

Original Article

Relationship between physical activity levels and perceived residential environment for rural older adults

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Abstract

Problem Statement: A low percentage of rural older adults participate in physical activity although regular physical activity is known to be beneficial to older adults. It is critical to public health to maintain desired amounts of physical activity among elderly individuals within rural residential settings. However, few studies have explored this area. **Purpose:** The purpose of this study was to examine the association between rural older adults' physical activity levels and perceived residential environment. **Approach:** A total of 153 rural older adults completed a structured, face-to-face survey. In the survey questionnaire, PASE (Physical Activity Scale for the Elderly) was employed to assess physical activity levels of rural older adults. Also, five questions relating to perceived residential environment were used, including perceived satisfaction levels with (1) neighborhood, (2) town environment, (3) connection to family in town, (4) connection to friends in town, and (5) overall health condition. **Results:** Regression models revealed that the measure of PASE was significantly associated with the perceived residential environment for rural older adults and that a person's overall health condition was the key contributing factor to their physical activity levels. **Conclusion:** Findings suggest that tailoring of physical activity programming or promotion may be required for rural older adults.

Key Words: physical activity, perceived residential environment, PASE, rural older adults

Introduction

Older adults constitute one of the fastest growing population segments among industrialized nations (Cleland et al., 2015). The United States (U.S.) is no exception to this worldwide phenomenon. According to the U.S. Census Bureau (2017), the aging population will reach 98.2 million by 2060 which will comprise nearly 25% of U.S. residents.

The aging process poses significant risk factors related to health in terms of developing numerous chronic diseases and health concerns. Regular exercise and physical activity have been shown to be beneficial factors and lower the risk of developing age-related diseases such as cardiovascular disease, diabetes, and obesity (Reiner, Niermann, Jekauc, & Woll, 2013). In addition, physical activity has an important role in helping older adults preserve independence, control weight, and maintain muscle, joint and bone health directly related to quality of life (American College of Sport Medicine, 1998). According to the Office of Disease Prevention and Health Promotion (2018), for older adults to have substantial health benefits, they recommend one of the following: (1) 150 minutes (2 hours and 30 minutes) each week of moderate-intensity aerobic physical activity (such as brisk walking or gardening), (2) 75 minutes (1 hour and 15 minutes) each week of vigorous-intensity aerobic physical activity (such as jogging or swimming laps), or (3) an equivalent combination of moderate- and vigorous-intensity aerobic physical activity.

Despite continuing efforts of government and health organizations to increase public awareness of the health benefits of regular physical activity, participation rates of physical activity remain low, particularly among older adults. In the U.S., at least 60% of adults are considered to be sufficiently inactive to achieve health benefits (Ward, Clarke, Nugent, & Schiller, 2016). Centers for Disease Control and Prevention (2008) reported that only 39% of Americans age 65 and older report at least 30 minutes of moderate physical activity five or more days/week or 20 minutes of vigorous physical activity three or more days/week. Particularly for rural populations, the numbers show an even less likelihood of meeting the physical activity recommendations compared to their urban and suburban counterparts (Trivedi et al., 2015). Martin and her colleagues (2006) investigated the physical activity and inactivity patterns between rural and urban older adults in the various regions of the U.S. and the levels of physical inactivity were the highest in most rural areas (33.1%) and the least were in two urban communities (25.7% to 25.9%). The odds of being physically inactive were 43% higher in most rural areas compared to those of urban areas. In the Southern region, prevalence of physical

inactivity was 43.1% in most rural areas as compared to 26.7% in most urban areas (Martin et al., 2006). Recent study confirms a similar pattern. According to the Centers for Disease Control and Prevention (Whitfield, et al., 2019), the prevalence of meeting physical activity guidelines reported lower rates among rural residents (19.6%) compared to among urban residents (25.3%).

Exercise or participation in regular physical activity is a behavior influenced by various factors. It is vital to understand these factors for an individual's success in routine exercise participation. A number of studies have been conducted to explain the association of these factors with physical activity. Historically, popular factors relate to personal (e.g., demographic, cognitive, behavioral) and social (e.g., support, peers, family) constructs (Cleland et al., 2015). Additionally, a large epidemiological study found that a race factor was a determinant of physical activity (Schoenborn & Barnes, 2002). While these factors are commonly assessed correlates of physical activity among urban older adults, not many studies have investigated determinants of physical activity among rural older adults. Wilcox and her colleagues (2003) investigated the perceived environmental and psychosocial correlates of physical activity for rural older adults and they reported that age, education level, perceived neighborhood barriers, and lack of social support from family and friends were all significantly associated with physical activity levels. However, this study was limited to assessing rural older women only.

Poorer health outcomes can be a key construct to the lower levels of physical activity (Van Cauwenberg, et al., 2011). Previous research has examined these factors using various theories and models. For example, rural older adults demonstrate higher rates of premature mortality, obesity, type 2 diabetes, and mental health problems than their urban counterparts (Janus, et al., 2007). Additional research has highlighted the importance of a supportive environment for physical activity (Bauman & Bull, 2007). According to Yen, Michael, and Perdue (2009), as independence and mobility decrease due to aging, the local neighborhood or town environment may play a significant role in influencing behaviors. Individuals living in urban settings typically experience easy access to transportation systems and health and community centers, while rural older adults have environmental barriers which may limit their opportunities to be active. These geographic disparities include poor quality, limited availability, and inadequate access to recreational facilities, as well as geographic and topographic features that obstruct active living and transportation (Anderson, Saman, Lipsky, & Lutfiyya, 2015). These factors change from individual to individual and from one society to another.

Research indicates that the nature of most suburban/rural built environments encourage car dependence and that older adults are spending more time driving than ever before (Rosenbloom, 2004). In addition, urban residents were more likely than rural residents to report the presence of sidewalks, streetlights, access to exercise facilities, and frequently seeing others exercise in their neighborhood (Wilcox et al., 2003). Therefore, older adults who reside in suburban/rural areas tend to be more sedentary than their urban counterparts, implying that rural older adults may have limitations to taking advantage of regular walking or jogging due to these environmental barriers. Regular walking and jogging have been shown to have weight-related and cardiorespiratory health benefits, and improvement in strength and flexibility. These residential and environmental barriers may cause rural older adults to have less interest in increasing their physical activity levels (Berlant, Newton, & Durning, 1999) and ultimately these factors influence their healthy living behaviors and result in physical inactivity.

These kind of behaviors for rural older adults, which are mainly influenced by physical-environmental, interpersonal, and sociocultural factors are defined as ecological models of health behavior (Sallis & Owen, 2002). This theory mainly focuses on identifying the environmental factors and interventions that promote healthy behavior (McLeroy, Bibeau, Steckler, & Glanz, 1988). Ecological theory has been widely used to determine various environmental circumstances which impact the participation in physical activity. For example, adults residing near coastal regions reported higher levels of physical activity regardless of socio-economic status (Bauman, Smith, Stoker, Bellew, & Booth, 1999). Proximity to physical activity programs is another important factor for both young and older adults (Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Sallis, Prochaska, & Taylor, 2000). Similarly, convenient access to the exercise facilities was also strongly associated with physical activity levels (Sallis, Bauman, & Pratt, 1998). These findings suggest that individual level factors and other environmental supports must be present before an individual engages in the recommended level of recreational activity.

The review of literature reveals that few studies have focused on determining the environmental correlates of physical activity in *rural older adults*. Given the lack of research examining residential environmental determinants in rural older adults, it is difficult to develop physical activity recommendations which are specifically tailored to this unique population. Therefore, the purpose of this study is to examine the associations between physical activity levels of rural older adults and their perceived residential environment.

Materials and Methods

Participants and Procedure

To collect data to assess relationships between physical activity levels of rural older adults and their residential environment, the researchers conducted a structured, face-to-face survey in rural areas in North Carolina (NC) between October 1, 2019 and March 6, 2020. In this study, counties with an average population

density of 250 people per square mile or less were considered as rural areas (NC Rural Center, 2020). When recruiting rural older adults, service providers in rural NC areas were used as contacts to announce our study purpose to their service clients or organization members; and the survey was conducted in six service providers' organizations (e.g., four senior centers, one senior housing community, and one community center). A total of 158 rural older adults participated in this study. After the data screening process, 153 older adults were selected for the data analysis.

Survey questions were drawn from existing and validated survey instruments including (1) the Physical Activity Scale for Elderly (PASE) which has been used for the assessment of physical activity in epidemiologic studies for older adults (Washburn, Smith, Jette, & Janney, 1993), (2) the Aging-in-Place Instrument from the aging-in-place project funded by U.S. Department of Agriculture's National Institute of Food and Agriculture (Blinded for Review #1), and (3) the Age-Friendly Community Survey which American Association of Retired Persons (AARP) has used to define livable communities in the U.S. (AARP, 2019).

Socio-demographic Characteristics

Socio-demographic information including age, gender, ethnicity, and level of education were obtained by self-report, and were tested as socio-demographic variables. In addition, information regarding income, number of individuals in the household, marital status, house types, and chronic health problems were also collected to describe the sample profiles.

Perceived Residential Environment

In the survey, perceived residential environment was assessed by using five questions, relating to satisfaction levels with neighborhood (1) and town environment (2), perspectives regarding the social connection to family (3) and friends (4) in town, and overall health condition (5). For neighborhood and town environment, items included "how satisfied are you with your neighborhood?" (scale: 1 = not at all satisfied, 5 = extremely satisfied) and "how would you rate your town as a good place to age?" (scale: 1 = poor, 5 = excellent). For perspectives on social connection to family and friends, two questions, "how satisfied are you with your town or community?" (connection to family) and "how satisfied are you with your town or community?" (connection to friends) were used with a Likert scale from "not at all satisfied (1)" to "extremely satisfied (5)". Also, overall health condition was measured as a perceived residential environment predictor, using a question "how would you rate your overall health condition?" (scale: 1 = poor, 5 = excellent).

Physical Activity Level

Physical activity was measured using the Physical Activity Scale for the Elderly (PASE) (Washburn et al., 1993). The PASE is a well-known instrument designed specifically to assess physical activity in older persons over a 1-week time frame. Participation in leisure activities included walking outside the home; light, moderate, and strenuous sport; recreation activities; and muscle strengthening.

These activities were recorded as never, seldom (1-2 days/week), sometimes (3-4 days/week), and often (5-7 days/week). Duration of the activities were categorized as less than 1 hour, 1 to 2 hours, 2 to 4 hours, or more than 4 hours. Paid or unpaid work, other than work that involves mostly sitting activity, was recorded in total hours per week. Housework (light and heavy), lawn work/yard care, home repair, outdoor gardening, and caring for others were recorded as yes/no (Washburn, McAuley, Katula, Mihalko, & Boileau, 1999). PASE is a reliable and valid measure of physical activity in older adults ($r = 0.75$) (Washburn et al., 1993).

Statistical Analysis

This study mainly focuses on correlates of physical activity and perceived residential environmental variables in rural older adults. Variable means, frequencies, or proportions were used to describe the sociodemographic and residential environmental characteristics and PASE scores (physical activity levels) of the sample, stratified by socio-demographic characteristics.

One-way analysis of variance (ANOVA) was used to examine mean differences of PASE and residential environmental satisfaction scores by sociodemographic variables. Pearson's bivariate correlations were employed to examine the relationships between the physical activity level and perceived residential environmental variables. In addition, multivariate linear regressions were conducted to determine the factors most associated with PASE in rural older adults. Data was analyzed using the SPSS 26.0. Significance was set at $p < .05$.

Results

Participants' Socio-Demographic Characteristics

As shown in Table 1, socio-demographic profiles of participants areas follows: most participants were in their 60s or above (range: 55 to 98 years; $M = 74$) and female (74.7%). Ethnic background was composed of Caucasian (56.5%), African American (39.6%), and Hispanic and others (3.2%). Most of them had completed at least a high school education or above (82.5%). Other socio-demographic profiles (not presented in Table 1) are as follows: Of the participants, 68.2% were either widowed, divorced, separated, or never married.

Less than half lived alone (45.0%), and 69.1% lived in a detached single-family home (69.1%), and 60.2% earned less than \$25,000 annually. Overall, 87% of the study population reported one or more chronic health problems (i.e., diabetes, high blood pressure, overweight, stroke, knee problems, arthritis, and fall injury), with 42% reporting at least three chronic health problems.

PASE and Perceived Residential Environment by Socio-Demographic Variables

Table 1 also provides a wide range in the level of physical activity, as measured by PASE, and mean scores of perceived residential environment factors by socio-demographic characteristics. PASE mean scores were higher in the 50-59 ($M = 163.8$), 60-69 ($M = 119.8$) and 70-79 ($M = 119.1$) age groups compared with the older age group 80s and above ($M = 96.8$), but there was no significant difference among age groups. Higher mean PASE scores were seen in male ($M = 128.3$) than female ($M = 112.5$) and in African American ($M = 117.5$) than Caucasian ($M = 112.1$), but there were no statistically significant differences between groups. PASE scores increased as education level increased. Some college or associate degree showed significantly higher PASE score ($147.2 \pm 95.2, p < .05$) than less than high school education ($M = 90.6$) and high school graduate group ($M = 104.5$).

Age groups of 70s and 80s or above showed a higher satisfaction rate to their neighborhood and town environment than did the 50s and 60s groups, and ANOVA showed there was significant difference between groups ($F=3.89, 4, p < .05$ for neighborhood; $F=2.73, 4, p < .05$ for town environment). Follow-up tests were conducted to evaluate pairwise differences among the means. There was a significant difference in the means between 50s and 70s, 50s and 80s, and 60s and 70s for neighborhood. For town environment, groups between 60s and 80s, and 70s and 80s reported significant differences. Group difference for gender, ethnicity, and education background showed that there was no significant difference for perceived residential environment factors. Interestingly, age groups of 60s and 70s reported a relatively lower health confidential rate than groups of 50s and 80s above, however, there was no significant difference reported.

Table 1
Key Socio-demographic Characteristics, PASE, and Satisfaction with Residential Environment of Rural Older Adults (N=153)

Socio-demographic Characteristics	n (%)	PASE (SD)	Satisfaction with Residential Environment				
			Neighborhood ^a	Town ^b	Connection to family ^a	Connection to friends ^a	Overall health ^b
Gender							
Female	115 (74.7%)	112.5 (81.9)	3.75	3.58	3.80	3.77	3.06
Male	38 (25.3%)	128.3 (89.8)	3.79	3.70	3.61	3.63	2.95
Age*							
50s	5 (3.4%)	163.8 (95.4)	3.00	3.40	3.00	3.20	3.25
60s	44 (29.9%)	119.8 (94.2)	3.57	3.41	3.73	3.70	2.89
70s	59 (40.1%)	119.1 (85.6)	3.93	3.61	3.75	3.66	3.04
80s above	38 (25.9%)	96.8 (67.9)	3.89	4.00	3.89	3.89	3.21
Ethnicity							
Caucasian	87 (56.5%)	112.1 (85.7)	3.84	3.71	3.67	3.76	3.06
African American	61 (39.6%)	117.5 (75.5)	3.67	3.48	3.85	3.60	2.95
Hispanic	1 (0.6%)	329.9 (N/A)	4.00	4.00	3.00	4.00	4.00
Others	4 (2.6%)	144.7 (121.0)	3.25	3.25	3.50	4.25	3.25
Education							
Less than high school	22 (14.3%)	90.6 (51.5)	3.73	3.86	3.68	3.73	3.00
High school graduate	67 (43.5%)	104.5 (72.8)	3.70	3.64	3.77	3.73	2.94
Some college or associate degree	40 (26%)	147.2 (95.2)	3.85	3.50	3.74	3.70	3.08
Bachelor's degree or more	20 (13%)	129.5 (109.8)	3.85	3.50	3.74	3.80	3.25

^a Scale: 1=not at all satisfied, 5 = extremely satisfied. ^b Scale: 1= poor, 5 = excellent.

Note. One-way ANOVA was used to investigate the association between satisfaction with residential environment and socio-demographic variables. * $p < .05$.

Analysis of Physical Activity with Perceived Residential Environment

Table 2 shows a Pearson correlation coefficient matrix of all the correlates of PASE scores and variables of perceived residential environment in this study. Not surprisingly, components of each theoretical construct were correlated with each other. For example, overall satisfaction rates for both neighborhood and town were

significantly correlated with connection to family ($r=.315$ and $.267$, respectively) and connection to friends ($r=.267$ and $.280$, respectively) in town environment. Surprisingly, PASE scores were only significantly associated with one residential environment predictor, overall health condition ($r=.296$).

Table 2
Correlation for Study Variables: PASE and Satisfaction with Residential Environment

	1	2	3	4	5	6
1. PASE	-					
2. Satisfaction with neighborhood	0.049	-				
3. Overall satisfaction with town	-0.093	0.442**	-			
4. Satisfaction with connection to family in town	-0.046	0.315**	0.297**	-		
5. Satisfaction with connection to friends in town	-0.071	0.267**	0.280**	0.748**	-	
6. Overall health condition	0.296**	0.261**	0.196*	0.025	-0.023	-

* $p < .05$. ** $p < .01$.

A multiple regression analysis was conducted to evaluate how well the residential environment satisfaction variables predicted physical activity level (Table 3). The linear combination of residential satisfaction measures was significantly related to the physical activity level, $F(5, 136) = 3.492, p < .05$. The sample multiple correlation coefficient was $.34$, indicating that approximately 11.4% of the variance of the physical activity in the sample can be accounted for by the linear combination of perceived residential environment.

A second multiple regression was conducted to measure whether the physical activity is predicted by participants' overall health condition (a perceived residential environment predictor), as well as whether the physical activity is predicted by their perceived residential environment predictors after controlling for the effects of overall health condition. The results, of the two ordered sets of predictors, indicated that overall health condition accounted for a significant amount of physical activity variability, $R^2 = .088, F(1, 140) = 13.46, p < .05$, indicating that rural older adults who had less health problems tended to have higher scores on the physical activity. However, the second regression model, after controlling for the effects of health condition, showed that the other four residential environment predictors did not account for a significant proportion of the physical activity variance.

Table 3
Linear Regression Analysis of Predictive Validity for Physical Activity (PA) Measurement

	Models	r	R^2	F	p
1.	PA's association with all perceived residential environmental predictors ^a	.337	0.114	3.492	0.005
2.	PA's association with health condition predictor	.296	0.088	13.455	0.000
3.	PA's association with residential environment predictors except health condition predictor	.337	0.114	1.001	0.409

Note. PA = Physical activity which was measured by PASE.

^a Predictors included satisfaction with neighborhood, town, and connection to family and friends in town; and health condition.

Discussion and Conclusions

The purpose of this study was to examine the associations between rural older adults' physical activity levels and their perceived residential environment by using a sample of NC rural counties. In this study, the physical activity level of rural older adults was measured using the PASE scores (Washburn et al., 1993). Our study reveals that the PASE mean score for rural older adults was 115.1 ($SD = 84.4$), which is relatively lower, compared to that of previous U.S. studies (Parker, Strath, & Swartz, 2008; Wilcox, Bopp, Oberrecht, Kammermann, & McElmurray, 2003). Also, one-way ANOVA analysis reveals that physical activity levels of rural older adults are significantly related to the level of education but are insignificantly related to age, gender, and ethnicity, which is a contrast finding from the previous studies (Duelberg, 1992; Macera, Croft, Brown, Ferguson, & Lane, 1995). A part of this discrepancy can be traced to unequal sample distribution in each socio-demographic profile (gender and age) in that most participants were female (74.7%) and 70 years and older (66.0%).

One-way ANOVA analysis also reveals that female older adults were more likely than male older adults to be less physically active. There was a significant decline in physical activity levels with age and those who were 70 years and older were likely to have a lower level of physical activity than those who were less than 70 years old. These findings were similar to previous studies (Booth et al., 2000; King et al., 2000; Parks et al., 2003; Wilcox et al., 2003). However, contrary to large epidemiological studies in which a race factor is considered as a determinant of physical activity (Schoenborn & Barnes, 2002), no significance was revealed for

racial differences in physical activity. It was also traced that profiles of each racial group tended to be homogeneous.

Previous studies on the correlates of physical activity in rural populations (Cleveland et al., 2015; Wilcox et al., 2003) suggested the environmental correlates impacted significant association with physical activity. A study of Cleveland and his colleagues (2015) reported the significance of environmental correlates based on the difference in physical activity with urban counterparts' assessment. However, the study did not include how physical activity directly associated with environmental variables for rural older adults. A study of Wilcox and her colleagues (2003) revealed that environmental factors played a significant role in influencing physical activity. However, the study provided limited definition of environmental factors which were measured only by the perceived *safety* related factors (i.e., sidewalks, light traffic, streetlights, and parks). The safety factors were insufficient for comprehensive assessment of the physical/residential environment, which is closely related to older adults' physical activity levels. Also, previous studies suggest that social support from family or friends in a town environment is an important predictor of physical activity (Booth et al., 2000; King et al., 2000; Parks et al., 2003; Wilcox et al., 2003). Accordingly, our present study attempted to *fully identify the underlying residential environment elements* associated with levels of physical activity. Residential environment was assessed with (1) perceived satisfaction levels with neighborhood and town environment, (2) perspectives regarding the social connection from family and friends in town, and (3) overall health condition.

From the Pearson correlation analysis, a positive association was found between physical activity and a residential environment predictor, participants' perceived health condition. Those who rated their health with relatively lower scores (poor health condition) were more likely to participate in lower levels of physical activity than those who report their health with relatively higher scores (good health condition). This finding was also measured from a multiple regression model with five residential environment predictors (health condition, neighborhood satisfaction, town satisfaction, and satisfaction regarding connection to family and friends in town) which were significant factors on physical activity from the previous studies. Similar findings of positive association with health predictor and other remaining residential environment predictors have been observed in previous studies (King et al., 2000; Wilcox, Castro, King, Housemann, & Brownson, 2000; Wilcox et al., 2002). Thus, we evaluated whether the Physical Activity Scale for Elderly (PASE) scores were predicted by perceived health condition, and subsequently, whether the rest of the residential environment factors predicted overall physical activity after controlling the effects of current health condition via conducting multiple regression with two ordered sets of predictors. The results emphasized that the regression model on physical activity and perceived residential environment predictors was statistically significant and that among environment predictors, only rural older adults' perceived health condition accounted for a significant amount of physical activity variability. This finding is particularly interesting given that the mean score of overall health condition ($M = 3.03$) was reported to be close to "good" range from 1 (poor) to 5 (excellent) and that the majority of the participants reported three or more chronic conditions or health problems. This is likely to be contributed to no mean differences in physical activity levels regardless of sociodemographic profiles as well as perceived residential environment variables except overall health condition variable.

This cross-sectional study design has some study limitations, such as sample representativeness, potential selection, and recall bias (Chad, et al., 2005). Since all participants were senior service clients and community organization members, certain demographic groups remain underrepresented, particularly, males, young elderly or higher income groups. Given the relatively small sample size, the relationships identified in this study may not reflect well the entire rural aging cohort, compared to study findings with a larger sample size. Also, it may reduce the statistical power, leading to a limitation in comparison analysis. The current study did not attempt to quantify physical activity level using accelerometers or other such devices. Rather, it relied on the self-reported PASE score. PASE measures physical activity over a week, which may cause recall bias.

Despite the relatively small sample size as a quantitative study, this study is meaningful in that all data were collected through the face-to-face interview method. This resulted in a very high response rate (96.8%) as well as increasing the quality of answers by minimizing the chances for misunderstanding by the study participants when answering the questions. Also, previous studies have had a relatively narrow focus, i.e., primarily assessing socio-demographic profiles and limited environmental factors which are associated with physical activity. However, this study did not restrict residential environment as the only barrier to physical activity. Rather, this study has attempted to comprehensively encompass a broad range of environmental elements, including satisfaction from neighborhood and town, connection to family and friends in town, and health condition.

However, to fully investigate the contribution of the residential environment to the physical activity level of rural older adults, a future study combining more objective measures of the environment with self-reporting data is required. In addition, a study expanding the measurement of psychological and behavioral correlates would be meaningful to capture more details about individuals' motivation associated with physical activity behaviors. Also, our research findings suggest the need for future studies with a qualitative approach which could employ an in-depth interview or focus group approach to define challenges or difficulties in rural environment settings when pursuing physical activity. Also, to increase external validity, a future study would be applied to a larger sample and/or multiple rural locations. Another opportunity for future research would be to

compare rural older adults' physical activity level and influential factors with that of urban older adults or high-income aging populations.

In conclusion, the findings of the present study highlighted rural older adults' health condition which was the most important predictor determining the association with physical activity apart from residential environmental factors. The findings are particularly critical for government, community, and nonprofit organizations including community senior centers and healthcare agencies who assist older adults in rural communities. The findings can help to develop and implement the appropriate and effective physical activity or relevant intervention programs for the aging cohort.

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