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Original Article

The Relation of Volunteering and Subsequent Changes in Physical Disability in Older Adults

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Abstract

Objectives: To describe the association between initiating volunteering and changes in physical disability in older adults, and whether intensity and gender modify this relationship.

Methods: Employing propensity score weighted regression adjustment, we calculate changes in disability using a sample of U.S. adults (n = 7,135) in the Health and Retirement Study (1996–2012) not volunteering at baseline but later initiating volunteering (1–99 hr/year or 100+ hours per year) or remaining a nonvolunteer.

Results: Relative to continuous nonvolunteers, low-intensity volunteering is related to 34% lower disability in the low-intensity group (average treatment effect [ATE] = −0.12) and 63% lower in the higher-intensity group (ATE = −0.23). For men, progression was lower only in the highest intensity group (ATE = +0.02), but women experienced similarly less progression of disability (38%–39%) at either level of new engagement (ATE = −0.17 and −0.18).

Discussion: Initiating a new volunteer role in later life is related to decreased progression of disability, at low or high levels for women and only at higher levels for men. This study suggests that volunteer intervention programs may represent a major public health strategy to delay the progression of physical disability for older adults.

Keywords: Functional health, Health and Retirement Study, Psychological health, Volunteer activity

As the number of older adults increases and with late-life disability no longer declining, we face a dramatic growth in the number of older people facing disability and subsequent dependence (Eggleston & Fuchs, 2012; Kaye, 2013). Public health efforts to reduce the onset and progression of disability in older adults, typically by attempting to increase physical activity, have yielded minimal benefit (Matthews et al., 2008). To the contrary, a growing number of older adults are highly sedentary and experiencing accelerated onset of disability leading to loss of independence (Dunlop et al., 2015; de Rezende, Rey-López, Matsudo, & do Carmo Luiz, 2014).

Recent evidence suggests that health interventions may be more successful if they motivate older adults in ways that are relevant to their lives, particularly in ways that facilitate a positive image of aging, and confidence in their ability to carry out the activity (Bardach, Schoenberg, & Howell, 2016). This may explain why a growing and robust body of research shows that volunteering in later life contributes to successful aging (Carr, Fried, & Rowe, 2015; Kail & Carr, 2017; Rowe & Kahn, 1997). The literature establishing that volunteering has the potential to contribute to positive health effects in later life is compelling (Choi, Tang, Kim, & Turk 2016; Kail & Carr, 2017; Lum & Lightfoot, 2005; Matz-Costa, Besen, Boone James, & Pitt-Catsouphes, 2014; Morrow-Howell, 2010; Musick, Herzog, & House, 1999; Musick & Wilson, 2003; Sneed & Cohen, 2013). Volunteering also seems to contribute to enhanced meaning and purpose in later life (Greenfield &

Marks, 2004; Schnell & Hoof, 2012), and offers financial and social benefits for society.

Volunteer interventions may provide an innovative, successful approach to helping older adults stay independent longer (Fried et al., 2004). However, most research on the health effects of volunteering is based on studies examining differences between nonvolunteers and volunteers, some of whom are engaged in volunteering for an extended period, making it difficult to determine if volunteers are simply selectively healthier than nonvolunteers (Li & Ferraro, 2005). In order to determine if volunteering might serve as a health intervention that delays onset of disability in later life, we need to better understand whether becoming a volunteer can "get under the skin" and modify functional health changes associated with aging, and further, if all individuals are likely to experience such benefits.

Potential Mechanisms

Despite the abundance of research that shows positive relationships between volunteering and physical health (e.g., Choi et al., 2016; Kail & Carr, 2017), we are only beginning to understand the potential mechanisms driving these benefits. One of the few, and best known, public health volunteer interventions ever performed, the Experience Corps Baltimore trial, was designed based on the notion that volunteering should be conceived as a social model for health promotion. Specifically, this theory proposes three primary mechanisms driving the health benefits experienced by volunteers—increases in physical, social, and cognitive engagement—which are very similar to the three criteria associated with successful aging and identified by the MacArthur Studies of Successful Aging (Rowe & Kahn, 1997). Although the Experience Corps study was designed to examine the effect of an intensive "dose" of volunteering (i.e., about 15 hr per week) that were atypical of the average older adult volunteer, relative to a control group, recent research (primarily using observational data) supports these factors as key drivers of health benefits. For instance, small increases in physical activity are associated with physiological changes in health among those who volunteer (Kail & Carr, 2017; Sneed & Cohen, 2013). In addition, volunteering provides greater opportunities for social interactions (Matz-Costa et al., 2016), and thus, cultivation of social capital, decreased likelihood of social isolation, and enhanced social support available to cope with medical conditions (Holt-Lunstad, Smith, & Layton, 2010; Lum & Lightfoot, 2005).

Another mechanism driving potential benefits of volunteering could be related to institutional support structures that facilitate broader lifestyle changes. For instance, individuals who volunteer are more likely involved in religious institutions, which are shown to explain the association between physical health (i.e., frailty) and volunteering (Jung, Gruenewald, Seeman, & Sarkisian, 2010). Similarly, volunteers are significantly more likely to utilize health care to support preventative health care practices (Kim & Konrath, 2016), and are less likely to engage in risky health behaviors (Musick et al., 1999). The affiliated institutions and organizations in which people engage may incentivize maintenance of health because participants want to continue engagement in the activity, but they also socially embed participants in environments that may offer access to a range of resources and cultural practices that are beneficial to health.

Gaps in Existing Research

Despite the research suggesting that volunteering has positive effects on physical health in late life, widespread implementation of volunteering programs require the resolution of three critical gaps: (a) differentiation of the impact of new onset volunteering from effects/benefits that may accrue over time, (b) the intensity of new volunteer engagement needed to have a significant impact on disability, for example, "the dose response", and (c) possible differences in effects of new volunteering between men and women.

First, the vast majority of volunteer research to date compares nonvolunteers with volunteers who may accumulate health benefits over extended periods of time and engagement (e.g., Burr, Tavares, & Mutchler, 2011; Choi et al., 2016; Jung et al., 2010; Li & Ferraro, 2005; Matz-Costa et al., 2015; Musick et al., 1999; Sneed & Cohen, 2013; Tang, 2009; Tavares, Burr, & Mutchler, 2013). If we are interested in designing volunteer interventions that improve health, we should design interventions based on whether adding volunteering to one's existing repertoire of lifestyle behaviors improves health trajectories, and this is not possible to determine by examining long-term volunteer engagement relative to those who do not participate in this activity at all. If we take into consideration the factors that shape propensity to start volunteering in the first place, and focus on only those who are not engaged in volunteering, we can begin to parse out the potential effects of a volunteer intervention on older people who are not currently engaged (Fried et al., 2004). Although some studies have attempted to address issues of endogeneity in studies of volunteering and health (e.g., Kail & Carr, 2017; Li & Ferraro, 2005; Tang, 2009), we are unaware of observational studies that have specifically examined the association between *new* engagement in volunteering and disability, and addressed the propensity of selection into these new roles.

Second, research that has examined the potential benefits for new volunteer engagement (i.e., volunteering as a potential intervention) and functional health has primarily been examined based on a dichotomous measure of volunteer engagement. In order for volunteering to serve as a health intervention for older adults, it is important to learn whether the number of hours per week of volunteering has a significant impact on disability for individuals who start a new role. The Experience Corps trial noted that relative

to not starting a new volunteer role, very high levels of engagement (15 hr per week or more) did relate to beneficial effects to physical health. However, most older adults are not likely to contribute this amount of time. Thus, it is important to determine whether a lower dose of volunteering can also produce significant benefits to health. Many observational research studies have explored whether there are differences in health effects based on how much time ongoing volunteers engage, with some study results suggesting that those who engage in lower levels (<2 hr per week) may not benefit as much as those who engage in moderate levels on a regular basis (2+ hours per week) (Lum & Lightfoot, 2005; Luoh & Herzog, 2002; Morrow-Howell, Hinterlong, Rozario, & Tang, 2003; Musick et al., 1999; Sneed & Cohen, 2013). However, other research, such as Kim & Konrath (2016) observed no difference in relation to dose, and others note that lower levels of volunteering may relate to similar or even better health effects as moderate doses (Morrow-Howell, 2010; Morrow-Howell et al., 2003). The discrepancies with respect to dose response for volunteering are likely related, in part, to the fact that these studies examine a range of physical health factors, and compare volunteers with nonvolunteers without taking into consideration selection effects related to engagement. Focusing on how new volunteer engagement relates to changes in functional health at onset of volunteering is important to determine if low or moderate levels of engagement differentially influence the functional health benefits of volunteer interventions.

Third, in addition to the limitations noted above, some discrepancies in the relation between volunteering and health may be related to another critical gap: the benefits of volunteering may differ for men and women. No research for which we are aware has explored whether men and women vary in the benefits of volunteering. However, there is reason to think that volunteer interventions may need to be designed differently by gender. Women tend to be more communal and relational, which translates to prosocial behaviors that are more socially oriented (Eagly, 2009). Moen, Dempster-McClain, and Williams (1992) proposed that when women take on new roles, they can either be beneficial or detrimental depending on context and intensity. They are beneficial if they provide role enhancement, helping women feel that they have greater power and status, which is likely to occur with adoption of a new volunteer role. On the other hand, roles may create greater stress if they burden women with too many roles or too much time expenditure. Given that women are more likely to have a range of social roles and already be fairly socially embedded to begin with, and men are more likely to be more socially isolated (Antonucci, 1985), the amount of volunteering that is beneficial is likely to differ. Volunteering may offer a new, meaningful role to women, but engaging in too much volunteering may lead to role strain. Men, however, may benefit more from the addition of a new social role, and may have the time and energy to take on (and benefit from) more intensive volunteering (Choi, Burr, Mutchler, & Caro, 2007). On the other hand, older men are, on average, more physically active than older women (Lee, 2005). As a result, even though men may benefit from enhanced social engagement, older women may benefit from enhanced physical engagement. What is not known is whether these potentially varying mechanisms may lead to differential benefits in relation to engagement in a new volunteer activity for men and women.

This research on the effects of initiating volunteer engagement on changes in physical disability is designed to address these gaps, and is guided by the following research questions:

1. *Does initiating a new volunteer role reduce disability in later life?*
2. *What intensity of volunteering is associated with level of disability?*
3. *How does the association between volunteering and disability vary by gender?*

Methods

This research comprises analysis of longitudinal data biennially collected from 1996 to 2012 in the Health and Retirement Study (HRS), a nationally representative survey of adults over age 50 (National Institute on Aging, 2007). These data are well suited to assess the health effects of intensity and duration of engagement as they provide comprehensive longitudinal data on older adults aged 51 years and older, including health changes and information about the amount of time spent engaged in volunteering. We used public release core survey and the cleaned and imputed (i.e., wealth and income) data released by RAND Center for the Study of Aging (2016).

Sample

In the HRS, individuals were asked every biennial wave beginning in 1996 about their volunteer behavior. First, individuals were asked: "Have you spent any time in the past 12 months doing volunteer work for a religious, educational, health-related, or other charitable organization?" Individuals who respond positively were then asked: "Altogether, about how many hours did you spend in the past 12 months doing volunteer work for such organizations?" Due to high nonresponse with the follow-up question, subsequent questions are asked to identify a categorical range of hours of volunteering in the previous 12-month period: 0 hr, 1–49, 50–99, 100–199, and 200 hr or more. Very few individuals transition from being consistent nonvolunteers to volunteering over 100 hr per year (0.89% transition to 100–199 hr, and 0.64% transition to 200 or more hours), and there were not enough individuals sorted into the lower hour groupings required to conduct our analysis, so the final sample groups included: continuous nonvolunteers, 1–99 hr/year, and 100+ hours/year.

We estimated the effect of volunteering on physical disability by examining onset of volunteering among nonvolunteers for 4 years (i.e., wave *t*-1 and wave *t*). We then considered whether these nonvolunteers had initiated volunteering 2 years later (i.e., wave *t+1*), and examined the relation between this new volunteer engagement and subsequent changes in physical disability 4 years after wave *t* (i.e., wave *t*+2). The duration of the volunteering period in this study was, thus, a minimum of 1 year, which was the year leading up to the wave *t+1* survey. While the actual duration of volunteering may have begun prior to the year preceding that wave, or extended beyond the time the wave *t+1* survey was completed, data on volunteering were not assessed for these periods.

Primary Outcome Measure

Our measure of *disability* is based on a standard measure of functional limitations, a composite sum of six indicators in which individuals self-report their ability to perform several physical tasks: walking one block, climbing one flight of stairs, stooping or kneeling, lifting or carrying 10 pounds, picking a dime up off the ground, and pushing or pulling a large object. Each are measured dichotomously based on whether an individual indicates having difficulty doing the task (Kail & Carr, 2017; RAND Center for the Study of Aging, 2016). We focus on functional limitations because this is the first step in the progression of disablement and ultimately mortality, and it is a key stage to target interventions seeking to delay disability and extend healthy living (Schultz, 2008). Our outcome is measured 2 years following self-report of new volunteer engagement because the impact of lifestyle interventions such as volunteering are likely not immediately noticeable in terms of changes in disability. This allows us to conservatively assess whether new volunteer engagement (occurring at wave *t*+1) impacted changes in disability. Thus, our dependent variable is the change in disability between baseline (wave *t*) and 2 years following initiation of volunteer engagement (wave *t*+2). Because our measure for functional limitations (baseline) is a count variable based on a series of dichotomous measures, we use the Kuder–Richardson coefficient to test reliability, which provides a similar interpretation as the Cronbach's Alpha measure. The coefficient is 0.7588, indicating that the measure is reliable.

Covariates

Informed by existing research on volunteering and health behaviors, we iteratively assess how variables are associated with model fit and the robustness of our results and selected the most parsimonious models. Our final models include demographic, health, and socioeconomic factors, measured at wave *t* (baseline).

First, health status variables were measured as continuous variables. We controlled for baseline disability—therefore the models can be viewed as measuring changes in disability between waves. Other variables include: *self-rated health* (measured from 1 (poor) to 5 (excellent), *number of major chronic conditions* (cancer, lung disease, heart disease, stroke, psychological diseases, arthritis, high blood pressure), and *number of depressive symptoms* (0–8). Second, we include several demographic covariates that were dichotomously measured: *race* (which includes four measures: non-Hispanic White (reference), Non-Hispanic Black, Non-Hispanic Other, and Hispanic) and *gender* (1 = female) and *married/partnered* (1 = married/partnered). Other demographic factors are continuous measures and include: *age,* examined as a continuous variable (51+), *number of household members*, and several socioeconomic status variables. *Total work hours* are measured as the average weekly hours worked in the last month. *Total household wealth* and *household income* were continuous, and transformed using the inverse hyperbolic sine function to decrease the impact of extreme values, as well as zero and negative values. *Years of education* were measured continuously (0–17).

Several other variables were considered but ultimately excluded from the final model because they were not significant and did not mediate or confound the relationship between initiating volunteering and changes in disability. These include: baseline year, smoking behaviors, alcohol consumption, church attendance, and caregiving for family members (parents, spouse, and grandchildren). Details are available upon request. The variables used in the *outcome* model and the *propensity* model are noted in Table 1.

Statistical Analysis

We used several strategies to minimize the potential bidirectional relationship between volunteering and changes in disability, including an innovative approach recently adopted by Grool and colleagues (2016), who faced a similar methodological challenge studying children with concussions. First, we used strict selection criteria for our sample. As noted above, we included only individuals who are consistent, nonvolunteers to minimize some of the accumulated effects of on-going volunteer engagement. We chose a conservative approach to identify nonvolunteers, using those with two consecutive data waves reporting no volunteer engagement (i.e., nonvolunteers for 4 years). Our study examined changes in health among those nonvolunteers who go on to volunteer relative to those who remain nonvolunteers.

Second, we used propensity score methods to adjust for key factors that influence capacity and likelihood of starting volunteering in later life. Specifically, we use inverse probability weighted regression adjusted models, which utilizes the "Rubin causal model" (Imbens & Rubin, 2010). We use Stata 14 *teffects* command with the *ipwra* option to perform our analyses. This model involves calculating potential outcome means (POMs), that is, the predicted mean associated with a treatment group relative to the control group

Table 1. Description of Primary Samples and Covariates

	All N = 7,135				Continuous Nonvolunteers N = 4,414		Initiate volunteering 1–99 hr N = 1,378		Initiate volunteering 100+ hours N = 1,343	
	Mean/proportion	*SD*	Minimum	Maximum	Mean/proportion	*SD*	Mean/proportion	*SD*	Mean/proportion	*SD*
Change in functional limitations	0.315	1.337	−5	6	0.386	1.419	0.233**	1.246	0.167***	1.112
Functional health (Time 1)[a,b]	1.256	1.574	0	6	1.445	1.676	1.072***	1.419	0.825***	1.235
Poor self-rated health[a,b]	0.074		0	1	0.094		0.050***		0.033***	
Fair self-rated health[a,b]	0.206		0	1	0.242		0.176***		0.119***	
Good self-rated health[a,b]	0.327		0	1	0.330		0.351		0.294*	
Very good self-rated health[a,b]	0.290		0	1	0.256		0.306***		0.385***	
Excellent self-rated health[a,b]	0.103		0	1	0.078		0.117***		0.169***	
Number of chronic conditions[b]	2.035	1.420	0	8	2.206	1.456	1.925***	1.372	1.585***	1.230
Number of depressive symptoms[a,b]	1.505	2.011	0	8	1.659	2.103	1.423***	1.969	1.083***	1.646
White[a,b]	0.742		0	1	0.718		0.756**		0.803***	
Black[a,b]	0.126		0	1	0.120		0.147**		0.122	
Other race[a,b]	0.023		0	1	0.024		0.025		0.019	
Hispanic[a,b]	0.109		0	1	0.138		0.071***		0.057***	
Female[a,b]	0.566		0	1	0.544		0.600***		0.606***	
Age[a,b]	65.152	8.605	51	94	66.356	8.974	63.795***	7.911	62.587***	7.164
Number of household residents[a,b]	2.175	1.097	1	13	2.204	1.162	2.155	1.041	2.102**	0.916
Married/partnered[a,b]	0.626		0	1	0.599		0.658***		0.683***	
Total work hours[a]	13.382	20.045	0	168	12.394	19.772	15.086***	20.480	14.883	20.288
Years of education[a,b]	12.226	3.179	0	17	11.798	3.290	12.781***	2.986	13.062***	2.716
Wealth[a,b,c]	9.630	6.274	−14.643	18.425	9.145	6.556	10.297***	5.690	10.540***	5.716
Income[a,c]	11.152	1.370	0	18.603	11.044	1.454	11.315***	1.102	11.3408***	1.299

Note: [a]Indicates measure is used in the propensity model, [b]indicates measure is used in the outcome model, [c]indicates variables were transformed using the inverse hyperbolic sine function. Statistical significance indicates statistical difference in characteristic of respective volunteer engagement relative to continuous nonvolunteering, using t tests for continuous measures and chi-square tests for bivariate measures; ***$p < .001$; **$p < .01$; *$p < .05$.

(i.e., volunteer group relative to the continuous nonvolunteer group), taking into consideration the propensity to be in a given volunteer "treatment" group. Based on the POMs, we calculate the average treatment effect (ATE). The ATE is the effect of initiating volunteering relative to remaining a nonvolunteer. Two statistical methods are used to perform this calculation: regression adjustment and inverse probability weighting. Regression adjustment calculates the *outcome* (i.e., change in disability), controlling for selected covariates that influence change in disability, and adjusts for the *propensity* of initiating a volunteer role at a given intensity level (i.e., the factors that shape the decision to volunteer).

Inverse probability weighting addresses a key problem: individuals have no data available had they stayed nonvolunteers. Inverse probability weighting calculates values, or "potential outcomes" had new volunteers remained nonvolunteers (Abadie & Imbens, 2012). This approach has a doubly robust property; unbiased estimates of treatment effects can be obtained even if either the outcome model or the propensity model (but not both) is misspecified (Wooldridge, 2007). Our approach used this method in a way that allowed for estimation of multiple values to test different "treatments" using semiparametric methods (Cattaneo, 2010). We estimated equations for three volunteer groups using a multivariate logit propensity model: (a) nonvolunteers, (b) those who initiate volunteering 1–99 hr per year, and (c) those who initiate volunteering 100 or more hours per year. We calculated the ATEs for a given intensity of volunteering, which is the difference in changes in disability for those who volunteer at a given intensity compared to what they would have experienced if they had remained a nonvolunteer. We calculated ATEs for the entire sample, and separately for each gender.

This approach allowed us to address changes in disability from baseline (wave *t*) relative to 4 years after baseline (wave *t+2*), examining the impact of intensity of self-reported volunteer engagement in the intervening wave (wave *t*+1). First, adjusting for the propensity of being in a given treatment group, we calculated the average change in disability for each treatment, and the associated error (i.e., a doubly robust standard error). To assess the differences in means between volunteer groups and determine whether they are statistically different from one another, we calculated the average difference (i.e., ATE) between the continuous nonvolunteers and each volunteer group, and the error associated with that estimated average difference. The ATE is the difference between what an individual would have experienced had they remained a continuous nonvolunteer relative to what is expected if they volunteer at the given intensity level.

Results

Bivariate Analysis

The characteristics of individuals in each volunteer intensity group are shown in Table 1. Bivariate tests indicate that relative to continuous nonvolunteers, those who initiate volunteering at either a low level or high level are less physically disabled, healthier at baseline, less racially diverse, more likely female, almost a year younger, more likely married, and at a higher overall socioeconomic status. These findings are in line with previous research (Carr, 2009; Matz-Costa, Carr, McNamara, & James, 2016).

Inverse Probability Weighted Regression Analysis

Results from inverse probability weighted regression models are provided in Table 2 and shown in Figure 1A and B. Initiating volunteering is associated with a statistically significant dose dependent reduction in disability (Figure 1A). This was found for individuals who volunteered at the lower-intensity level—1–99 hr (0.096 reduction in disability relative to nonvolunteers; $p < .05$) and those who volunteered at the higher-intensity level—100+ hours per year (0.195 reduction in disability relative to nonvolunteers; $p < .001$). That is, compared to consistent nonvolunteers, the loss of physical function was reduced by 34% for lower-intensity volunteers, and 63% for higher-intensity volunteers. Initiating volunteering 100+ hours was related to a statistically greater benefit with respect to disability than volunteering only 1–99 hr per year ($p < .05$) (these results not shown, but available upon request).

In men volunteering at a higher intensity (100+ hours), physical function *improved* after onset of volunteering relative to baseline (0.015 fewer disabilities relative to baseline, or a 0.288 reduction in disability relative to nonvolunteers; $p < .001$). Initiating volunteering 1–99 hr was not associated with disability for men. For women, initiating volunteering 1–99 hr per week and volunteering 100+ hours per week was associated with a smaller increase in disability relative to those who remain nonvolunteers (reduction of 0.174 and 0.179 disabilities relative to nonvolunteers, respectively; $p < .01$). That is, compared to consistent nonvolunteers, the loss of physical function was reduced by 38% for lower-intensity volunteers, and 39% for higher-intensity female volunteers. In other words, women did not experience additional benefit when they volunteered at higher-intensity levels. The disability calculations are shown in Figure 1B.

Discussion

Developing public health interventions that effectively decrease the number of years older people spend disabled is perhaps one of the greatest challenges in this era of rapid population aging. With traditional efforts unable to modify stagnant disability rates among older adults, this study explored the potential for volunteer engagement as an innovative public health intervention.

Our research addresses limitations of previous research—(a) the conflation of the effects of new onset volunteering with accrued effects of prior volunteering, (b)

Table 2. Change in Disability and Initiating Volunteering Among Adults Aged 51+ Years

	Increase in disability score (*SE*)	Difference relative to nonvolunteers (*SE*)		% less decline relative to nonvolunteers	95% CI	95% CI
All						
Continuous nonvolunteer	0.36 (0.02)				0.33	0.40
Initiate 1–99 hr/year	0.24 (0.04)	−0.12 (0.04)	*	34%	0.17	0.31
Initiate 100+ hours/year	0.13 (0.05)	−0.23 (0.05)	***	63%	0.05	0.22
Females						
Continuous nonvolunteer	0.45 (0.03)				0.40	0.51
Initiate 1–99 hr/year	0.28 (0.04)	−0.17 (0.05)	***	38%	0.19	0.37
Initiate 100+ hours/year	0.28 (0.06)	−0.18 (0.07)	**	39%	0.15	0.40
Males						
Continuous nonvolunteer	0.27 (0.03)				0.21	0.34
Initiate 1–99 hr/year	0.17 (0.07)	−0.10 (0.07)		37%	0.04	0.30
Initiate 100+ hours/year	−0.02 (0.07)	−0.29 (0.08)	***	105%	−0.15	0.12

Note: "Increase in disability" is the potential outcome mean calculation for continuous nonvolunteers and the "Difference Relative to Non-Volunteers" are estimated average treatment effects for volunteer treatment groups. Statistical significance indicates significant differences relative to the control group (i.e., consistent nonvolunteers); ***$p < .001$; **$p < .01$; *$p < .05$. All calculations use inverse probability weighted regression adjustment. The variables used in the propensity models and the outcome models are shown in Table 1. CI = Confidence interval.

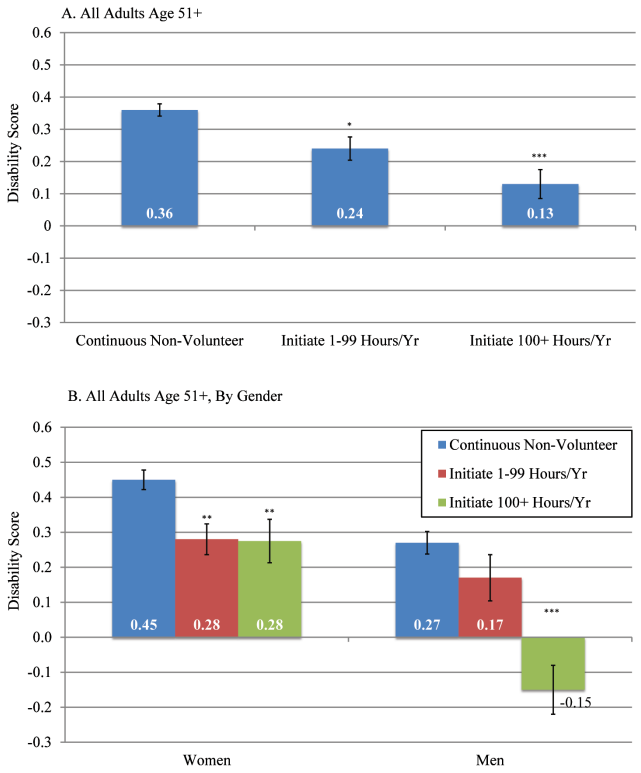

Figure 1. Estimated increase in disability scores associated with intensity of new volunteer engagement. (A) All adults age 51+. (B) All adults age 51+, by gender. Note: Statistically significant differences indicate difference between volunteer engagement group relative to remaining a continuous nonvolunteer; ***$p < .001$; **$p < .01$; *$p < .05$.

the "dose" needed to produce benefits in new volunteers, and (c) the differential benefits experienced by women and men. Specifically, we find that becoming actively engaged in volunteering in later life is related to lower levels of subsequent disability. Although it is not possible to parse out the degree to which engagement *causes* health benefits in later life without experimental research designs, our study used several strategies to reduce the bidirectional effects of health and volunteering. Given that our results offer conservative estimates, these findings are particularly encouraging. Among nonvolunteering adults over age 50 in the United States, initiating a volunteer role was associated with lower levels of disability, with the extent of the associated benefit contingent upon intensity level and gender.

Specifically, we discovered that the relation between new volunteering and disability are different for men and women. As is clear in Figure 1B, although both men and women experience lower levels of disability if they start volunteering, only men experience an absolute improvement from function at baseline (i.e., an improvement in health). Women experience similar benefits from new volunteering at both intensity levels relative to remaining a nonvolunteer. For men, however, new volunteer engagement was only associated with lower levels of disability at 2 hr per week of intensity. Although our research does not allow us to explore why there are different effects of volunteering for males and females, we offer some plausible explanations.

Our study does not allow us to assess exactly how volunteering gets "under the skin," but there are some plausible explanations. First, for nonvolunteers in later life, a new volunteer role may provide a series of beneficial structures that support health. As noted earlier, intervention research of older adults who volunteer 15 or more hours per week suggest that volunteering may benefit health because it relates to increased overall physical, social, and cognitive engagement (Fried et al., 2004). Although all three of these pathways are likely important, very low levels of volunteering as we explore in the present study (i.e., less than 2 hr per week) unlikely contribute to a *significant* increase in physical, social, or cognitively engagement through volunteering itself. Although it is possible that these small increases in activity could limit disability, it is perhaps equally, if not more likely that volunteering could produce a spillover effect into other aspects of life, particularly with respect to social engagement. For instance, although an individual may volunteer at the hospital every Saturday morning for an hour or two, those 2 hr may offer opportunities for social interactions with other volunteers that lead to changes in everyday behaviors outside of the volunteer role. For instance, a volunteer may choose to have coffee on Saturday after his or her volunteer "shift." This social behavior may lead that individual to engage in more meaningful and purposeful activities, more physical activities, and more cognitively engaging activities, perhaps replacing other lifestyle behaviors such as watching TV, which would have a more deleterious health effect.

The mechanisms driving the gender differences associated with these benefits are even more important to consider for development of volunteer interventions that may lead to delayed onset of disability in later life. On average, older women maintain more social roles and are more socially connected than older men (Cornwell, Schumm, Laumann, & Graber, 2009; Goodreau, Kitts, & Morris, 2009), and social network connections are proposed to be a key driver of some of the physical health benefits associated with volunteering (Fried et al., 2004). Thus, women may not receive as much benefit to physical function, specifically from new volunteer roles, because they may already have a range of other activities in which they are engaged, with volunteering adding to an existing reservoir of socially engaging activities. Older men, on the other hand, may benefit more from higher-intensity engagement because new volunteer roles may offset an existing deficit in social engagement in their lives. On the other hand, as noted earlier, one reason that men may not benefit from lower levels of engagement is that older men are on average more physically active than older women (Lee, 2005). It stands to reason that observed benefits for older women could relate to enhanced physical engagement. Given the likely small incremental increases in physical activity associated with volunteering, this may explain the ceiling effect for women, at the relatively low

levels of volunteer engagement that are examined in the present study. Future research should explore the differential drivers of benefits from new volunteer engagement for both genders, identifying the mechanisms and extent of benefit by which volunteering tasks influence physical health processes.

The results from this study suggest that initiating a new volunteer role of modest intensity in later life limits the progression of disability, and in this way, volunteering seems to be equally beneficial at low or high levels for women and only at higher levels for men (two or more hours per week). These findings have potential policy implications that could ultimately influence the design of local and government sponsored volunteer programs as well as recommendations of nationally respected professional groups such as the U.S. Preventive Services Task Force, which are generally used by health providers as a basis for their recommendations to patients. Additional research regarding the impacts of gender and intensity require additional study before sufficient information is available to disseminate specific guidance or recommendations to policymakers. Our findings do suggest the possibility of greater specificity regarding the role of volunteering in maintaining the wellbeing and functional status of older persons. Older adults benefit from engagement in a range of healthy activities, and engagement in a new volunteer activity may be particularly beneficial.

These results are encouraging, but it is important to point out the principal limitations of this study that should be taken into consideration when interpreting the results. First, while we attempted to minimize bias through propensity score weighting and specifically selecting nonvolunteers at the outset, the research design available to us in this study does not provide a definitive result with respect to the causal effect of volunteering on health. Second, our method does not examine the impact of the time-varying relationships between engagement and health outcomes. For instance, if an individual experienced decline prior to potential onset of volunteer engagement, our method does not allow us to account for the possibility that volunteering did not occur due to this health status change. Third, the mechanisms of the potential benefits of these results are untested. However, it is possible that the benefits attributed to volunteering are due to significant differences in everyday overall physical activity among those who tend to choose to volunteer versus those who do not. Given our results, further study of the relative contributions of physical activity and types of volunteering to the benefits and other outcomes, such as changes in cognitive function and utilization of health care services, would be especially valuable.

Despite these limitations, if the relationships shown in this analysis are confirmed by prospective controlled trials, our findings can serve as a basis for development of interventions. The "dose response" associations revealed in our analysis are similar to the proven beneficial effects of smoking cessation and regular physical exercise (Haskell et al., 2007; Taylor, Hasselblad, Henley, Thun, & Sloan, 2002). The Experience Corps trial, a well-known study examining an intensive volunteer engagement intervention among older adults (i.e., 15+ hours/week), provided compelling evidence that volunteering is beneficial to physical health (Fried et al., 2004). The results of the present study suggest that even modest amounts of volunteer engagement may provide an intervention that delays or reduces the rate of progression of physical decline in later life.

If future studies establish a causal effect, volunteer engagement can serve as a basis for preventive health strategies, with differential recommendations for men and women. Our research suggests that it may be important to add volunteering to the well-established portfolio of strategies effective in reducing disability in late life. Not only does volunteering appear to be as effective as other lifestyle behaviors at facilitating successful aging, it imposes little to no expense, and offers a social and financial benefit to society (Fried, 2016).

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Conflict of Interest

None reported.

Author Contributions

D. C. Carr planned the study, performed the statistical analyses, and wrote the paper. B. L. Kail also planned the study, assisted with statistical analyses, and contributed to revising the paper. J. W. Rowe assisted in planning the study and contributed to the writing of the paper.

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