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Brief Report

Productive Activities and Development of Frailty in Older Adults

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Objective. Our aim was to examine whether engagement in productive activities, including volunteering, paid work, and childcare, protects older adults against the development of geriatric frailty.

Methods. Data from the first (1988) and second (1991) waves of the MacArthur Study of Successful Aging, a prospective cohort study of high-functioning older adults aged 70–79 years (n = 1,072), was used to examine the hypothesis that engagement in productive activities is associated with lower levels of frailty 3 years later.

Results. Engagement in productive activities at baseline was associated with a lower cumulative odds of frailty 3 years later in unadjusted models (odds ratio [OR] = 0.74, 95% confidence interval [CI] = 0.58–0.96) but not after adjusting for age, disability, and cognitive function (adjusted OR = 0.78, 95% CI = 0.60–1.01). Examination of productive activity domains showed that volunteering (but neither paid work nor childcare) was associated with a lower cumulative odds of frailty after adjusting for age, disability, and cognitive function. This relationship diminished and was no longer statistically significant after adjusting for personal mastery and religious service attendance.

Discussion. Though high-functioning older adults who participate in productive activities are less likely to become frail, after adjusting for age, disability, and cognitive function, only volunteering is associated with a lower cumulative odds of frailty.

***Key Words*:** Productive activities—Volunteering—Frailty

ENGAGEMENT in productive activity has been a growing area of interest in the field of gerontology. In contrast to the stereotype of older adults as dependent unproductive members of society, the productive aging perspective emphasizes older adults' contributions to the economy, community, and family as paid workers, volunteers, and care providers (Caro & Bass, 1995; Glass, Seeman, Herzog, Kahn, & Berkman, 1995). Engagement in productive activities is positively associated with physical and psychological health as well as survival of older adults (Baker, Cahalin, Gerst, & Burr, 2005; Glass, Mendes de Leon, Marottoli, & Berkman, 1999; Hinterlong, Morrow-Howell, & Rozario, 2007; McIntosh & Danigelis, 1995).

Frailty—a common problem among older adults—is an age-associated condition of multisystem impairment, resulting in increased vulnerability to stress and mortality risk (Fried, Ferrucci, Darer, Williamson, & Anderson, 2004; Strawbridge, Shema, Balfour, Higby, & Kaplan, 1998). Behavioral and social factors such as sedentary lifestyle, smoking, alcohol use (Bortz, 2002; Woods et al., 2005), and lower social integration (Nourhashemi et al., 2001; Strawbridge, Shema, Balfour, Higby, & Kaplan, 1998) contribute to frailty. Engagement in productive activities that require complex physical functioning may work to postpone declines in physical muscle performance and skeletal stability (Svanborg, 2001), as well as induce psychosocial changes that could affect functioning in domains captured by measures of frailty. The present study aims to examine associations between productive activities and geriatric frailty.

Methods

Data

Data for the present analyses are from the MacArthur Study of Successful Aging (MSSA), a longitudinal cohort of high-functioning older adults from three sites of the Established Populations for the Epidemiologic Study of the Elderly (EPESE; Berkman et al., 1993). Selection criteria for MSSA included (a) age 70–79 years, (b) no reported disability on the Activities of Daily Living scale (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963), (c) no more than one reported limitation on an eight-item measure of range of motion and mobility disability (Nagi, 1976; Rosow-Breslau, 1966), (d) ability to hold semitandem balance for at least 10 seconds, (e) ability to stand from a chair at least five times in 20 s, (f) scoring six or more on the Short Portable Mental

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Status Questionnaire, and (g) remembering three or more items from a six-item short story (Pfeiffer, 1975).

Of 4,030 age-eligible EPESE participants screened for the MSSA, 1,313 met all selection criteria and 1,189 (90.6%) agreed to participate. Baseline data collection was conducted in 1988 through a 90-min face-to-face interview (n = 1,189). Follow-up assessments occurred in 1991 (n = 1,103) and 1995 (n = 853). The present study utilized the baseline and the first follow-up data.

Measures

Productive activities.—Measures of productive activities were adopted from the Americans' Changing Lives study (Herzog, Kahn, Morgan, Jackson, & Antonucci, 1989). Engagement in productive activities was assessed with three items: volunteering, paid work, and providing care for children. Participants were asked if they volunteered in the past 12 months, and if so, the number of hours. Participants were asked whether they currently worked and, if so, the number of weeks employed in the last year and average number of hours worked per week. Respondents were also asked whether they spent time caring for children younger than 18 years living in or out of the household, including the number of hours of care.

Three measures capturing engagement in productive activities were generated: (a) a binary measure of engagement in ≥1 activities versus no engagement, (b) the number of productive activities (0, 1, or 2 or 3), (c) binary measures of any versus no engagement in each activity domain, and (d) hours spent in each activity. We created categories to approximate part-time versus full-time hours of engagement: For paid work—0 (no engagement), 1 (≤520 hr), 2 (521–1040 hr), and 3 (≥1041 hr); for volunteering—0 (no engagement), 1(≤39 hr), 2 (40–159 hr), and 3 (≥160 hr); and for childcare—0 (no engagement), 1 (≤260 hr), 2 (261–1040 hr), and 3 (≥1041 hr).

Frailty.—Frailty status was measured with the definition developed by Fried and colleagues (2001) using five criteria: weight loss, weak grip strength, exhaustion, slow gait, and low physical activity level. As previously described (Sarkisian, Gruenewald, Boscardin, & Seeman, 2008), a dichotomous variable was created for each of the frailty indicators using the same or similar cutpoint criteria as Fried. Because weight loss was not available, baseline frailty estimates are based on only four of the criteria.

Weight loss was calculated as the percent of body weight lost from the baseline (1988) to 3-year follow-up exams. Grip strength was assessed with a hand-held dynamometer. Exhaustion was assessed using the Hopkins Symptom Checklist, "During the past week, how much have you been distressed by feeling low in energy or slowed down?" Gait speed was measured as the time to complete a 10-foot walk (usual pace). Physical activity was quantified using energy expenditure–weighted frequency assessments of engagement in recreational, exercise, housework, and yard work activities from the Yale Physical Activity Survey (Brown, Sinacore, Binder, & Kohrt, 2000). Those with 0 frailty criteria were considered non-frail, those with one or two criteria were considered to have intermediate frailty, and those with three or more criteria were considered frail.

Covariates.—Covariates measured at the baseline interview included age, gender, race (White vs. African American), educational attainment (highest year completed), and marital status (not married vs. married). Medical comorbidity was measured as the number (none or one vs. two or more) of self-reported physician-diagnosed chronic diseases. Presence or absence of disability was assessed combining the Nagi scale (Nagi, 1976) and the Rosow and Breslau scale (Rosow-Breslau, 1966). To quantify cognitive function, we used a previously tested summary score using a set of standardized tests including language, executive function, special ability, verbal memory and nonverbal memory naming, memory, abstraction, and spatial ability. Depressive mood was measured by an 11-item subscale of the Hopkins' Symptom Checklist for Depression.

We also examined psychosocial covariates including personal mastery beliefs, religious service attendance, social club participation, and emotional support. Personal mastery belief was measured with a seven-item scale by Pearlin and Schooler (1978). Attending religious services was assessed with a dichotomized variable (never or less than monthly vs. monthly to weekly) and attending social clubs was also assessed with a binary variable (never vs. sometimes or often). Emotional support was measured by asking how frequently participants felt they received emotional support from their spouse, children, and friends and relatives.

Analyses.—Eighty-six participants were lost by the first follow-up interview either due to death (n = 71) or refusal to participate in the study (n = 15). Of the 1,103 participants who were interviewed at the first follow-up (1991), 7 were missing data on baseline frailty levels, 21 on baseline productive activities, 87 on 1991 frailty levels, and the proportions of missing data on covariates ranged from 0.3% to 2.27%. Of those 1,103, 3% were classified as frail at baseline, 45% as intermediate frail, and 52% as not frail. At follow-up, 7% were classified as frail, 51% as intermediate frail, and 43% as not frail. We excluded participants classified as frail at baseline (n = 31). Multiple imputation (We repeated analyses using data obtained when imputing only missing covariates and those data obtained from list-wise deletion of missing data. Results from these analyses were essentially the same as the presented analyses.) was employed for missing data on those who participated in both baseline and follow-up, and presented models repre-

Table 1. Sample Characteristics by Productive Engagement Status Category (N = 1,072)

Variables	No productive engagement (n = 483) (%)	Any productive engagement (n = 589) (%)	p Value
1988 Frailty			
No frailty	55.0	56.8	.14
Intermediate frailty	49.0	43.2	
1991 Frailty			
No frailty	39.0	46.9	.03
Intermediate frailty	54.0	47.9	
Frailty	7.0	5.2	
Female	61.6	54.1	.00
African American	13.0	24.0	.00
Physical disability	27.3	22.4	.06
Married	44.3	49.4	.11
Two or more chronic medical conditions	23.8	23.0	.74
Attends religious service	70.0	78.5	.00
Attends club meetings	36.1	62.0	.00
	M (SD)	M (SD)	
Age	74.5 (2.7)	74.0 (2.7)	.01
Education (years)	10.2 (2.9)	10.9 (3.5)	.00
Depressive mood	14.1 (3.1)	14.1 (3.2)	.67
Cognitive functioning	52.0 (9.2)	53.81 (10.3)	.00
Personal mastery belief	18.9 (2.1)	19.1 (2.3)	.13
Emotional support	2.4 (0.5)	2.5 (0.5)	.01

Note: All variables measured at baseline (1988) unless otherwise specified.

sent estimates averaged across five imputed data sets using procedures in STATA 10.0. Our final analytic sample size is 1,072. To select covariates for the multivariate models, the bivariate relationships between each candidate variable and baseline productive engagement and 1991 frailty were assessed using t-tests and chi-square analyses. With the goal of including potential confounders, variables associated ($p \leq .15$) with 1991 frailty levels and any one of the measures of baseline productive engagement were included in the multivariable analyses.

To examine the association between baseline productive engagement and 1991 frailty, we constructed a series of nested ordered logistic regression models examining the cumulative odds of frailty in 1991 (intermediate frail and frail vs. non-frail and frail vs. intermediate frail and non-frail) based on baseline productive activities engagement. The first model includes engagement in productive activities and baseline intermediate frailty. The second model adds age and baseline health and function variables and the third model adds psychosocial covariates to the second model. Three sets of nested ordered logistic regression models were examined utilizing different engagement in productive activities predictors in each set: (a) any versus no engagement at baseline, (b) number of productive activities (0, 1, 2–3) engaged in at baseline, (c) engagement (any vs. none) in volunteering, paid work, and childcare activities (three separate dichotomous predictors), and (d) degree of engagement measured as linear trend of time categories for each activity.

Results

In all, 45% of the participants did not engage in any productive activities, 39% of participants engaged in one activity, and 15% engaged in two or three activities. Fifty-five percent of the participants engaged in at least one activity. Twenty-eight percent reported volunteering, 19% reported engagement in paid work, and 25% provided care to children.

Analyses on the sample characteristics by productive activity engagement status at baseline (Table 1) revealed that compared with participants without productive engagement, participants with productive engagement were younger, more educated, had better cognitive functioning, higher personal mastery belief scores, and greater emotional support. Those who frequently attended religious services and attended club meetings were more likely to be engaged in productive activities.

Age, cognitive functioning, disability, personal mastery belief, attending religious services, and emotional support were associated ($p \leq .15$) with at least one of the indicators of productive engagement and the odds of higher 1991 frailty levels; thus, these variables were retained for multivariable regression analyses.

Table 2 exhibits the results from the ordered logistic regression analyses. Model 1 demonstrates that participants who engaged in productive activities had a lower unadjusted cumulative odds of frailty in 1991 compared with those without engagement (odds ratio [OR] = 0.74, 95% confidence interval [CI] = 0.58–0.96). When age, physical disability, and cognitive function were added (Model 2), the association was reduced and not statistically significant (OR = 0.78, 95% CI = 0.60–1.01). Further adjustment for psychosocial covariates (Model 3) resulted in a further reduction in magnitude of the odds ratio estimate for productive engagement. Older age, lower personal mastery belief, and attending religious services were independently associated with frailty.

As shown, participants who engaged in one productive activity had a lower cumulative odds of frailty at follow-up compared with those without engagement in unadjusted models, but this association was no longer statistically significant after inclusion of age, disability, and cognitive function (OR = 0.76, 95% CI = 0.58–1.00). Similar to the pattern with the binary measure of productive engagement status, the magnitude of associations between the number of activities and frailty levels was reduced further by inclusion of psychosocial covariates in the models.

The results of analyses examining associations between different domains of productive activities and frailty level indicate that volunteering (OR = 0.73, 95% CI = 0.55–0.98) but neither paid work nor childcare was associated with lower cumulative odds of frailty at follow-up. This association was unchanged after adjusting for age, disability, and cognitive functioning. As illustrated in Table 2, personal mastery belief and attending religious services attenuated the relationship between volunteering and 1991 frailty

Table 2. Ordered Logistic Regression Models Predicting 1991 Frailty Levels (N = 1,072)

	Model 1 (N = 1,072)		Model 2 (N = 1,072)		Model 3 (N = 1,072)	
	OR	95% CI	OR	95% CI	OR	95% CI
Productive activity						
Any vs. none	0.74	0.58, 0.96	0.78	0.60, 1.01	0.82	0.63, 1.07
Intermediate frailty	3.23	2.50, 4.18	3.07	2.37, 3.98	2.99	2.30, 3.89
Age			1.08	1.03, 1.13	1.08	1.03, 1.13
Physical disability			1.15	0.86, 1.54	1.13	0.82, 1.50
Cognitive functioning			0.99	0.98, 1.00	0.99	0.97, 1.00
Personal mastery belief					0.94	0.89, 0.99
Religious service attendance					0.69	0.50, 0.95
Emotional support					0.91	0.73, 1.18
Productive activity (number of activities)						
One (vs. none)	0.72	0.55, 0.95	0.76	0.58, 1.00	0.79	0.60, 1.05
Two or more (vs. none)	0.79	0.55, 1.14	0.84	0.58, 1 22	0.92	0.63, 1.34
Intermediate frailty	3.24	2.51, 4.19	3.05	2.34, 3.97	2.99	2.29, 3.91
Age			1.08	1.03, 1.13	1.08	1.03, 1.13
Physical disability			1.16	0.86, 1.55	1.14	0.85, 1.53
Cognitive functioning			0.99	0.98, 1.00	0.99	0.98, 1.00
Personal mastery belief					0.94	0.88, 0.99
Religious service attendance					0.68	0.49, 0.94
Emotional support					0.93	0.73, 1.18
Productive activity (specific domains)						
Volunteering (any vs. none)	0.72	0.54, 0.96	0.73	0.55, 0.98	0.78	0.58, 1.06
Paid work (any vs. none)	0.79	0.58, 1.10	0.83	0.60, 1.14	0.85	0.62, 1.18
Childcare (any vs. none)	1.12	0.85, 1.49	1.16	0.87, 1.54	1.18	0.88, 1.57
Intermediate frailty	3.24	2.50, 4.19	3.09	2.39, 4.01	3.00	2.30, 3.92
Age			1.08	1.03, 1.13	1.08	1.03, 1.13
Physical disability			1.14	0.85, 1.53	1.12	0.84, 1.50
Cognitive functioning			0.99	0.98, 1.00	0.99	0.98, 1.00
Personal mastery belief					0.94	0.88, 0.99
Attending religious service					0.70	0.51, 0.97
Emotional support					0.93	0.73, 1.18
Productive activity (engagement hours)						
Volunteering	0.87	0.77, 1.00	0.88	0.77, 1.01	0.92	0.80, 1.06
Paid work	0.91	0.79, 1.05	0.94	0.81, 1.08	0.95	0.82, 1.09
Childcare	1.06	0.91, 1.24	1.08	0.92, 1.26	1.08	0.93, 1.27
Intermediate frailty	3.23	2.50, 4.18	3.08	2.38, 3.99	3.00	2.31, 3.90
Age			1.09	1.03, 1.14	1.09	1.04, 1.13
Physical disability			1.15	0.86, 1.54	1.13	0.84, 1.51
Cognitive functioning			0.99	0.98, 1.00	0.99	0.98, 1.00
Personal mastery belief					0.94	0.88, 1.00
Attending religious service					0.69	0.51, 0.95
Emotional support					0.92	0.72, 1.17

Note: All variables measured at baseline (1988) unless otherwise specified. OR = odds ratio; CI = confidence interval.

levels. None of the hours of engagement measures were associated with frailty levels in adjusted models.

Discussion

In this longitudinal cohort of high-functioning older adults, engagement in productive activities, as assessed with a multi-activity measure, was not independently associated with a lower cumulative odds of frailty 3 years later. Volunteering, but not paid work or childcare, was associated with a lower cumulative odds of frailty after adjusting for age, disability, and cognitive function. Adjusting for personal mastery belief and attending religious services—both independent correlates of frailty—attenuated this relationship.

Though not significant in the final model, our findings indicate that volunteering is a more significant predictor of frailty than paid work or childcare. The lack of an observed association between paid work or childcare and frailty may reflect the complicated relationships between paid work, caregiving, and health in later life. Arguably, volunteering is often discretionary behavior (Burr, Choi, Mutchler, & Caro, 2005), while older adults may engage in paid work and childcare for reasons less under their personal control, such as economic necessity.

Previous research has suggested that the effects of productive activities may be mediated by older individuals' subjective evaluations of the activities. For example, perceived social reciprocity might explain the association between productive activities and well-being. Wahrendorf, von dem Knesebeck, and Siegrist (2006) reported that volunteering and informal helping were associated with

reduced levels of depression and better quality of life only when respondents felt their activities were appreciated by the recipients. Older individuals involved with childcare and paid work might perceive their efforts are greater than the reward from the activities, whereas volunteers might experience "balanced social exchange" (Wahrendorf et al. 2006, p. 71). Perceived importance of roles, such as role salience or role centrality, has also been shown to influence the association between performing roles and well-being (Musick & Wilson, 2003). Older adults in our study may have ascribed varying levels of importance to the different roles examined, and this may account for our findings. Future studies including measures of perceived social responsibility and rewards gained from engagement in productive activities should examine this issue in greater depth.

There are important limitations to this study. Though the analytic models accounted for baseline frailty level, our analyses do not prove a causal relationship between observed associations. Most importantly, our finding that volunteering is no longer independently associated with frailty after adjusting for personal mastery and religious attendance raises the possibility that these characteristics (as well as other unmeasured related confounders) rather than volunteering may be protective against frailty.

Our study only looked at one definition of frailty; whether productive engagement prevents frailty using other definitions that include psychosocial factors (Rockwood et al., 1999) should be examined. Though only 71 participants died between baseline and the first follow-up interview, this attrition was not random; it is likely that at least some of the 71 deceased participants were frail prior to death, which could bias our findings. As described, the MSSA sample was selected from the highest functioning tertile of 70- to 79-year-olds in EPESE; it is possible that productive activities might be protective among younger or lower functioning older adults. Additionally, findings should be retested in a larger population of older adults with greater racial and ethnic diversity.

In conclusion, though high-functioning older adults who participate in productive activities are less likely to become frail, after adjusting for age, disability, and cognitive function, only volunteering (and not childcare or paid work) was independently associated with a lower cumulative odds of frailty.

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