*Article*

SGS SOUTHERN GERONTOLOGICAL SOCIETY

Journal of Applied Gerontology
2016, Vol. 35(9) 939–959

DOI: 10.1177/0733464814544214
jag.sagepub.com
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# Health Risk Perceptions and Exercise in Older Adulthood: An Application of Protection Motivation Theory

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**Abstract**

Protection Motivation Theory (PMT) was applied to explore the relationship between perceived risk of acute health crises and intent to exercise. Interviews of 351 community-living older adults assessed prior physical activity (PPA), all PMT components, and exercise intent. A multi-group structural equation model revealed gender differences in PMT predictors of exercise intent. PPA, age, self-efficacy, and response efficacy directly predicted men's intent. Women's PPA and age predicted PMT components of self-efficacy and response costs, which predicted intent. Findings have implications for devising interventions to enhance physical activity in later life by targeting different PMT components for older men and women.

**Keywords**

health perceptions, exercise, older adults

Manuscript received: August 28, 2013; final revision received: June 18, 2014; accepted: June 29, 2014.

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Various acute health crises become more likely with age. By 65, the risk of a stroke doubles for older adults (Rogers et al., 2012). Likewise, 84% of heart attacks among men and 73% of heart attacks among women occur after the age of 65 (Greenlee, Naleway, & Vidaillet, 2002). Hip fractures are eight times as likely in women above 84 compared with their 65- to 74-year-old counterparts (Stevens & Olson, 2000). Such acute health crises can lead to functional disability, loss of independence, and death (An & Shaughnessy, 2011; Leibson, Tosteson, Gabriel, Ransom, & Melton, 2002). Fortunately, preventive health behaviors such as regular exercise can significantly reduce the risk of these acute health crises (Goldstein et al., 2011; Tinetti et al., 1994).

Given the severe consequences and staggering health care costs associated with such health crises (i.e., US$297.7 billion/year for heart disease/stroke; Rogers et al., 2012; >US$10 billion/year for hip fractures; National Institutes of Health [NIH], 2001), surprisingly little is known about how older individuals view their likelihood of suffering an acute health crisis or the role of such risk perceptions in engaging in regular exercise. The current study addresses this knowledge gap by utilizing a well-established theoretical framework to identify how older adults perceive their acute health risks and how those perceptions relate to exercise.

## Perceived Health Risks and Protection Motivation Theory (PMT)

Research on older adults' health risk perceptions has focused on chronic diseases such as cancer and heart disease (Berkowitz, Hawkins, Peipins, White, & Nadel, 2008; Wilcox & Stefanick, 1999). Consequently, less is known about how older adults perceive their risk of suffering acute health crises. An exception is Harwell et al. (2005) who found that at-risk adults estimated their risk of a stroke to be no higher than their non-risk counterparts. In contrast, other research shows that older adults tend to overestimate their risk of a stroke, heart attack, or hip fracture (Frijling et al., 2004; Ruthig, Chipperfield, Bailis, & Perry, 2008). Aside from determining accuracy of personal risk, it is important to consider how older adults' beliefs about suffering acute health crises relate to engaging in preventive behaviors.

One health promotion theory successfully used to link younger individuals' health risk perceptions with engagement in preventive behaviors is *PMT* (Rogers, 1975, 1983). It builds on the earlier Health Belief Model (Becker, 1974) by emphasizing two cognitive appraisal processes: *threat appraisal* and *coping appraisal.* These appraisals predict intent to engage in preventive health behaviors. Threat appraisals include fear, perceived severity of the

health event, vulnerability or perceived risk of the health event, and maladaptive response rewards (perceived benefits gained by not engaging in the health behavior; Rogers, 1983). According to PMT, maladaptive response rewards should predict less intent to perform preventive behaviors, whereas fear, perceived vulnerability, and severity should predict greater intent to perform preventive behaviors (Floyd, Prentice-Dunn, & Rogers, 2000). Coping appraisals include response efficacy (belief that the preventive behavior will protect against the health event), self-efficacy (belief in one's ability to enact the preventive behavior), and response costs (barriers to the preventive behavior; Rogers, 1983). According to PMT, response efficacy and self-efficacy should predict greater intent; response costs should predict less intent to engage in the behavior (Rogers & Prentice-Dunn, 1997). In turn, and consistent with assumptions of the Theory of Planned Behavior (Ajzen, 1985), PMT implies that intent should predict actual preventive behavior (Floyd et al., 2000; Milne, Sheeran, & Orbell, 2000).

PMT is an effective framework for predicting preventive health behavior (Boer & Seydel, 1996), and ample empirical support for PMT components has been demonstrated with risk perceptions and preventive behaviors relating to health issues such as cancer (Berkowitz et al., 2008), smoking cessation (Maddux & Rogers, 1983), and cardiovascular disease (see Floyd et al., 2000; Milne et al., 2000 for meta-analytic reviews). For example, Plotnikoff and Higginbotham (2002) examined perceived threat of coronary heart disease (CHD) and engagement in regular exercise. They found that self-efficacy and response efficacy were associated with regular exercise behavior and that the strongest association was between intention and the exercise behavior. Plotnikoff, Rhodes, and Trinh (2009) longitudinally tested PMT's predictive ability for engagement in physical activity in a large population-based sample of adults. Their findings indicated that response efficacy, self-efficacy, and perceived severity predicted intent to be physically active. They also found that both self-efficacy and intent predicted subsequent engagement in physical activity. Likewise, Milne, Orbell, and Sheeran (2002) experimentally manipulated perceived severity, vulnerability, response efficacy, self-efficacy, and response costs to increase exercise as a preventive behavior against CHD. Their findings showed that exposure to an intervention intended to increase perceived vulnerability, severity, fear, self-efficacy, and response efficacy, and reduce perceived response cost was effective in doing so and also led to greater intent to exercise. Milne et al. also found that in combination with a volitional intervention, the PMT component-enhancing intervention resulted in greater engagement in subsequent exercise.

Although PMT is a well-established model for linking health risk perceptions to preventive behaviors in younger adults, there is a need to test PMT

among older adults. Runge, Prentice-Dunn, and Scogin (1993) used PMT to examine beliefs and behaviors associated with alcohol use among a small sample of adults age 60+. Their findings showed that compared with a community sample, individuals with alcohol abuse issues reported lower response efficacy and greater response costs associated with the preventive behavior of moderating their drinking. Another study of adults age 55+ examined some components of PMT and found that greater self-efficacy predicted higher intentions to prepare advance directives (Allen, Phillips, Pekmezi, Crowther, & Prentice-Dunn, 2009). In a larger study of adults age 60+, Yardley, Donovan-Hall, Francis, and Todd (2007) found that perceived severity, vulnerability, response efficacy, and self-efficacy were positively correlated with intent to engage in strength training. These cross-sectional studies provide support for some PMT components among older adults, yet the complete PMT model has not been applied to examine perceived health risks and preventive behaviors in later life.

Within the current study, PMT was applied to examine the relationship between older adults' perceived risk of acute health crises and intent to engage in regular exercise. In addition to providing critical insights for designing interventions to increase preventive behaviors that enhance health and survival, the current study builds upon past PMT research in several important ways. First, it utilizes the PMT framework among a large, exclusively older adult sample. Second, as Rogers and Prentice-Dunn (1997) acknowledged, most PMT studies have omitted key threat appraisal components of the theory. The current study includes all threat and coping appraisal components of PMT as predictors of intent to exercise. It is expected that perceived vulnerability, severity, fear, self-efficacy, and response efficacy will predict greater intent to exercise, whereas response costs and rewards associated with maladaptive responses (i.e., physical inactivity) will predict less intent.

Third, this study tests the reciprocal nature of the perceived risk–preventive behavior association. Although perceived risk predicts engaging in preventive behaviors (Wilcox & Stefanick, 1999), individuals may perceive their risk as low *because* they already engage in preventive behaviors (Plotnikoff & Higginbotham, 1995). However, there is a "woeful lack of knowledge" of how preventive behavior affects threat appraisals (Rogers & Prentice-Dunn, 1997, p. 128). Prior physical activity (PPA) is expected to negatively predict perceived vulnerability to acute health crises.

Fourth, with the exception of Plotnikoff et al. (2009) who examined the moderating effects of age and gender among a younger sample (e.g., 18-65), the extent to which age contributes to components of the PMT model and their link to exercise intention remains unknown. Moreover, men and women

differ in actual risk of acute health crises and gender differences have been found in the relationship between perceived risk and preventive behaviors (Legato, Padus, & Slaughter, 1997; O'Brien-Cousins, 2000). Thus, the current study design accounts for the role of age when investigating the associations between each PMT component and intent to exercise, doing so separately for men and women to directly assess gender differences. Finally, this study examines the appraisal components of PMT in reference to multiple acute health crises (i.e., heart attack, stroke, hip fracture) that are particularly salient to older adults.

## Method

### Participants and Procedure

The sample consisted of community-living older men ($n$ = 184) and women ($n$ = 247) residing in the upper Midwestern United States. Using a list of 489 individuals who took part in a prior aging-related study (see Ruthig, Hanson, Pedersen, Weber, & Chipperfield, 2011 for a detailed description), participants were recruited by telephone and 431 agreed to take part in the current study on health and aging (Institutional Review Board [IRB] protocol: IRB-200904-317). After providing written informed consent, participants completed either an in-person interview ($n$ = 339 or 79%) or identically mailed in survey ($n$ = 92 or 21%) that included measures of each PMT component, prior physical activity, age, and gender. Both interview methods took participants approximately 1 hr to complete and did not differ in age ($M$ = 70.8 vs. 71.0) or gender composition (female = 52% vs. 59%).

Participants were asked whether they had suffered a heart attack, stroke, or hip fracture. In all, 31 participants indicated suffering a prior heart attack, 17 suffered a stroke, 13 suffered a hip fracture, and 12 participants suffered both a heart attack and stroke. Data from these participants and those who did not respond to these items ($n$ = 7) were excluded from the current analyses, resulting in 351 participants (148 men and 203 women) for all subsequent analyses.

### Measures

*Age.* Participants ranged from 56 to 100 years of age ($M$ = 70.96; $SD$ = 7.29).[1]

*Prior physical activity (PPA).* As in prior research assessing older adults' perceived physical activity (e.g., Bailis, Chipperfield, Perry, Newall, & Haynes, 2008; Ruthig & Chipperfield, 2007), participants were asked, "Thinking

about the past few months, how would you rate your physical activity," with responses ranging from 1 (*extremely inactive)* through 7 (*extremely active*), with a midpoint of 4 (*moderately active*). Prior research has shown this measure to be significantly associated with other indices of perceived activity level among older individuals, including positive correlations with comparative estimates of physical activity levels (e.g., Bailis, Chipperfield, Perry, Newall, & Haynes, 2008; Hanson & Ruthig, 2012) and negative correlations with health-related activity restriction (e.g., Ruthig, Chipperfield, Newall, Perry, & Hall, 2007). More broadly, it is also positively correlated with older adults' self-rated health and negatively correlated with the number of existing chronic health conditions (Ruthig et al., 2007).

*Threat appraisal measures.* The following measures of vulnerability, severity, fear, and maladaptive response rewards were used to assess PMT's threat appraisal components. To measure perceived *vulnerability* to suffering a stroke, participants responded to these statements adapted from Milne et al. (2002) in which "CHD" was replaced with "a stroke": "My chances of suffering a stroke in the future are . . ." (1 = *not at all strong*; 5 = *very strong*) and "I am unlikely to suffer a stroke in the future" (1 = *strongly disagree*; 5 = *strongly agree*). Questions were repeated for heart attack and hip fracture risk estimates (in which "stroke" was replaced with "heart attack" or "hip fracture") and the current inter-item reliability (α) for each acute health risk ranged from .67 to .78.

Two items from Plotnikoff and Higginbotham (1995) assessed participants' perceived *severity* of each acute health crisis: "How serious of a health problem is a heart attack?" (1 = *not at all serious*; 5 = *very serious*) and "How much will a heart attack interfere with someone leading a normal life?" (1 = *not at all*; 5 = *very much so*). Responses to the two items were summed, so that higher scores reflect greater perceived severity. Questions were repeated for stroke and hip fracture (with either "stroke" or "hip fracture" replacing "heart attack") and the current inter-item reliability (α) for each acute health risk ranged from .56 to .80.

Participants' *fear* of each acute health crisis was assessed by four items adapted from Milne et al. (2002) in which "CHD" was replaced with "a stroke." For example, "The thought of suffering a stroke makes me feel . . ." (1 = *not at all frightened*; 5 = *very frightened*). These four items were repeated for heart attack and again for hip fracture (with either "heart attack" or "hip fracture" replacing "stroke"). Similar to previously reported inter-item reliabilities (Milne et al., 2002), current inter-item reliabilities (α) for each health crisis ranged from .92 to .96.

Three items were created to assess *rewards of maladaptive response* (i.e., physical inactivity): "Being physically inactive allows me to conserve energy," "Being physically inactive allows me to save time for doing other things that I enjoy," and "Being physically inactive helps ensure that I won't strain, injure, or overexert myself," response options: 1 = *strongly disagree*; 5 = *strongly agree*. Item responses were summed to create a total maladaptive response rewards score in which higher scores reflect greater rewards (current inter-item reliability: $\alpha = .81$).

*Coping appraisal measures.* The following measures of self-efficacy, response efficacy, and response costs reflect PMT's coping appraisal components. Participants were given a definition of exercise: "Activities that make you breathe harder, such as brisk walking, bicycling, swimming or playing sports, that are completed 3 or more times per week for at least 20 minutes each time" (Haskell, Lee, Pate, Powell, & Blair, 2007). *Self-efficacy* was then assessed using a six-item measure from Plotnikoff and Higginbotham (2002). For example, "To what extent do you think you will be able to have adequate exercise even when you feel a little tired?" (response options: 1 = *I know I cannot*; 5 = *I know I can*). Item responses were summed to create a total self-efficacy score (current inter-item reliability: $\alpha = .92$; reported 6-month test–retest reliability: $r = .95$; Plotnikoff & Higginbotham, 2002).

Two items from Plotnikoff and Higginbotham's (2002) original measure assessed participants' *response efficacy*.[2] One item was "Regular exercise will reduce my chances of having a heart attack," response options: 1 = *definitely not*; 5 = *definitely yes*. The second item was "Regular exercise could give me a heart attack," with the same response scale. Responses to this second item were reverse coded, then responses were summed. Items were repeated for stroke and hip fracture by replacing "heart attack" with "hip fracture" or "stroke" and the current inter-item reliability ($\alpha$) for each acute health risk ranged from .25 to .36.

Perceived *response costs* were assessed using a five-item scale adapted from Marcus, Selby, Niaura, and Rossi (1992) that has been extensively validated (Plotnikoff, Blanchard, Hotz, & Rhodes, 2001) in which "regular exercise" replaced "physical activity." For example, "I am too tired to get regular exercise because of my other daily responsibilities." Item responses were summed so that higher scores indicate greater barriers (current inter-item reliability: $\alpha = .77$).

*Intent.* After being reminded that "Adequate or regular exercise is defined as activities that make you breathe harder, such as brisk walking, bicycling,

**Table 1.** Gender Comparisons of Older Adults' Age, PPA, and Protection Motivation Theory Components.

| | Men | | Women | | |
|---|---|---|---|---|---|
| Variable | *M* | *SD* | *M* | *SD* | *F* |
| Age | 71.65 | 6.99 | 70.46 | 7.47 | 2.28 |
| PPA | 4.65 | 1.24 | 4.50 | 1.27 | 1.19 |
| Severity | 23.17 | 3.68 | 24.49 | 3.82 | 10.33** |
| Vulnerability | 14.31 | 4.04 | 15.78 | 4.09 | 11.02** |
| Fear | 22.16 | 7.70 | 25.95 | 8.19 | 19.16*** |
| Maladaptive response rewards | 5.22 | 2.69 | 4.83 | 2.60 | 1.90 |
| Self-efficacy | 23.67 | 4.61 | 23.38 | 5.36 | 0.27 |
| Response efficacy | 47.26 | 5.53 | 48.90 | 4.94 | 8.35** |
| Response costs | 7.49 | 3.21 | 7.69 | 3.10 | 0.33 |
| Intent | 16.44 | 3.01 | 16.28 | 3.70 | 0.68 |

*Note.* PPA = prior physical activity.
**$p < .01$. ***$p < .001$.

swimming or playing sports, that are completed 3 or more times per week for at least 20 minutes each time," participants were instructed to use this definition of adequate exercise when responding to four items (Plotnikoff & Higginbotham, 2002) assessing their *intent* to exercise. For example, "How likely or unlikely is it that you will get adequate exercise during the next several months?" (response range: 1 = *no chance*; 5 = *100% chance*). Item responses were summed, so that higher scores indicate greater intent (current inter-item reliability: $\alpha = .83$; reported 6-month test–retest reliability: $r = .98$; Plotnikoff & Higginbotham, 2002).

## Results

Table 1 shows means and standard deviations for age, PPA, and all components of PMT: threat appraisal components (severity, vulnerability, fear, maladaptive response rewards), coping appraisal components (self-efficacy, response efficacy, response costs), and protection motivation or intent to engage in regular exercise. Compared with men, women reported significantly higher threat appraisals in terms of greater severity, vulnerability, and fear of suffering an acute health crisis. Women also reported greater response efficacy than men. There were no other significant gender differences.

## Predicting Intent to Engage in Regular Exercise

A multi-group structural equation model (SEM) using AMOS Version 18 was computed to identify which of PMT's threat and coping appraisal components predict intent to engage in regular exercise. The model also enabled determination of whether PPA and age predict the threat or coping appraisal components, as well as intent to exercise. Thus, age and PPA were included as predictors of all appraisal components and intent to exercise, and all appraisal components were included as predictors of intent to exercise.

The maximum likelihood method was used for the SEM model and fit was evaluated based on chi-square ($\chi^2$), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). The CFI contrasts the proposed model fit to a null model that assumes independence between all variables. CFI values range from 0 to 1.0, with values of .90 or greater representing acceptable fit (Hu & Bentler, 1999). The RMSEA compares the proposed model and a hypothetical population covariance matrix, with values less than .06 indicating good fit (McDonald & Ringo Ho, 2002).

Within the SEM, two-item parcels were used for latent constructs of severity, vulnerability, and response efficacy. Parcel construction was based on both conceptual (e.g., items pertaining to the same health crisis) and empirical reasoning (e.g., item-to-construct loading), and parcels were used for the sake of parsimony as well as to avoid problems associated with specifying latent variables that have several indicators (e.g., Type 1 error; Little, Cunningham, Shahar, & Widaman, 2002). Factor loadings of measured indicators on their hypothesized latent constructs are shown in Table 2. The overall multi-group SEM produced good fit: $\chi^2 = 2130.78$, $df = 1{,}427$, $p < .001$; CFI = .925; RMSEA = .038.

Once the overall model was determined to have good fit, the next objective was to determine whether the predictive associations of the PMT components with intent to exercise differed between older men and older women. Gender group differences were assessed within the multi-group SEM by contrasting the baseline model (with no constrained pathways) to a model that constrains the path(s) in question to be equal in the models for the two groups (Byrne, 2001). A significant $\Delta\chi^2$ from the baseline model to the constrained model indicates that the constrained path(s) is not invariant (i.e., it significantly differs between groups). Subsequent multi-group SEM models testing for differences between men versus women by constraining the paths of age and PPA to each appraisal component and intent, and from each appraisal component to intent revealed that the paths significantly differed between the two groups (e.g., $\Delta\chi^2 = 16787.22$, $\Delta df = 42$, $p < .001$). These differences indicate that the predictors of intent to engage in regular exercise are not invariant

**Table 2.** Factor Loadings onto Latent Variables for Older Men and Women.

| | Men | Women |
|---|---|---|
| Severity: | | |
| Parcel 1: Heart attack | .51 | .49 |
| Parcel 2: Hip fracture | .30 | .49 |
| Parcel 3: Stroke | .64 | .34 |
| Vulnerability: | | |
| Parcel 1: Heart attack | .62 | .71 |
| Parcel 2: Hip fracture | .54 | .43 |
| Parcel 3: Stroke | .86 | .66 |
| Fear: | | |
| Frightened stroke | .74 | .71 |
| Anxious stroke | .85 | .72 |
| Worried stroke | .81 | .84 |
| Scared stroke | .86 | .82 |
| Frightened heart attack | .85 | .77 |
| Anxious heart attack | .86 | .84 |
| Worried heart attack | .91 | .87 |
| Scared heart attack | .91 | .85 |
| Frightened hip fracture | .69 | .72 |
| Anxious hip fracture | .67 | .70 |
| Worried hip fracture | .62 | .74 |
| Scared hip fracture | .68 | .74 |
| Maladaptive response rewards: | | |
| Conserve energy | .66 | .72 |
| Save time | .81 | .95 |
| Won't overexert | .71 | .88 |
| Self-efficacy: | | |
| When tired | .87 | .80 |
| Have many demands | .73 | .84 |
| Though feeling depressed | .74 | .79 |
| Do it by yourself | .81 | .72 |
| Bored with activities | .74 | .83 |
| Can't notice improvement | .84 | .84 |
| Response efficacy: | | |
| Parcel 1: Heart attack | .88 | .83 |
| Parcel 2: Hip fracture | .66 | .61 |
| Parcel 3: Stroke | .74 | .83 |
| Response costs: | | |
| Too tired | .60 | .76 |
| Take too much time | .71 | .64 |
| Less time for family/friends | .87 | .64 |
| Worry about looking awkward | .71 | .40 |
| Cost too much | .61 | .54 |
| Intent: | | |
| Likelihood of adequate exercise | .83 | .90 |
| Tell self to get adequate exercise | .30 | .66 |
| Plan to get adequate exercise | .79 | .91 |
| Chances of adequate exercise | .78 | .90 |

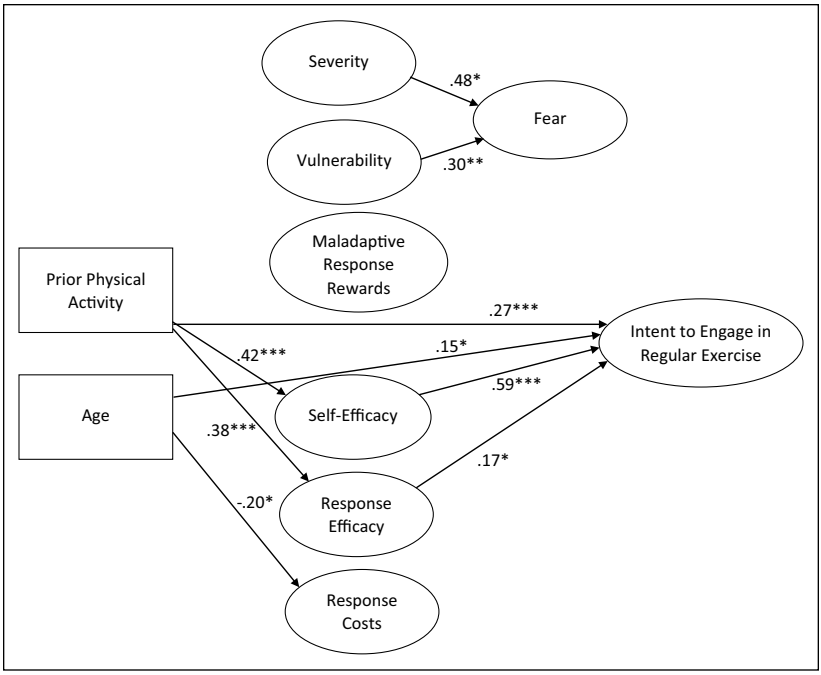


**Figure 1.** Structural equation model predicting older men's intent to engage in regular exercise.
*Note.* Only significant paths are shown.
*$p$ < .05. **$p$ < .01. ***$p$ < .001.

across men versus women, supporting the decision to conceptualize them as distinct groups. Specific parameters for older men and women are subsequently described.

*Older men.* All significant paths for older men based on standardized coefficients are indicated in Figure 1. Neither PPA nor age predicted any of the threat appraisal components for older men, nor did the threat appraisal components predict intent to exercise (although both severity and vulnerability predicted fear, $\beta = .40$, $p = .01$ and $\beta = .30$, $p = .008$, respectively).

PPA and age did predict coping appraisal components: PPA predicted greater self-efficacy ($\beta = .42$, $p < .001$) and response efficacy ($\beta = .38$, $p < .001$), as well as greater intent to engage in regular exercise ($\beta = .27$, $p < .001$; Figure 1). Age negatively predicted response costs and positively predicted intent: Compared with their "younger" counterparts, older men reported

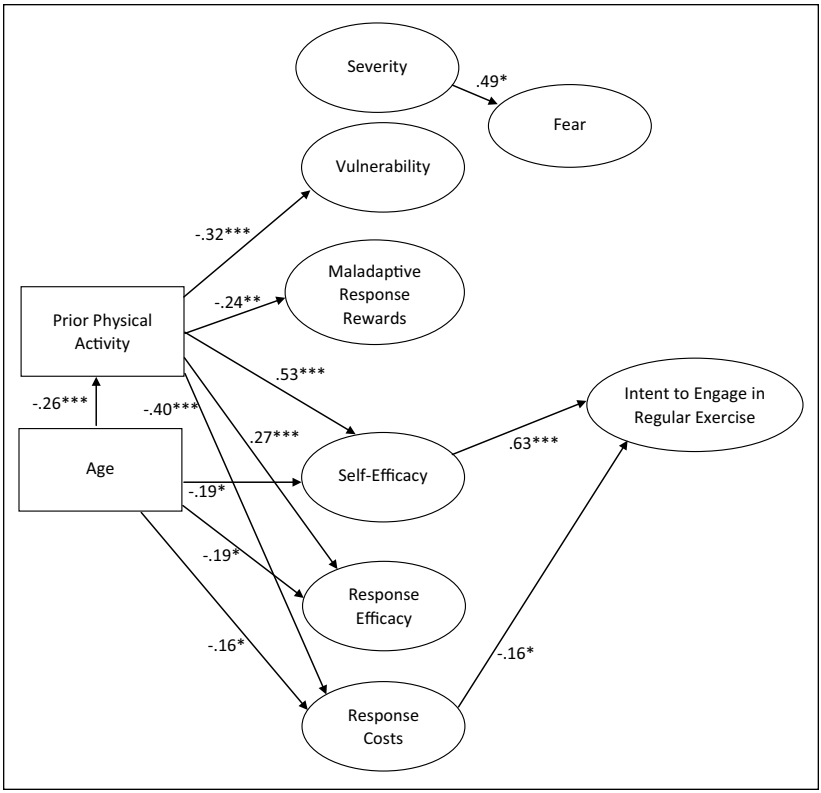


**Figure 2.** Structural equation model predicting older women's intent to engage in regular exercise.
*Note.* Only significant paths are shown.
*$p < .05$. **$p < .01$. ***$p < .001$.

fewer costs associated with engaging in regular exercise ($\beta = -.20$, $p = .02$), and greater intent to engage in regular exercise ($\beta = .15$, $p = .02$). Self-efficacy and response efficacy also predicted intent to exercise ($\beta = .59$, $p < .001$ for self-efficacy; $\beta = .17$, $p = .04$ for response efficacy). Together, these findings indicate that PPA, age, and coping appraisals are key predictors of older men's intent to exercise.

*Older women.* Significant paths for older women based on standardized coefficients are indicated in Figure 2. Unlike the findings for older men, older women's age negatively predicted.

PPA ($\beta = -.26$, $p < .001$) and PPA predicted threat appraisal components: Greater PPA predicted lower perceived vulnerability ($\beta = -.32$, $p < .001$) and lower maladaptive response rewards ($\beta = -.24$, $p = .001$). Although severity predicted greater fear ($\beta = .49$, $p = .03$), none of the threat appraisal components predicted intent to exercise.

Also in contrast to older men, neither older women's age nor PPA directly predicted intent to exercise. However, both PPA and age predicted each coping appraisal component. PPA predicted greater self-efficacy ($\beta = .53$, $p < .001$) and response efficacy ($\beta = .27$, $p < .001$), as well as fewer response costs ($\beta = -.40$, $p < .001$). Age negatively predicted self-efficacy ($\beta = -.19$, $p = .002$), response efficacy ($\beta = -.19$, $p = .014$), and response costs ($\beta = -.16$, $p = .03$). In turn, greater self-efficacy and fewer response costs predicted greater intent to exercise ($\beta = .63$, $p < .001$ for self-efficacy; $\beta = -.16$, $p = .03$ for response costs). Overall, these findings indicate that PPA and age predict threat and coping appraisals in older women, and in turn, coping appraisals predict older women's intent to engage in regular exercise.

## Discussion

The current study utilized a PMT framework to identify the relationship between perceived risk of acute health crises and intent to engage in regular exercise among a large community-based sample of older adults. A major objective was to go beyond the tradition of examining threat appraisal components of PMT as predictors of intent to exercise by also examining the reverse relationship in terms of PPA predicting perceived vulnerability to suffering acute health crises. As expected, greater PPA was associated with lower perceived vulnerability for both genders. However, when age and all PMT components were accounted for, greater PPA predicted less vulnerability among older women but not older men. These findings suggest individuals perceiving their acute health risks as low because they already engage in preventive behaviors (Plotnikoff & Higginbotham, 1995) may be especially true for older women.

All threat and coping appraisal components of PMT were incorporated into the current study, including the often omitted rewards of maladaptive response component (Rogers & Prentice-Dunn, 1997). Contrary to the current expectations based on the tenets of PMT, none of the threat appraisal components (severity, vulnerability, fear, and maladaptive response rewards) predicted intent to exercise. A possible explanation for this lack of a predictive relationship is that greater perceived threat can have differing consequences, in some cases enhancing intent to engage in a preventive behavior, but in other cases, resulting in denial and avoidance (Rippletoe & Rogers,

2006). Moreover, threat appraisals may have a more distal relationship with intent compared to coping appraisals in that the threat may trigger consideration of action but perceived efficacy and feasibility play a more prominent role in determining the type of action to be taken (Plotnikoff et al., 2009). In addition, the majority of threat appraisal components are framed around the potential health crisis (e.g., heart attack) without mention of the preventive behavior (i.e., exercise). Accordingly, some older individuals in the current study may have perceived exercise as less salient than other possible preventative behaviors (e.g., healthy eating, stress management) in reducing the threat of the specified health crises. If this were the case, future research examining older adults' intent to engage in a wider range of relevant preventative behaviors, or having older adults identify the preventive behavior that they deem most salient, may yield stronger relationships between PMT's threat appraisal components and intent. Such research would also provide a clearer sense of how older adults perceive exercise compared to other preventive behaviors in terms of its relative importance in reducing the threat of health crises such as heart attack, hip fracture, or stroke.

Although there was a lack of predictive findings for threat appraisals, the current results do provide support for PMT's assumptions regarding coping appraisals. As expected and similar to past research (Milne et al., 2000), older adults' coping appraisals were important in predicting intent to exercise. In particular, self-efficacy was the most prominent predictor of exercise intention for both older men and women, even after accounting for PPA and age. This prominence of self-efficacy is consistent with findings among younger samples (Milne et al., 2000; Plotnikoff & Higginbotham, 1998) and with prior research examining predictors of exercise behavior among older adults using other theoretical frameworks (e.g., Social Cognitive Theory; Bandura, 1997). In particular, recent research by McAuley and colleagues has shown self-efficacy to be a robust predictor of physical activity behavior among various groups of older adults, including breast cancer survivors (Philips & McAuley, 2014), those with multiple sclerosis (Motl, McAuley, Wynn, Sandroff, & Suh, 2013) as well as geographically diverse community samples of older adults (Mullen, McAuley, Satariano, Kealey, & Prohaska, 2012).

Despite the commonality of self-efficacy predicting their intent to exercise, older men and women differed in the magnitude of some PMT components. Older women perceived the acute health crises (heart attack, hip fracture, and stroke) as more severe, felt more vulnerable to them, and reported greater fear of suffering the health crises compared with older men. Older women also reported greater response efficacy by viewing exercise as an effective way to reduce their risk of acute health crises more so than older men did.

Older men and women also differed in how their PPA and PMT components predicted intent to exercise. The current findings indicate that for older women, PPA affects how vulnerable they feel to suffering acute health crises and both PPA and age predict their coping appraisals. In turn, greater self-efficacy and fewer response costs predict greater intent to exercise. For older men, PPA, age, self-efficacy, and response efficacy were key predictors of intent to exercise. These differences indicate that the importance of various PMT components and the nature of the associations among those components and with intent to exercise vary as a function of gender.

The current findings have implications for older adults living within the community. Given the importance of self-efficacy in predicting intent to exercise, community health promotion efforts should focus on enhancing older adults' self-efficacy to bolster their intent, and in turn, their engagement in regular exercise. Such interventions targeting older adults' exercise self-efficacy (e.g., McAuley et al., 2011; Neupert, Lachman, & Whitbourne, 2009) have been effective in enhancing continued engagement in regular exercise. More broadly, by indirectly enhancing physical activity, such interventions could contribute to cost-effective management of cardiovascular and functional health, as well as prevention of related acute health crises.

It is important to recognize that for older women, additional factors such as response costs may inhibit their intent to exercise. Thus, it would be helpful for community health promotion efforts to address issues such as competing responsibilities, lack of time or energy, and other potential response costs that may reduce older women's exercise intent. In contrast, the current findings suggest that these response costs are less of an obstacle to exercise intent for older men. Instead, health promotion efforts should focus on bolstering older men's response efficacy by persuading them that exercising is an effective way to lower their risk of various acute health crises. Overall, while enhancing self-efficacy can benefit intent to exercise in both genders, it is critical to recognize that older men and women differ in what affects their intent to exercise.

In addition to the practical implications for older adults, the current findings also have implications for the overall PMT framework. A test of the reciprocal link between PPA and perceived threat addressed a gap in prior PMT research (Rogers & Prentice-Dunn, 1997), and indicated that for older women, PPA predicted less perceived vulnerability to acute health crises. Including this reciprocal link between engagement in a protective health behavior and perceived threat is critical to the PMT framework because it identifies prior behavior as an antecedent to perceived threat while also acknowledging the impact of threat perceptions on subsequent protective behavior. As the current findings among older women suggest, engagement in protective behavior may

be a stronger antecedent of perceived threat than a consequence of it. Subsequent applications of the PMT framework should include this reciprocal link between health behavior and perceived threat to determine the extent to which it exists beyond the scope of older adults engaging in exercise in response to perceived threat of an acute health crisis.

The current study also examined the rarely considered maladaptive response rewards component of threat appraisals. The lack of a significant relationship found between it and intent to exercise may be partly due to a conceptual overlap between maladaptive response rewards (i.e., benefits of not exercising) and the coping appraisal component of response costs (i.e., costs of exercising). Although further examination of all components of the PMT model will contribute to better understanding the extent of the full model's contribution to predicting intent and subsequent preventive behavior, the overlap between maladaptive response rewards and response costs should be considered to determine the potential for a more parsimonious theoretical model.

Overall, the current findings among a sample of exclusively older adults are consistent with prior applications of the PMT framework in three ways. First, threat appraisals were a poor predictor of intent. Second, coping appraisals were more important than threat appraisals in predicting behavioral intent. Third, self-efficacy was the most prominent coping appraisal component in predicting intent. These PMT patterns are consistent with those found in Milne et al.'s (2000) meta-analysis based on 27 studies with more than 7,500 participants. Accordingly, coping appraisals appear to play a more direct role in predicting intent; however, it would be premature to focus exclusively on coping appraisals without a better understanding of threat appraisal contributions in the overall PMT model. In particular, future research should attempt to determine whether the impact of threat appraisals on intent is moderated by other variables such as perceived complexity of the preventive behavior under contemplation.

The current findings should be considered within the context of the following limitations. Inter-item reliabilities for the response efficacy component were quite low. Despite this, the response efficacy parcels for each health risk loaded well onto the latent construct that significantly predicted intent for men. Nonetheless, future research should retain the full response efficacy measure from which the current items were drawn and which has adequate internal reliability ($\alpha$ = .80; Plotnikoff & Higginbotham, 2002). Although important predictors of intent to exercise were identified, actual subsequent exercise behavior was not assessed. Although prior PMT research has shown a link between intent and engagement in the target health behavior (Milne et al., 2000), further research is needed to examine this link between older adults' intent to exercise and their actual exercise behavior within the PMT

framework. Efforts were made to reduce the limitations of the cross-sectional nature of the study by framing the PPA measure in a retrospective manner and the intent measure prospectively. However, further research should aim to replicate these findings among older adults within a longitudinal research design. It is also important to note that PMT and the current study focus primarily on individual-level factors that influence intent to exercise. Subsequent research could examine predictors of exercise intent from a more holistic ecological approach by examining PMT constructs in combination with broader level social and environmental factors (e.g., social support and community resources; Waites, 2013). Finally, the generalizability of the current findings is limited to well-educated older adults as 93% of the larger sample from which the current participants were drawn had some postsecondary education (Ruthig et al., 2011). The sample was also racially homogeneous in nature (i.e., 99% Caucasian). Thus, research based upon a more diverse sample of older adults is critical to advancing the application of PMT in an attempt to predict exercise in later life. Despite these limitations, the current application of PMT identified key predictors of exercise intent among older adults, as well as areas to focus further aging and health promotion research.

## Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author received no financial support for the research, authorship, and/or publication of this article.

## Notes

1. The original study from which the current sample was recruited focused on the full range of older adulthood. For the current study, there were four participants under the age of 60. The main findings did not change when data for these four under-60 participants were excluded; thus, they were retained for the current study analyses.
2. For the current purposes, five items were omitted from the original scale, because they were not adaptable to all of the health crises: hip, stroke, and heart attack (e.g., “Regular exercise will improve my overall alertness and thinking”).

## References

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckman (Eds.), *Action-control: From cognition to behavior* (pp. 11-39). Heidelberg: Springer.

Allen, R. S., Phillips, L. L., Pekmezi, D., Crowther, M. R., & Prentice-Dunn, S. (2009). Living well with living wills: Application of protection motivation theory to living wills among older Caucasian and African American adults. *Clinical Gerontologist*, *32*, 44-59.

An, M., & Shaughnessy, M. (2011). The effects of exercise-based rehabilitation on balance and gait for stroke patients: A systematic review. *Journal of Neuroscience Nursing*, *43*, 298-307.

Bailis, D. S., Chipperfield, J. G., Perry, R. P., Newall, N. E., & Haynes, T. L. (2008). Exploring the commonalities between adaptive resources and self-enhancement in older adults' comparative judgments of physical activity. *Journal of Aging and Health*, *20*, 899-919.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Becker, M. H. (1974). The health belief model and personal health behavior. *Health Education Monographs*, *2*, 324-508.

Berkowitz, A., Hawkins, N. A., Peipins, L. A., White, M. C., & Nadel, M. (2008). Beliefs, risk perceptions, and gaps in knowledge as barriers to colorectal cancer screening in older adults. *Journal of American Geriatrics Society*, *56*, 307-314.

Boer, H., & Seydel, E. R. (1996). Protection motivation theory. In M. Connor & P. Norman (Eds.), *Predicting health behavior* (pp. 95-120). Buckingham, UK: Open University Press.

Byrne, B. M. (2001). *Structural equation modeling with AMOS: Basic concepts, applications and programming*. Mahwah, NJ: Lawrence Erlbaum.

Floyd, D. L., Prentice-Dunn, S., & Rogers, R. W. (2000). A meta-analysis of research on Protection Motivation Theory. *Journal of Applied Social Psychology*, *30*, 407-429.

Frijling, B. D., Lobo, C. M., Keus, I. M., Jenks, K. M., Akkermans, R. P., Hulscher, M., . . .Grol, R. (2004). Perceptions of cardiovascular risk among patients with hypertension or diabetes. *Patient Education and Counseling*, *52*, 47-53.

Goldstein, L. B., Bushnell, C. D., Adams, R. J., Appel, L. J., Braun, L. T., Chaturvedi, S., . . .Pearson, T. A. (2011). Guidelines for the primary prevention of stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*, *42*, 517-584.

Greenlee, R. T., Naleway, A. L., & Vidaillet, H. (2002). Incidence of myocardial infarction in a general population: The Marshfield epidemiological study area. *Wisconsin Medical Journal*, *101*, 46-52.

Hanson, B. L., & Ruthig, J. C. (2012). The unique role of sleep quality in older adults' psychological well-being. *Journal of Applied Gerontology*, *31*, 587-607.

Harwell, T. S., Blades, L. L., Oser, C. S., Dietrich, D. W., Okon, N. J., Rodriguez, D. V., … Gohdes, D. (2005). Perceived risk for developing stroke among older adults. *Preventive Medicine*, *41*, 791-794.

Haskell, W. L., Lee, I-M., Pate, R. R., Powell, K. E., & Blair, S. N. (2007). Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*, *116*, 1081-1093.

Hu, L., & Bentler, P. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1-55.

Legato, M. J., Padus, E., & Slaughter, E. (1997). Women's perceptions of their general health, with special reference to their risk of coronary artery disease: Results of a national telephone survey. *Journal of Women's Health*, *6*, 189-198.

Leibson, C. L., Tosteson, A. N. A., Gabriel, S. E., Ransom, J. E., & Melton, L. J. (2002). Mortality, disability, and nursing home use for persons with and without hip fracture: A population-based study. *Journal of the American Geriatrics Society*, *50*, 1644-1650.

Little, T., Cunningham, W., Shahar, G., & Widaman, K. (2002). To parcel or not to parcel: Exploring the question, weighing the merits. *Structural Equation Modeling: A Multidisciplinary Journal*, *9*, 151-173.

Maddux, J., & Rogers, R. (1983). Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journal of Experimental Social Psychology*, *19*, 469-479.

Marcus, B. H., Selby, V. C., Niaura, R. S., & Rossi, J. S. (1992). Self-efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport*, *63*, 60-66.

McAuley, E., Mullen, S. P., Szabo, A. N., White, S. M., Wójcicki, T. R., Mailey, E. L., . . .Kramer, A. F. (2011). Self-regulatory processes and exercise adherence in older adults: Executive function and self-efficacy effects. *American Journal of Preventative Medicine*, *41*, 284-290.

McDonald, R., & Ringo Ho, M. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods*, *7*, 64-82.

Milne, S., Orbell, S., & Sheeran, P. (2002). Combining motivational and volitional interventions to promote exercise participation: Protection motivation theory and implementation intentions. *British Journal of Health Psychology*, *7*, 163-184.

Milne, S., Sheeran, P., & Orbell, S. (2000). Prediction and intervention in health-related behavior: A meta-analytic review of protection motivation theory. *Journal of Applied Social Psychology*, *30*, 106-143.

Motl, R. W., McAuley, E., Wynn, D., Sandroff, B., & Suh, Y. (2013). Physical activity, self-efficacy, and health-related quality of life in persons with multiple sclerosis: Analysis of associations between individual-level changes over one year. *Quality of Life Research*, *22*, 253-261.

Mullen, S. P., McAuley, E., Satariano, W. A., Kealey, M., & Prohaska, T. R. (2012). Physical activity and functional limitations in older adults: The influence of self-efficacy and functional performance. *The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, *67*, 354-361.

National Institutes of Health. (2001). *Timing, intensity, and duration of rehabilitation for stroke and hip fracture*. Retrieved from http://grants2.nih.gov/grants/guide/rfa-files/RFA-HD-01-022.html

Neupert, S. D., Lachman, M. E., & Whitbourne, S. B. (2009). Exercise self-efficacy and control beliefs: Effects on exercise behavior after an exercise intervention for older adults. *Journal of Aging and Physical Activity*, *17*, 1-16.

O'Brien-Cousins, S. (2000). "My heart couldn't take it": Older women's beliefs about exercise benefits and risks. *The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, *55*, P283-P294.

Philips, S. M., & McAuley, E. (2014). Physical activity and quality of life in breast cancer survivors: The role of self-efficacy and health status. *Psycho-Oncology*, *23*, 27-34.

Plotnikoff, R. C., Blanchard, C., Hotz, S., & Rhodes, R. (2001). Validation of the decisional balance constructs of the transtheoretical model in the exercise domain: A longitudinal test in a population sample. *Measurement in Physical Education and Exercise Science*, *5*, 191-206.

Plotnikoff, R. C., & Higginbotham, N. (1995). Predicting low-fat diet intentions and behaviors for the prevention of coronary heart disease: An application of protection motivation theory among an Australian population. *Psychology & Health*, *10*, 397-408.

Plotnikoff, R. C., & Higginbotham, N. (1998). Protection motivation theory and the prediction of exercise and low-fat diet behaviors among Australian cardiac patients. *Psychology & Health*, *13*, 411-429.

Plotnikoff, R. C., & Higginbotham, N. (2002). Protection motivation theory and exercise behaviour change for the prevention of coronary heart disease in a high-risk, Australian representative community sample of adults. *Psychology, Health & Medicine*, *7*, 87-98.

Plotnikoff, R. C., Rhodes, R., & Trinh, L. (2009). Protection motivation theory and physical activity: A longitudinal test among a representative population sample of Canadian adults. *Journal of Health Psychology*, *14*, 1119-1134.

Rippletoe, P. A., & Rogers, R. W. (2006). Effects of components of Protection–Motivation Theory on adaptive and maladaptive coping with a health threat. *Journal of Personality and Social Psychology*, *52*, 596-604.

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Psychology*, *91*, 93-114.

Rogers, R. W. (1983). Cognitive and psychological processes in fear appeals and attitude change: A revised theory of protection motivation. In J. T. Cacioppo & R. E. Petty (Eds.), *Social psychophysiology* (pp. 153-176). New York, NY: Guilford.

Rogers, R. W., & Prentice-Dunn, S. (1997). Protection motivation theory. In D. S. Gochman (Ed.), *Handbook of health behavior research* (pp. 113-132). New York, NY: Plenum.

Rogers, V. L., Go, A. S., Lloyd-Jones, D. M., Benjamin, E. J., Berry, J. D., Borden, W. B., . . .Turner, M. B. (2012). Heart disease and stroke statistics—2012 update: A report from the American Heart Association. *Circulation*, *125*, e2-e220.

Runge, C., Prentice-Dunn, S., & Scogin, F. (1993). Protection motivation theory and alcohol use attitudes among older adults. *Psychological Reports*, *73*, 96-98.

Ruthig, J. C., & Chipperfield, J. G. (2007). Health incongruence in later life: A longitudinal analysis of well-being and health care. *Health Psychology*, *26*, 753-761.

Ruthig, J. C., Chipperfield, J. G., Bailis, D. S., & Perry, R. P. (2008). Perceived control and risk characteristics as predictors of older adults' health risk estimates. *Journal of Social Psychology*, *148*, 667-688.

Ruthig, J. C., Chipperfield, J. G., Newall, N. E., Perry, R. P., & Hall, N. C. (2007). Detrimental effects of falling on health and well-being in later life: The mediating roles of perceived control and optimism. *Journal of Health Psychology*, *12*, 231-248.

Ruthig, J. C., Hanson, B. L., Pedersen, H., Weber, A., & Chipperfield, J. G. (2011). Later life health optimism, pessimism, and realism: Psychosocial contributors and health correlates. *Psychology & Health*, *26*, 835-853.

Stevens, J. A., & Olson, S. (2000). *Reducing falls and resulting hip fractures among older women* (Report No. 49RR02;1-12). Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/rr4902a2.htm#top

Tinetti, M. E., Baker, D. I., McAvay, G., Claus, E. B., Garrett, P., Gottschalk, M., . . . Horwitz, R. I. (1994). A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *The New England Journal of Medicine*, *331*, 821-827.

Waites, C. (2013). Examining the perceptions, preferences, and practices that influence healthy aging for African American older adults: An ecological perspective. *Journal of Applied Gerontology*, *32*, 855-875.

Wilcox, S., & Stefanick, M. L. (1999). Knowledge and perceived risk of major diseases in middle-aged and older women. *Health Psychology*, *18*, 346-353.

Yardley, L., Donovan-Hall, M., Francis, K., & Todd, C. (2007). Attitudes and beliefs that predict older people's intention to undertake strength and balance training. *The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, *62*, P119-P125.

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