention pattern improved the social participation which led to higher reach of intervention, facilitated maximum coverage removing barriers to access and reception of the program by most marginalized groups of the rural area.

Limitations and recommendations

The study with its positive impacts also has some limitations to be considered. Limited to rural settings, mid-intervention data collection and longitudinal with repeated assessments may be useful for tracking qualitative progress through-out the program.

Promoting PA among older adults is crucial for healthy aging, especially when their social support and social connectedness might be lower. In the countries like India with emerging public health policies based on Healthy Aging, public health interventions should target this demographic need to consider strong support networks. Capacity building of the health care professionals such as medical, nursing and allied professionals such as physiotherapy engaged in primary care and academicians engaged in aging and public health research focused in aging and health promotion are recommended to apply such interventions with team-based collaborative approach. Programs like HAAEP raise awareness among gross root level health workers, community leaders, self-help group communities, aging societies, and related voluntary associations for sustainable healthy aging interventions at community level.

Conclusion

The findings of the study highlight the vital role of physical activity and quality social connections for physical and mental wellbeing. The novelty of the study in contributing healthy aging with primary care approach

derives essential direction for future health policies in Indian public health care by integrating multi-disciplinary and collaborative approach of health care and allied health care professionals working for preventive care for healthy aging in reference to the swift growing aging population in India, consistent to the WHO Global Action Plan on Physical Activity (GAPPA).[49] A cost-effective community-based multicomponent exercise program like HAAEP protocol makes a valuable and effective program for preventive community-based health care, adaptable to age varying populations and diverse community settings, especially low resource settings and middle income countries like India. Significant improvement was found in the overall health and well-being of the participants along with the enhancement of supportive and inclusive environment for diverse age groups. HAAEP will be a sustainable strategy for preventive health to promote active aging with focus on gait, balance-coordination, psychological, and social wellbeing to claim overall quality health outcomes in aging population.

Abbreviations

Basal Metabolic Rate (BMR)
Body Composition Analyser (BCA)
Body Mass Index (BMI)
CG (Control Group)
Full turn (FT)
Functional Reach Test (FRT)
Hand-Held Dynamometer (HHD)
Healthy and Active Aging Exercise Program (HAAEP)
IG (Intervention Group)
International Physical Activity Questionnaire (IPAQ)
Modified Sit And Reach test (MSRT)
Physical Activity (PA)
Sit-to-stand test (StS)
Six-minute walk test (6MWT)
Timed up-and-go test (TUG)
World Health Organization (WHO)

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Informed consent

Informed consent was obtained from all participants involved in the study.

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Conflicts of interest

There are no conflicts of interest.

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