

# A systematic review of single health behavior change interventions vs. multiple health behavior change interventions among older adults

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## ABSTRACT

Multiple behavior change is widely used to reduce targeted health behaviors; however, its effect on behaviors such as physical activity, nutrition, and alcohol and tobacco use among older adults remains inconclusive. The primary purpose of this systematic review was to evaluate the effects of single health behavior change (SHBC) interventions vs. multiple health behavior change (MHBC) interventions among older age individuals. PubMed was searched for publications on health behavior interventions from 2006 to 2011. Twenty-one randomized clinical trials assessed the effects of health behavior change in older individuals. Results were reviewed by a number of health behaviors and effectiveness. Results revealed that within SHBC interventions, physical activity or exercise behavior revealed that interventions were the most common and showed the most promise in influencing positive outcomes in physical activity behavior among community-dwelling older adults. There were too few MHBC studies identified to allow confident comparison to SHBC interventions. The MHBC field is still at an early stage within the older adult literature, and more attention is recommended to investigate if the benefits of MHBC apply to this age group.

## KEYWORDS

Health behavior change, Older adults, Physical activity, Nutrition, Tobacco, Alcohol

According to the Center for Disease Control, National Center for Health Statistics (CDC), 80 % of older adults have one chronic condition, and 50 % have at least two [4]. In 2007, the top four major causes of death among older adults were heart disease (28.2 %), cancer (22.2 %), stroke (6.6 %), and chronic lower respiratory disease (6.2 %). This demonstrates the need for more focused public health research that identifies effective chronic disease prevention efforts.

Additionally, CDC projects that by 2030, the number of U.S. adults aged 65 or older will more than double to about 71 million adults [4]. These estimates have led the CDC to make several

## Implications

**Research:** More MHBC studies are needed in older adults to inform if such approaches are effective, provide synergy, provide savings of resources, are more cost effective; or if they provide too large of a burden, are too confusing; and ultimately if MHBC is a better investment compared to SHBC approaches.

**Practice:** Older adults respond well to behavior change interventions delivered one behavior at a time. Practical experience in MHBC needs to be gained, evaluated, and documented to see if MHBC interventions are feasible and accepted by older adults.

**Policy:** Evidence-based single health behavior change programs exist for older adults; however, the evidence of multiple health behavior change does not yet exist.

recommendations for efforts that target to improve the mental and physical health of all Americans in their later years [4]. The National Report Card for the State of Aging and Health in America depicts data on 15 key indicators related to the health of adults aged 65 years and older for the United States. Key indicators for health risk behaviors for older adults include lack of activity, eating less than five fruits and vegetables per day, obesity, and current smoking. In 2009, data for persons 65 and older revealed that 32.7 % of older adults engaged in no leisure time activity, 72.5 % were eating less than five fruits and vegetables daily, 23.8 % were obese, and 8.3 % were currently smoking [5]. The United States met five of the ten healthy people 2010 targets for older adults ahead of schedule. The targets included oral health/complete tooth loss, people currently smoking, mammograms within the past 2 years, colorectal cancer screenings, and cholesterol checked within the past 5 years; however, only one target (people currently smoking) was from the key indicators for health behavior as listed in [5]. This underscores the importance of identifying specific health intervention efforts that address

preventable health risk behaviors among older adults.

#### SINGLE VS. MULTIPLE BEHAVIOR CHANGE APPROACH

Single health behavior change (SHBC) interventions may be more focused on specific content, less confusing, and able to more comprehensively address intervention components. This notwithstanding, intervening on single behaviors can be complex and challenging—treating multiple behaviors is even more so. Conventional wisdom has been that it is not possible to treat multiple behaviors simultaneously because it is too burdensome and places too many demands on a person's inherent ability to change [21]. Multiple health behavior change (MHBC) interventions are defined as efforts to treat two or more health behaviors either simultaneously or sequentially within a limited time period [22]. However, MHBC interventions for a common health objective, e.g., cancer prevention, diabetes self-management, or weight management, have shown significant multiple behavior changes [13–15, 26, 27, 31]. For example, smokers treated for two or three behaviors were as effective in being abstinent at long-term follow-up as those treated for only smoking [28].

The hypothesis is that treating multiple behaviors is as, or more, effective with each of the target behaviors without reducing the effectiveness of treating one behavior at a time. MHBC interventions, if as effective or better, provide a better use of resources applicable to a variety of health behaviors [20, 23]. Moreover, since it has been noted that multiple risks multiply the health care burden both in terms of medical consequences and costs [7, 32], studying intervention effectiveness in this context is important. Goldstein et al. [10] concluded that large gaps remain in MHBC knowledge and efficacy.

MHBC interventions also address covariation/coaction concepts that individuals taking effective action on one target behavior are much more likely to take effective action on a second behavior and that individuals are likely to take effective action on untreated behaviors that are related to the treated behaviors [13]. Moreover, success in changing one or more lifestyle behaviors also may increase confidence or self-efficacy to improve risk behaviors in individuals who have a lower motivation to change [22]. This is related to the concept of a gateway behavior [21] where one specific health behavior change is thought to lead other health behavior changes. In addition to potentially greater efficiency and impacts on health, MHBC interventions have a high potential for greater real-world applicability and for providing information on effective treatments for behaviors that co-occur [23]. This is especially true among older adults who are more likely to have concurrent health conditions compared to younger adults.

The purpose of this paper is to assess whether SHBC interventions differ in effectiveness when compared to MHBC interventions in older adults by reviewing the literature. The primary health behaviors included physical activity, nutrition, alcohol use, and tobacco use. To increase understanding in this topic, we identified conceptual issues potentially related to SHBC vs. MHBC interventions (Fig. 1).

#### METHODS

Eligibility criteria, data sources, selection of studies, data extraction, precision, and subgroup analyses were identified a priori. The procedure was conducted in accordance with the Cochrane Reviewers' Handbook [12].

##### Eligibility criteria

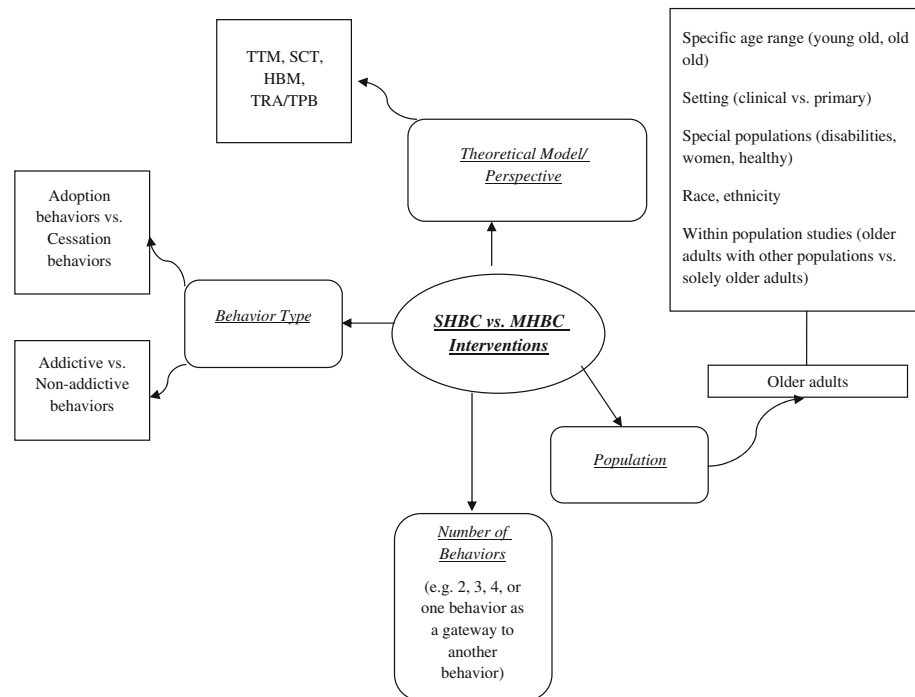
For this review, we included randomized control trials (RCTs) with physical activity, nutrition, tobacco, and alcohol behavior interventions either individually or in some combination on older adults published in the English language. The health behaviors included both adoption (e.g., physical activity) and cessation behaviors (e.g., smoking cessation). As the MHBC field is relatively young [24], the focus was on papers from 2006 to 2011. We included studies with older adults ( $\geq 55+$ ) from community and clinical settings. We excluded trials where the intervention and the outcome were incongruent, trials where the outcome variable was not a health behavior, and animal studies.

##### Information sources and search

A search of the PubMed database was conducted using a systematic combination of key words describing health behavior: physical activity, nutrition, diet, alcohol, drinking, and smoking. Table 1 presents the search terms used and the number of articles identified.

##### Data collection process and quality analysis

First, the first author (CN) independently input all key word search combinations into the PubMed database. After inputting each search combination, the second author (CL) extracted all of the relevant trials and interventions based on the title and abstract. Second, CN and CL then both independently evaluated all the applicable abstracts. Third, CL extracted all of the appropriate full-text articles. If there was a disagreement whether to include an abstract, both authors evaluated the article to come to a joint consensus. For instance, several RCTs where older adult participants were given vitamin D supplements were not included because the trials involved physicians or other health care providers administering the vitamin rather than the older adult performing the behavior themselves. Moreover,



**Fig 1 | Working conceptual map: issues related to SHBC vs. MHBC intervention.** *TTM* transtheoretical model, *SCT* social cognitive theory, *HBM* health belief model, *TRA/TPB* theory of reasoned action/theory of planned behavior, *SHBC* single health behavior change, *MHBC* multiple health behavior change

other trials including exercise behavior but studying falls as the outcome were excluded because the intervention was not congruent with the outcome behavior (Fig. 2).

Titles and abstracts from each of the key word combinations were reviewed, and after applying exclusion criteria, 18 publications incorporating 21 interventions were retained. Precision is defined as the number of relevant reports identified divided by the total number of reports identified [12], so for this review, precision was calculated through the following equation:

$$\text{Precision} = 21/300 = .07 = 7\%.$$

#### Data extraction and coding

The following were extracted for each dataset: population, study recruitment setting, mean age, gender, ethnicity, target sample, health behavior, adoption vs. cessation behavior, results, conclusion, and effectiveness decision. Effectiveness decision was coded a “+” for significance in the right direction, a “0” for null findings, and a “-” for significance of findings in the opposite direction hypothesized. Since the data search yielded RCTs which often combined single and multiple interventions, they were aggregated to see which category (single intervention or multiple intervention) would be conceptually appropriate for data analysis. For example, an intervention may consist of one large study on physical activity in older adults and include two more trials. The trials could include assessments of physical activity and nutrition and/or physical

activity, nutrition, and smoking cessation behavior. Each of the interventions in the trial was then listed or coded as “single” if one health behavior was being studied or “multiple” if more than one health behavior was being studied in the trial.

#### RESULTS

The literature search and review process (see Fig. 2) identified 18 RCTs that met the selection criteria and were included. Sixteen of these studies were SHBC interventions, and two were MHBC interventions in the older adult population. The majority of the included interventions was also adoption interventions (16), while only two were cessation interventions. The most frequently studied was physical activity or exercise behavior (14 studies). Of those, 12 were SHBC interventions, and 2 were MHBC interventions. Four of the included interventions included nutrition or weight loss behaviors, two were SHBC and two were MHBC. Two included SHBC interventions addressed alcohol reduction. Other specific characteristics are displayed in Tables 2 and 3. Effectiveness ratings are also noted in Tables 2 and 3 for each intervention selected.

#### SHBC intervention studies

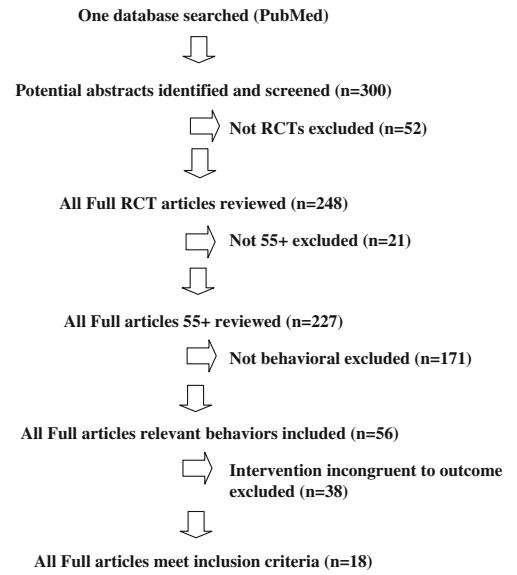
Overall, there was a positive rating of effectiveness in the SHBC interventions. Of the 16 SHBC interventions, the sample size ranged from 38 to 1,971 older adults. Fourteen were conducted in a community setting whereas only two were conducted in a primary

**Table 1** | Search terms used and number of publications identified

Search terms used	Number of results
Older adults + random control trial + physical activity	126
Older adults + random control trial + nutrition	70
Older adults + random control trial + diet	50
Older adults + random control trial + alcohol	13
Older adults + random control trial + drinking	13
Older adults + random control trial + smoking	10
Older adults + random control trial + multiple behavior	0
Older adults + random control trial + multiple health behavior	0
Older adults + random control trial + physical activity + nutrition	13
Older adults + random control trial + physical activity + diet	5
Older adults + random control trial + physical activity + smoking	0
Older adults + random control trial + physical activity + alcohol	0
Older adults + random control trial + physical activity + drinking	0
Older adults + random control trial + nutrition + smoking	1
Older adults + random control trial + nutrition + alcohol	1
Older adults + random control trial + nutrition + drinking	2
Older adults + random control trial + diet + smoking	1
Older adults + random control trial + diet + alcohol	1
Older adults + random control trial + diet + drinking	2
Older adults + random control trial + smoking + alcohol	3
Older adults + random control trial + smoking + drinking	2

care setting. The majority of the reviewed interventions included more females than males. The race/ethnicity of the selected interventions was mainly from the non-Hispanic White population.

Fourteen of the SHBC studies examined adoption behaviors and two studies assessed cessation behaviors. Of the 12 SHBC studies evaluating physical activity or exercise among older adults, participants generally improved their level of activity at follow-up (at 6–12 months). In the nutrition or weight loss behavior studies, intervention participants did better



**Fig 2** | Flow chart of articles in the systematic review. *RCT* randomized control trial

than the controls at follow-up (at least 6 months after the intervention), improving their intake of fruits and vegetables and compliance to dietary recommendations. Both cessation interventions positively influenced the older adult participant’s intake of alcoholic drinks, reducing the number beginning at 2 weeks, up through 12 months. There were 16 positive, 4 zero or neutral, and 2 negative effectiveness ratings for the SHBC interventions (Table 2).

**MHBC intervention studies**

Overall, there was moderate rating of effectiveness in the MHBC interventions. Of the two MHBC interventions, the sample sizes were 94 and 735 older adults. Both were conducted in a community setting. Each of the interventions included more females than males, and the race/ethnicity was mainly from the non-Hispanic White population.

Both MHBC studies examined adoption behaviors, namely, a physical activity behavior and a nutrition related behavior. In one study, the combination of physical activity and fruit and vegetable consumption among older adults improved only the nutrition behavior and not the physical activity behavior at follow-up. In fact, the physical activity behavior result was in the unexpected direction [3]. In the other study, participants improved in both the weight loss behavior and the physical activity behavior (indicated by + signs on Table 3). Thus, there were three positive, zero neutral, and one negative effectiveness rating for the MHBC interventions (Table 3).

**DISCUSSION**

The purpose of this paper was to systematically review the literature and assess whether SHBC interventions differ in effectiveness when compared

Table 2 | Systematic review of SHBC interventions for older adults

Author	Number	Recruitment setting (community vs. clinical)	Mean age	Gender	Ethnicity	Behavior(s)	Adoption vs. cessation behavior	Results	Conclusion	Effectiveness (-, 0, +)
Tan et al. 2006 [33]	113	Community	69	94 % Female	96 % Black	Physical activity (PA, as measured by change in physical activity levels)	Adoption	Results revealed that 53 % of the study participants were more active than the previous year by self-report, as compared to 23 % of the controls ( $P < 0.01$ ). When adjusted for age, gender, and education, there was a trend toward increased physical activity in the study participants as calculated by a kilocalorie per week increase of 40 vs. a 16 % decrease in the controls ( $P = 0.49$ ). Study participants who reported “low activity” at baseline experienced an average 110 % increase in their physical activity at follow-up. Among the controls who were in the low activity group at baseline, there was,	Results suggest that a high-intensity volunteer program that is designed as a health promotion intervention can lead, in the short term, to significant improvements in the level of physical activity of previously inactive older adult volunteers	+ (PA at follow-up)

Table 2 | (continued)

Baker et al. 2007 [1]	38	Community	76.1	63.2 % Female	Not reported	Exercise (EX, as measured by 6-min walk and habitual physical activity level)	Adoption	There were no significant changes in 6-min walk performance (1 % change in exercise group vs. 0.3 % change in controls, $P=0.81$ ). Subjects with the lowest baseline 6-min walk performance showed the greatest improvement in that measure at 10 weeks ( $r=-0.508$ , $P=0.001$ ) compared to controls	on average, only a 12 % increase in physical activity ( $P=0.03$ ). Among those who were previously active, there was no significant difference ( $P=0.30$ )	The findings of the current study may be important when considering exercise prescription in a practical setting	0 (EX 10 weeks)
Fielding et al. 2007 [8]	213	Community	76.5	68.5 % Female	24.9 % Non-White	Physical activity (PA, as measured by increase participation in moderate-intensity walking at a minimum of 150 min/week, in addition to strength	Adoption	Participation in moderate-intensity physical activity increased from baseline to months 6 and 12 in PA compared with health education controls ( $P<0.001$ ). At 12 months, PA	Older individuals at risk for disability can adhere to a regular program of physical activity in a long-term randomized trial	+ (PA at 6 months), + (PA at 12 months)	

participants who reported  $\geq 150$  min/wk-1 of moderate activity demonstrated a significantly greater improvement in their Short Physical Performance Battery score compared with participants who reported  $< 150$  min/wk-1 of moderate activity ( $P=0.017$ )

and balance training three times per week)

Kolt et al. 2007 [16]	186	Clinical	74.1	62.4 % Female	100 % White	Physical activity (PA, Adoption as measured using the Auckland Heart Study Physical Activity Questionnaire)	Moderate leisure physical activity increased by 86.8 min/week more in the intervention group than in the control group ( $P=0.007$ ). More participants in the intervention group reached 2.5 h of moderate or vigorous leisure physical activity per week after 12 months (42 vs. 23 %, odds ratio=2.9, 95 % confidence interval=1.33–6.32, $P=0.007$ )	Telephone-based physical activity counseling is effective at increasing physical activity over 12 months in previously low-active older adults	+ (PA at 12 months)
Greene et al. 2008 [11]	834	Community	74.7	72.9 % Female	79.5 % White, 13.2 % Hispanic-Portuguese, 7.3 % other	Fruit and vegetable consumption (F&V, as measured by the NCI Fruit and	The intervention group increased intake by 0.5 to 1.0 serving more than the control group	The intervention was effective in increasing the intake of fruits and vegetables in older	+ (F&V intake at 24 months)



Table 2 | (continued)

Resnick et al. 2008 [30]	166	Community	73	81 % Female	72 % Black	Physical activity (PA, Adoption time spent in exercise and overall physical activity)	Vegetable Screener and the 5 A Day Program screener)	over 24 months as measured by the NCI Fruit and Vegetable Screener and the 5 A Day Program screener. The majority of the participants (58 %) perceived that they maintained five or more servings per day for 24 months	adults. Those who maintained their level of perceived intake as five or more servings per day consumed two to four servings per day more than those who failed to progress	0 (PA time spent in exercise and overall physical activity week)
Borschman et al. 2010 [2]	121	Community	70	63 % Female	100 % White	Walking (WK, as measured by a pedometer, counted steps	Adoption	No significant differences were found between experimental	This study has highlighted methodological considerations for	0 (WK per week)



Duru et al. 2010 [6]	62	Community	72.8	100 % Female	100 % Black	Walking (WK, as measured by pedometer)	walked daily for 1 week)	groups in steps per day as measured by a pedometer	PA health promotion and research with culturally and linguistically diverse older adults. These findings support the need for investigating person-centered approaches to PA promotion, to overcome individuals' personal and cultural barriers	+ (WK at 6 months)
						Adoption		Intervention participants averaged 12,727 steps per week at baseline, compared to 13,089 steps among controls ( $P=0.88$ ). At 6 months, intervention participants had increased weekly steps by 9,883 on average compared to an increase of 2,426 for controls ( $P=0.016$ )	The Sisters in Motion intervention led to an increase in walking. This is the first RCT of a faith-based physical activity program to increase physical activity among older African-American women and represents an attractive approach to stimulate lifestyle change within this population	
Lin et al. 2010 [17]	239	Community	68.7	74.2 % Male	86.1 % Non-Hispanic, White	Alcohol reduction (AR, as measured by reductions in the number of alcoholic drinks)		There were statistically significant differences in baseline alcohol-related factors	Concern about risks, reading educational material, and perception of physicians providing advice to	+ (AR, per week)

Table 2 | (continued)

<p>between the two groups. Thirty-nine percent of the sample had reduced drinking within 2 weeks of receiving the initial intervention, (13.4+7.9, <math>P=0.001</math>) compared to the controls</p>	<p>reduce drinking were associated with early reductions in alcohol use in older at-risk drinkers. Understanding these factors will enable the development of better intervention strategies to reduce unhealthy alcohol use</p>								
<p>McMurdo et al. 2010 [18]</p>	<p>Community</p>	<p>77.3</p>	<p>100 % Female</p>	<p>100 % White</p>	<p>Physical activity (PA, Adoption as measured by change in daily activity counts measured by accelerometry)</p>	<p>After adjustment for baseline differences, accelerometry counts increased more significantly in the behavior change intervention (BCI) group at 3 months than the control group (<math>P=0.002</math>) and the pedometer plus group (<math>P=0.04</math>). By 6 months, accelerometry counts in both intervention groups had fallen to levels that were no longer statistically and significantly different from baseline</p>	<p>The BCI was effective in objectively increasing physical activity in sedentary older women at 3 months, but physical activity reverted to baseline after withdrawal from the intervention. Provision of a pedometer yielded no additional benefit in physical activity but may have motivated participants to remain in the trial</p>	<p>+ (PA at 3 months), 0 (PA at 6 months)</p>	
<p>Moore et al. 2010 [19]</p>	<p>Clinical</p>	<p>68.4</p>	<p>71 % Male</p>	<p>87 % White, 9 % Hispanic, 3 % other</p>	<p>Reduction in alcohol consumption (RAC, as measured</p>	<p>Cessation</p>	<p>At 3 months, relative to controls, fewer intervention group participants were</p>	<p>A multifaceted intervention among older at-risk drinkers in primary</p>	<p>+ (RAC at 3 months), + (RAC at 12 months)</p>

<p>by the number of drinks in the past 7 days, heavy drinking (four or more drinks in a day) in the past 7 days and risk score)</p>	<p>at-risk drinkers (odds ratio (OR) 0.41, 95 % confidence interval (CI) 0.22–0.75); they reported drinking fewer drinks in the past 7 days (rate ratio (RR) 0.79, 95 % CI 0.70–0.90), less heavy drinking (OR 0.46, 95 % CI 0.22–0.99), and had lower risk scores (RR 0.77, 95 % CI 0.60–0.94). At 12 months, only the difference in the number of drinks remained statistically significant (RR 0.87, 95 % CI 0.76–0.99)</p>	<p>care does not reduce the proportions of at-risk or heavy drinkers, but does reduce amount of drinking at 12 months</p>							
<p>Troyer et al. 2010 [35]</p>	<p>Community</p>	<p>60</p>	<p>82.9 % Female</p>	<p>61 % White</p>	<p>Dietary Approach to Stop Hypertension (DASH) dieting (DD, as measured by using 24-h food recalls at baseline, 6 and 12 months)</p>	<p>Adoption</p>	<p>Participants who received meals were 20 % (<math>P=0.001</math>) more likely to reach intermediate DASH at 6 months and were 18 % (<math>P=0.007</math>) more likely to meet saturated fat at 12 months than were those who did not receive meals. When stratified by race and income, gains were</p>	<p>Delivery of seven DASH meals per week was found to increase compliance with dietary recommendations among noncompliant older adults with cardiovascular disease</p>	<p>+ (DD at 6 months), + (DD at 12 months)</p>

Table 2 | (continued)

van Stralen et al. 2010 [37]	1,971	Community	64	57 % Female	100 % White	Physical activity (PA, Adoption as measured by weekly minutes of total PA behavior and weekly minutes of five leisure activities)	marginally larger for Whites and higher income individuals	At baseline, participants were physically active for on average 634.9 min/week (SD=451.9). Participants in the environmentally tailored intervention increased their PA behavior by almost 50 min/week more than participants in the basic intervention (environment vs. basic = 48.5, 95 % CI=-6.3-103.3; P=0.08)	The results found that providing environmental information is an effective intervention strategy for increasing PA behavior among older adults, especially among certain at-risk subgroups, such as lower educated, overweight, or insufficiently active participants	- (PA at baseline), - (PA at 12 months)
Teri et al. 2011 [34]	273	Community	79.2	61.9 % Female	90.5 % White, 3.3 % Asian or Pacific Islander, 4.8 % Black not Hispanic, 0.4 % Hispanic, 0.7 % native American, 0.4 % multiracial	Physical activity (PA, Adoption as measured by the Seattle Protocol for Activity (SPA) curriculum for home-based physical activity including a 6-min walk test)	Older adults participating in low levels of regular exercise can establish and maintain a home-based exercise program that yields immediate and long-term physical and affective benefits	Older adults participating in low levels of regular exercise can establish and maintain a home-based exercise program that yields immediate and long-term physical and affective benefits	+ (PA as measured by the SPA at 3 months), + (PA as measured by the SPA at 18 months)	

Rejeski et al. 2011 [29]	83	Community	66.9	62.7 % Female	79.5 % White, 18.1 % Black, 2.4 % other	Physical activity (PA, Adoption as measured by participating in 30+ min of moderate-intensity activity in most, if not all, days of the week for a total weekly accumulation of 150+ min)	Levels of moderate PA at 6 months were significantly higher in the PA group ( $P=0.0028$ ) than the successful weight loss and physical activity or aging groups (PA (mean (SE) = 189.5 (13.7) min/week, WL + PA = 223.4 (12.9) min/week, and SA = 123.8 (13.9) min/week)	Additional research is required to examine the meditational processes such as weight loss and successful aging that related to physical activity in older adults	+ (PA at 6 months)
Weinstock et al. 2011 [36]	1,650	Community	70.8	63.6 % Female	48.3 % White, 15.2 % Black, 35.8 % Hispanic, 0.7 %	Physical activity (PA, Adoption as measured by pedometer use)	In the telemedicine group compared with the usual care group, the rate of decline in PA ( $P=0.0128$ ) was significantly less over time. Significant mean endpoint differences were observed for PA ( $P=0.003$ ). Pedometer use was significantly associated with PA ( $P=0.0006$ ) and PI ( $P<0.0001$ )	The telemedicine intervention reduced rates of decline in PA in older adults with diabetes. Pedometers may be a helpful inexpensive adjunct to diabetes initiatives delivered remotely with emerging technologies	+ (PA)

Table 3 | Systematic review of MHBC interventions in older adults

Author	Number	Recruitment setting (community vs. clinical)	Mean age	Gender	Ethnicity	Behavior(s)	Adoption vs. cessation behavior	Results	Conclusion	Effectiveness (-, 0, +)
Campbell et al. 2009 [3]	735	Community	66.5	49.4 % Female	64.6 % White, 35.4 % Black	Fruit and vegetable consumption (F&V, measured as how often food was consumed in the last month), physical activity (measured as minutes per week spent in very hard, and moderate intense activity)	Adoption	A significant increase in F&V consumption was found for the combined intervention group in the entire sample ( $P < 0.05$ ). An increase of 1.0 serving in the combined intervention group (baseline: mean 5.4, 2.8 SD; follow-up: mean 6.4, 2.8 SD), compared to a 0.5 serving for each independent intervention and little change for controls ( $P < 0.01$ ). For physical activity, none of the interventions produced statistically significant improvements. At baseline, average self-reported MVPA was approximately 290 minutes per week, meeting the Centers for Disease Control recommendation of at least	This study indicates that combining tailoring and motivational interviewing may be an effective and cost-effective method for promoting dietary behavior change among older healthy adults	+ (F&V consumption) – (PA at follow-up)

150 min per week of moderate and vigorous physical activity. At follow-up, participants in all study conditions reported less physical activity compared to baseline, and there were no differences between groups

Rejeski et al. 2011 [29]	94	Community	66.8	67 % Female	86.2 % White, 13.8 % Black	Weight loss (WL, as measured by reducing caloric intake to produce a weight loss of approximately 0.3 kg/week for the first 6 months of treatment for a total of weight loss of 7–10 %; physical activity (PA, measured by participating in 30+ min of moderate-intensity activity in most, if not all, days of the week for a total weekly accumulation of 150+ min)	Adoption	There was statistical significance related to the number of days individuals meet their calorie ( $r=0.25$ , $P=0.02$ ) and saturated fat ( $r=0.29$ , $P<0.01$ ) goals. In addition, those in the WL + PA lost 8.6 % (17.8 kg) of their body weight in the first 6 months, whereas weight loss was approximately 1 % in both PA (2.7 kg) and SA (2.3 kg). Levels of moderate PA at 6 months were significantly higher in WL + PA ( $P<0.001$ ) as compared with SA: PA (mean (SE)=189.5 (13.7) min/week, WL + PA=223.4 (12.9) min/week, and SA=123.8 (13.9) min/week	Results illustrate that WL + PA can be effective in improving older adults' eating behavior and that these changes are prospectively related to the amount of weight loss	+ (WL by caloric intake), + (PA by moderate-intensity activity)
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to MHBC interventions in older adults. The primary health behaviors included were physical activity, nutrition, alcohol use, and tobacco use. To our knowledge, this is the first review to attempt to compare SHBC interventions to MHBC interventions among older adults. The idea of identifying which type of intervention (SHBC vs. MHBC) is most effective among older adult populations has been alluded to in several studies [9, 22, 25]. Our preliminary findings show that there were substantially more (>4 times) positive SHBC intervention behavior changes than MHBC interventions behavior changes identified, while the number of negative SHBC interventions behavior changes was higher than the number of negative MHBC interventions (2:1 ratio). However, there were also substantially more SHBC interventions found overall than MHBC interventions (8:1 ratio). We strongly caution any comparative interpretations of SHBC vs. MHBC interventions at this time. In fact, there are too few MHBC interventions at this point to make any confident comparative conclusions at this point.

Overall, the SHBC interventions on physical activity or exercise behavior revealed the most positive outcomes in physical activity behavior among community-dwelling older adults. In addition, two of the SHBC studies included positive nutrition/weight loss behaviors, and two included positive alcohol cessation behaviors. Single behavior intervention targets one behavior, and interventions may be more focused on specific content, less confusing, and able to more comprehensively address intervention components compared to multiple behavior approaches. The SHBC intervention findings reflect that single behavior health interventions can be effective in physical activity, nutrition, and alcohol use. These findings are important and underline to continue implementing effective efforts to promote the health behaviors of older adults.

Conversely, it is too early to conclude about the effectiveness of MHBC interventions in older adults although there is some preliminary evidence presented that these intervention types are feasible and can produce positive results in this population [29] including underserved/minorities. Identifying if MHBC interventions are effective with older adults, with underserved and minority older adults, and for what conditions, may improve the way health behavior change interventions are designed to maximize benefits. This type of knowledge has the potential to improve the efficiency and impacts that interventions have on health for greater real-world applicability [23].

Limitations to be considered are that this review was limited to peer-reviewed studies on older adults accessed through one database, PubMed, using specific key word choices. Due to the nature of this process, some RCT may have been missed. To mitigate this limitation, the reference list of each study in this review was cross-checked for other viable studies. Moreover, the limited number of

MHBC interventions limited any conclusions for these types of studies at this time. Finally, although many of these interventions reported significant results, the majority of these studies were conducted with community-dwelling older adults who were of a similar background limiting the possibility of generalizing these results to other populations.

#### Future directions/conclusions

More MHBC studies are needed in older adults at this time to inform if such approaches are effective, provide synergy and savings of resources or are more cost effective, provide too large of a burden, are too confusing, and if this is a better investment compared to SHBC approaches.

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1. Baker MK, Kennedy DL, Boble PL, et al. Efficacy and feasibility of a novel tri-modal robust exercise prescription in a retirement community: a randomized, controlled trial. *J Am Geriatr Soc.* 2007;55(1):1-10.
2. Borschman K, Moore K, Russell M, Ledgerwood K, Renehan E, Lin X. Overcoming barriers to physical activity among culturally and linguistically diverse older adults: a randomized controlled trial. *Australas J Aging.* 2009;29(2):77-80.
3. Campbell MK, Carr C, DeVellis B, et al. A randomized trial of tailoring and motivational interviewing to promote fruit and vegetable consumption for cancer prevention and control. *Ann Behav Med.* 2009;38(2):71-85.
4. Centers for Disease Control and Prevention Healthy Aging Program State of Aging and Health in America Available at: <http://www.cdc.gov/aging/data/stateofaging.htm>. Accessed September 20, 2011.
5. Centers for Disease Control and Prevention Chronic Disease Prevention and Health Promotion Healthy Aging. Available at: <http://www.cdc.gov/chronicdisease/resources/publications/AAG/aging.htm>. Accessed September 20, 2011.
6. Duru OK, Sarkisian CA, Leng M, Mangione CM. Sisters in motion: a randomized controlled trial of a faith-based physical activity intervention. *J Am Geriatr Soc.* 2010;58(10):1863-1869.
7. Edington DW, Yen LT, Witting P. The financial impact of changes in personal health practices. *J Occup Environ Med.* 1997;39:1037-1046.
8. Fielding RA, Katula J, Miller ME, et al. Activity adherence and physical function in older adults with functional limitations. *Med Sci Sports Exerc.* 2007;39:1977-2004.
9. Fisher EB, Fitzgibbon ML, Glasgow RE, et al. Behavior matters. *Am J Prev Med.* 2011;40(5):e15-e30.
10. Goldstein MG, Whitlock EP, Depue J. Multiple behavioral risk factor interventions in primary care: summary of research evidence. *Am J Prev Med.* 2007;27:61-79.
11. Greene GW, Fey-Yensan N, Padula C, Rossi S, Rossi JS, Clark PG. Change in Fruit and Vegetable intake over 24 months in older adults: results of the SENIOR Project intervention. *Gerontologist.* 2008;48(3):378-387.
12. Higgins JPT, Green S (editors). *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from: [www.cochrane-handbook.org](http://www.cochrane-handbook.org).
13. Johnson SS, Pavia AL, Cummins CO, et al. Transtheoretical model-based multiple behavior intervention for weight management: effectiveness on a population basis. *Prev Med.* 2008;46(3):238-246.
14. Jones H, Edwards L, Greene G, et al. The efficacy of stages of change interventions in diabetes self-care and control. In: *61st Annual Conference of the American Diabetes Association*. Philadelphia, PA; 2001.
15. Jones H, Edwards L, Vallis TM, et al. Changes in diabetes self-care behaviors make a difference in glycemic control: the Diabetes Stages of Change (DiSC) study. *Diabetes Care.* 2003;26(3):732-737.
16. Kolt GS, Schofield GM, Kerse N, Garrett N, Oliver M. Effect of telephone counseling on physical activity for low-active older people in primary care: a randomized, controlled trial. *J Am Geriatr Soc.* 2007;55:986-992.

17. Lin JC, Karno MP, Barry KL, Blow FC, Davis JW, Tang L, Moore AA. Determinants of elderly reductions in drinking in older-at-risk drinkers participating in the intervention arm of a trial to reduce at-risk drinking in primary care. *J Am Geriatr Soc.* 2010;58:227-233.
18. McMurdo ME, Sugden J, Argo I, et al. Do pedometers increase physical activity in sedentary older women? A randomized controlled trial. *J Am Geriatr Soc.* 2010;58:2099-2106.
19. Moore AA, Blow FC, Hoffing M, et al. Primary care-based intervention to reduce at-risk drinking in older adults: a randomized control trial. *Soc Study Addict.* 2010;106:111-120.
20. Nigg CR, Allegrante JP, Ory M. Theory-comparison and multiple-behavior research: common themes advancing health behavior research. *Heal Educ Res.* 1999;17:670-679.
21. Patterson R. *Changing Patient Behavior: Improving Outcomes in Health and Disease Management.* San Francisco: Jossey-Bass; 2001:238.
22. Prochaska JO. Multiple health behavior research represents the future of preventive medicine. *Prev Med.* 2008;46:281-285.
23. Prochaska JJ, Nigg CR, Spring B, Velicer WF, Prochaska JO. The benefits and challenges of multiple health behavior change in research and in practice. *Prev Med.* 2010;50:26-29.
24. Prochaska JJ, Spring B, Nigg CR. Multiple health behavior change research: an introduction and overview. *Prev Med.* 2008;46(3):181-188.
25. Prochaska JJ, Velicer WF, Nigg CR, Prochaska JO. Methods of quantifying change in multiple risk factor interventions. *Prev Med.* 2008;46:260-265.
26. Prochaska JO, Velicer WF, Rossi JS. Multiple risk expert systems interventions: impact of simultaneous stage-matched expert system interventions for smoking, high-fat diet, and sun exposure in a population of parents. *Heal Psychol.* 2004;23(5):503-516.
27. Prochaska JO, Velicer WF, Redding C. Stage-based expert systems to guide a population of primary care patients to quit smoking, eat healthier, prevent skin cancer, and receive regular mammograms. *Prev Med.* 2005;41(2):406-416.
28. Prochaska JJ, Velicer WF, Prochaska JO, Delucchi K, Hall SM. Comparing intervention outcomes in smokers treated for single versus multiple behavioral risks. *Heal Psychol.* 2006;25(3):380-388.
29. Rejeski WJ, Mihalko SL, Ambrosius WT, Bearon LB, McClelland JW. Weight loss and self-regulatory eating efficacy in older adults: the cooperative lifestyle intervention program. *The J Gerontol, Ser B Psychol Sci Soc Sci.* 2011;66(3):279-286.
30. Resnick B, Luisi D, Vogel A. Testing the Senior Exercise Self-efficacy Project (SESEP) for use with urban dwelling minority older adults. *Public Health Nurs.* 2008;25(3):221-234.
31. Rossi J (editor). The healthy changes trial biomedical results. In L. Ruggiero (Chair). Helping people change: the impact of stage-based behavior change interventions in diabetes care. In: *28th Annual Conference of the American Association of Diabetes Educators.* Louisville, KY; 2001.
32. Stewart AL, Verboncoeur CJ, McLellan BY, et al. Physical activity outcomes of CHAMPS II: a physical activity promotion program for older adults. *The J Gerontol Ser A Biol Sci Med Sci.* 2001;56(8):M465-M470.
33. Tan EJ, Qiau-Li X, Tao L, Carlson M, Fried L. Volunteering: a physical activity intervention for older adults—the Experience Corps program in Baltimore. *J Urban Health Bull NY Acad Med.* 2006;83(5):954-969.
34. Teri L, McCurry SM, Hogsdon RG, Gibbons LE, Buchner DM, Larson EB. A randomized controlled clinical trial of the Seattle protocol for activity in older adults. *J Am Geriatr Soc.* 2011;59:1188-1196.
35. Troyer JL, Racine EF, Ngugi GW, McAuley WJ. The effect of home-delivered Dietary Approach to Stop Hypertension (DASH) meals on the diets of older adults with cardiovascular disease. *Am J Clin Nutr.* 2010;91:1204-1212.
36. Weinstock RS, Brooks G, Palmas W, et al. Lessened decline in physical activity and impairment of older adults with diabetes with telemedicine and pedometer use: results from the IDEATEL study. *Age Aging.* 2011;40:98-105.
37. van Stralen MM, de Vries H, Bolman C, Mudde AN, Lechner L. Exploring the efficacy and moderators of two computer-tailored physical activity interventions for older adults: a randomized control trial. *Ann Behav Med.* 2010;39:139-150.