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Physical Activity and Cognitive-Health Content in Top-Circulating Magazines, 2006–2008

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King, A.C. (2001). Interventions to promote physical activity by older adults. *Journals of Gerontology: Series A, 56(2),* 36–46.
King, A.C., Rejeski, W.J., & Buchner, D.M. (1998). Physical activity interventions targeting older adults: A critical review and recommendations. *American Journal of Preventive Medicine, 15*(4), 316–333.
Kossert, A.L., & Munroe-Chandler, K. (2007). Exercise imagery: A systematic review of the empirical literature. *Journal of Imagery Research in Sport and Physical Activity, 2.* Available at http://www.bepress.com/jirspa/vol2/iss1/art2
Luebbert, K., Dahme, B., & Hasenbring, M. (2001). The effectiveness of relaxation training in reducing treatment-related symptoms and improving emotional adjustment in acute non-surgical cancer treatment: A meta-analytical review. *Psycho-Oncology, 10,* 490–502.
Maxwell, S.E., & Delaney, H.D. (2004). *Designing experiments and analyzing data: A model comparison perspective* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.
Milne, M., Burke, S., Hall, C., Nederhof, E., & Gammage, K. (2006). Comparing the imagery use of older and younger adult exercisers. *Imagination, Cognition and Personality, 25,* 59–67.
Morone, N.E., & Greco, C.M. (2007). Mind-body interventions for chronic pain in older adults: A structured review. *American Academy of Pain Medicine, 8*(4), 359–375.
Murphy, K.R., & Myors, B. (2004). *Statistical power analysis* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.
Naparstek, B. (1994). *Staying well with guided imagery.* New York: Warner Books.
Pliner, P., Chaiken, S., & Flett, G. (1990). Gender differences in concern with body weight and physical appearance over the life span. *Personality and Social Psychology Bulletin, 16,* 263–273.
Rodgers, W.M., Hall, C.R., Blanchard, C.M., & Munroe, K.J. (2001). Prediction of obligatory exercise by exercise-related imagery. *Psychology of Addictive Behaviors, 15,* 152–154.
Tabachnick, B.G., & Fidell, L.S. (2006). *Using multivariate statistics* (5th ed.). Boston: Allyn & Bacon.
Taylor, A.H., Cable, N.T., Faulkner, G., Hillsdon, M., Narici, M., & Van Der Bijk, A.K. (2006). Physical activity and older adults: A review of health benefits and the effectiveness of interventions. *Journal of Sports Sciences, 22*(8), 703–725.
Walker, L.G., Walker, M.B., Ogston, K., Heys, S.D., Ah-See, A.K., Miller, I.D., . . . Eremin, O. (1999). Psychological, clinical and pathological effects of relaxation training and guided imagery during primary chemotherapy. *British Journal of Cancer, 80*(1–2), 262–268.
Wickens, T.D., & Keppel, G. (2004). *Design and analysis: A researcher's handbook* (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
Wiederhold, B.K., Jang, D.P., Gevirtz, R.G., Kim, S.I., Kim, I.Y., & Wiederhold, M.D. (2002). The treatment of fear of flying: a controlled study of imaginal and virtual reality graded exposure therapy. *IEEE Transactions on Information Technology in Biomedicine: A Publication of the IEEE Engineering in Medicine and Biology Society, 6*(3), 218–223.
Willumsen, T., Vassend, O., & Hoffart, A. (2001). A comparison of cognitive therapy, applied relaxation, and nitrous oxide sedation in the treatment of dental fear. *Acta Odontologica Scandinavica, 61*(2), 93–99.
Wilson, P.M., Rodgers, W.M., Hall, C.R., & Gammage, K.L. (2003). Do autonomous exercise regulations underpin different types of exercise imagery? *Journal of Applied Sport Psychology, 15,* 294–306
Wójcicki, T.R., White, S.M., & McAuley, E. (2009). Assessing outcome expectations in older adults: The multidimensional outcome expectations for exercise scale. *Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 64*(1), 33–40
Wolsko, P.M., Eisenberg, D.M., Davis, R.B., & Phillips, R.S. (2004). Use of mind-body medical therapies. *Journal of General Internal Medicine, 19*(1), 43–50.
Wynd, C.A. (2005). Guided health imagery for smoking cessation and long-term abstinence. *Journal of Nursing Scholarship, 37*(3), 245–250.

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Physical Activity and Cognitive-Health Content in Top-Circulating Magazines, 2006–2008

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Physical activity may promote cognitive health in older adults. Popular media play an important role in preventive health communication. This study examined articles discussing associations between physical activity and cognitive health in top-circulating magazines targeting older adults. 42,753 pages of magazines published from 2006 to 2008 were reviewed; 26 articles met inclusion criteria. Explanations regarding the link between physical activity and cognitive health were provided in 57.7% of articles. These explanations were generally consistent with empirical evidence; however, few articles included empirical evidence. Physical activity recommendations were presented in 80.8% of articles; a wide range was recommended (90–300 min of physical activity per wk). Socioeconomic status and education level were not mentioned in the text. Results suggest an opportunity for greater coverage regarding the role of physical activity in promoting cognitive health in popular media. Magazine content would benefit from including more empirical evidence, culturally sensitive content, and physical activity recommendations that are consistent with U.S. guidelines.

Keywords: mass media, health communication, healthy behaviors, content analysis

Cognitive impairment is an important public health issue—it is a major cause of disability and reduced quality of life. This issue is especially relevant for older adults because the prevalence of cognitive decline increases with age (Alzheimer's Association [AA], 2008). Federal agencies and researchers have called for communication campaigns encouraging physical activity to promote cognitive health among older adults (Centers for Disease Control and Prevention [CDC] & AA, 2007; Mathews et al., in press; Mathews et al., 2010; Prohaska & Peters, 2007; Wilcox et al., 2009). Although evidence from randomized controlled trials with humans remains mixed (Heyn, Abreu, & Ottenbacher, 2004), growing evidence from animal models and epidemiology suggests that physical activity may reduce the risk of cognitive decline (American College of Sports Medicine [ACSM] et

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al., 2009; Etgen et al., 2010; Hamer & Chida, 2008; Liu-Ambrose et al., 2010; Sun et al., 2010).

Responding to the *National Public Health Road Map to Maintaining Cognitive Health* (CDC & AA, 2007), the Healthy Brain Study recently examined the public's perceptions of associations between cognitive health and health behaviors (Friedman, Laditka, et al. 2009; Laditka, Beard, et al., 2009; Mathews et al., 2010; Wilcox et al., 2009). The results showed that older adults perceived cognitive health as an important component of healthy aging (Laditka, Corwin, et al., 2009). Participants recognized the link between physical activity and cognitive health; however, they were unclear about the amount of physical activity needed to achieve cognitive-health benefits (Mathews et al., 2010; Wilcox et al., 2009). To inform communication campaigns promoting physical activity and cognitive health, it is useful to examine the volume and scope of existing messages about the association between physical activity and cognitive health (Friedman, Laditka, 2009; Mathews, Laditka, Laditka, & Friedman, 2009; Randolph & Viswanth, 2004).

Messages in the popular media—media frequently accessed by large mainstream audiences—play a vital role in how people construct their notion of reality (Bryant & Zillmann, 2002). Media messages can increase awareness of health risks, provide people with motivation and skills to reduce those risks, and thus positively affect public health (U.S. Department of Health and Human Services, 2000). In addition, media often help establish the public's health agenda by influencing policy makers to support community interventions designed to promote healthy behaviors (Jones, 2004; Kreps & Maibach, 2008).

At the same time, research suggests that health information described in the popular media can be inaccurate and unreliable (Clarke & Binns, 2006; Hoffman-Goetz, Shannon, & Clarke, 2003; Kline, 2006). Friedman, Laditka, et al. (2009) found that many older adults are concerned about confusing and contradictory cognitive-health messages that they receive from the popular media. Randolph and Viswanth (2004) suggest that too few health-promotion campaigns consider what other messages are being presented to their target audiences. It is important to identify similar or competing messages already in existence because they may affect how an audience reacts to or processes newly developed communication (Randolph & Viswanth, 2004).

Cognitive Health in the Popular Media

Research examining cognitive-health content in the popular media is sparse. Clarke (2006) identified 25 articles with content related to Alzheimer's disease in the 20 highest circulation mass-print English-language magazines published in 1991, 1996, and 2001 in the United States and Canada. Clarke reported that little attention was given to prevention or risk reduction; in addition, there was no discussion about the presence or lack of content related to physical activity.

To better understand how messages linking cognitive health and health behaviors are presented in the popular media, two recent studies examined the cognitive-health content of top-circulating magazines published in the United States in 2006 and 2007 (Friedman, Laditka, Laditka, & Mathews, 2010; Mathews et al., 2009). They found that most articles containing information about cognitive health focused on diet or summarized multiple health behaviors including physical activity, diet,

mental or social activities, and stress management. Rarely was physical activity the main focus. The fact that there were relatively few messages in the popular media about physical activity as it relates to cognitive health is puzzling given increasing evidence of associations between health behaviors, particularly physical activity, and cognitive health (Albert et al., 2007; ACSM et al., 2009; Baker et al., 2010; CDC & AA, 2007; Colcombe et al., 2004; Etgen et al., 2010; Liu-Ambrose et al., 2010; Sun et al., 2010). In a recent report, the ACSM et al. concluded that greater levels of physical activity may reduce the risk of cognitive decline and dementia. Recent studies have also suggested that aerobic exercise and resistance-training exercises may improve cognitive performance among older adults (ACSM et al., 2009; Baker et al., 2010; Etgen et al., 2010; Liu-Ambrose et al., 2010; Sun et al., 2010). Research is needed to understand how the popular media describe the relationship between physical activity and cognitive health.

This study contributes to the literature extending recent content analyses of cognitive health in the popular media (Clarke, 2006; Friedman et al., 2010; Mathews et al., 2009) by focusing on articles highlighting associations between physical activity and cognitive health, covering a more recent time period. This study also compares the evidence cited in the articles identified with empirical evidence to examine the accuracy of the information presented in the popular-media articles. We also classify intensity of the physical activities mentioned in the text or shown in the illustrations of articles using metabolic equivalents (METs; Ainsworth et al., 2000). The use of METs in this study allows for the comparison of physical activity intensity across articles. Such information is useful, because physical activity recommendations such as the U.S. Physical Activity Guidelines (USDHHS, 2008) usually quantify physical activity in terms of intensity. Using recent top-circulating popular magazines published in print in the United States and intended largely for older adults, the specific aims of this study were to examine cognitive-health and physical activity information, population characteristics represented (e.g., gender, age, and ethnic groups), specific information sources linking physical activity and cognitive health, and intensity of physical activities described using METs.

Methods

Theoretical Framework

The elaboration likelihood model (ELM; Petty & Cacioppo, 1986a) and the extended parallel-processing model (EPPM; Witte & Allen, 2000) are health-communication theories that guide this research. According to the ELM, changes in attitude and ultimately behavior depend on the likelihood that a topic presented will be elaborated on by the intended audience. Petty and Cacioppo (1986b) suggest that people are more likely to engage in "central processing," which is characterized by thorough, systematic thought about an issue, when messages are understandable and relevant (Simons, Berkowitz, & Moyer, 1970; Wilson & Sherrel, 1993). "Peripheral processing," on the other hand, is an appraisal process that lacks active awareness, comprehension, and careful thought about the information presented (Petty & Cacioppo, 1986b). This usually involves some type of cognitive shortcut such as focusing on whether the source of the message is attractive and likeable (Wilson, 2007). Petty and Cacioppo (1986b) suggest that attitudes that are modified as a

result of the central-processing route are more likely to result in permanent changes and lead to subsequent behavior change, whereas messages processed peripherally are more likely to result in short-term changes in attitude that have little effect on behavior. The ELM is an appropriate framework for this study given our focus on examining the content and potential relevance of the identified articles for older readers. According to the ELM framework, these factors influence central processing and can lead to changes in behavior.

According to the EPPM (Witte, 1992), messages promoting physical activity to prevent or delay cognitive decline should address the intended audiences' perceived susceptibility, severity, response efficacy, and self-efficacy. Thus, the ELM and EPPM suggest that older adults who are presented with information that physical activity may help prevent or delay cognitive decline will engage in physical activity if they feel (a) that the message about the association between physical activity and cognitive health is understandable and relevant and the information source is credible, (b) that cognitive decline is a serious problem, (c) that they are susceptible to cognitive decline, (d) that physical activity may prevent cognitive decline, (e) and confident that they can engage in physical activity. If older adults feel threatened by cognitive decline but do not feel confident about the physical activity–cognitive health link or their ability to engage in physical activity, they will focus on controlling their fear by denying or avoiding the message (Witte & Allen, 2000). Many older adults are concerned about their cognitive health (Connell, Scott Roberts, & McLaughlin, 2007; Connell, Scott Roberts, McLaughlin, & Akinleye, 2009; Laditka, Corwin, et al., 2009), suggesting that the EPPM is an appropriate framework to examine health messages about cognitive health because it addresses individuals' potential responses to health messages, which may elicit a fear response or cause people to feel threatened.

Sample

Advertising Age's (2008) "Magazine Circulation Rankings Index" was used to select top-circulating magazines in the United States, including *AARP: The Magazine, Time, Newsweek, U.S. News and World Report,* and *Reader's Digest*. Readership and age information was obtained from Mediamark Research and Intelligence (2007, 2008). Inclusion criteria were being a print magazine, published and distributed in the United States, in existence and available in 2006–2008, and written in English and having a readership consisting exclusively or largely of adults age 50 and over and circulation rates available through *Advertising Age*. *Advertising Age* was chosen because it is a leading source for media and marketing data; this resource is readily available and is often used in studies examining health coverage in the popular media (Kean & Prividera, 2007; Nelson & Paek, 2007; Stang, Hoss, & Story, 2010). Older adult populations are commonly defined as age 50 years and over when the context of the definition is health promotion or disease prevention (CDC & The Merck Company Foundation, 2007).

Article Selection

Every page of every issue of the magazines (42,753 pages) was searched manually for articles published from 2006 to 2008 that mentioned an association between physical activity and cognitive health. One researcher performed a manual page-by-page search of each magazine to identify articles that described an association between physical activity and cognitive health. Search terms were prespecified to minimize selection bias. Articles were identified as related to cognitive health if they included the following terms: *brain, cognition, cognitive health, Alzheimer's, cognitive decline, cognitive impairment, memory, dementia, staying sharp, alert,* and *mind*. Articles were identified as related to physical activity if they included the following terms in the text of the article: *physical activity, exercise, aerobic,* or any type of physical activity (e.g., *walking, gardening, tennis, swimming,* and *resistance training*). Articles identified were photocopied; each article was assigned an identification number. The researcher performing the search also recorded the total number of pages in each magazine issue searched.

Coding Procedures

Each article was examined and categorized according to specific variables and criteria in a codebook based on published content analyses of cognitive-health-related magazine articles (Friedman et al., 2010; Mathews et al., 2009) and also consistent with content analysis of popular media for other health conditions (Friedman & Hoffman-Goetz, 2003; Friedman, Hoffman-Goetz, & Arocha, 2006; Friedman & Kao, 2008; Hoffman-Goetz et al., 2003; Mathews et al., 2009; Stryker, Fishman, Emmons, & Viswanth, 2009). This study differs from two previous studies on cognitive-health content by focusing on content discussing associations between physical activity and cognitive health. This area of focus was selected because there is particularly strong evidence supporting the benefits of regular physical activity for cognitive health (Baker et al., 2010; Colcombe & Kramer, 2003; Etgen et al., 2010; Liu-Ambrose et al., 2010; Patterson et al., 2008; Sun et al., 2010). Table 1 shows the links between the study's theoretical framework and the variables coded, together with the definitions for each variable. With the exception of variables coded qualitatively, variables were coded as having a characteristic if the characteristic was mentioned or appeared a single time, for example, an illustration, rather than as a measure of intensity (see Table 1; Friedman & Hoffman-Goetz, 2003; Friedman et al., 2006; Friedman & Kao, 2008; Hoffman-Goetz et al., 2003; Mathews et al., 2009; Stryker et al., 2009). When authorship type was not provided, the Google search engine was used to obtain this information.

The intensity of physical activity described in the text and portrayed in the articles' illustrations was assessed using METs from the "Compendium of Physical Activities" (Ainsworth et al., 2000). The "Compendium of Physical Activities" was developed so physical activities from physical activity records and logs could be coded by intensity level and compared. There are 605 specific activities listed in the compendium; all are coded as multiples of the resting MET level (1.0). These codes range from 0.9 METs (sleeping) to 18 METs (running at 10.9 miles/hr). For this study, physical activity was categorized into one of the following three categories according to Pate's (1995) criteria: light intensity (<3 METs), moderate intensity (3–6 METs), or vigorous intensity (>6 METs).

Descriptions of associations between physical activity and cognitive health were evaluated for each cognitive-health article and compared with the scientific evidence described in recent empirical articles. The researchers recorded instances when an article described the mechanism by which physical activity may help individuals achieve cognitive-health benefits (e.g., physical activity increases blood flow to the brain) or quantified the cognitive-health benefit to be expected (e.g.,

Table 1 Theoretical Constructs, Research Questions, Variables, and Variable Descriptions for the Content Analysis

Theoretical construct	Variables	Variable definitions and measurement
—	Publication	*AARP: The Magazine, Reader's Digest, Time, Newsweek, U.S. News & World Report*
	Article length	Brief item, <1 page; shorter feature, 1–2 pages; longer feature, >2 pages
	Illustration	Yes/no
	Section placement	(e.g., Health, Family, Feature)
Understandability (ELM)	Cognitive-health terminology	Yes/no for *alert/sharp, Alzheimer's disease, dementia, memory*
Perceived severity (EPPM)	Severity information	Yes/no; then qualitative in adjacent column[a]; messages promoting the seriousness of cognitive decline[b]
Perceived susceptibility (EPPM)	Susceptibility info	Yes/no; then qualitative in adjacent column[a]; messages promoting the likelihood that the target audience will experience cognitive decline[b]
Response efficacy (EPPM)	Link explanation	Yes/no; then qualitative in adjacent column[a]; messages promoting the effectiveness of engaging in PA to prevent cognitive decline[b]
Understandability (ELM) and self-efficacy (EPPM)	PA terminology	Yes/no for PA, exercise, other (with adjacent qualitative column)
	PA-type text	Yes/no; then qualitative in adjacent column[a]
	PA-type illustrations	Yes/no; then qualitative in adjacent column[a]
	MET text	Light, moderate, vigorous
	MET illustrations	Light, moderate, vigorous
	PA frequency	Yes/no; then qualitative in adjacent column[a]
	PA duration	Yes/no; then qualitative in adjacent column[a]
	PA intensity	Yes/no; then qualitative in adjacent column[a]
Understandability (ELM) and self-efficacy (EPPM) *(continued)*	Self-efficacy	Yes/no; then qualitative in adjacent column[a]; messages promoting the ability to engage in PA[b]
Personal relevance (ELM)	Gender illustrated	Males, females
	Age illustrated	Child/adolescent, adult, older adult
	Ethnicity illustrated	White, Latino, Asian, Black, Native American, other
	Gender text	Males, females
	Age text	Child/adolescent, adult, older adult
	Ethnicity text	White, Latino, Asian, Black, Native American, other
Credibility (ELM) (Resources for further information could influence response efficacy [EPPM].)	Authorship type	Editor, health writer, columnist, science writer, layperson, freelance writer, no type provided
	Authorship researched	Editor, health writer, columnist, science writer, layperson, freelance writer, cannot find
	Information source	Yes/no for nonprofit, for profit, university, federal agency, scientific journal, book
	First-person quote	Researcher, doctor, university, layperson, celebrity, no quote
	Contact organization	Yes/no for nonprofit, for profit, magazine containing article, university, federal agency, no contact info
	Contact format	Yes/no for Web site, phone, address

Note. ELM = elaboration likelihood model; EPPM = extended parallel-processing model; PA = physical activity; MET = metabolic equivalent.

[a]Qualitative descriptions were written out to describe the variable. [b]Definitions derived from Witte (1992) and Lapinski (2006).

walking 30 min each day may reduce dementia risk by one third). We then searched the literature to determine whether there was supporting evidence in peer-reviewed scientific journals for each of the claims made in the articles reviewed.

Data Management and Analysis

Data were analyzed using descriptive statistics using SPSS (v. 14.0). The qualitative information was reviewed by the first author to identify recurring topics and themes. Two of the other authors independently read all the articles to ensure consistent and accurate coding. Coding was discussed until all three authors were in agreement. Although the primary focus of this study was to analyze article content, we also provide an analysis of illustrations. Illustrations were analyzed to identify the types of physical activity shown and to examine the age, gender, and ethnicity of people depicted in the articles. Illustrations were also evaluated to identify the intensity of physical activity described. Our evaluation and coding of narrative and illustrative content is consistent with previous studies of print and Web-based health information (Friedman & Hoffman-Goetz, 2003; Friedman et al., 2006; Friedman & Kao, 2008; Hoffman-Goetz et al., 2003; Mathews et al., 2009; Stryker et al., 2009).

The number of cognitive-health articles is reported. To provide a general measure of the frequency of cognitive-health articles among magazines, a standardized frequency was calculated as the number of articles per 1,000 pages. For example, 13,547 pages were searched for *Time* magazine (56 issues published per year), whereas only 1,556 pages were searched for *AARP: The Magazine* (six issues per year).

Results

Table 2 lists the average paid-circulation rates for the magazines included in the study and shows the readership characteristics for these magazines. Twenty-six articles that mentioned the association between physical activity and cognitive health were identified. Thirty-one percent of the articles were longer features (>2 pages), 42.3% were 1–2 pages, and 26.9% were less than 1 page. Nearly 70% of articles were in a health section; about 15% were in a special section, such as a section on how to maintain cognitive health.

Cognitive-Health Information: Text and Illustrative Content

When discussing the association between physical activity and cognitive health, the articles most often used general terms to describe cognitive health, such as staying *sharp* and *alert* (84.6%). *Alzheimer's disease* was mentioned in 53.8% of articles, *memory* in 38.5%, and *dementia* in 26.9%.

Messages Potentially Influencing Readers' Perceived Susceptibility to Cognitive Decline

About 19% of articles discussed the prevalence of cognitive decline. Two articles mentioned that an estimated 4.5 million people in the United States currently have Alzheimer's disease. One article suggested that will rise to 34 million in 2025; another to 16 million in 2050. One study mentioned that the prevalence of dementia

Table 2 Cognitive Health and Physical Activity in Top-Circulating Popular Magazines, 2006–2008: Study Sample and Quantitative Results

				Number of Articles						Readership Statistics		
Publication	Circulation[a]	Annual issues	Pages searched	2006	2007	2008	Total	Per 1,000 pages	Median age, years[a]	Readers 50+, *n*[a]	Readers 50+, %[a]
AARP: The Magazine	23,434,052	6	1,556	3	0	2	5	3.21	61.6	34,755,000	100.0
Reader's Digest	10,094,281	12	7,184	1	0	2	3	0.42	52.0	19,000,000	55.0
Time	4,066,545	56	13,547	3	0	2	5	0.37	46.4	8,658,000	41.6
Newsweek	3,118,432	53	11,348	1	3	1	5	0.44	46.9	8,000,000	43.2
U.S. News & World Report	2,036,261	52	9,118	2	2	4	8	0.87	46.9	4,786,000	47.0
Total		179	42,753	10	5	11	26				

[a]Source: (*Advertising Age*, 2006).

at age 85 is 50%. However, this same article mentioned that the average life expectancy of both men and women is less than 80 years; therefore, if you reach that age "you're not likely to be troubled by Alzheimer's disease, or anything else" (Halpern, 2008, p. 43).Twenty-seven percent of articles mentioned that some degree of cognitive decline is normal with age. These articles mentioned that declines in memory and "mental processing" begin in early adulthood. Two articles mentioned that the rate of decline increases in older adulthood. Another article mentioned that the risk of dementia "leaps" with advancing age. Nearly 20% of articles, however, mentioned that the brain maintains "plasticity" with increasing age and that older adults have the capacity to develop new neurons and connections in their brains.

Messages Potentially Influencing Readers' Perceptions of the Seriousness of Cognitive Decline

Problems with memory were discussed; however, few articles described symptoms experienced by people with cognitive decline. Characteristics of individuals with cognitive decline were discussed in four articles. These characteristics included "blunted reaction time" and "diminished spatial orientation," which make driving more difficult; increased confusion; interference with activities of daily living; difficulty processing information and solving problems; failed "executive function"; and possible death from complications of Alzheimer's disease.

Physical Activity Information

The terms *exercise* (76.9%) and *physical activity* (23.1%) were most often used in articles to describe physical activity. Some articles (11.5%) did not use a term to describe physical activity; instead they mentioned a specific type of physical activity, such as walking or swimming. The term *aerobic* was used in conjunction with exercise and physical activity (e.g., aerobic exercise, aerobic activity) in 42.3% of the articles. Nearly half of the articles (46%) referred to increased risk of cognitive decline with "physical inactivity."

A wide variety of examples of physical activity were described, including walking (42.3%), resistance training (23.1%), stretching (19.2%), biking (15.4%), dancing (11.5%), jogging (7.7%), swimming (7.7%), and balance exercises (3.8%). Similarly, illustrations showed many different examples of physical activity types such as Ping-Pong, biking, running, walking, tennis, soccer, swimming, gardening, dancing, basketball, yoga, and resistance training.

Several mixed messages about types of physical activity that are most beneficial to cognitive health were presented. Specifically, one article mentioned that "the few studies that have examined stretching, toning, and weight lifting have found little to no effect on cognition" (Carmichael, 2007, p. 46). In the same issue of the same magazine, another article mentioned that "the type of exercise also doesn't seem to matter much—aerobic exercise and strength training or a combination are equally effective" (Miller, 2007, p. 52). Another article in a different issue of the same magazine mentioned that aerobic exercise, compared with other types of physical activity, is particularly beneficial to cognitive health.

Recommendations for physical activity were presented in 21 (80.8%) articles. A wide range of recommendations on physical activity duration was provided, ranging from 90 to 300 min/week (see Table 3).

Table 3 Frequency, Intensity, Time, and Type of Physical Activity Mentioned in 26 Articles Discussing a Link Between Physical Activity and Cognitive Health, 2006–2008

Time/Distance/Sets, Reps	Frequency	Intensity	Type
General Exercise			
30 min	—	—	Workout
—	Daily	—	Exercise
30 min	Daily	Moderate	Exercise
60 min	4 days/week		Exercise
70–300 min	Per week	—	Physical education
30 min	3 days/week	—	Physical activity
30 min	4 days/week	Moderate	Physical activity
Aerobic Exercise			
—	3 times/week	—	Aerobics
45–60 min	Most days	—	Aerobics
—	4 times/week	—	Treadmill
15 min	3 times/week	—	Walking, biking
30 min	Most days	Brisk	Walking
2 min	Per day	—	Walking
30 min	—	—	Walking
—	Daily	—	Walking
20 min	Per day	—	Walking
30 min	Per day	—	Walking
Resistance Training			
—	2–3 days/week	—	Strength training
10–15 reps/set	2–3 days/week	—	Strength training
20 min	2–3 days/week	—	Strength training
Stretching/Balance exercises			
15 min	3 days/week	—	Stretching
10 min	Per day	—	Stretching
10 min	Per day	—	Balance exercises

Note. Metabolic equivalents (METs) developed by Ainsworth et al. (2000) and criteria developed by Pate et al. (1995) were used to categorize the articles in terms of intensity. A specific exercise type (e.g., aerobic, resistance training, stretching, or balance exercises) was not mentioned.

Few articles explicitly mentioned physical activity intensity. Table 3 reports the results of the analysis of intensity of physical activity shown in the illustrations or described in the text, using the MET classification developed by Ainsworth et al. (2000). Of the 14 articles including illustrations of physical activities, 57.1% included activities categorized as vigorous in intensity, 28.6% included activities categorized as light in intensity, and 28.6% included activities categorized as moderate in intensity. Of the articles describing intensity in the text, about 54% described moderate-intensity activities; 19.2%, vigorous-intensity activities; and 15.4%, light-intensity activities.

Messages Potentially Influencing Readers' Confidence in Their Ability to Engage in Physical Activity

Only six (23.1%) articles provided information to promote readers' confidence in their ability to engage in physical activity. Three of the six articles provided suggestions to help readers begin a physical activity program. Suggestions included choosing enjoyable activities, drinking plenty of water to reduce exercise discomfort, listening to music while exercising to make it more enjoyable, and starting slow and building up. Two of those articles showed diagrams of how to perform the activity, for example, resistance-training exercises and a yoga pose. One of the articles provided two Web sites so readers could locate local fitness centers and personal trainers who are certified to work with older adults.

Messages Potentially Influencing Readers' Perceptions About the Association Between Physical Activity and Cognitive Health

A number of articles that described cognitive decline also mentioned ways to prevent or slow the rate of decline, including engaging in physical activity. An explanation of associations between physical activity and cognitive health was provided in 57.7% of articles. Table 4 compares the explanations for the association between physical activity and cognitive health presented in the articles with empirical evidence described in articles in peer-reviewed journals relating physical activity and cognitive health that the authors identified by searching the literature. This comparison was made to determine whether the information presented in the articles was supported by information in the scientific literature. The most common explanation provided was that physical activity increases blood flow to the brain, increasing the flow of oxygen and other nutrients. Three articles quantified the relationship between physical activity and cognitive health, providing an estimate of the reduction in risk of cognitive decline with physical activity.

Contact Information Provided

Contact information for further resources about cognitive health and physical activity was provided in about 27% of articles; each of these articles provided Web sites for readers. The Web addresses referred readers to the magazine's Web page (*Reader's Digest*, *Newsweek*, and *U.S. News & World Report*), the *Harvard Mental Health Newsletter*, the Alzheimer's Association, a Web page to help readers locate workout facilities in their area, and a Web site to help readers locate personal trainers who are certified to work with older populations in their area.

Table 4 Explanations for the Association Between Physical Activity and Cognitive Health: Article Claims (2006–2008) and Empirical Evidence

Article claims	Empirical evidence
Physical activity increases blood flow to the brain and therefore increases the oxygen and nutrient supply to the brain.	Physical exercise improves cerebral blood flow and oxygen delivery (Hirofumi, 2009; Kramer & Erickson, 2007; Rogers, Meyer, & Mortel, 1990). Nutrients and oxygen delivered in the blood are essential to survival of neurons in the brain (Kramer & Erickson, 2007).
Physical activity reduces chance of blood-vessel blockage, improves circulation, and benefits heart health, which enhances cognitive health.	Physical activity lowers cardiovascular risk (Nelson et al., 2007), which may be related to the integrity of neurons and cognitive function (Crawford, 1996, 1998; Hagger-Johnson, Shickle, Deary, & Roberts, 2010).
Engaging in physical activity increases the production of neurotrophic factors or growth factors that cause the growth of new cells and neurons in the brain. Three articles mentioned brain-derived neurotrophic factor (BDNF) as the growth agent.	Findings from animal studies suggest that physical activity leads to increases in BDNF, a hormone that assists in neurogenesis in the brain, enhances learning, and protects against decline (Adlard, Perreau, Engesser-Cesar, & Cotman, 2004; Berchtold, Chinn, Chou, Kesslak, & Cotman, 2005; Cotman & Berchtold, 2002; Currie, Ramsbottom, Ludlow, Nevill, & Gilder, 2009).
Muscle movement stimulates the release of insulin growth factor-1 (IGF-1), which travels to the brain and stimulates increased production of BDNF.	Physical exercise leads to increased uptake of circulating IGF-1 by target organs such as the muscle (Eliakim et al., 1997) and the brain (Carro, Nunez, Busiguina, & Torres-Aleman, 2000). Increased BDNF is mediated by IGF-1 (Carro et al., 2000).
Engaging in 15 min of walking, biking, or stretching 3 times/week can reduce dementia risk by one third.[a]	Older adults (age 65+ years) who exercised at least 15 min 3 times/week had a 32% reduction in risk of dementia compared with those who did not exercise at least 3 times/week (Larson et al., 2006).
Thirty minutes of activity 3 days/week can reduce the risk of Alzheimer's disease by up to 60%.	A study could not be found to support this claim.
People of Japanese ancestry living in Hawaii who walk 2 miles/day are half as likely to develop dementia as those who walk a quarter of a mile or less.[a]	People who walked a quarter of a mile or less per day were 1.93 (95% CI 1.11–3.34) times more likely to develop dementia than those who walked at least 2 miles/day (Abbott et al., 2004).

[a]No information about the study's authors or the journal in which the study is published was provided.

Credibility of Information Sources

About 70% of articles provided no indication of authorship type. When authorship type was not specified, the authors' names were searched using Google. The results of both the manual examination of the articles and the Internet search revealed that 30.8% of articles were written by editors, 15.4% by columnists, 15.4% by freelance

writers, 7.7% by senior writers, 3.8% by project writers, and 3.8% by health writers. Authorship type could not be determined for 23.1% of the articles.

The main sources of information for the articles' claims about physical activity and cognitive health were colleges or research institutions (65.4%), scientific journals (38.5%), books (26.9%), nonprofit agencies (19.2%), federal agencies (15.4%), for-profit institutions (7.7%), personal stories from laypeople (7.7%), and hospitals (3.8%). Scientific studies examining the relationship between physical activity and cognitive health were described in 46.2% of the articles. About 19% of articles provided no information source. Quotes were provided in 69.2% of the articles. Quotes were most often contributed by researchers (26.9%), laypeople (11.5%), and celebrities (11.5%). They were less often contributed by doctors (7.7%), representatives from nonprofit and federal agencies (7.7%), and book authors (3.8%).

Messages Promoting Personal Relevance

In discussions of associations between physical activity and cognitive health, about 58% of articles mentioned older adults, 34.6% mentioned younger or middle-aged adults, and 15.4% mentioned children. Articles most often mentioned only girls or women (46.2%) or women and men (15.4%). Few articles mentioned only boys or men in discussions about physical activity and cognitive health (3.8%). According to Mediamark Research and Intelligence data (2008), the percentage of male readers for the five magazines included in the study ranges from 39% to 55%. None of the articles mentioned race or ethnicity in the text. About 20% of articles did not mention age, and 34.6% did not mention gender.

Among the illustrations of people that were included in the 21 articles, 19% were of children, 57.1% were of younger or middle-aged adults, and 33.3% were of older adults. Nearly 15% of illustrations showed boys or men, 38.1% included girls or women, and 47.6% showed women and men. Most illustrations including people were of White people (89.4%); only two articles included illustrations of Black people.

Discussion

Increasingly, research suggests that physical activity may reduce the risk of cognitive decline among older adults (ACSM et al., 2009; Baker et al., 2010; Colcombe et al., 2004; Etgen et al., 2010; Liu-Ambrose et al., 2010; Sun et al., 2010). The media play an important role in delivering messages to increase awareness of cognitive decline and ways to reduce risks (USDHHS, 2000). They may also influence policy makers to support community interventions (Jones, 2004; Kreps & Maibach, 2008) such as efforts to promote physical activity and cognitive health. Thus, it is useful to examine what the popular media report about associations between physical activity and cognitive health. This study is among the first to examine popular-media messages about the association between physical activity and cognitive health and to compare those messages with the empirical evidence. To our knowledge, this is the first study to examine media messages on physical activity using METs. This approach allowed us to quantify physical activity in terms of intensity.

Over half the articles included an explanation about why physical activity may be beneficial to cognitive health. Almost all of the explanations were consistent

with the scientific literature; however, less than half of the articles cited studies to support the claims. Previous studies have also found that empirical evidence and sources for evidence are not cited frequently in articles discussing cognitive health (Clarke, 2006; Friedman et al., 2010; Mathews et al., 2009). Older adults have expressed concerns about the quality of health and medical information disseminated in the mass media (Friedman & Hoffman-Goetz, 2003; Friedman, Laditka, et al., 2009). The fact that many articles do not reference empirical studies may contribute to those concerns. Older adults have reported that evidence from credible research sources enhances message credibility (Mathews et al., in press). It may be useful to include empirical evidence in messages linking physical activity and cognitive health.

The articles most often recommended aerobic exercise, resistance training, and flexibility; balance exercises were less often recommended. There were mixed messages about the types of physical activity that are beneficial for cognitive health. The mixed messages and the lack of physical activity recommendations for resistance, flexibility, and balance exercises may reflect the limited evidence examining the association between various physical activity types and cognitive health when the articles were written. Until recently, most research examined associations between aerobic exercise and cognitive health. Recent studies suggest an association between resistance training and improved cognitive health (ACSM et al., 2009; Liu-Ambrose & Donaldson, 2009; Liu-Ambrose et al., 2010). There is little evidence to support an association between stretching exercises and enhanced cognitive health (Larson et al., 2006). The ACSM recommends a comprehensive physical activity program including aerobic physical activity and resistance training to help achieve cognitive-health benefits.

A wide range of recommendations was also provided for physical activity duration, ranging from as little as 15 min 3 days/week to as much as 45–60 min most days of the week. The range of recommendations may send mixed messages to readers who are trying to determine how much physical activity they need in order to experience cognitive health benefits. Older adults have expressed uncertainty as to how much physical activity is needed to achieve cognitive-health benefits (Mathews et al., in press; Wilcox et al., 2009). Mixed messages in the media may contribute to this uncertainty. It would be useful for public health messages to more clearly define adequate physical activity (Mathews et al., 2010; Wilcox et al., 2009).

Few articles mentioned physical activity intensity. Through the use of METs, we determined that moderate-intensity physical activities were most often mentioned in the text of articles, and vigorous-intensity activities were often shown in illustrations. Because the current physical activity recommendations are quantified in terms of intensity (USDHHS, 2008), it may be useful if future messages explicitly mention the terms *moderate-intensity physical activity* and *vigorous-intensity physical activity* in addition to providing examples of each (USDHHS, 2008).

Revisiting the conceptual frameworks that guided this research, according to the EPPM, messages promoting physical activity and cognitive health would be most persuasive if they addressed perceived susceptibility, severity, response efficacy, and self-efficacy. Several articles contained content that could influence older readers' perceptions about their likelihood of experiencing cognitive decline in the future (i.e., perceived susceptibility). Much of this content emphasized the greater prevalence of cognitive decline among older adults than in younger age groups.

Few articles included information about the severity of cognitive decline. Most described declines in memory or cognition without mentioning the effects. According to the EPPM, if older readers do not feel that cognitive decline is severe, they may not pay attention to information presented on how to avoid it (Witte & Allen, 2000). Recent research examining older adults' perceptions of cognitive-health messages that include a fear component, which may heighten perceptions of the severity of cognitive decline, is mixed (Mathews et al., in press). Furthermore, questions have been raised about the efficacy and appropriateness of fear appeals in communication motivating behavior change (Hastings, Stead, & Webb, 2004). Thus, it is unclear whether the lack of messages about the severity of cognitive decline is a limitation.

Few articles included empirical evidence to support claims about the association between physical activity and cognitive health, and few articles provided credentials for the authors. This may limit the response efficacy of older readers; that is, older readers may not believe the claims that physical activity may prevent or delay cognitive decline. Only a small percentage of articles included information—for example, diagrams—designed to increase older adults' confidence in their ability to engage in physical activity.

The ELM suggests that messages should be both credible and relevant to the intended audience. The findings suggest that the articles may have limited relevance for diverse groups of older readers. The articles reviewed most often mentioned or illustrated older White women. It is understandable that most articles focused on adults and older adults, because cognitive problems dramatically increase with age (AA, 2008), and magazines included in the study targeted exclusively, or largely, older adults. The lack of racial and ethnic diversity shown in the text and illustrations is of concern. Race and ethnicity were never mentioned in the text. Only two illustrations were of Black people. This may be partially because minorities are often underrepresented in health research (Sheikh, 2006). Lack of inclusion of racial and ethnic minorities in illustrations may decrease the personal relevance of physical activity and cognitive-health information for people in minority groups (Rogers & Bhowmik, 1970; Simons et al., 1970; Wilson & Sherrel, 1993). This is of concern because older Blacks may be more likely than older Whites to suffer from memory problems, mild cognitive impairment (McDougall, Vaughan, Acee, & Becker, 2007), and Alzheimer's disease (Demirovic et al., 2003; Laditka et al., 2008). Furthermore, studies have found that Blacks may have misperceptions related to cognitive decline, including their risk of decline with increasing age (Connell et al., 2007; Connell et al., 2009), knowledge about the disease itself, and where to find information about it (Roberts et al., 2003). We acknowledge that differences in cognitive-health status and perceptions about cognitive health may be influenced by income, education, and other factors rather than race or ethnicity per se.

It may be difficult for older people to determine the credibility of the information presented in the magazine articles because nearly 70% of articles did not provide author credentials, 19.2% of articles did not provide a source for the information presented, and 53.8% did not describe scientific studies to support the claims made about physical activity and cognitive health (Simons et al., 1970; Wilson & Sherrel, 1993).

Several limitations are acknowledged. We searched a large number of publications (537 issues; 179 per year for each of 2006, 2007, and 2008). However, the magazines selected for study are read largely by older adults with more education and those who are more affluent (Mediamark Research and Intelligence, 2007, 2008) than the average older adult living in the United States (U.S. Census Bureau, 2010a, 2010b). It would be useful to extend this research, focusing on magazines and print media read more often by older adults with less education and lower literacy levels. In addition, we did not have the resources to examine other types of media. Future research would benefit from a broader review including newspapers, radio, television, and Internet communications. Such research might examine whether the results of this study are consistent across multiple media types. Another consideration is that we examined only top-circulating magazines targeting older adults published in English in the United States. An examination of physical activity and cognitive-health messages in additional magazine types, such as magazines targeting African Americans, women's magazines, and men's magazines, and in magazines published in the United States in another language such as Spanish would be useful. In addition, an examination of this topic among popular media in other countries would be of interest. We acknowledge that the findings from this study may not generalize to other publication types, publications published in other languages in the United States, or publications in other countries. In addition, our analyses were limited to publications from 2006 to 2008. We began our analyses with 2006 because the *National Public Health Road Map to Maintaining Cognitive Health,* developed by the CDC and the AA (2007), was released soon thereafter. Thus, our study provides a useful baseline for examining future growth of brain-health information in response to the national public health action plan. In another area, although content analyses provide insight to messages presented, they do not provide insight regarding individuals' use of content or what they learn from it. It was not within the scope of this study to examine whether articles with cognitive-health messages actually motivated increased physical activity among older readers. The use of theory as a framework, however, did identify several factors that could be enhanced in future messages. Communication promoting physical activity to prevent or delay cognitive decline would benefit from including text and illustrations culturally appropriate to multiple racial and ethnic groups. Communication may also benefit from including empirical evidence to support claims about the association between physical activity and cognitive health. Mobilizing information, directing older readers to resources that may increase their self-efficacy for physical activity, might also enhance future communication.

This study highlights opportunities for future research. It may be useful for researchers to examine diverse groups of older adults' reactions to, and use of, media messages promoting physical activity to prevent or delay cognitive decline. Additional research to examine the impact of messages in print media on older adults' self-efficacy for physical activity may be warranted (Cress et al., 2004). It may also be useful for future research to examine whether the exclusion of authorship type and information sources in print media influences perceptions of the credibility of communication among older readers. Research examining older adults' responses to various types of media messages promoting physical activity and cognitive health, including those with and without a fear component, is warranted.

The media have an opportunity to promote the cognitive health of their audience by promoting physical activity. Our findings highlight opportunities for the media to enhance communication about physical activity and cognitive health. Our

findings, however, may be most useful for those whose publications are designed to promote health (e.g., *AARP: The Magazine*), as well as for public health professionals promoting physical activity and cognitive health. Given the popular media's broad reach and older adults' concerns about cognitive health, there is an opportunity for messages promoting physical activity and cognitive health to improve health and quality of life among older adults.

References

Abbott, R., White, L., Ross, G., Masaki, K., Curb, J., & Pretovitch, H. (2004). Walking and dementia in physically capable elderly men. *Journal of the American Medical Association, 292,* 1447–1453.

Adlard, P., Perreau, V., Engesser-Cesar, C., & Cotman, C. (2004). The time course of induction of brain-derived neurotrophic factor mRNA and protein in the rat hippocampus following voluntary exercise. *Neuroscience Letters, 363,* 43–48.

Advertising Age. (2006). *Magazine circulation rankings index.* Retrieved July 1, 2008, from http://adage.com/datacenter/article?article_id=106355

Advertising Age. (2008). *Magazine circulation rankings index.* Retrieved July 1, 2008, from http://adage.com/datacenter/article?article_id=106355

Ainsworth, B., Haskel, W., Whitt, M., Irwin, M., Swartz, A., Strath, S., . . . Leon, A.S. (2000). Compendium of physical activities: An update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise, 32*(9 Suppl.), S498–S504.

Albert, M., Brown, D.R., Buchner, D., Laditka, J., Launer, L., Scherr, P., & Thies, W. (2007). The healthy brain and our aging population: Translating science to public health practice. *Alzheimer's & Dementia, 3*(S1), S3–S5.

Albert, M., Buchner, D., Laditka, J., Launer, L., Scherr, P., & Thies, W. (2007). The healthy brain and our aging population: Translating science to public health practice. *Alzheimer's & Dementia, 3*(S1), S3–S5.

Alzheimer's Association. (2008). *Alzheimer's disease facts and figures, 2008.* Chicago, IL: Alzheimer's Association.

American College of Sports Medicine, Chodzko-Zajko, W., Proctor, D., Fiatarone, S., Minson, C., Nigg, C., . . . Skinner, J.S. (2009). Exercise and physical activity for older adults. *Medicine and Science in Sports and Exercise, 41*(7), 1510–1530.

Baker, L., Frank, L., Foster-Schubert, K., Green, P., Wilkinson, C., McTiernan, A., . . . Craft, S. (2010). Effects of aerobic exercise on mild cognitive impairment: A controlled trial. *Archives of Neurology, 67*(1), 71–79.

Berchtold, N., Chinn, G., Chou, M., Kesslak, J., & Cotman, C. (2005). Exercise primes a molecular memory for brain-derived neurotrophic factor protein induction in the rat hippocampus. *Neuroscience, 133,* 853–861.

Bryant, J., & Zillmann, D. (2002). *Media effects: Advances in theory and research* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.

Carmichael, M. (2007, March 26). Stronger, faster, smarter. *Newsweek, 149*(13), 38–46.

Carro, E., Nunez, A., Busiguina, S., & Torres-Aleman, I. (2000). Circulating insulin-like growth factor I mediates effects of exercise on the brain. *The Journal of Neuroscience, 20,* 2926–2933.

Centers for Disease Control and Prevention & Alzheimer's Association. (2007). *The Healthy Brain Initiative: A national public health road map to maintaining cognitive health.* Chicago, IL: Alzheimer's Association.

Centers for Disease Control and Prevention & The Merck Company Foundation. (2007). *The state of aging and health in America 2007.* Retrieved April 15, 2008, from www.cdc.gov/aging and www.merck.com/cr

Clarke, J. (2006). The case of the missing person: Alzheimer's disease in mass print magazines 1991–2001. *Health Communication, 19*(3), 269–276.

Clarke, J., & Binns, J. (2006). The portrayal of heart disease in mass print magazines, 1991–2001. *Health Communication, 19*(1), 39–48.

Colcombe, S., & Kramer, A. (2003). Fitness effects on the cognitive function of older adults: A meta-analytic study. *Psychological Science, 14,* 125–130.

Colcombe, S., Kramer, A., Erickson, K., Scalf, P., McAuley, E., Cohen, N., . . . Elavsky, S. (2004). Cardiovascular fitness, cortical plasticity, and aging. *Proceedings of the National Academy of Sciences of the United States of America, 101*(9), 3316–3321.

Connell, C.M., Scott Roberts, J., & McLaughlin, S.J. (2007). Public opinion about Alzheimer's disease among Blacks, Hispanics, and Whites: Results from a national survey. *Alzheimer Disease and Associated Disorders, 21*(3), 232–240.

Connell, C.M., Scott Roberts, J., McLaughlin, S.J., & Akinleye, D. (2009). Racial differences in knowledge and beliefs about Alzheimer disease. *Alzheimer Disease and Associated Disorders, 23*(2), 110–116.

Cotman, C., & Berchtold, N. (2002). Exercise: A behavioural intervention to enhance brain health and plasticity. *Trends in Neurosciences, 25,* 295–301.

Cotman, C., & Engesser-Cesar, C. (2002). Exercise enhances and protects brain function. *Exercise and Sport Sciences Reviews, 30,* 75–79.

Crawford, J. (1996). Alzheimer's disease risk factors as related to cerebral blood flow. *Medical Hypotheses, 46,* 367–377.

Crawford, J. (1998). Alzheimer's disease risk factors as related to cerebral blood flow: Additional evidence. *Medical Hypotheses, 50,* 25–36.

Cress, M., Buchner, D., Prohaska, T., Rimmer, J., Brown, M., Macera, C., . . . Chodzko-Zajko, W. (2004). Physical activity programs and behavior counseling in older populations. *Medicine and Science in Sports and Exercise, 36*(11), 1997–2003.

Currie, J., Ramsbottom, R., Ludlow, H., Nevill, A., & Gilder, M. (2009). Cardiorespiratory fitness, habitual physical activity and serum brain derived neurotrophic factor (BDNF) in men and women. *Neuroscience Letters, 45*(2), 152–155.

Demirovic, J., Prineas, R., Loewenstein, D., Bean, J., Duara, R., Sevush, S., & Szapocznik, J. (2003). Prevalence of dementia in three ethnic groups: The South Florida Program on Aging and Health. *Annals of Epidemiology, 13*(6), 472–478.

Eliakim, A., Moromisato, M., Moromisato, D., Brasel, J., Roberts, C., & Cooper, D., Jr. (1997). Increase in muscle IGF-I protein but not IGF-I mRNA after 5 days of endurance training in young rats. *The American Journal of Physiology, 273,* R1557–R1561.

Etgen, T., Sander, D., Huntgeburth, U., Poppert, H., Forstl, H., & Bickel, H. (2010). Physical activity and incident cognitive impairment in elderly persons: The INVADE study. *Archives of Internal Medicine, 170*(2), 186–193.

Friedman, D., Corwin, S., Rose, I., & Dominick, G. (2009). Prostate cancer communication strategies recommended by older African American men in South Carolina: A qualitative analysis. *Journal of Cancer Education, 24*(3), 204–209.

Friedman, D., & Hoffman-Goetz, L. (2003). Sources of cancer information for seniors: A focus group pilot study report. *Journal of Cancer Education, 18*(4), 215–222.

Friedman, D., Hoffman-Goetz, L., & Arocha, J. (2006). Health literacy and the World Wide Web: Comparing the readability of leading incident cancers on the Internet. *Medical Informatics, 31,* 67–87.

Friedman, D., & Kao, E. (2008). A comprehensive assessment of the difficulty level and cultural sensitivity of online cancer prevention resources for older minority men. *Preventing Chronic Disease, 5,* A07.

Friedman, D., Laditka, J., Hunter, R., Ivey, S., Wu, B., Laditka, S., . . . Mathews, A.E. (2009). 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. *The Gerontologist, 49*(S1), S50–S60.

Friedman, D., Laditka, J., Laditka, S., & Mathews, A. (2010). Information about cognitive health in popular magazines for women or men: A content analysis. *Preventing Chronic Disease, 7*(2), 1–10.

Hagger-Johnson, G., Shickle, D., Deary, I., & Roberts, B. (2010). Direct and indirect pathways connecting cognitive ability with cardiovascular disease risk: Socioeconomic status and multiple health behaviors. *Psychomatic Medicine, 72,* 777–785.

Halpern, S. (2008, May 19). Forgetting is the new normal. *Time, 171*(20), 42–45.

Hamer, M., & Chida, Y. (2008). Physical activity and risk of neurodegenerative disease: A systematic review of prospective evidence. *Psychological Medicine, 39*(1), 3–11.

Hastings, G., Stead, M., & Webb, J. (2004). Fear appeals in social marketing: Strategic and ethical reasons for concern. *Psychology and Marketing, 21*(11), 961–986.

Heyn, P., Abreu, B., & Ottenbacher, K. (2004). The effects of exercise training on elderly persons with cognitive impairment and dementia: A meta-analysis. *Archives of Physical Medicine and Rehabilitation, 85,* 1694–1704.

Hirofumi, T. (2009). Cerebral blood flow: Sleeping beauty awakened by exercise. *Exercise and Sports Science Review, 37*(3), 111.

Hoffman-Goetz, L., Shannon, C., & Clarke, J. (2003). Chronic disease coverage in Canadian Aboriginal newspapers. *Journal of Health Communication, 8*(5), 475–488.

Jones, S. (2004). Coverage of breast cancer in the Australian print media—Does advertising and editorial coverage reflect correct social marketing messages? *Journal of Health Communication, 9*(4), 309–325.

Kean, L., & Prividera, L. (2007). Communicating about race and health: A content analysis of print advertisements in African American and general readership magazines. *Health Communication, 21*(3), 289–297.

Kline, K. (2006). A decade of research on health content in the media: The focus on health challenges and sociocultural context and attendant informational and ideological problems. *Journal of Health Communication, 11*(1), 43–59.

Kramer, A., & Erickson, K. (2007). Capitalizing on cortical plasticity: Influence of physical activity on cognition and brain function. *Trends in Cognitive Neuroscience, 11*(8), 342–348.

Kreps, G., & Maibach, E. (2008). Transdisciplinary science: The nexus between communication and public health. *The Journal of Communication, 58*(4), 732–748.

Laditka, J., Beard, R., Bryant, L., Fetterman, D., Hunter, R., Ivey, S., . . . Wu, B. (2009). Promoting cognitive health: A formative research collaboration of the Healthy Aging Research Network. *The Gerontologist, 49*(S1), S12–S17.

Laditka, J., Laditka, S., Cornman, C., Porter, C., Davis, D., & Mintzer, J. (2008). Notable higher rates of both vascular risk factors and vascular dementia among African American women in South Carolina: A public health intervention opportunity. *The Journal of the South Carolina Medical Association, 104,* 216–219.

Laditka, S., Corwin, S., Laditka, J., Liu, R., Tseng, W., Wu, B., . . . Ivey, S.L. (2009). Attitudes about aging well among a diverse group of older Americans: Implications for promoting cognitive health. *The Gerontologist, 49*(S1), S30–S39.

Lapinski, M. (2006). StarvingforPerfect.com: A theoretically based content analysis of pro-eating disorder Websites. *Health Communication, 20*(3), 243–253.

Larson, E., Wang, L., Bowen, J., McCormick, W., Teri, L., Crane, P., & Kukull, W. (2006). Exercise is associated with reduced risk for incident dementia among persons 65 years of age and older. *Annals of Internal Medicine, 144,* 73–81.

Liu-Ambrose, T., & Donaldson, M. (2009). Exercise and cognition in older adults: Is there a role for resistance training programmes? *British Journal of Sports Medicine, 43,* 25–27.

Liu-Ambrose, T., Nagamatsu, L., Graf, P., Beattie, B., Ashe, M., & Handy, T. (2010). Resistance training and executive functions: A 12-month randomized controlled trial. *Archives of Internal Medicine, 170*(2), 170–178.

Mathews, A., Corwin, S., Laditka, S., Friedman, D., Colabianchi, N., & Montgomery, K. (in press).Older adults' perceptions of physical activity and cognitive health: Implications for health communication. *Health Education & Behavior.*

Mathews, A., Laditka, S., Laditka, J., & Friedman, D. (2009). What are top-circulating magazines in the United States telling older adults about cognitive health? *American Journal of Alzheimer's Disease and Other Dementias, 24*(4), 302–312.

Mathews, A., Laditka, S., Laditka, J., Wilcox, S., Corwin, S., Liu, R., . . . Logsdon, R.G. (2010). Older adults' perceived physical activity enablers and barriers: A multicultural perspective. *Journal of Aging and Physical Activity, 18*(2), 119–140.

McDougall, G.J., Vaughan, P., Acee, T., & Becker, H. (2007). Memory performance and mild cognitive impairment in Black and White community elders. *Ethnicity & Disease, 17*(2), 381–388.

Mediamark Research & Intelligence. (2007). *Spring/fall MRI.* Retrieved from http://www.mediamark.com/

Mediamark Research & Intelligence. (2008). *Spring/fall MRI.* Retrieved from http://www.mediamark.com/

Miller, M. (2007, March 26). Exercise is a state of the mind. *Newsweek, 149*(13), 48–55.

Nelson, M., & Paek, H. (2007). A content analysis of advertising in a global magazine across seven countries: Implications for global advertising strategies. *International Marketing Review, 24*(1), 64–86.

Nelson, M., Rejeski, W., Blair, S., Duncan, P., Judge, J., King, A., . . . Castaneda-Sceppa, C. (2007). Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Medicine and Science in Sports and Exercise, 39*(6), 1435–1445.

Pate, R., Pratt, M., Blair, S., Haskell, W., Macera, C., Bouchard, C., . . . King, A.C., et al. (1995). Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association, 273,* 402–407.

Patterson, C., Feightner, J., Garcia, A., Hsuing, R., MacKnight, C., & Sadovnick, D. (2008). Diagnosis and treatment of dementia: 1. Risk assessment and primary prevention of Alzheimer's disease. *Canadian Medical Association Journal, 178*(5), 548–556.

Petty, R., & Cacioppo, J. (1986a). *Communication and persuasion: Central and peripheral routes to attitude change.* New York: Springer-Verlag.

Petty, R., & Cacioppo, J. (1986b). The elaboration likelihood model of persuasion. *Advances in Experimental Social Psychology, 19,* 123–125.

Prohaska, T., & Peters, K. (2007). Physical activity and cognitive functioning: Translating research to practice with a public health approach. *Alzheimer's & Dementia, 3*(2), S58–S64.

Randolph, W., & Viswanth, K. (2004). Lessons learned from public health mass media campaigns: Marketing health in a crowded media world. *Annual Review of Public Health, 25,* 419–437.

Roberts, J., Connell, C., Cisewski, D., Hipps, Y., Demissie, S., & Green, R. (2003). Differences between African Americans and Whites in their perceptions of Alzheimer's disease. *Alzheimer Disease and Associated Disorders, 17*(1), 19–26.

Rogers, E.M., & Bhowmik, D.K. (1970). Homophily-heterophily: Relational concepts for communication research. *Public Opinion Quarterly, 34*(4), 523–538.

Rogers, R., Meyer, J., & Mortel, K. (1990). After reaching retirement age physical activity sustains cerebral perfusion and cognition. *Journal of the American Geriatrics Society, 38,* 123–128.

Sheikh, A. (2006). Why are ethnic minorities unre-represented in US research studies? *PLoS Medicine, 3*(2), e49.

Simons, H.W., Berkowitz, N.N., & Moyer, R.J. (1970). Similarity, credibility, and attitude change: A review and theory. *Psychological Bulletin, 73*(1), 1–16.

Stang, J., Hoss, K., & Story, M. (2010). Health statements made in infant formula advertisements in pregnancy and early parenting magazines. *Infant, Child, and Adolescent Nutrition, 2*(1), 16–25.

Stryker, J., Fishman, J., Emmons, K., & Viswanth, K. (2009). Cancer risk communication in mainstream and ethnic newspapers [electronic version]. *Preventing Chronic Disease, 6*. Retrieved April 12, 2010, from http://www.cdc.gov/pcd/issues/2009/Jan/08_0006.htm

Sun, Q., Townsend, M., Oereke, O., Franco, O., Hu, F., & Grodstein, F. (2010). Physical activity at midlife in relation to successful survival in women age 70 years or older. *Archives of Internal Medicine, 170*(2), 194–201.

U.S. Census Bureau. (2010a). 2006–2008 American community survey: Educational attainment. Retrieved April 12, 2010, from http://factfinder.census.gov/servlet/STTable?_bm=y&-geo_id=01000US&-qr_name=ACS_2008_3YR_G00_S1501&-ds_name=ACS_2008_3YR_G00_

U.S. Census Bureau. (2010b). 2006–2008 American community survey: Income in the past 12 months. Retrieved April 12, 2010, from http://factfinder.census.gov/servlet/STTable?_bm=y&-geo_id=01000US&-qr_name=ACS_2008_3YR_G00_S1901&-ds_name=ACS_2008_3YR_G00_&-redoLog=false

U.S. Department of Health and Human Services. (2000). *Healthy People 2010: Understanding and improving health* (2nd ed.). Washington, DC: Government Printing Office.

U.S. Department of Health and Human Services. (2008). Physical activity guidelines for Americans. Retrieved November 20, 2008, from http://www.health.gov/PAGuidelines/factsheetprof.aspx

Wilcox, S., Sharkey, J., Mathews, A., Laditka, J., Laditka, S., Logsdon, R., . . . Liu, R. (2009). Perceptions and beliefs about the role of physical activity and nutrition on brain health in older adults. *The Gerontologist, 49*(S1), S61–S71.

Wilson, B. (2007). Designing media messages about health and nutrition: What strategies are most effective? *Journal of Nutrition Education and Behavior, 39*(2 Suppl.), S13–S19.

Wilson, E.J., & Sherrel, D.L. (1993). Source effects in communication and persuasion research: A meta-analysis of effect size. *Journal of the Academy of Marketing Science, 21*(2), 101–112.

Witte, K. (1992). Putting fear back into fear appeals: The extended parallel process model. *Communication Monographs, 59*, 329–349.

Witte, K., & Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. *American Journal of Health Behavior, 27*(5), 591–615.