J G S	14129	WILEY	Dispatch: 11.3.16	CE: Ishwarya
Journal Code	Manuscript No.		No. of pages: 15	PE: Iniya Selvi

CLINICAL INVESTIGATIONS

Behavioral Interventions in Six Dimensions of Wellness That Protect the Cognitive Health of Community-Dwelling Older Adults: A Systematic Review

Kelley A. Strout, PhD, RN,* *Daniel J. David*, RN, MSN,† *Elizabeth J. Dyer*, MLIS,‡ *Roberta C. Gray*, MLS,‡ *Regula H. Robnett*, PhD,§ and *Elizabeth P. Howard*, PhD¶

OBJECTIVES: To systematically identify, appraise, and summarize research on the effects of behavioral interventions to prevent cognitive decline in community-dwelling older adults using a holistic wellness framework.

DESIGN: Systematic review of randomized controlled trials that tested the effectiveness of behavioral interventions within each of the six dimensions of wellness: occupational, social, intellectual, physical, emotional and spiritual. Databases searched included PubMed MEDLINE, EMBASE, CENTRAL, PsycINFO, CINAHL, ALOIS, and The Grey Literature Report through July 1, 2014.

SETTING: Community.

PARTICIPANTS: Individuals aged 60 and older (N = 6,254).

MEASUREMENTS: Consolidated Standards of Reporting Trials Checklist.

RESULTS: Eighteen studies met the inclusion criteria. Interventions in the physical dimension of wellness were most common (11 studies); interventions in the spiritual dimension were least common (0 studies). Fifty-nine different measures were used to measure multiple cognitive domains, with memory being the most commonly measured (17 studies) and language being the least commonly measured (5 studies). Fifty percent of the interventions examined in the 18 studies demonstrated statistically significant outcomes on at least one cognitive measure. Interventions in the intellectual dimension that examined cognitively stimulating activities using pen and paper or a computer represented the greatest percentage of statistically significant outcomes.

CONCLUSION: Intellectual and physical interventions were most studied, with varied results. Future research is needed using more-consistent methods to measure cognition. Researchers should include the National Institutes of Health Toolbox Cognition Battery among measurement tools to facilitate effective data harmonization, pooling, and comparison. **J Am Geriatr Soc 2016.**

Key words: cognition; memory; aging; independent living; NIH Toolbox

Maintaining cognitive health and preventing age-related cognitive decline in older adults is a public health priority.[1,2] Older adults want to preserve their cognitive abilities as they age; losing cognitive abilities is among the most feared consequences of aging.[3–5] Risk of cognitive decline increases significantly with age.[6] Adults in their 90s are 75% more likely to demonstrate symptoms of decline than those in their 70s,[6] although cognitive decline is not a direct consequence of aging.[1] To support older adults' ability to protect their cognitive health, providers need to increase their awareness and use of behavioral interventions that demonstrate effectiveness.[2] One specific cognitive intervention may not work for all adults.[7,8] A client-centered holistic approach to address the cognitive health needs of aging adults will lead to stronger protection for the older adult population.[7,8]

Wellness is a holistic and multidimensional state of being that guides one to achieve one's full potential.[9] Wellness behaviors within six dimensions of wellness are associated with cognitive health protection as adults age.[7,8] Healthcare providers need evidence-based recommendations for specific interventions within each dimension of wellness that demonstrate effective cognitive health protection for aging adults within each dimension of wellness. The wellness framework complements a shared decision-making philosophy, through which older adults may select evidence-based interventions based on their preferences,

From the *Department of Nursing, University of Maine School of Nursing, Orono, Maine; †Department of Nursing, Regis College, Weston, Massachusetts; ‡Library Services; §Department of Occupational Therapy, University of New England, Portland, Maine; and ¶School of Nursing, Bouve College of Health Science, Northeastern University, Boston, Massachusetts.

Address correspondence to Kelley A. Strout, School of Nursing, University of Maine, 234 Dunn Hall, Orono, ME 04469. E-mail: kelley.strout@maine.edu

DOI: 10.1111/jgs.14129

0002-8614/16/$15.00

Table 1. Theoretical Definitions for Six Dimensions of Wellness

Dimension of Wellness	Definition
Social	Ability to form and maintain positive personal and community relationships
Intellectual	Commitment to lifelong learning through continuous acquisition of skills and knowledge
Physical	Commitment to self-care through regular participation in physical activity and healthy eating
Emotional	Ability to acknowledge personal responsibility for life decisions and their outcomes with emotional stability and positively
Spiritual	Having purpose in life and a value system
Occupational	Ability to contribute unique skills to personally meaningful and rewarding paid or unpaid work

Adapted from.[9]

values, and motivations. Health behaviors based on a shared-decision making framework increases engagement, confidence, and adherence to evidence-based treatment options.[10] Therefore, it is critical that providers have knowledge of a holistic range of effective behavioral interventions to protect cognitive health as adults age. This study was a systematic review of cognitive health behavioral interventions within six dimensions of wellness.

The Six Dimensions of Wellness[9] guided this review. According to the book, wellness is multidimensional.[9] The integration of six dimensions completes a person. Any dimension can influence each of the other dimensions. For example, if someone demonstrates a low degree of physical wellness, this may negatively influence his or her social wellness. If someone demonstrates a high degree of emotional wellness, this may positively influence his or her occupational wellness. This framework provides an opportunity to offer multiple cognitive health intervention options within the dimension(s) in which the person is most motivated and interested and, consequently, most ready to embrace. The theoretical definitions for each dimension are listed in Table 1.

METHODS

This was a systematic review of the literature on the interventions within six dimensions of wellness that protect cognition as adults age. The review protocol was registered on PROSPERO (CRD42014006654)[11] and conducted in concordance with PRISMA guidelines.[12,13] The research question was: Do community-dwelling older adults aged 60 and older who participate in interventions within the six dimensions of wellness (intellectual, spiritual, emotional, physical, social, occupational) demonstrate less cognitive decline than those who do not participate in these interventions?

Data Sources

Electronic literature searches to locate randomized controlled trials (RCTs) on community-dwelling older adults (≥60) who participated in cognitive decline interventions within the Six Dimensions of Wellness were performed in PubMed MEDLINE (1947-), EMBASE (1980-), CENTRAL (1966-), CINAHL (1937-), PsycINFO (1887-), ALOIS (1982-), and The (NYAM) Grey Literature Report (1999-). All seven databases were accessed in July 2014. Medical Subject Headings (MeSH), subheadings, filters, keyword search terms, and truncated vocabulary were used in the MEDLINE search (Appendix S1). Controlled vocabularies, filters, keywords, and truncated vocabularies were used in the search strategies for EMBASE, CENTRAL, CINAHL, PsycINFO, ALOIS and The (NYAM) Grey Literature Report. (Search strategies are available upon request.) A selection of retrieved articles was also manually searched.

Study Selection

The systematic search followed the inclusion criteria listed in Table 2. The dependent variable of interest was cognition. Cognitive health, as defined by the National Institutes of Health (NIH) Cognitive and Emotional Health Project guided this review: "Cognitive health, as it pertains to the older adult, should not be defined by the presence or absence of disease, but rather the development and preservation of a multidimensional cognitive structure that allows an older adult to maintain social connectedness, experience a sense of purpose, function independently, permit functional recovery from illness or injury, and cope with residual functional deficits."[14] The dependent variable criteria did not include specific cognitive disease states but rather studies that measured at least three of the six cognitive

Table 2. Inclusion Criteria

Inclusion Category	Criteria for Inclusion
Design	Randomized controlled trial
Sample	Interventions involving community-dwelling men or women aged 60 and older
Instrumentation or measurement	Must include measurements from at least three of the following cognitive domains: executive function, attention, episodic memory, language, processing speed, working memory
Outcome comparison variable	Control group
Interventions	Must include at least one behavioral intervention from one or more dimension of wellness: *Occupational*: volunteering, work or career *Social*: social engagement in groups (e.g., movies, concerts, activities), support groups (e.g., reminiscing about life), pets *Intellectual*: computerized games, crossword puzzles, education courses, reading, musical instruments, arts and crafts, cooking, writing *Physical*: physical activity (walking, running, gardening, yoga, Pilates, weight training, video fitness, group fitness, diet) *Emotional*: stress reduction interventions (e.g. meditation, yoga, positive affirmations, stress education classes) *Spiritual*: religious activity involvement (e.g. attending church, prayer, Bible study), spiritual activities (e.g., Reiki)

subdomains included in the NIH Toolbox for the Assessment of Neurological and Behavioral Function, Cognitive Battery (NIHTB-CB),[15,16] which a team of cognitive scientists developed based on results of an intensive systematic review of methods to measure cognition. The toolbox is a valid, reliable multidimensional cognitive measurement that is freely available and applicable to participants aged 3 to 85. The toolbox provides a consistent measure of cognition that facilitates pooling cognitive outcome data to compare cognitive risk factors and interventions.

Because the toolbox was recently developed, it was hypothesized that the number of published studies using it as the primary cognitive measurement or as a supplemental measurement would be minimal. Therefore, the cognitive domains measured in the toolbox were used as a guide for inclusion criteria in this review to assure that included studies were measuring cognition using a multidimensional approach. The six domains were executive function, attention, episodic memory, language, processing speed, and working memory. Memory is a cognitive construct that can be described globally or with specific components of working and episodic memory. Although measurement of working and episodic components provides a more-accurate assessment of how wellness interventions may influence cognition, many authors failed to make this distinction. Broad measures of memory were often used without specific mention of episodic or working memory components. Because memory was inconsistently defined throughout the articles included in this review, articles that measured memory as a global measure were included.[15] The independent variables included interventions from each of the Six Dimensions of Wellness.[9]

Data Abstraction and Analysis

After removal of duplicates, the first selection of studies was based on article title and abstract. Two researchers (KAS, DJD) independently adhered to the inclusion criteria to examine articles to select for full review. Disagreements about articles to include were resolved by consultation with a third reviewer (EPH, RHR). Articles selected for full review underwent quality screening according to the CONSORT checklist for RCTs.[17,18] Data from selected articles were extracted to examine quality of the title and abstract, introduction, methods, results, and discussion. If the article contained half of the required items that the CONSORT checklist identified, the reviewer gave the article a full point for the item. Research studies earning scores of 30 to 35 were defined as high quality, 24 to 29 as moderate quality, 18 to 23 as low quality, and less than 18 as poor quality. One reviewer screened all of the articles for quality, and a second reviewer screened half of them, and then scores were compared. Disagreements between raters were discussed until agreement was reached; a third rater was consulted when needed.

RESULTS

Search Results

Three thousand eight hundred twelve articles were identified, 3,582 of which were excluded after a title review. The remaining 230 were reviewed in abstract form, 52 of which were retrieved in full text. Three articles were added from the authors' knowledge of the literature. Two investigators independently reviewed 55 articles to determine whether they met the established inclusion criteria. Consensus was achieved, and 18 articles qualified for full quality review (Figure 1).

Cognitive Interventions within Dimensions of Wellness

The results of the 18 studies that examined the effect of behavioral wellness interventions on cognition in older adults are listed in Table 3. Within the 18 studies,[19–36] the interventions targeted two main dimensions of wellness—intellectual and physical—but within these main dimensions, some interventions influenced multiple dimensions. Seven studies were coded as influencing multiple dimensions of wellness.[20,23,26,28–31] For example, interventions that were conducted in groups were also coded as influencing social dimensions of wellness. Three studies targeted the emotional dimension of wellness,[28–30] one explicitly targeted social,[30] one targeted occupational,[23] and no studies targeted the spiritual dimension of wellness.

Methods to Measure Cognition

In the 18 studies that met the inclusion criteria for this review,[19–36] 59 different instruments were used to measure multiple cognitive domains. Table 4 shows the cognitive measures according to cognitive domain measured. This summary includes subscales, alternate forms, and alternate language versions of measurement tools. The most common cognitive domain measured in the studies was memory,[19–36] followed by processing speed,[19–23,25–27,32–36] executive function,[19,20,22–25,27,28,30–32,34,35] attention,[21,24–30,32–34] and language.[25,27–29,36] Many authors did not provide the theoretical or operational definitions for subdomains but focused on cognition globally using a variety of subconstructs and instruments. A variety of measurements were used to create composite scores for cognition. Tables 3 and 4 provide a breakdown of the specific cognitive measurements and targeted cognitive domains. When researchers did not clearly link theoretical and operational definitions for cognitive constructs and instruments, the psychometric properties of the instrument were consulted to identify the specific intended cognitive domain. Sixty-six percent of the studies did not explicitly define the subconstructs of memory; when they did, they are identified in Table 3. Five studies[22,28,30,31,36] specifically measured working memory, and three studies[24,30,31] specifically measured episodic memory. Because memory was the most inconsistently defined, Table 3 labels memory subsets when researchers explicitly defined them. There was a notable inconsistency between conceptual and operational definitions of cognitive domains across studies. For example, one study[22] aimed to measure visual scanning and visual motor speed using the Trail Making Test Part A (TMT-A) and executive function using the Trail Making Part B (TMT-B), whereas another[20] aimed to measure executive function and "mental flexibility" using the TMT-A and TMT-B. The specific measures along with the targeted domains for each study are listed in Table 3.

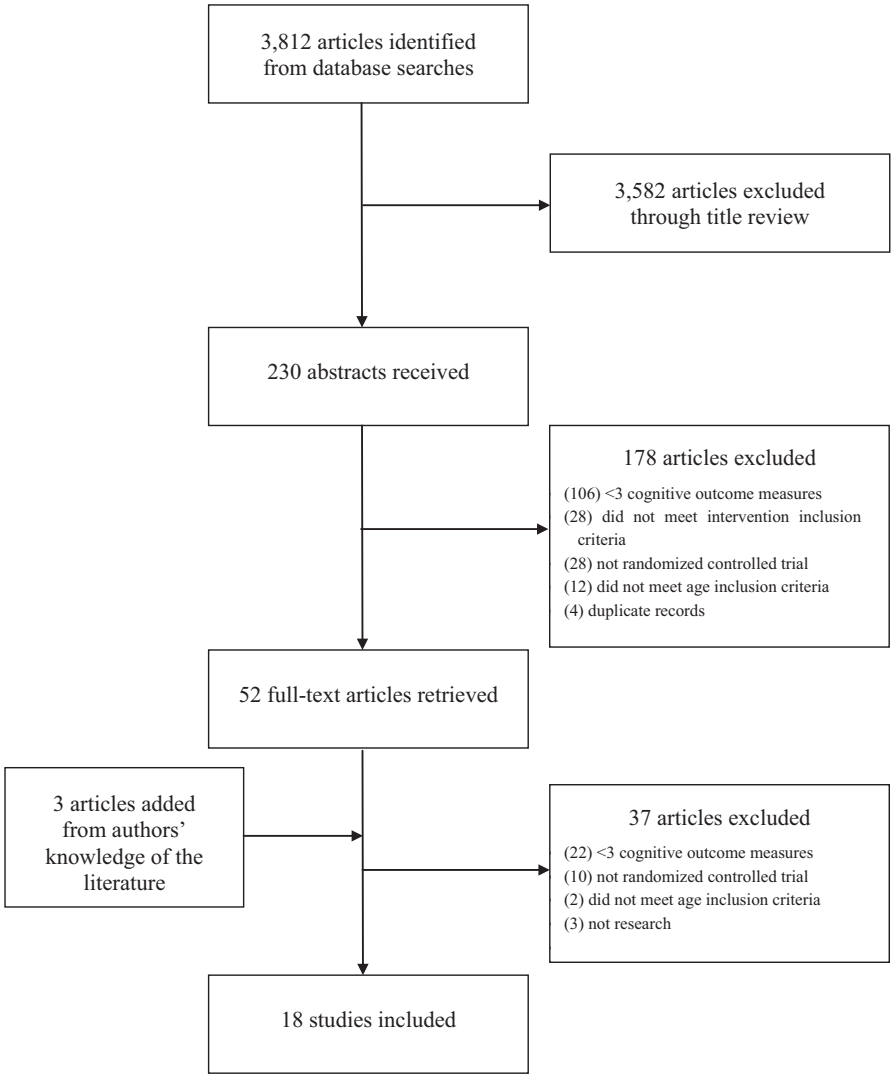

Figure 1. A flowchart summarizing the article selection process.

None of the studies included in this review used the NIHTB-CB as a cognitive measure.

Intervention Details

Thirteen studies (72%) tested an intervention that lasted 12 weeks or longer.[20,22–30,32,34,35] Five studies (28%) tested an intervention that lasted fewer than 12 weeks.[19,21,31,33,36] Interventions that lasted 12 weeks or longer resulted in a greater percentage of statistically significant cognitive outcomes (38%)[22,24,25,28] than those that lasted fewer than 12 weeks (20%).[19] Interventions conducted in groups were most common (72%)[19,20,24–31,34,35]; five studies examined interventions that each older adult conducted independently.[21,22,32,33,36] Brain exercises were the most commonly examined intervention within the intellectual dimension (70%)[19–21,25,32,33,36]; three of these studies examined the effects of brain exercises using a pen-and-paper format,[19,20,25] and four studies examined computerized brain exercises.[21,32,33,36] Other intellectual interventions included piano, theater class, and volunteering.[22,23,31] Walking was the most common intervention examined in the physical dimension of wellness (40%),[27,29,34,35] followed by tai chi.[28,30] General aerobic exercise and resistance training were each examined in two studies,[20,24] and one study examined the effect of a class on the benefits of lifestyle changes.[26] The intervention details are listed in Table 3.

Interventions Demonstrating Improvement in Cognitive Outcomes

Half of the interventions examined in this review demonstrated statistically significant outcomes in at least one cognitive measure.[19,22,24,25,28–30,33,36] Interventions in the intellectual dimension of wellness demonstrated the largest percentage of statistically significant outcomes; 50% of intellectual interventions demonstrated statistically significant improvement in at least one cognitive domain.[19,22,25,33,36] Four studies demonstrated that cognitively stimulating activities significantly improved cognition.[19,25,33,36] One study found that 30 minutes of piano instruction for participants without previous experience with the piano and 3 hours of independent practice resulted

Table 3. Results of Randomized Controlled Trials that Examined Interventions in Six Dimensions of Wellness to Protect Cognitive Health in Community-Dwelling Older Adults

Reference	Participants, n	Age, Mean	Dimension of Wellness	Cognitive Domains and Measures	Intervention Details	Frequency and Dose of Intervention	Results (After Intervention)	Quality Score[a]
Ball (2002)[19]	2,832	77	Intellectual	Memory: Hopkins Verbal Learning Test, RAVLT, RBMT Processing speed: UFOV, word series Executive function: letter series, letter sets, Everyday Problems Test, Observed Tasks of Daily Living	ACTIVE Trial—small-group sessions on memory and episodic memory training for recalling word lists and narratives; reasoning training for problem solving and identifying, blocking, and marking patterns in abstract series of letters and words; speed-of-processing training to identify with increasing difficulty briefly appearing visual objects on a computer screen:	Ten 60- to 75-minute sessions for 5–6 weeks	Significantly greater improvement in memory, reasoning, and processing speed in ACTIVE intervention group than control group; significantly greater improvement in processing speed and function with booster session than with no booster	35
Barnes (2013)[20]	126	73	Physical, intellectual	Memory: RAVLT Executive function: TMT-A and -B, Eriksen Flanker Task Processing speed: UFOV, DSST	Mental games (mental activity intervention); DVD of education lectures (mental activity control); 60 minutes of aerobic exercise 3 x/wk (exercise intervention), stretching (exercise control)	1-hour session 3 x/wk for 12 weeks	No statistically significant difference in cognition outcomes between intervention and control groups	33
Bozoki (2013)[21]	60	Intervention 68 Controls 70	Intellectual	Attention, memory, processing speed: Cogstate battery	My Better Mind: 4 on-line games designed to train attention, processing speed, and memory	1-hour session most days of the week for 6 weeks	No statistically significant difference in cognitive outcomes between intervention and control groups	22
Bugos (2007)[22]	31	Intervention 70 Controls 71	Intellectual	Working memory: WAIS-III, Processing speed: TMT-A Executive function: TMT-B	Individualized Piano Instruction: a broad-based piano education program that becomes progressively more difficult in motor skills and dexterity Music theory: piano exercises from Alfred All-in-one Basic Piano Course Level 1	30-minute lesson and 3 hours of independent practice and homework per week for 6 months	Significantly greater improvement in memory, attention, and executive function in intervention group than control group	19

(Continued)

Table 3 (Contd.)

Reference	Participants, n	Age, Mean	Dimension of Wellness	Cognitive Domains and Measures	Intervention Details	Frequency and Dose of Intervention	Results (After Intervention)	Quality Score[a]
Carlson (2008)[23]	149	Intervention 70 Controls 68	Occupational, social, intellectual, physical	Processing speed: TMT-A Executive function: TMT-B Executive function and memory: ROCF	Intensive volunteer preparation course and volunteering to help elementary school children with reading, library support, and classroom behavior	32-hour volunteer preparation course for 2 weeks; 15 h/wk of volunteering for 1 academic year	No significant difference in cognitive outcome measures between intervention and control groups	28
Cassilhas (2007)[24]	62		Physical	Executive function and short-term memory: WAIS-III Memory: WMS-R Attention: Toulouse-Pieron concentration test Episodic memory: ROCF	High- and medium-intensity resistance training based on American College of Sports Medicine guidelines on resistance training for elderly adults; 8 repetitions of each exercise was completed twice (1:30 minutes between repetitions and 3 minutes rest between exercises)	1-hour session, 3 x/wk for 24 weeks with 10-minute warm-up and leg stretching	Significantly greater improvement in memory, executive function, and attention in moderate- and high-intensity resistance training intervention groups than in control group	19
Cheng (2012)[25]	270	Multidomain training 71 Single-domain training 70 Controls 70	Intellectual	Memory, language, attention: RBANS (Form A) Executive function and attention: Color Word Stroop Test Executive function Visual reasoning test from World Health Organization Neuropsychological Battery of Cognitive Assessment Instruments Processing speed: TMT-A and -B	Multidomain cognitive training and single-domain cognitive training in small-group settings of 15 people	1-hour session, 2 x/wk for 12 weeks with 15 minutes of education, 30 minutes of cognitive training technique, 15 minutes of real-life problem-solving	Single-domain cognitive training resulted in significant improvement in memory, visuospatial, and executive functioning; multidomain cognitive training resulted in significant improvement in attention, memory, and executive functioning; multidomain training demonstrated significantly better maintenance at 12-month follow-up; 1 booster training session significantly enhanced initial training effects	35

(Continued)

Table 3 (Contd.)

Reference	Participants, n	Age, Mean	Dimension of Wellness	Cognitive Domains and Measures	Intervention Details	Frequency and Dose of Intervention	Results (After Intervention)	Quality Score[a]
Clark (2012)[26]	460	75	Physical, social	Memory: Consortium to Establish a Registry for Alzheimer's Disease word list procedure Attention: visual search task Processing speed: DSST	Group sessions with individual one-on-one sessions with an occupational therapist; educational courses on activity, energy, time use, transportation use, home and community safety, social relationships, cultural awareness, goal setting, changing habits	2-hour sessions, 1 x/wk for 6 months for small-group didactics, peer exchange, activities, plus 10 individual 1-hour sessions	No significant difference in cognitive outcomes between intervention and control groups	33
Ijuin (2013)[27]	65	Intervention 74 Controls 74	Physical	Attention, memory, language, executive function: 5-Cog Language, processing speed, attention: WAIS-III Attention, processing speed: DS, A Quick Test of Cognitive Speed color-form, TMT Memory: WMS-R	Walking group	1-h/wk group walk for 20 weeks	No statistically significant difference in cognitive outcomes between intervention and control groups	12
Lam (2011)[28]	389	Intervention 77 Controls 78	Physical, emotional	Memory, executive function, attention: Alzheimer's Disease Assessment Scale-cognitive subscale Language: DS Working memory: delayed recall Executive function, language: CVFT Attention, executive function: TMT—Chinese versions	Introductory tai chi course with weekly teaching; maintenance with a self-study tai chi exercise CD; participants could go to a practice center voluntarily	Introductory course: 30 min/wk for 8–12 weeks; Maintenance: ≥30 minutes 3 x/wk; monthly in-person refresher classes	Significantly greater improvement in attention and global cognitive performance in tai chi intervention than control group	27

(Continued)

Table 3 (Contd.)

Reference	Participants, n	Age, Mean	Dimension of Wellness	Cognitive Domains and Measures	Intervention Details	Frequency and Dose of Intervention	Results (After Intervention)	Quality Score[a]
Maki (2012)[29]	150	72	Physical, social, emotional	Memory, executive function, language, attention: 5-Cog Attention: DSST Executive function: Yamaguchi-Kanji Symbol Substitution Test, TMT	Participants set specific action-oriented and measurable goals, participated in a weekly walking program, planned walking events with other group members, and were encouraged to walk daily with a pedometer	One 90-minute session/wk for 12 weeks with 30 minutes of exercise and 60 minutes of group work setting goals and recording progress	Significantly greater improvement in language and functional capacity for walking intervention group than control group; significant decrease in functional capacity for control group	28
Mortimer (2012)[30]	120	Tai chi 67 Walking 68 Social 68 Controls 68	Physical, social, emotional	Working memory: WAIS-R DS Memory, attention, executive function: Bell Cancellation Test Memory, attention, working memory, executive function: ROCF Episodic memory: Chinese Auditory Verbal Learning Test Executive function: CVFT, WAIS-R, TMT, Clock Drawing Test Attention, executive function: Stroop Test	Tai chi intervention: 20 minutes of warm-up exercises, 20 minutes of tai chi practice, 10 minutes of cool-down Walking intervention: 10 minutes of warm-up, brisk 400-m walk, 10 minutes of cool-down Social Intervention: participant-driven discussion points	Tai chi, walking and social intervention groups met 3 x/wk for 40 weeks	Tai chi intervention demonstrated significantly greater improvement in global cognition, attention, executive function, and memory than control group; social intervention group demonstrated significantly greater improvement in language than control group; no significant difference in cognitive outcomes between walking and control groups	33
Noice and Noice (2009)[31]	122	Theater 80 Voice 83 Controls 82	Social, intellectual	Working memory: Word List Recall, Delayed Word List Recall, DS Episodic memory: Story Recall Task (East Boston Memory Test) Executive function: Problem Solving (Means-End-Problem-Solving Procedure) Memory: Memory Controllability Inventory	Theater course: focused on core process of acting, not line memorization Voice course: focused on breathing, vocal exercises, lyrics	1-hour session 2 x/wk for 4 weeks	No significant difference in cognitive outcomes between intervention and control groups	21

(Continued)

Table 3 (Contd.)

Reference	Participants, n	Age, Mean	Dimension of Wellness	Cognitive Domains and Measures	Intervention Details	Frequency and Dose of Intervention	Results (After Intervention)	Quality Score[a]
Slegers (2009)[32]	191		Intellectual	Memory: Verbal Memory Learning Test Processing speed: Motor Choice Reaction Time, Digit Letter Substitution Test Executive function: Concept Shifting Test Attention: SCWT	Computer and Internet training: participants provided with computer, internet access, and instruction consisting of email, word processing, software, and Internet applications	Three 4-hour training sessions for 2 weeks; 16 homework assignments: 1 every 2 weeks for 4 months, and 1 every month for 8 months	No significant difference in cognition between intervention and control groups	23
Smith (2009)[33]	487	Intervention 76 Controls 75	Intellectual	Memory and attention: RBANS Memory: RAVLT, RBMT, WMS Processing speed: exercise performance	Computerized training: participants provided with computer and asked to perform 6 computer exercises designed to improve speed and accuracy of auditory information processing; gradual increase in difficulty; exercises included time order judgment, discrimination of confusable syllables, matching pairs of confusable syllables, reconstruction sequences of verbal instruction, identification of details in an orally presented story	1-hour session 5 x/wk for 8 weeks (40 hours total)	Statistically significantly greater improvement in processing speed, memory, language, episodic memory, and working memory for computer training group than control group	32
Van Uffelen (2009)[34]	151	75	Physical	Memory: Auditory Verbal Learning Test Executive function: Verbal Fluency Test Processing speed: DSST, Attention: Abridged SCWT	Moderate-intensity walking program based on Sportive Walking, with warm-up, moderate-intensity walking at >3 METs, and cool-down, in outdoor environment Low-intensity walking program with introduction, low-intensity activity at <3 METs, and closing	1-hour session 2 x/wk for 1 year	No significant difference in cognitive outcomes between intervention and control groups	25

(Continued)

Table 3 (Contd.)

Reference	Participants, n	Age, Mean	Dimension of Wellness	Cognitive Domains and Measures	Intervention Details	Frequency and Dose of Intervention	Results (After Intervention)	Quality Score[a]
Williamson (2009)[35]	102	77	Physical	Processing speed, working memory: DSST Processing speed, executive function: Modified Stroop Test Memory: RAVLT	Physical activity intervention combined walking, strength, balance, and flexibility exercises in 3 phases: adoption (Weeks 1–8), transition (Weeks 9–24), and maintenance (Weeks 25–32); one individualized introductory session discussed safety and participation; intervention took place in a center and at home; overall goal to build to at least 150 minutes of walking per week	Adoption phase: 40–60 minutes, 3 x/wk in supervised setting; transition phase: 40–60 minutes 2 x/wk with ≥3 e days of home-based endurance and flexibility exercises, optional 1 x/wk or 2 x/wk center-based sessions, and 1 x/month telephone contact	No significant difference in cognitive outcome measures between intervention and control groups	32
Zelinski (2011)[36]	487	Intervention 76 Control 75	Intellectual	Memory, RAVLT, WMS-R, RBMT Working memory, language, and attention RBANS Processing speed: exercise performance	Computerized cognitive exercises	1-hour session, 4–5 x/wk, 8–10 weeks, total 40 hours	Significantly greater improvement in memory and processing speed for intervention group than control group	31

[a] Maximum 35.

RAVLT = Rey Auditory Verbal Learning Test; RBMT = Rivermead Behavioral Memory Test; UFOV = Useful Field of View; ACTIVE = Advanced Cognitive Training for Independent and Vital Elderly; TMT = Trail-Making Test; DSST = Digit Symbol Substitution Test; WAIS-III = Wechsler Adult Intelligence Scale, Third Edition; ROCF = Rey-Osterrieth Complex Figure; WMS-R = Wechsler Memory Scale—Revised; WMS = Wechsler Memory Scale; RBANS = Repeatable Battery for the Assessment of Neuropsychological Status; WAIS-III DS = WAIS-III, Digit Symbol; WAIS-R = WAIS Revised; DS = Digit Span; CVFT = Category Verbal Fluency Test; SCWT = Stroop Color Word Test; MET = metabolic equivalent of task.

Table 4. Instruments Used to Measure Executive Function, Attention, Memory, Language, and Processing Speed

Instrument	Executive Function	Attention	Memory	Language	Processing Speed
Alzheimer's Disease Assessment Scale—Cognitive Subscale	Lam[28]	Lam[28]	Lam[28]	Lam[28]	
A Quick Test of Cognitive Speed		Ijuin[27]			Ijuin[27]
Auditory Verbal Learning Test			Van Uffelen[34]		
Bell Cancellation Test	Mortimer[30]	Mortimer[30]	Mortimer[30]		
Chinese Auditory Verbal Learning Test	Mortimer[30]				
Clock Drawing Test	Mortimer[30]				
Consortium to Establish a Registry for Alzheimer's Disease Word List Procedure			Clark[26]		
Concept Shifting Test	Slegers[32]				
Cogstate Battery		Bozoki[21]	Bozoki[21]		Bozoki[21]
Category Verbal Fluency Test	Lam[28]		Mortimer[30]	Lam[28]	
Color Word Stroop Test	Cheng[25]	Cheng[25]			
Delayed Word List Recall			Noice[31]		
DS		Ijuin[27]	Lam,[28] Noice[31]		Ijuin27
Delay Recall			Lam[28]		
Digit Symbol Substitution Test		Maki[29]	Williamson[35]		Barnes,[20] Clark,[26] Van Uffelen,[34] Williamson[35]
East Boston Memory Test			Noice[31]		
Eriksen Flanker Task	Barnes[20]				
Everyday Problems Test	Ball[19]				
Exercise Performance					Smith,[33] Zelinski[36]
Hopkins Verbal Learning Test			Ball[19]		
Letter Digit Substitution Test					Slegers[32]
Letter Series	Ball[19]				
Letter Sets	Ball[19]				
Memory Controllability Inventory			Noice[31]		
Motor Choice Reaction Time					Slegers[32]
Modified Stroop Test	Williamson[35]				Williamson[35]
Observed Tasks of Daily Living	Ball[19]				
Problem Solving (Means-End-Problem-Solving Procedure)	Noice[31]				
Rey Auditory Verbal Learning Test			Ball,[19] Barnes,[20] Smith,[33] Williamson,[35] Zelinski[36]		
RBANS		Smith,[33] Zelinski[36]	Smith,[33] Zelinksi[36]	Zelinski[36]	
RBANS (Form A)		Cheng[25]	Cheng[25]	Cheng[25]	
Rivermead Behavioral Memory Test			Ball,[19] Smith,[33] Zelinski[36]		
Rey-Osterrieth Complex Figure	Carlson,[23] Mortimer[30]	Mortimer[30]	Carlson,[23] Cassilhas,[24] Mortimer[30]		
SCWT		Slegers[32]			
Abridged SCWT		Van Uffelen[34]			
Stroop Test	Mortimer[30]	Mortimer[30]			
Story Recall Task (East Boston Memory Test)			Noice[31]		
5-Cog	Ijuin,[27] Maki[29]	Ijuin,[27] Maki[29]	Ijuin,[27] Maki[29]	Ijuin,[27] Maki[29]	
TMT	Mortimer[30]	Ijuin[27]			Ijuin27
TMT—Chinese Version	Lam[28]	Lam[28]			
TMT—Japanese Version	Maki[29]				
TMT A					Bugos,[22] Carlson[23]
TMT A and B	Barnes[20]				Barnes,[20] Cheng[25]
TMT B	Bugos,[22] Carlson[23]				
Toulouse-Pieron Concentration Test		Cassilhas[24]			
Useful Field of View					Ball,[19] Barnes[20]
Verbal Fluency Test	Van Uffelen[34]				

(Continued)

Table 4 (Contd.)

Instrument	Executive Function	Attention	Memory	Language	Processing Speed
Visual Reasoning Test (World Health Organization Neuropsychological Battery of Cognitive Assessment Instruments)	Cheng[25]				
Visual Search Task		Clark[26]			
Verbal Memory Learning Test			Slegers[32]		
WAIS-III	Cassilhas[24]	Ijuin27	Bugos,[22] Cassilhas[24]	Ijuin[27]	Ijuin27
WAIS-III DS				Ijuin[27]	
WAIS-R		Mortimer[30]			
WAIS-R DS			Mortimer[30]		
Word List Recall			Noice[31]		
Word series	Ball[19]				
WMS			Smith[33]		
WMS-R			Cassilas,[24] Ijuin,[27] Zelinski[36]		
Yamaguchi-Kanji Symbol Substitution Test	Maki[29]				

SCWT = Stroop Color Word Test; WAIS = Wechsler Adult Intelligence Scale; DS = Digit Span; WMS = Wechsler Memory Scale; WMS-R = Wechsler Memory Scale Revised.

in significant improvement in memory, attention, and executive function after 6 months for those in the intervention group.[22]

Interventions in the physical dimension of wellness resulted in the second largest percentage of statistically significant outcomes; 40% of physical interventions led to significant improvement in at least one cognitive domain.[24,28–30] Two studies demonstrated significant improvement in at least one cognitive domain after a tai chi intervention,[28,30] one study after resistance training,[24] and one study after a walking intervention.[29] Two studies (40% of studies reviewed) that examined the effect of an intervention in the emotional dimension of wellness demonstrated statistical significance,[28,29] although both of the interventions also influenced the social and physical dimensions of wellness. None of the studies that exclusively examined the cognitive effects of interventions in the emotional, social, or occupational dimensions of wellness demonstrated statistical significance.

Research Quality Review

Eight studies (44%) were of the highest quality (30–35 points) based on the CONSORT checklist,[19,20,25,26,30,33,35,36] four studies (27%) were of moderate quality (24–29 points),[23,28,29,34] five studies (27%) were low quality (18–23 points),[21,22,24,31,32] and one study (5%) was of poor quality (<18 points).[27]

DISCUSSION

The aim of this review was to examine the effectiveness of cognitive health behavioral interventions within Six Dimensions of Wellness. Behavioral interventions have been designed to address cognitive decline in older adults. Intellectual and physical wellness behavioral interventions were most frequently researched to address cognition in older adults, although half of these interventions did not demonstrate statistically significant improvements in at least one cognitive domain.[20,21,23,31,32] The most common interventions in the intellectual dimension involved brain exercises. In the physical dimension walking programs were the most frequently evaluated form of physical activity. Interventions in the intellectual and physical dimensions of wellness resulted in more statistically significant improvements in at least one cognitive domain than interventions in the social, emotional, spiritual, and occupational dimensions of wellness.

Gaps in the Literature

The most prominent gap in the literature is the variation in cognitive measures. This review identified 59 different cognitive measures throughout the 18 studies,[19–36] which creates challenges when trying to compare the effectiveness of interventions on cognitive outcomes. Science addressing cognition in older adults should focus on standardizing cognitive measures.[14] The NIHTB-CB provides royalty-free use of a valid, reliable, multidimensional cognitive measure for individuals aged 3 to 85.[16] Scientific evaluations of cognitive interventions need to measure cognition using standardized tools to increase the ability to pool data and compare outcomes. Scientists should consider including the NIHTB-CB as the exclusive or complementary battery for cognitive measurement.

Correlational cohort studies have demonstrated that behaviors in all six dimensions of wellness are significantly associated with maintaining cognition as adults age,[7] but high-quality studies using a randomized controlled design to examine the effectiveness of behavioral interventions in these dimensions of wellness are limited. Interventions such as aromatherapy, meditation, music therapy, theater, voice, and massage may influence spiritual and emotional dimensions of wellness and therefore may also be associated with better or maintained cognition in older adults.[37,38] More RCTs that measure cognition in multiple

domains are needed in these less-researched dimensions. Scientists should consider expanding their development and assessment of interventions beyond physical and intellectual. Social engagement is another emerging area of research that suggests positive effects on cognition.[2] Ethical considerations may limit the ability to examine the effectiveness of wellness-associated behavioral interventions. For example, engagement in wellness behaviors such as physical activity, healthy eating, and smoking cessation can facilitate chronic disease prevention,[39] and withholding known wellness behaviors from older adults in a randomized controlled trial to examine the benefits of these activities on cognition may increase their risk of developing other chronic diseases.

More research on the functional transferability of interventions is needed. The overall goal of cognitive interventions is to maintain older adults' ability to remain functionally independent, but only two studies that met the established inclusion criteria for this review also measured the effect of cognitive interventions on cognitive function.[19,35] Based on the studies included in this review, even if an intervention significantly influences memory or executive function, it is unknown whether and how the effects transfer to functional performance and independence in daily activities. The results of these findings suggest the importance of examining the interconnected effects of the cognitive domains; there may be combinations of interventions that work in synergy to maintain and affect function.[25] Perhaps providers could identify poorly performing cognitive domains and target interventions accordingly.

The sustainability of intervention effects must also be examined in future research. Even if an intervention successfully improves, or maintains, cognition, it is unknown how long the effects will benefit the older adult or if booster sessions will be needed. Recent investigations found that older adults who received cognitive training in reasoning and speed of processing demonstrated significant improvement in the trained areas that were maintained over 10 years.[40] Older adults who received memory training initially experienced significant memory improvement, but the outcomes were not maintained after 10 years, although all adults who received cognitive training self-reported significantly less difficulty with activities of daily living than those who did not receive the cognitive training.[40] The results of this seminal longitudinal study on the sustainability of behavioral interventions over time highlight the need for more research on optimal dosing and targeting of specific cognitive interventions and how these variables influence daily function.

The timing of interventions should be examined in future research. As adults' age, their risk of cognitive decline increases.[6] Only one study included in this review considered age stratification at baseline; it compared the sample age stratification at baseline with that of the general population, but the effect of the intervention was not compared in specific age groups (65–74, 75–84, ≥85).[19] None of the studies in this review examined the effect of age stratification on intervention effects. Identifying the optimal age(s) at which to promote interventions designed to protect cognition should be explored. RCTs included in this review were designed with at least one control group and included adults aged 60 and older; methods were applied at baseline to maintain consistently between groups, but understanding the age ranges in which cognitive interventions are most influential, which could be decades earlier than currently studied, will ensure the efficacious use of limited healthcare resources.

Supporting an older adults' cognitive health through behavioral interventions is complex and will be influenced by individual levels of motivation, physical and cognitive abilities, and self-efficacy. The most effective interventions may need to target multiple cognitive domains and influence multiple dimensions of wellness while integrating sensorimotor abilities.[7,8,22]

Strengths of the Literature

Nonpharmacological, individual-centered behavioral interventions are viable options to address cognitive decline in older adults. A variety of interventions are available for providers, although more research is needed to determine the most-effective behavioral intervention(s) for maintaining or even improving cognition. Examining behavioral interventions in the dimensions of wellness that may protect and maintain cognition benefits providers in all care settings. Behavioral interventions may incur less risk than pharmacological options, which have not demonstrated significant efficacy in preventing cognitive decline.[41] All of the interventions examined in this review may be administered in the community. The shift of care settings from institutions to the community may reduce healthcare costs and lead to better health outcomes.[42]

Strengths and Limitations of Systematic Review

The older adults included in this review were living in the community. Their ability to live in the community demonstrates a level of independence that is associated with a higher level of cognitive ability than that of those who live with assistance. The overall goal of cognitive health science is to keep older adults living in good health and independently in the community; examining the effects of cognitive interventions in adults living in community settings enables the examination of cognitive benefits before the onset of significant cognitive decline.

The search strategy was limited because of the sample inclusion criteria term "community-dwelling;" this is not a MeSH term and does not map to the MeSH term "independent living." Therefore, some RCTs that included a community-dwelling sample that was not reflected in indexing, title, or abstract would not return in the search results. The breadth of this review, spanning six dimensions of wellness, required this search parameter. Future research with community-dwelling older adult samples should consider adding the term "community-dwelling" to the title, abstract, or key words to assure that studies are identified in database searches.

The duration of interventions ranged from 1 day to 1 year. The time between baseline and final cognitive measurement may not be long enough to establish cognitive changes. More research is needed to establish effective doses and durations for cognitive interventions. The specificity of the inclusion criteria for this review, specifically the exclusion of studies that did not measure at least three

cognitive domains, generated a small number of articles to analyze, but the aim was to include studies that provided a multidimensional cognitive measure, as recommended previously.[14]

Finally, the criteria for the interventions in the six dimensions of wellness and the variation in cognitive measurement created a myriad of findings. Fifty-nine different instruments were used to measure various cognitive domains. The variation of cognitive measures precluded the conduction of a metaanalysis. Methods to pool data adjusting for measurement variation to effectively compare outcomes of cognitive measures are underreported.[43] The variation of cognitive measures limited the ability to combine valid estimates of pooled effects within interventions representing dimensions of wellness. Future research is needed to develop guidelines for effectively pooling data from cognitive measures when instruments and cognitive domains are so disparate,[43] but the most feasible solution for comparing cognitive effects is likely to be for researchers to include the NIH Toolbox Cognition Battery.

Wellness is holistic, and older adults want to improve their cognition.[4,44] Behavioral interventions for improving cognition within a wellness framework strengthen individual-centered care by offering older adults evidence-based cognitive health interventions in which they can decide if they are able, willing, or motivated to participate.

Many studies in the current review used control groups involving intervention for sustained attention, which strengthens the design because researchers can determine more effectively if results are associated with the intervention, rather than with the additional attention/social interaction the participant is receiving. Two-thirds of the studies in the review were of high or moderate quality.

CONCLUSION

Behavioral wellness interventions to maintain cognition or reduce cognitive decline in older adults have been developed but have not been researched adequately. Further research is needed to identify effective behavioral interventions within the Six Dimensions of Wellness[9] and to effectively establish frequency and dosage recommendations of cognitive health interventions. A major concern is the current use of multitudinous cognitive measures, which make interstudy comparisons unfeasible. Researchers need to include the NIH Toolbox Cognition Battery[16] when measuring cognition in wellness-based intervention studies. This relatively simple measure will facilitate the comparison and pooling of cognitive outcomes of behavioral interventions, which have the potential to positively influence cognitive performance in late life.

ACKNOWLEDGMENTS

Conflict of Interest: The editor in chief has reviewed the conflict of interest checklist provided by the authors and has determined that the authors have no financial or any other kind of personal conflicts with this paper.

Author Contributions: Strout: Concept and design, drafting of manuscript, analysis and interpretation of data. David: Analysis and interpretation of data. Dyer, Gray: Acquisition of data, drafting, critical revision. Robnett: Analysis and interpretation of data, drafting, critical revision. Howard: Concept and design, drafting, critical revision.

Sponsor's Role: None.

REFERENCES

1. Centers for Disease Control and Prevention and the Alzheimer's Association. The Healthy Brain Initiative: A National Public Health Road Map to Maintaining Cognitive Health. Chicago: Alzheimer's Association, 2007 [on-line]. Available at http://www.cdc.gov/aging/pdf/thehealthybraininitiative.pdf Accessed March 23, 2015.
2. Institute of Medicine. Committee on the public health dimension of cognitive aging. Cognitive aging: Progress in understanding and opportunity for action [on-line]. Available at http://www.iom.edu/Reports/2015/Cognitive-Aging.aspx Accessed April 16, 2015.
3. Marist Poll. November 2004: Alzheimer's most feared disease [on-line]. Available at www.maristpoll.marist.edu/1114alzheimers-most-feared-disease/ Accessed March 6, 2013.
4. Phelan EA, Anderson LA, LaCroix AZ et al. Older adults' views of "successful aging"—how do they compare with researchers' definitions? J Am Geriatr Soc 2004;52:211–216.
5. Friedman DB, Rose ID, Anderson LA et al. Beliefs and communication practices regarding cognitive functioning among consumers and primary care providers in the United States, 2009. Prev Chronic Dis 2013;10:E58; quiz 8–13.
6. Plassman BL, Langa KM, Fisher GG et al. Prevalence of dementia in the United States: The aging, demographics, and memory study. Neuroepidemiology 2007;29:125–132.
7. Strout KA, Howard EP. The six dimensions of wellness and cognition in aging adults. J Holist Nurs 2012;30:195–204.
8. Strout KA, Howard EP. Five dimensions of wellness and predictors of cognitive health protection in community-dwelling older adults: A historical COLLAGE cohort study. J Holist Nurs 2015;33:6–18.
9. Hettler W. The six dimensions of wellness. 1976 [on-line]. Available at http://www.hettler.com/sixdimen.htm Accessed March 23, 2015.
10. Adams JR, Drake RE. Shared decision-making and evidence-based practice. Community Ment Health J 2006;42:87–105.
11. International prospective register of systematic reviews, PROSPERO [on-line]. Available at http://www.crd.york.ac.uk/PROSPERO/ Accessed May 11, 2015.
12. Liberati A, Altman D, Tetzlaff J et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: Explanations and elaboration. BMJ 2009;339:b2700.
13. Moher D, Liberati A, Tetzlaff J et al. Preferred reporting items for systematic review and meta-analysis: The PRISMA statement. PLoS Med 2009;6:e1000097.
14. Hugh CH, Marilyn SA, Meryl AB et al. The NIH cognitive and emotional health project: Report of the critical evaluation study committee. Alzheimers Dement 2006;2:12–32.
15. Slotkin J, Kallen M, Griffith J et al. NIH toolbox technical manual. National Institutes of Health and Northwestern University, 2012 [on-line]. Available at http://www.nihtoolbox.org/HowDoI/TechnicalManual/Technical%20Manual%20sections/Toolbox%20Cognition%20Battery%20Composite%20Scores%20Technical%20Manual.pdf Accessed April 13, 2015.
16. National Institutes for Health. NIH toolbox for the assessment of neurological and behavioral function [on-line]. Available at http://www.nihtoolbox.org/WhatAndWhy/Cognition/Pages/default.aspx Accessed April 14, 2015.
17. Schultz KF, Altman DG, Moher D. CONSORT 2010 statement: Updated guidelines for reporting parallel group randomized trials. Ann Intern Med 2010;152:W293.
18. Piaggio G, Elbourne DR, Pocock SJ et al. Reporting of noninferiority and equivalence randomized trials: Extension of the CONSORT 2010 statement. JAMA 2012;308:2594–2604.
19. Ball K, Berch DB, Helmers KF et al. Effects of cognitive training interventions with older adults: A randomized controlled trial. JAMA 2002;288:2271–2281.
20. Barnes DE, Santos-Modesitt W, Poelke G et al. The Mental Activity and Exercise (MAX) trial: A randomized controlled trial to enhance cognitive function in older adults. JAMA Intern Med 2013;173:797–804.
21. Bozoki A, Radovanovi M, Winn B et al. Effects of a computer-based cognitive exercise program on age-related cognitive decline. Arch Gerontol Geriatr 2013;57:1–7.

22. Bugos JA, Perlstein WM, McCrae CS et al. Individualized piano instruction enhances executive functioning and working memory in older adults. Aging Ment Health 2007;11:464–467.
23. Carlson MC, Saczynski JS, Rebok GW et al. Exploring the effects of an "everyday" activity program on executive function and memory in older adults: Experience. Corps Gerontol 2008;48:793–801.
24. Cassilhas RC, Viana VA, Grassmann V et al. Impact of resistance exercise on the cognitive function of the elderly. Med Sci Sports Exec 2007;39:1401–1407.
25. Cheng Y, Wu W, Feng W et al. The effects of multi-domain versus single-domain cognitive training in non-demented older people: A randomized controlled trial. BMC Med 2012;10:30–42.
26. Clark F, Jackson J, Carlson M et al. Effectiveness of a lifestyle intervention in promoting the well-being of independently living older people: Results of the Well Elderly 2 randomized controlled trial. J Epidemiol Community Health 2012;66:782–790.
27. Ijuin M, Sugiyama M, Sakuma N et al. Walking exercise and cognitive functions in community-dwelling older adults: Preliminary results of a randomized controlled trial. Int J Geriatr Psychiatry 2013;28:109–110.
28. Lam L, Fung A. Interim follow-up of a randomized controlled trial of leisure activity intervention on preservation of cognitive function in Chinese older adults with mild cognitive impairment. Int J Geriatr Psychiatry 2011;26:733–740.
29. Maki Y, Ura C, Yamaguchi T et al. Effects of intervention using a community-based walking program for prevention of mental decline: A randomized controlled trial. J Am Geriatr Soc 2012;60:505–510.
30. Mortimer JA, Ding D, Borenstein AR et al. Changes in brain volume and cognition in a randomized trial of exercise and social interaction in a community-based sample of non-demented Chinese elders. J Alzheimers Dis 2012;30:757–766.
31. Noice H, Noice T. An arts intervention for older adults living in subsidized retirement homes. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2009;16:56–79.
32. Slegers K, Boxtel V, Jolles J. Effects of computer training and internet usage on cognitive abilities in older adults: A randomized controlled study. Aging Clin Exp Res 2009;21:43–54.
33. Smith GE, Housen P, Davis L et al. A cognitive training program based on principles of brain plasticity: Results from the Improvement in Memory with Plasticity-Based Adaptive Cognitive Training (IMPACT) study. J Am Geriatr Soc 2009;57:594–603.
34. Van Uffelen JGZ, Chinapaw MJM, Hopman-Rock M et al. Feasibility and effectiveness of a walking program for community-dwelling older adults with mild cognitive impairment. J Aging Phys Act 2009;17:398–415.
35. Williamson JD, Espeland M, Kritchevsky SB et al. Changes in cognitive function in a randomized trial of physical activity: Results of the lifestyle interventions and independence for elders pilot study. J Gerontol A Biol Sci Med Sci 2009;64A:688–694.
36. Zelinski EM, Spina LM, Yaffe K et al. Improvement in memory with plasticity-based adaptive cognitive training: Results of the 3-month follow-up. J Am Geriatr Soc 2011;59:258–265.
37. Strout KA, O'Brien LM, Howard EP. The mediator role of positive emotion interventions and cognitive health among community dwelling older adults: A longitudinal cohort study. Healthy Aging Research 2015;4 [online]. Available at http://www.har-journal.com/wp-content/uploads/2015/03/HAR12–2350.pdf Accessed April 17, 2015.
38. Noice T, Noice H, Kramer AF. Participatory arts for older adults: A review of benefits and challenges. Gerontologist 2014;54:741–753.
39. Centers for Disease Control and Prevention. Chronic disease overview [online]. Available at http://www.cdc.gov/chronicdisease/overview/ Accessed May 5, 2015.
40. Rebok GW, Ball K, Guey LT et al. Ten-year effects of the advanced cognitive training for independent and vital elderly cognitive training trial on cognition and everyday functioning in older adults. J Am Geriatr Soc 2014;62:16–24.
41. Naqvi R, Liberman D, Rosenberg J et al. Preventing cognitive decline in healthy older adults. Can Med Assoc J 2013;185:881–885.
42. Institute of Medicine. Committee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing. Washington, DC: National Academies Press, 2011 [on-line]. Available at http://www.iom.edu/Reports/2010/The-Future-of-Nursing-Leading-Change-Advancing-Health.aspx Accessed September 2013.
43. Griffith LE, Heuval EVD, Fortier I et al. Statistical approaches to harmonize data on cognitive measures in systematic reviews are rarely reported. J Clin Epidemiol 2015;68:154–162.
44. Friedman DB, Laditka JN, Hunter R et al. Getting the message out about cognitive health: A cross-cultural comparison of older adults' media awareness and communication needs on how to maintain a healthy brain. Gerontologist 2009;49:S50–S60.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Search strategy for pubmed medline.

Please note: Wiley-Blackwell is not responsible for the content, accuracy, errors, or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.