Title

Increases in Lifestyle Activities as a Result of Experience Corps® Participation

Journal

Journal of Urban Health, 92(1)

ISSN

1099-3460

Authors

Parisi, Jeanine M
Kuo, Julie
Rebok, George W
et al.

Publication Date

2015-02-01

DOI

10.1007/s11524-014-9918-z

Peer reviewed

Journal of Urban Health: Bulletin of the New York Academy of Medicine, Vol. 92, No. 1
doi:10.1007/s11524-014-9918-z

Increases in Lifestyle Activities as a Result of Experience Corps® Participation

Jeanine M. Parisi, Julie Kuo, George W. Rebok, Qian-Li Xue, Linda P. Fried, Tara L. Gruenewald, Jin Huang, Teresa E. Seeman, David L. Roth, Elizabeth K. Tanner, and Michelle C. Carlson

ABSTRACT *Experience Corps® (EC) was designed to simultaneously increase cognitive, social, and physical activity through high-intensity volunteerism in elementary school classrooms. It is, therefore, highly likely that EC participation may alter pre-existing patterns of lifestyle activity. This study examined the impact of "real-world" volunteer engagement on the frequency of participation in various lifestyle activities over a 2-year period. Specifically, we examined intervention-related changes on reported activity levels at 12 and 24 months post-baseline using Intention-to-Treat (ITT) and Complier Average Causal Effect (CACE) analyses, which account for the amount of program exposure. ITT analyses indicated that, compared to the control group, EC participants reported modest increases (approximately half a day/month) in overall activity level, especially in intellectual and physical activities 12 months post-baseline. Increases in activity were not found at the 24-month assessment. CACE models revealed similar findings for overall activity as well as for intellectual and physical activities at 12 months. Additionally, CACE findings suggested modest increases in social activity at 12 months and in intellectual and passive activities at 24 months post-baseline. This community-based, health promotion intervention has the potential to impact lifestyle activity, which may lead to long-term increases in activity and to other positive cognitive, physical, and psychosocial health outcomes.*

KEYWORDS *Lifestyle, Engagement, Activities, Older adults, Volunteers*

Several studies have suggested the beneficial effects of maintaining an active lifestyle on cognitive, physical, and psychosocial health in adulthood.[1–5] In addition, remaining active in later life has also been associated with reduced risk of incident disability[6] and mortality.[7] However, the directionality of such associations in

Parisi, Kuo, Rebok, and Carlson are with the Department of Mental Health, Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, USA; Rebok, Xue, Huang, Roth, Tanner, and Carlson are with the Johns Hopkins Center on Aging and Health, Baltimore, MD, USA; Xue and Roth are with the Johns Hopkins University School of Medicine, Baltimore, MD, USA; Fried is with the Columbia University Mailman School of Public Health, New York, NY, USA; Gruenewald is with the University of Southern California School of Gerontology, Los Angeles, CA, USA; Seeman is with the David Geffen School of Medicine at the University of California at Los Angeles, Los Angeles, CA, USA; Tanner is with the Johns Hopkins University School of Nursing, Baltimore, MD, USA.

Correspondence: Jeanine M. Parisi, Department of Mental Health, Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, USA. (E-mail: jparisi1@jhu.edu)

observational studies is unclear and susceptible to reverse causation (i.e., healthier individuals choose to be active).[8,9]

Although findings on the effects of a healthy lifestyle on later life outcomes are generally encouraging, the type and amount of activity needed to confer such benefits remains poorly understood. In addition, there is great variation in activity patterns across individuals, with some individuals focusing all of their time and efforts on a few select activities and others allocating their time across many different contexts.[10] Moreover, research has suggested that older adults continue to actively engage in activities that hold the most importance or meaningfulness in their lives.[11] Therefore, from a public health perspective, identifying opportunities that are accessible and attractive to diverse older populations and that further allow for meaningful, active engagement is of utmost importance.[12]

One such model of meaningful engagement, Experience Corps® (EC), was designed to capitalize on older adults' generative motives (i.e., desire to "give back") in order to increase cognitive, social, and physical activity in daily life through high-intensity volunteer service, which in turn, is hypothesized to positively impact cognitive, physical, and psychosocial health.[13–15] In this program, teams of older adults are trained and placed in public elementary school classrooms to perform various roles, including providing literacy and math support, as well as assisting with behavior management activities for children in kindergarten through third grade. By design, the EC program creates an ideal "win–win" scenario, increasing academic and behavioral outcomes for elementary school children and providing a variety of health benefits for older adults.[14,15] At the national level, the EC model was initially implemented in five cities (1996–1998) and now operates in 22 cities across the USA.[15]

Using data from one of the sites of the national EC program, Morrow-Howell and colleagues[16] examined the question of whether activity patterns change as a result of volunteer participation. In this observational study, EC volunteers were classified into two groups based on their initial activity level (low or high activity). They found that about one third were classified as low activity upon joining the program, yet almost two thirds of the members of that class were re-categorized as being highly active at the end of the first year of program participation. In contrast, individuals reporting high activity levels at baseline appeared to shift away from previously held activities to make time for EC participation. Together these findings support the likelihood of changes in activity patterns as result of volunteer service; however, this most likely depends on prior levels of engagement in daily activities.[16]

Within the context of a randomized, controlled trial of the Experience Corps conducted in Baltimore City, we previously characterized the nature and extent of participation in activities prior to randomization to the Experience Corps intervention or to a low-activity control condition.[17] Our profile analysis indicated that, at baseline, most individuals frequently engaged in passive activities, such as listening to music (99.1 %) and watching television (99.1 %), as well as activities that are typically thought of as more intellectually challenging, such as reading (88.7 %) and discussing local and national issues (96.0 %). As individuals were already highly engaged with multiple activities (at baseline), we were interested in examining how patterns of lifestyle activity would change as a result of participating in a demanding, real-world, volunteer service program. The Baltimore Experience Corps requires a minimum of 15 hours per week of volunteer service in a variety of roles (e.g., literacy and math activities, cooperative problem solving, library support), which is hypothesized to alter pre-existing patterns of lifestyle activities in various

ways. For instance, activity levels may be increased among mostly sedentary older adults as they engage with the roles and activities required by the EC program, whereas more active older adults might have to reduce the number or hours spent in various daily activities to adjust for the time demands required of their newly formed volunteer role.

If, as suggested earlier, involvement in Experience Corps is related to older adults' health and well-being, a clearer understanding of various activity engagement patterns for cognitive and physical maintenance is needed. However, the issues of non-compliance and attrition often complicate examination of outcomes in "real-world" behavioral interventions, such as Experience Corps. Specifically, although Experience Corps participants are asked to commit to at least 15 hours per week of volunteer service, in reality, there is great variation in the amount of exposure individuals actually receive. Traditional Intention-to-Treat (ITT) analyses, which are often used to examine outcomes in the context of randomized, controlled trials, may underestimate effects as they ignore protocol violations that may occur after randomization to a particular treatment condition. Complier average causal effect (CACE) models, which can account for level of compliance, may provide a more appropriate statistical method to analyze data resulting from complex "lab-to-life" interventions.[18–20] In the current manuscript, both ITT and CACE models were used to examine whether change occurs in participation in daily lifestyle activities as a function of participation in the EC program.

METHODS

Sample

Detailed information regarding study design and procedures for the Baltimore EC trial has been fully described elsewhere.[14] Briefly, older adults (aged 60 years and older) were recruited and screened for eligibility. Eligible individuals were administered a battery of cognitive, physical, and psychosocial assessments as well as questionnaires asking about health status and lifestyle activity. Subsequently, individuals (N=702) were randomized to the Experience Corps program (n=352) or referred to a usual volunteer activity control condition (n=350) (see Consolidated Standards of Reporting Trials (CONSORT) diagram for detailed information about study participants; Fig. 1). Those randomized to the EC program were trained, placed in kindergarten through third-grade classrooms in public elementary schools, and asked to contribute a minimum of 15 hours per week of volunteer service for two academic years. In addition to the baseline assessment, all individuals were asked to complete in-person, follow-up assessments at 12 and 24 months post-baseline.

At baseline, individuals were, on average, 67 years of age (range, 60–89 years) and were mostly female (85 %) and African American (92 %). The majority of participants were in good physical (as indicated by number of major morbidities), mental (as indicated by number of depressive symptoms on the Geriatric Depression Scale-short form (GDS)[21]), and cognitive health (as indicated by a score of greater than 23 on the Mini-Mental State Exam (MMSE)[22]) (Table 1). No significant differences were noted between individuals randomized to the EC program and those randomized to the low-activity control condition (all p>0.05).

Sample Attrition. Of the 352 participants randomized to the EC intervention, 68 participants did not receive the intervention due to self-selection (n=41), program

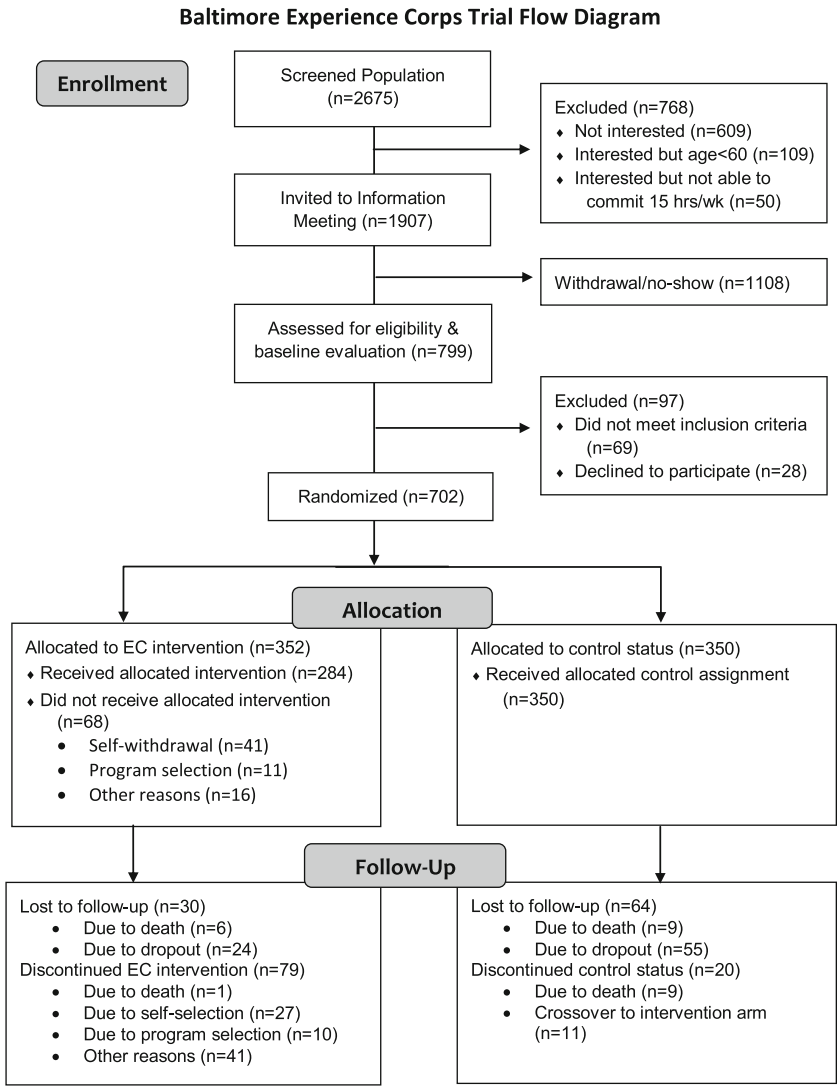

FIGURE 1. CONSORT flowchart

selection (n=11; e.g., deemed inappropriate by EC program or school staff for school placement), or other reasons (n=16; e.g., unable to attend training program or declined to participate). Over the course of the study, intervention participants (17 %) were more likely than control participants (9 %) to formally withdraw from the study or become deceased over the 2-year trial period (p<0.001) (see also Fig. 1).

Measures

Lifestyle Activity Questionnaire (LAQ[10]). Participants were asked to rate their typical frequency of participation in various lifestyle activities (e.g., cooking, singing, gardening, listening to music, reading) during the past year on a 6-point scale (0=never; 5=every day). To provide more exact quantitative estimates of daily activity participation (in days per month), responses were weighted according to a

TABLE 1 Participant characteristics by intervention status

	Overall (N=702)	Intervention (n=352)	Control (n=350)
	M (SD) or %	M (SD) or %	M (SD) or %
Age (years)	67.4 (5.9)	67.4 (5.9)	67.4 (5.8)
Female (%)	85	85	85
Race (%)			
Black/African-American	92	92	93
White/European-American	5	6	4
Other	3	2	3
Education			
≤HS/GED	44	45	43
≥Some college	56	55	57
Income (past 12 months)			
<$15,000	30	30	29
>$15,000–<$35,000	36	35	37
>$35,000	34	35	34
Cognitive status (MMSE)	28.1 (1.6)	28.1 (1.6)	28.1 (1.5)
Multiple major morbidities (2+)	37	36	38
Depressive symptoms (number of reported symptoms)			
Less than 5	95	95	96
5 to 10	4.2	4.8	3.4
More than 10	0.4	0	0.9

Depressive symptoms were measured by the number of reported symptoms on the Geriatric Depression Scale (GDS); higher scores are associated with greater likelihood of depressive symptomatology

MMSE Mini-Mental State Exam

30-day scale: never (0 days/month), once a month (1 day/month), 2 to 3 times a month (2.5 days/month), once a week (4 days/month), 2 to 3 times a week (10 days/month), and every day (30 days/month). Overall frequency of activity participation was defined as the average of responses made on the 30-point scale. Scores could range from 0–30 days per month, with higher scores indicating greater frequency (i.e., greater number of days) of activity participation.

In addition to examining the frequency of participation, lifestyle activities were classified into one of five activity domains based on an extensive review of the literature and our previous work.[17] Specifically, we first developed a "cross-walk" of activity, mapping our activity items onto activity classification schemes used in prior studies.[e.g.,10,17,23–25] Given the consistency of activity items between the LAQ and other self-reported activity assessments, this approach allowed us to conceptualize and develop our activity domains using the classification schemes most frequently used in the literature. Next, four activity experts (within the institution where the study was conducted) reviewed individual items comprising each activity domain, and agreement on the final activity domains was reached thorough panel consensus. The final five activity domains were *intellectual* (seven items: discussing local/national issues, reading a book, reading a newspaper, balancing a checkbook, using a computer, crossword puzzles, taking courses/classes), *social* (six items: attending church/

religious service, visiting, clubs/organizations, playing cards/ games, going to movies, going to plays/concerts), *physical* (three items: shopping, gardening, hunting/fishing/camping), *creative* (five items: preparing food, sewing/mending/fixing things, singing/playing instrument, drawing/painting, looking at art), and *passive* (three items: watching TV, listening to music, listening to radio (not music)). Summary scores for activity domains were created by averaging responses to individual activity items (frequency) within each of the activity domains. Higher scores indicate greater frequency of activity participation within specific activity domains.

Data Analyses

In order to test whether levels of lifestyle activity differed as a function of participating in the EC intervention, Intention-to-Treat and Complier Average Causal Effect models were conducted for overall frequency of participation as well as for each of the activity domains defined above. For both ITT and CACE analyses, separate models were tested for activity outcomes at the 12- and 24-month assessments. Given the level of attrition over the 24-month trial period, study evaluations were available for 558 (79.5 %) and 560 (79.8 %) participants at the 12- and 24-month assessments, respectively. Multiple imputation Markov chain Monte Carlo procedures were applied to estimate missing outcome data at each of these time points.[26] All final models were adjusted for individual characteristics, including demographic information (e.g., age, sex, education), number of major morbid health conditions (e.g., hypertension, cardiovascular disease, stroke, diabetes), depressive symptoms (as measured by the Geriatric Depression Scale (GDS; 15-item)[21]), and baseline activity levels (as measured by the LAQ).

Intention-to-Treat Models. This include data from all randomized individuals according to initial assignment to trial condition, regardless of extent of adherence or withdrawal from the intervention. ITT analyses were conducted using maximum likelihood estimation procedures within the PROC GENMOD command in SAS statistical software, Version 9.3 (SAS Institute, Cary, NC, USA).

Complier Average Causal Effect Models. As ITT models utilize data from all participants randomized to the trial, regardless of the extent to which they received the intervention, they tend to provide a conservative estimate of intervention effects. CACE models[18–20] provide unbiased estimates by taking into account the amount of exposure to the intervention. Specifically, in these analyses, outcomes for individuals in the intervention condition who complied with treatment are compared with individuals in the control group who would have complied with treatment if given the opportunity.[19] In the present analyses, compliance was defined by completing at least half of the required EC volunteer contract hours: 225 hours for 12 months and 450 hours for 24 months post-baseline, which is the minimum number of volunteer hours needed to be considered an active volunteer within the Experience Corps program.

In developing and testing our models, the following standard CACE assumptions were applied: (1) participants were randomly assigned to either the EC intervention or to a usual volunteer activity control condition; (2) potential outcomes for each participant were unrelated to the outcomes of other participants (i.e., stable unit treatment value assumption); (3) the opportunity to receive the intervention induced at least some individuals to actually participate (i.e., non-zero denominator assumption); (4) intervention status (EC intervention vs. control condition) did not

reduce likelihood of participation and, as such, there were no treatment "defiers" (i.e., those who would do opposite of assigned treatment condition; monotonicity assumption); and (5) intervention status did not alter participants' behaviors or outcomes (i.e., exclusion restriction).[19]

All CACE models were tested using full-information maximum likelihood estimation procedures with robust standard errors via Mplus statistical software, Version 6.2.[27]

RESULTS

Activity Levels at Baseline, 12-, and 24-Month Assessments

Prior to examining intervention-related effects of participation in Experience Corps, levels of activity were examined at baseline, 12-, and 24-month assessments for the overall sample. Collapsed across intervention condition, reported activity levels remained relatively stable across the 24-month period (Table 2).

Findings from ITT Analyses

ITT analyses suggested that, compared to the control group, those randomized to the EC program reported modest increases (approximately half a day per month) in overall activity level (estimate=0.43; SE=0.19) as well as in intellectual (estimate=0.66; SE=0.31) and physical activities (estimate=0.43; SE=0.21) 12 months post-baseline ($p<0.05$) (Table 3). We did not find an increase in overall activity level at the 24-month assessment; however, there was a trend towards greater participation in intellectual activities among EC participants (estimate=0.59; SE=0.30; $p<0.10$) (Table 2). We did not find any differences at the 0.05 significance level for social, creative, or passive activity for either the 12- or 24-month assessments.

Findings from CACE Analyses

CACE analyses suggest that, compared to the control group, those who participated in the EC program reported modest increases (approximately half a day to one day per month) in overall activity level (estimate=0.59; SE=0.29), as well as in intellectual (estimate=0.92; SE=0.42), social (estimate=0.43; SE=0.17), and physical (estimate=0.43; SE=0.17) activities at 12 months post-baseline ($p<0.05$) (Table 3). Although conventional significance levels were not reached, we did note a trend

TABLE 2 Activity levels collapsed across intervention status

	Assessment		
	Baseline	12-month	24-month
Overall	9.06	8.77	8.76
Activity domain			
Intellectual	9.53	9.27	9.37
Social	3.22	3.16	3.12
Physical	4.05	3.67	3.51
Creative	7.76	7.13	7.35
Passive	23.26	23.30	23.00

Values represent days per month of activity participation on a 30-day scale

TABLE 3 Findings from 12- and 24-month ITT and CACE models

	12-month		24-month	
	ITT	CACE	ITT	CACE
	B (SE)	B (SE)	B (SE)	B (SE)
Activity	0.43 (0.19)*	0.59 (0.29)*	0.22 (0.19)	0.55 (0.31)†
Activity domain				
Intellectual	0.66 (0.31)*	0.92 (0.42)*	0.59 (0.30)†	1.07 (0.48)*
Social	0.10 (0.14)	0.43 (0.17)*	−0.26 (0.16)	−0.16 (0.39)
Physical	0.43 (0.21)*	0.95 (0.19)*	0.26 (0.22)	0.15 (0.17)
Creative	0.32 (0.32)	0.50 (0.44)	0.39 (0.33)	0.54 (0.43)
Passive	0.61 (0.51)	1.42 (0.83)†	0.83 (0.51)	1.94 (0.95)*

Compliance was defined as completing at least half of required EC contract hours. All models adjusted for age, sex, education, major morbidities, depressive symptoms, cohort, and baseline LAQ

12-month 225 hours, *24-month* 450 hours

*$p<0.05$; †$p<0.10$

towards increased participation in overall frequency of participation in activities at the 24-month assessment (estimate=0.55; SE=0.31; $p<0.10$) (Table 3). We also found greater participation in intellectual (estimate=1.07; SE=0.48; $p<0.05$) and passive (estimate=1.94; SE=0.95; $p<0.05$) activities among EC participants (Table 3).

As we did not expect that EC participation would result in increased passive activity, subsequent sensitivity analyses were conducted to independently examine the contribution of each of the three passive activities (watching television, listening to music, listening to the radio (not music)). We found that the effects were driven by increases in listening to music and to the radio. Importantly, television watching significantly decreased among individuals who were exposed to the intervention at the 12 month (estimate=–0.08; SE=0.03) and 24 month (estimate=–0.07; SE=0.03) assessments ($p<0.05$).

DISCUSSION

Participation in the EC program provides an arena for meaningful engagement in daily life and developing social networks later in life. Although volunteers are asked to devote at least 15 hours of volunteer service per week over a full academic year, in actuality, individuals committed varying degrees of time to this program. This study examined intervention-related changes on reported activity levels at 12 and 24 months post-baseline using both Intention-to-Treat and Complier Average Causal Effect analyses.

In general, a similar pattern of findings emerged when using ITT and CACE estimation methods, although CACE models provided larger magnitude estimates, possibly because they accounted for the degree of program exposure. Both analytic methods suggested modest increases in overall activity level as well as increased participation in intellectual and physical activities at the 12-month assessment; reports of greater social activity were only found for the CACE models at the 12-month assessment. At the 24-month assessment, CACE models provided evidence of sustained increases in intellectual activity among EC volunteers, which is interesting in view of findings demonstrating the beneficial effects of intellectually demanding activities on cognitive health in later life.[1,4,28] Although our findings suggested increased intellectual activity, findings also revealed increased passive activity.

Sensitivity analyses showed that increases in passive activity were driven by increases in listening to music and to the radio and not due to increased television watching; a finding that is notable given observations of increased risk of poor health as a function of greater frequency of TV watching.[29–31] It should also be noted that we did not find sustained increases in social or physical activity from the 12- to the 24-month assessments. This may suggest that existing activity levels are immediately impacted by participating in a high-intensity volunteer role but tend to level out over time as individuals become accustomed to their newly formed routines and social connections. Nevertheless, individuals who are able to maintain current activity levels across this 2-year period may still experience greater health benefits than those with decreased levels of participation over time.

As relatively little is known about changes in activity patterns among older adults as the result of intervention, the findings of this study contribute significantly to the existing literature. Although several beneficial effects have been linked to remaining actively engaged, few studies have systematically experimentally demonstrated that exposure to a social engagement, health promotion intervention leads to higher levels of activity across multiple domains, especially intellectual activity. As such, the modest increases in activity (half a day to 1 day per month) found in the present study are not trivial. Findings have demonstrated that modest increases in bouts of activity are associated with significant health benefits;[32,33], and the ability of Experience Corps to increase activity levels may hold even greater importance for older adults at elevated risk for cognitive and functional impairment by virtue of their sociodemographic risk.[34] Further, from a behavioral change perspective, these small increases in daily activity may become routinized into daily life and sustained over time, leading to long-term benefits. Once such lifestyle changes are firmly established, we can more fully understand the potential health benefits of real-world interventions, such as Experience Corps, and how they may alter one's existing daily routine.[16,35]

The limitations of the LAQ assessment and other similar self-reported methods for activity measurement should be noted. First, individuals were asked to report the frequency (daily to never) of participation, regardless of the nature, intensity, or duration of the activity. Over the 2-year trial period, even though the overall frequency of participation in certain activities remained relatively stable, individuals may have changed how they approached the activity. For instance, although daily television watching was endorsed at each assessment, the type of show (e.g., soap operas to educational programming) or the time allocated (e.g., 20 minutes each day as opposed to 2 hours each day) may have changed over time. Our earlier work suggests that types of programs viewed are related to cognitive aging and thus may represent a more sensitive outcome than hours viewed.[36] Second, consistent with other extensively used activity assessments, the LAQ was designed to capture a wide variety of activities. For our analyses, we classified activities based on a comprehensive review of the literature and our previous work.(e.g.10,17) We fully acknowledge that the classification of activities is complex, and specific activities rarely fit into one activity domain. For instance, preparing food may be both creative and intellectual or perhaps even social, depending on the individual approach and environmental context. Further, by design, the LAQ was not meant to extensively measure physical activity and exercise, and as a result, our metric of physical activity did not include more traditional measures of this activity domain (e.g., walking, aerobic exercise). Therefore, although the LAQ was able to detect program-related

changes in overall activity levels, as well as for specific activity domains, classification of activity into sub-domains with few or non-traditional items may have restricted power to detect more robust changes in activity patterns. Such issues regarding the measurement and classification of activity are not unique to our study. Across the literature, further psychometric testing needs to be conducted to examine the reliability and validity of self-reported activity assessments, including the LAQ, as well as the classification of activity. Lastly, we were unable to distinguish between activities completed in and outside of the classroom. Therefore, we have no way of knowing whether reports of increased participation in specific activities, such as reading books (i.e., an intellectually demanding activity), were due to reading to children as part of EC duties or whether they were reading linguistically complex novels at home.

Along with these measurement issues, compliance was based on the total number of required contract hours completed. Different definitions of compliance or metrics of participation (e.g., total weeks of volunteer service) may have altered findings. To this end, we reexamined the distribution of volunteer hours in the Experience Corps program and tested our models with varying definitions of compliance. Specifically, we estimated models for quintiles of volunteer hours for the 20th, 40th, 60th, and 80th percentiles of exposure for the 12- and 24-month analyses, respectively. Similar to our current findings, we found that participation in the Experience Corps program, even at the lowest percentile of exposure (20th percentile; 275 hours), appeared to be beneficial for increasing overall lifestyle activity (estimate=0.46; SE=0.23; $p<0.05$) at the 12-month assessment. Additionally, we did not find participation in the Experience Corps program had a significant impact on overall activity on the 24-month assessment. Therefore, we did not find overwhelming evidence of a dose-dependent response at 12- or 24-month assessment.

In conclusion, our findings suggest that Experience Corps has the potential to impact lifestyle activity, which may lead to other positive health outcomes. Using both traditional ITT analyses, as well as an approach that accounts for the extent of program exposure (CACE models), offers complementary ways of analyzing and understanding findings of "real-world" engagement models. Further research using objective methods is warranted to identify individual differences in activity patterns across the 2-year period, distinguish between roles and activities inside and outside of the EC program, and perhaps most importantly, examine activity pathways as potential mechanisms of physical, cognitive, and psychosocial health and well-being in adulthood.

ACKNOWLEDGMENTS

This work was supported by the National Institutes of Health, the National Institute on Aging (P01 AG027735), the John A. Hartford Foundation, and the Johns Hopkins Older Americans Independence Center under contracts P30-AG02133 and R37-AG19905 from the National Institute on Aging, National Institutes of Health. The authors would also like to thank the Greater Homewood Community Corporation, Experience Corps National, Civic Ventures, the Baltimore City Public School System, the City of Baltimore, the Commission on Aging and Retirement Education, the Baltimore City Retirees Association, AARP, the Harry and Jeanette Weinberg Foundation, and The John D. and Catherine T. MacArthur Foundation for ongoing vision and support. Special

thanks to all the staff and volunteers of the Baltimore Experience Corps who have made this all possible.

REFERENCES

1. Bennett DA, Arnold SE, Valenzuela MJ, Brayne C, Schneider JA. Cognitive and social lifestyle: links with neuropathology and cognition in late life. *Acta Neuropathol*. 2014; 127: 137–150.
2. Hillman CH, Erickson KI, Kramer AF. Be smart, exercise your heart: exercise effects on brain and cognition. *Nat Rev Neurosci*. 2008; 9: 58–65.
3. Hong S, Hasche L, Bowland S. Structural relationships between social activities and longitudinal trajectories of depression among older adults. *Gerontologist*. 2009; 49: 1–11.
4. Wang HX, Xu W, Pei JJ. Leisure activities, cognition, and dementia. *Biochim Biophys Acta*. 1822; 2012: 482–491.
5. Wilson RS, Barnes LL, Aggarwal NT, et al. Cognitive activity and the cognitive morbidity of Alzheimer disease. *Neurology*. 2010; 75: 990–996.
6. James BD, Boyle PA, Buchman AS, Bennett DA. Relation of late-life social activity with incident disability among community-dwelling older adults. *J Gerontol Ser A Biol Med Sci*. 2011; 66: 467–473.
7. Paganini-Hill A, Kawas CH, Corrada MM. Activities and mortality in the elderly: the Leisure World Cohort Study. *J Gerontol Ser A Biol Med Sci*. 2011; 66: 559–567.
8. Mitchell MB, Cimino CR, Benitez A, et al. Cognitively stimulating activities: effects on cognition across four studies with up to 21 years of longitudinal data. *J Aging Res*. 2012. doi:10.1155/2012/461592.
9. Small BJ, Dixon RA, McArdle JJ, Grimm KJ. Do changes in lifestyle engagement moderate cognitive decline in normal aging? Evidence from the Victoria Longitudinal Study. *Neuropsychology*. 2012; 26: 144–155.
10. Carlson MC, Parisi JM, Xia J, et al. Lifestyle activities and memory: variety may be the spice of life. The Women's Health and Aging Study II. *J Int Neuropsychol Soc*. 2012; 18: 286–294.
11. Nilsson I, Löfgren B, Fisher AG, Bernspång B. Focus on leisure repertoire in the oldest old: the Umeå 85 study. *J Appl Gerontol*. 2006; 25: 391–406.
12. Stine-Morrow EAL, Basak C. Cognitive interventions. In: Schaie KW, Willis SL, eds. *Handbook of the psychology of aging*. 7th ed. New York, NY: Elsevier; 2011.
13. Fried LP, Carlson MC, Freedman M, et al. A social model for health promotion for an aging population: initial evidence on the Experience Corps model. *J Urban Health*. 2004; 81: 64–78.
14. Fried LP, Carlson MC, McGill S, et al. Experience Corps: a dual trial to promote the health of older adults and children's academic success. *Contemp Clin Trials*. 2013; 36: 1–13.
15. Rebok GW, Barron JS, Carlson MC, et al. Experience Corps®: a civic engagement-based public health intervention. In: Hartman-Stein PE, La Rue A, eds. *Enhancing cognitive fitness in adults: a handbook for the development of community based programs*. New York, NY: Springer; 2011: 469–488.
16. Morrow-Howell N, Hong S-L, McCrary S, Blinne W. Changes in activity among older volunteers. *Res Aging*. 2012; 34: 174–196.
17. Parisi JM, Rebok GW, Seeman TE, et al. Lifestyle activities in sociodemographically at-risk urban, older adults prior to participation in the Baltimore Experience Corps trial. *Act Adapt Aging*. 2012; 36: 242–260.
18. Frangakis CE, Rubin DB. Principal stratification in causal inference. *Biometrics*. 2002; 58: 21–29.
19. Jo B. Estimation of intervention effects with noncompliance: alternative model specifications. *J Educ Behav Stat*. 2002; 27: 385–409.

20. Yau LHY, Little RJ. Inference for the complier-average causal effect from longitudinal data subject to noncompliance and missing data, with application to a job training assessment for the unemployed. *J Am Stat Assoc*. 2001; 96: 1232–1244.
21. Sheik J, Yesavage J. Geriatric depression scale (GDS): recent evidence and development of a shorter version. In: Brink TL, ed. *Clinical Gerontology: a Guide to Assessment and Intervention*. New York, NY: Haworth Press; 1986: 165–173.
22. Folstein MF, Folstein SE, McHugh PR. Mini-mental state: a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975; 12: 189–198.
23. Hultsch DF, Hertzog C, Small BJ, Dixon RA. Use it or lose it: engaged lifestyle as a buffer of cognitive decline in aging? *Psychol Aging*. 1999; 14: 245–263.
24. Jopp D, Hertzog C. Activities, self-referent memory beliefs, and cognitive performance: evidence for direct and mediated relations. *Psychol Aging*. 2007; 22: 811–825.
25. Verghese J, Lipton RB, Katz MJ, et al. Leisure activities and the risk of dementia in the elderly. *N Engl J Med*. 2003; 348: 2508–2516.
26. Little RJ, D'Agostino R, Cohen ML, et al. The prevention and treatment of missing data in clinical trials. *N Engl J Med*. 2012; 367: 1355–1360.
27. Muthén LK, Muthén BO. *Mplus user's guide*. 6th ed. Los Angeles, CA: Muthén & Muthén; 1998–2011.
28. Fratiglioni L, Wang HX. Brain reserve hypothesis in dementia. *J Alzheimers Dis*. 2007; 12: 11–22.
29. Grøntved A, Hu FB. Television viewing and risk of type 2 diabetes, cardiovascular disease, and all-cause mortality: a meta-analysis. *JAMA*. 2011; 305: 2448–2455.
30. Hamer M, Stamatakis E, Mishra GD. Television- and screen-based activity and mental well-being in adults. *Am J Prev Med*. 2010; 38: 375–380.
31. Thorp AA, Owen N, Neuhaus M, Dunstan DW. Sedentary behaviors and subsequent health outcomes in adults: a systematic review of longitudinal studies, 1996–2011. *Am J Prev Med*. 2011; 41: 207–215.
32. Moore SC, Patel AV, Matthews CE, et al. Leisure time physical activity of moderate to vigorous intensity and mortality: a large pooled cohort analysis. *PLoS Med*. 2012; 9: e1001335.
33. Carlson MC, Varma VR. Activity and neurocognitive health in older adults. In: Waldstein SR, Elias MF, eds. *Neuropsychology of cardiovascular disease*. 2nd ed. New York, NY: Psychology Press; 2014.
34. Carlson MC, Seplaki CL, Seeman TE. Reversing the impact of disparities in socioeconomic status over the life course on cognitive and brain aging. In: Wolfe B, Evans WN, Seeman TE, eds. *The biological consequences of socioeconomic inequalities*. New York, NY: Russell Sage; 2012: 215–247.
35. Varma VR, Tan EJ, Wang T, et al. Low-intensity walking activity is associated with better health. *J Appl Gerontol*. 2014; 33: 870–887.
36. Fogel J, Carlson MC. Soap operas and talk shows on television are associated with poorer cognition in older women. *South Med J*. 2006; 99: 226–233.