

- Ulrich, R. S. (1981). Natural versus urban scenes: Some psychophysiological effects. *Environment and Behavior*, 13, 523-556.
- Ulrich, R. S. (1983). Aesthetic and Affective Response to Natural Environment. In I. Altman and J. F. Wohlwill (Eds.), *Human Behavior and Environment, Vol. 6: Behavior and the Natural Environment*. New York: Plenum Press.
- Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224, 420-421.
- Ulrich, R. S. (1992). Effects of interior design on wellness: Theory and recent scientific research. *Journal of Healthcare Design*, 3, 97-109.
- Ulrich, R. S. (1999). Effects of gardens on health outcomes: Theory and research. In C. C. Marcus and M. Barnes (Eds.), *Healing Gardens: Therapeutic Benefits and Design Recommendations*. New York: John Wiley & Sons.
- Ulrich, R. S. and Addoms, D. L. (1981). Psychological and recreational benefits of a residential park. *Journal of Leisure Research*, 13, 43-65.
- Ulrich, R. S., Dimberg, S. U., Driver, B. L. (1991). Psychophysiological indicators of leisure benefits. In B. L. Driver, P. J. Brown, and G. L. Peterson (Eds.), *Benefits of Leisure*. State College PA: Venture Publishing.
- Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., and Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, 11(3), 201-230.
- U. S. Bureau of the Census. (2000). Census 2000 Summary File 1(SF 1) 100-Percent Data.
- Viriden, R. J. & Walker, G. J. (1999). Ethnic/racial and gender variations among meanings given to, and preferences for, the natural environment. *Leisure Sciences*, 21, 219-239.
- Wenger, G. C.; Davies, R.; Shahtahmasebi, S., and Scott, A. (1996). Social isolation and loneliness in old age: Review and model refinement. *Aging and Society*, 16, 333-358.
- Whall, A. L., Black, M. E., Groh, C. J., Yankou, D. J., Kupferschmid, B. J., and Foster, N. L. (1997). The effect of natural environments upon agitation and aggression in late stage dementia patients. *American Journal of Alzheimer's Disease*, 12, 216-320.

Presence and Visibility of Outdoor and Indoor Physical Activity Features and Participation in Physical Activity Among Older Adults in Retirement Communities

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SUMMARY. In this paper we examine how the presence and visibility of outdoor and indoor physical activity resources (e.g., walking path/trail, outdoor tennis courts, gardens, etc.) influences participation in physical activity among elderly residents in non-profit continuing care retirement communities and other senior housing communities. This pa-

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per reports findings from a survey of 800 such communities. A social ecological model was used to study the relationships between the environment and physical activity behavior. A fifty-two percent response rate ($n = 398$) was obtained. Campuses with more attractive outdoor and indoor physical activity facilities had more residents participating in different types of physical activity. [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@haworthpress.com> Website: <<http://www.HaworthPress.com>> © 2005 by The Haworth Press, Inc. All rights reserved.]

KEYWORDS. Physical activity, older adults, outdoor features

INTRODUCTION

Regular physical activity contributes to better health among old and very old individuals, allowing them to remain independent for a longer period of time (Shephard, 1997). However, despite the well-established benefits of routine moderate physical activity for older adults, this segment of the U.S. population is the most sedentary, with inactivity being particularly pervasive among people 75 and older (King, Rejeski, & Buchner, 1998; USDHHS, 1996). As with other populations, public health policymakers and researchers are increasingly examining the role of the physical setting in encouraging or discouraging physical activity. For example, one of the strategies identified in the National Blueprint on Physical Activity Among Adults Age 50 and Older to enhance health and increase physical activity among older adults is "to create, promote and sustain communities that support lifelong physical activity" including physical settings that support activity (RWJF, 2000, p. 28).

Researchers from different fields such as public health, recreation science, urban planning and architecture are providing convergent evidence that neighborhood design is associated with physical activity by older people. For example, factors shown to encourage older adults to be active include the presence of walkable green areas and tree-lined walking paths near residence (Takano, Nakamura, & Watanabe, 2002), aesthetic beauty of the neighborhood (Brownson et al., 2000), safe and well-maintained walking paths in the neighborhood (Booth, Owen, Bauman, Clavisi, & Leslie, 2000) and convenient location and access to exercise facilities (Booth et al., 2000; Brownson et al., 2000; Carnegie, 2002).

While many older adults spend the vast majority of their day in and around buildings, there is much less rigorous research focusing on the

impact of design features at the spatial scale of the site, campus or building. Recommendations from case studies and observations at residential communities for older adults suggest that visibility of exercise related areas from public and semi-public areas within a building (Howell, 1980; Regnier, 1994), views to the outside from exercise rooms, presence of walkable spaces within the facility (Regnier, 1994), perceived safety of outdoor spaces as well as the presence of interesting destinations within the facility (Parker and Joseph, 2003) may be factors that encourage older adults to be active. Further, it is plausible that factors such as availability of resources for physical activity, that have been shown to influence participation in physical activity at the neighborhood scale, may also be linked to physical activity behaviors at building and site scales.

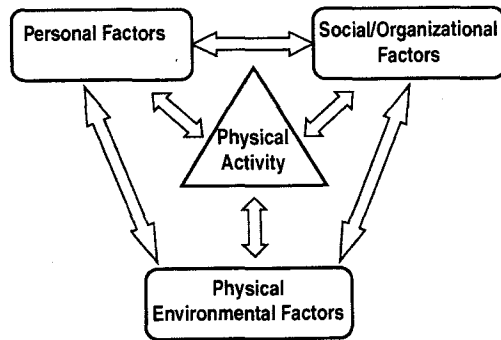
Most previous research on the impact of the environment on physical activity behavior has focused on older people who live in apartments and homes in the community. An estimated 600,000 Americans live in continuing care retirement communities (CCRCs) and other retirement facilities. This number is rapidly increasing as the baby boom generation ages (AAHSA, 2005).

This questionnaire study examines what environmental support for physical activity is available at the site and building scale of continuing care retirement communities (CCRCs) and how the presence of physical activity outdoor and indoor features is related to self-reported physical activity. In the following sections we provide a model for organizing the research, define key terms and describe the research methods used. This is followed by discussion of the results of the survey and implications for future work.

Theoretical Concerns

The physical environment interacts with a host of other factors in influencing an individual's decision to be physically active. We adopted a *social ecological model* for this study that acknowledges the multiple factors that influence an older person's decision to be active. Social ecology models seek to understand complex patterns of causation where individual and group behaviors are influenced by, and influence, social and physical structures (Satariano & McAuley, 2003; Zimring, Joseph, Nicoll & Tsepas, 2005). As illustrated in Figure 1, we see physical activity as related to environmental factors, but where organizational and personal factors both moderate the role of the environment and have direct effects. *Personal Factors* include demographic and

FIGURE 1. A Social Ecological Model of Influences on Physical Activity



Source: Zimring, Joseph, Nicoll, Tsepas (2005). (Kerr, Eves, & Carroll, 2001)

health variables, an individual's knowledge, attitudes and beliefs related to physical activity and psychological or behavioral attributes and skills that may facilitate or impede efforts to participate in physical activity (King, 2001). Age is an important factor influencing participation in physical activity. In a survey of cognitively intact subjects aged 90 and older it was found that age was negatively related to physical activity (Hilleras et al., 1999). *Social/Organizational Factors* include the goals, philosophies and culture of organizations and social structure and support which may facilitate or impede efforts to participate in physical activity. This includes the type and number of physical activity programs that are easily available to older adults (King, 2001). *Physical Environmental Factors* can be considered at four nested levels of spatial scale: (1) urban design; (2) site selection and design; (3) building design; and, (4) building element design.

The physical environment offers different resources and constraints to participation in physical activity at different spatial scales. For example, issues such as traffic safety and land use mix may be important factors affecting participation in physical activity at the urban scale while factors such as location of social areas and views to interesting destinations may be important for walking within buildings. Most of the physical activity-environment research is focused on urban and neighborhood scale issues for different population groups. The relationship between building and site characteristics and participation in physical activity has not been explored in any detail.

This paper focuses on the role of environmental factors and their relationship with physical activity among older residents of CCRCs and other housing with services communities. In a separate paper (Harris-Kojetin, Kiefer, Zimring, Joseph, under review), we look at the role that social and organizational factors play in facilitating physical activity among retirement community residents.

Key Definitions

Physical activity has been defined as any 'bodily movement produced by the contraction of skeletal muscles that substantially increases energy expenditure, although the intensity and duration can vary' (Singh, 2002, p. 263). It is important to make a distinction between 'physical activity' and 'activity.' While physical activity involves bodily movement and results in energy expenditure, an activity may or may not require bodily movement. Hence, reading, watching television, playing bingo are activities, though not physical activities. Walking, swimming, playing tennis or gardening are examples of physical activity.

The Surgeon General recommends at least 30 minutes of moderate intensity physical activity on most days of the week for health impact. The authors of the new recommendation on physical activity also suggest that physical activity benefits can be accrued in small bouts of regular household, occupational and leisure activities lasting at least 10 minutes at a time over the course of the day rather than necessarily in a single dedicated exercise session (Pate et al., 1995).

Research Questions

The findings presented here are part of a larger project that seeks to identify programs, practices and physical environmental features that promote physical activity in CCRCs and other senior housing with services settings. This project is a collaboration between the College of Architecture at the Georgia Institute of Technology and the Institute for the Future of Aging Services, an independent applied research center at the American Association of Homes and Services for the aging (AAHSA). This project was reviewed and approved by the Georgia Institute of Technology's Institutional Review Board.

The goals of this more specific inquiry are to:

1. Understand the extent of outdoor and indoor physical activity features and resources present in CCRCs and other senior housing providers to support physical activity among older adults
2. Identify how the presence and visibility of these physical activity features and resources may be related to physical activity participation levels among older adults in these communities.

The broad research question that emerges is: Is the presence and visibility of indoor and outdoor physical activity resources and features related to participation in physical activity among older adults in these communities? Throughout this paper, the independent living setting is abbreviated as IL, assisted living as AL, and nursing care as NC.

METHODS

Target Population

Continuing care retirement communities (CCRCs) are campus-type retirement communities offering a range of housing, services and health care that is centrally planned and administered. CCRCs are intended to supply a continuum of care (skilled nursing care, assisted living and independent living) throughout the lifetime of elderly residents. The majority of CCRCs offer all three levels of care. This allows residents to enter into the community while still relatively healthy and then move on to more intensive care as it becomes necessary (Sanders, 1997).

There are an estimated 2,600 CCRCs in the United States. There is no "universal" definition for CCRCs because individual states define what they are. Most CCRCs are located in urban or suburban locations—69% and 12%, respectively. About three-quarters are not-for-profit organizations (AAHSA, 2005). More than 660,000 Americans live in CCRCs. According to a 2004 survey of CCRCs by AAHSA, the average age of independent living CCRC residents is 83, compared to 87 for both assisted living and nursing care CCRC residents (AAHSA, 2005). Seventy-two percent of CCRC residents are female. Residents sign a contract with CCRCs articulating the specific housing and health services to be provided. These contracts come in several models, and range from moderate to expensive. The majority of CCRCs provide lifetime care in exchange for an upfront entrance fee and ongoing monthly fee.

Some provide an agreement that may be for a shorter period, however, with no upfront fee required.

Sample Frame Development and Sample Selection

The sample frame consists of not-for-profit providers in the membership of the AAHSA that provide more than one level of care—one of which is independent living (IL)—at the same address or at addresses within close geographic proximity. These providers are primarily CCRCs, but also include other IL housing providers offering at least one other level of care on the same campus. The final sample frame included 1,371 AAHSA CCRCs and housing providers meeting the above inclusion criteria. From the sample frame, we randomly selected 800 CCRCs and housing providers using SPSS statistical software.

Data Collection Design and Response Rate

Data collection occurred for eight weeks starting in January 2004. Surveys were sent via U.S. mail to prime contacts identified in the AAHSA membership database. Prime contacts were mainly Administrators, Assistant Administrators, CEOs and Executive Directors, and Directors of Nursing. We used a dual-mode approach, allowing respondents to complete the survey either by U.S. mail or web. Cover letters were sent with the mailed surveys and included a link to a web-based version of the survey questionnaire. The prime contacts were asked to direct specific survey questions to others in their facility as needed.

To ensure a favorable response rate and quality data, we implemented a multi-pronged data collection design—awareness messages about the upcoming survey using AAHSA's normal channels for communicating with members (e.g., web site, electronic memos, listservs), an advance letter, U.S. mailed questionnaire, reminder post card, e-mail reminders, phone call reminders, and the option to complete a web-based version of the survey.

A total of 463 surveys were returned (of the 800 in the random sample). Forty-one cases had to be excluded because their responses indicated that they did not meet inclusion criteria. Another 24 cases (all web survey completions) had to be excluded because of corrupt data ($N = 10$) or blank surveys being submitted ($N = 14$). In total, we had 398 valid respondents. The overall response rate is 52% (398/759).¹

Description of Sample

The key characteristics of responding facilities are summarized in Table 1.

Survey Instrument Development

The survey instrument was developed using information collected through a literature review and informational interviews with CCRC management and staff and with architects that design retirement communities. We pretested the survey instrument with nine respondents from sites reflective of the target population, to gain insight into the substance of the survey (e.g., questions asked, definitions used) and the most effective ways to administer surveys and to increase response rates. The draft survey instrument was also sent to the project's Advisory Committee for comment. Input from pretest sites and committee members was compiled and used to refine the final draft of the survey instrument.

The final survey instrument contains 45 items, divided into four main sections to obtain the following information: (1) basic characteristics of responding campuses; (2) campus locations, grounds and outside community; (3) campus facilities and buildings; and, (4) campus residents and physical activity. Majority of the questions were close ended. Five open ended questions were included to obtain additional qualitative information (e.g., Please tell us some of the challenges your community has faced in getting your residents physically active). The paper survey is eight pages. The web version contained identical survey items. Only minor differences exist between the paper and web-based versions due to skip patterns and other web design issues. The survey takes about an hour to complete provided the information is at hand.

Research Design

In this paper we are focusing on describing available physical activity resources and their association with physical activity. The effect of personal factors (i.e., average age of residents) and organizational factors (i.e., number of organized physical activity programs offered on campus) on these relationships is also considered. The larger project also examined in detail the role of organized activities and of management structures and these findings are presented in another paper (Harris-Kojetin, Kiefer, Zimring, Joseph, under review).

TABLE 1. Key Characteristics of Responding Campuses

Characteristics of responding facilities		Distribution
Whether CCRC	CCRC Non-CCRC	75% 25%
Type of Contract ¹	Type A Type B Type C No contract Other	25% 22% 43% 6% 4%
Levels of care offered ²	AL & IL NC & IL All three levels	12% 16% 72%
Average age of residents (years)	Independent Living residents Assisted Living residents Nursing Care residents	82 85 86
Average # of residents	Independent Living residents Assisted Living residents Nursing Care residents	157 45 82
Location ³	Urban-large Urban-small Suburban Rural	14% 27% 43% 16%
Campus Size (acreage)	< 5 acres 5-25 acres 26-50 acres 51-100 acres > 100 acres	16% 37% 24% 14% 9%
Campus age	1-10 years old 11-30 years old 31-40 years old > 40 years old	10% 39% 16% 35%
Campus terrain	Entirely flat Mostly flat with some gradual slopes Some hills Very hilly	31% 51% 12% 6%
Number of organized activities available on campus	Between 1-3 activities Between 4-6 activities Between 7-9 activities Between 10-12 activities Between 13-14 activities	37% 33% 21% 9% < 1%

¹Type A—extensive (lifetime); assisted living and skilled nursing costs included in basic fees; Type B—modified; some lifetime care benefits covered through basic fees, while other benefits offered at an additional charge, as needed; Type C—fee-for-service; all services offered on a pay-as-you-go basis, at a rate specified by the provider

²IL—Independent Living, AL—Assisted Living, NC—Nursing Care

³Urban-large—located within city limits of city with a population exceeding 500,000

Urban-small—located within city limits of a city with a population up to 500,000

Suburban—located within 50 miles of small or large urban population

Rural—no small or large urban population within 50 miles of the campus

Physical Environmental Variables

The paper focuses on the relationship between the presence and number of indoor and outdoor physical activity resources and features and participation in physical activity. Further, we examine whether visibility of outdoor resources present on campus is related to participation in physical activity. While the impact of visibility on physical activity has not been dealt with previously in any empirical studies within the physical activity research arena, case studies conducted in residential facilities for older adults suggest that this may be an important factor influencing an older adults decision to use outdoor spaces for physical activity (Regnier, 1994; Parker & Joseph, 2003). The independent variables considered in this study include:

1. Presence of specific outdoor features on campus including walking paths, swimming pools, golf course/putting greens, outdoor tennis court, resident garden plots, outdoor bowling areas, gardens, courtyards and porches with seating.
2. Number of outdoor features: This variable is the numerical sum of all outdoor features available on campus.
3. Visibility of outdoor features: For each of the outdoor features, respondents were asked: whether the feature was easily visible by many residents during daily activities (i.e., from apartments, public areas, or while walking on the campus).
This information was provided by the key contact based on personal experience or input from other staff members. This may vary somewhat from resident experience but still provides a close estimate of features that are visible easily while walking around campus.
4. Presence of indoor physical activity facilities on campus including dedicated aerobics/exercise classroom, fitness room with equipment, indoor swimming pool, warm water therapy pool, indoor tennis courts, dance studio, indoor bowling alley, multipurpose activity room and dedicated physical therapy room.
5. Number of indoor physical activity facilities: This variable is the sum of all indoor physical activity facilities on campus

Outcome Variable

The key outcome described in this paper is resident participation in physical activity. The outcome measures described below were reported by respondents based on observed and recorded information

available to them when completing the survey. While we have no independent confirmation of these numbers, the outcomes provide a measure of the general levels of physical activity among residents in a community and provide an idea of the degree of participation in specific activities such as swimming, golf, etc.

Respondents were asked to provide information on the average percentage of residents in each setting participating in different types of physical activities. We measure participation in physical activity in three ways:

1. Overall physical activity levels
2. Participation in particular physical activities
3. Walking to meals

Overall Physical Activity (PA) Levels: This outcome measures the percentage of residents (at three levels of care) that do at least 30 minutes of physical activity (PA) at least 3 times/week. This is based on physical activity guidelines that recommend at least 30 minutes of moderate intensity physical activity on most days of the week (Fletcher et al., 1996). The percentage of IL residents (43%) participating in PA for at least 30 minutes duration 3 times a week is almost twice the percentage of NC residents (23%) (Table 2). The literature suggests a decline in physical activity levels with functional ability and age, and that is borne out by these findings.

Activity PA: This is the average percentage of residents who participated in a particular physical activity at least once a week based on the question asking what percent of residents (at three levels of care) participated in a particular activity (13 items) at least once a week. Walking is by far the most popular activity among residents in all three settings, followed by aerobics and physical therapy (Table 2). As expected, for all physical activities there is a decline in participation levels from IL to AL settings. The only exception to this decline in participation is physical therapy, which is greatest among NC residents. This reflects the greater focus on providing restorative care to NC residents compared to IL and AL residents.

Walk to Meals: Since most communities offer a meal plan to residents as part of their monthly fee, walking to meals constitutes a regular instrumental activity. This outcome is based on a question that asks what percent residents (at three levels of care) walked to meals with or without assistance on a regular basis. Most IL and AL residents walk to meals on a regular basis. Only 29% of NC residents walk to meals regularly.

TABLE 2. Percentage of Residents in Different Settings Participating in Physical Activity

Outcome measure	IL residents (%)	AL residents (%)	NC residents (%)
Overall PA	43	32	23
Activity PA			
Walking on own	72	60	21
Walking as part of a club	7	4	2
Yoga/Pilates	2	1	0
Tai-chi/martial arts	3	1	1
Dance	4	1	1
Golf	5	1	0
Swimming (Indoor or Outdoor)	7	1	1
Shuffleboard	3	1	1
Bowling (Indoor or lawn)	3	2	3
Tennis (Indoor or Outdoor)	1	0	0
Aerobics	9	7	4
Water aerobics	5	1	0
Physical Therapy	7	9	20
Walk to meals	87	81	29

ANALYSIS

All data from the surveys were imported into SPSS statistical software version 13.1. The data were analyzed using different types of statistical techniques such as bivariate correlations, t-tests for significance of independent samples and linear regression.

Relationships between physical activity outcomes and variables of interest are reported in this paper only when the physical activity is prevalent in at least 5% of the responding communities. All relationships are statistically significant at 0.05 level or better. Statistically non-significant relationships are designated as NS in the tables presented in this paper.

RESULTS

Outdoor Features on Campus

More than two-thirds of the communities have paths, gardens, garden plots, courtyards and porches. Less than a third of the communities have outdoor swimming pools, golf courses, shuffleboard courts, bowling facilities and outdoor tennis (Table 3).

In most communities where the outdoor feature is present, it is easily visible during daily activities (e.g., from apartments, public areas, or while walking on campus). The only exception is tennis courts, which are easily visible in only 17% of the communities where they are available (Table 3). In terms of the number of outdoor features available on campus (Table 4), around a third of the campuses have 5 outdoor features, and 85% of the campuses have between 3 and 7 features.

Relationship Between Presence of Outdoor Features and Participation in Physical Activity

There appears to be a consistent association between the presence of an outdoor feature on campus and residents' participation in physical

TABLE 3. Presence and Visibility of Outdoor Features on Campus

Outdoor facility features	% of campuses where this feature is present	% of campuses where this feature is available and also visible
Swimming Pool	20	86
Paths	85	93
Golf Course	18	93
Outdoor Tennis	5	17
Gardens	77	89
Garden Plot	69	81
Shuffleboard Court	29	79
Bowling Area	11	89
Courtyard	83	90
Porch	82	89

TABLE 4. Number of Outdoor Features on Campus

Number of outdoor features on campus	% distribution of campuses
0	1
1	1
2	6
3	10
4	19
5	31
6	16
7	10
8	5
9	2

activity. Table 5 shows the participation levels in different activities among residents in campuses that have a certain outdoor feature and campuses that do not have the feature. Of specific interest is the fact that more IL residents participate in walking clubs on campuses that have walking paths (8% vs. 3%), gardens (14% vs. 6%) or outdoor lawn bowling areas (14% vs. 6%). Though the numbers are relatively small, the presence of walking paths is also related to more AL residents walking as part of a club (5% vs. >1%). These relationships are true even controlling for age of residents.

The presence of an outdoor swimming pool is related to more IL residents participating in swimming (17% vs. 4%) and water aerobics (11% vs. 3%). Interestingly enough, the one outdoor feature that appears to be related to many physical activity outcomes is the presence of a golf course. Eighteen percent of the campuses surveyed have golf courses and these communities clearly have more IL residents participating in many different activities. Also more residents (in all three levels of care) that live on campuses with golf courses are active for at least 30 minutes 3 times a week. These relationships remained significant even after controlling for differences in age of residents across campuses.

It should be noted that the number of features on a campus are highly correlated with the number of activity programs available on campus. Our initial informational interviews with campus administrators sug-

TABLE 5. Relationship Between Presence of Outdoor Feature and Participation in PA

Campuses where outdoor features are present more/less residents are likely to participate in.....	Indoor physical activity facility											
	Walking Paths		Outdoor Swimming Pool		Golf Course		Garden		Shuffleboard Court		Outdoor Lawn Bowling Area	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Average % of IL residents engaging in...												
Walk on own	NS		NS		NS		NS		NS		NS	
Walking Club	3	8	NS		NS		6	14	NS		6	14
Aerobics	NS		8	15	8	15	4	11	8	12	8	17
Swimming	NS		4	17	6	12	5	8	6	10	NS	
Golf	NS		4	8	4	10	3	6	4	8	4	12
Dance	NS		NS		3	9	NS		3	7	3	11
Shuffleboard	NS		NS		NS		NS		1	8	NS	
Yoga	NS		NS		2	5	NS		NS		2	5
Bowling	NS		NS		NS		NS		NS		1	11
Water Aerobics	NS		3	11	4	8	3	5	NS		NS	
Physical Therapy	NS		6	10	8	10			NS		NS	
Average % of AL residents engaging in...												
Walking Club	>1	5	NS		NS		NS		NS		NS	
Aerobics	6	11	NS		6	11	NS		NS		NS	
Average % of IL residents participating in 30 minutes of PA 3 times a week	42	49	NS		41	53	NS		NS		NS	
Average % of AL residents participating in 30 minutes of PA 3 times a week	NS		NS		30	39	NS		NS		NS	
Average % of NC residents participating in 30 minutes of PA 3 times a week	NS		NS		22	30	NS		NS		NS	
Average % of IL residents walking to meals	NS		NS		85	92	80	88	NS		NS	
Average % of NC residents walking to meals	NS		NS		NS		22	31	NS		NS	

gested that such a recursive relationship may exist: more active communities are likely to create and maintain facilities while the presence of facilities allows physical activity programs to go on. When the number of physical activity programs offered on campus was introduced as a control variable many of the relationships became statistically non-significant. That is, campuses with golf courses are also likely to have many different types of program offerings which may influence resident participation in physical activity. This is consistent with an ecological model where many different factors together influence participation in physical activity.

Relationship Between Number of Outdoor Features on Campus and Participation in Physical Activity

Campuses with more outdoor features tend to have more residents at all three levels of care participating in different types of physical activities (Table 6), though the relationships are strongest for IL residents. Also, there is a significant correlation between number of outdoor facility features and

TABLE 6. Relationship Between Number of Outdoor Features on Campus and Resident Participation in PA

Campuses with more outdoor facility features on campus tend to have more residents participating in PA... (in descending order of strength of relationship among IL residents)	Pearson's R correlation		
	Independent Living (IL) residents	Assisted Living (AL) residents	Nursing Care (NC) residents
Average % of residents engaging in...			
Swimming	.34	.22	.12
Golf	.33	.14	NS
Tennis	.29	.15	NS
Water aerobics	.28	.17	.18
Aerobics	.28	.20	.13
Dance	.28	.13	NS
Yoga	.21	.16	NS
Bowling	.16	NS	NS
Walking clubs	.15	.12	NS
Tai chi	.14	NS	NS
Physical therapy	.11	NS	NS
Average % of IL residents participating in 30 minutes of PA 3 times a week	.16	NS	NS

participation in physical activity for as many as 11 activities for IL residents, 8 activities for AL residents and only 3 activities for NC residents. Also, more IL residents participate in at least 30 minutes of PA 3 times a week in campuses with more outdoor features. These relationships are significant even when controlling for age of residents. However, most of these relationships become statistically non-significant when the number of physical activity programs offered on campus is included as a control variable. The relationship between the number of outdoor facility features on campus and IL residents participating in golf, tennis and aerobics remains significant even when controlling for age and number of physical activity programs offered on campus.

Relationship Between Visibility of Outdoor Features and Participation in Physical Activity

We were interested in finding out if more people participated in specific activities when outdoor features related to that activity were present as well as visible during the course of daily activities. We found that where courtyards were visible, more IL residents walk as part of a club and where shuffleboard courts are visible more of IL residents participate in shuffleboard (Table 7). However, the actual level of participation in these physical activities is low in all communities.

Indoor Physical Activity Facilities

The communities surveyed reported having a range of different indoor physical activity facilities (Table 8). More than two-thirds of the

TABLE 7. Relationship Between Visibility of Specific Outdoor Facilities and Resident Participation in PA

Compared to campuses where outdoor facilities features are not visible, campuses that have visible outdoor facility features tend to have more residents engaging in PA....	Courtyard Visible?		Shuffleboard Court Visible?	
	Yes	No	Yes	No
Average % of IL residents engaging in...				
Walk as part of a club	7	1	NS	
Shuffleboard	NS		9	3

TABLE 8. Distribution by Type of Indoor Physical Activity Facilities Present on Campus

Indoor physical activity facility on campus	% distribution of campuses
Multipurpose activity room (used for many activities including, but not limited to, PA)	88
Fitness room with equipment	70
Dedicated physical therapy room/facility	67
Dedicated aerobics/exercise classroom	35
Indoor swimming pool	21
Warm-water therapy pool	18
Dance studio	4
Indoor bowling alley	2
None	2
Indoor tennis courts	< 1

communities have a multipurpose activity room (88%), fitness room with equipment (70%) and dedicated physical therapy room/facility (67%). Around 35% of the communities have dedicated an aerobics/exercise room. Twenty-one percent of the communities have an indoor swimming pool and 18% have a warm-water therapy pool. Very few communities have indoor tennis courts, dance studios or indoor bowling alley.

Relationship Between Presence of Indoor PA Facility and Participation in PA

The presence of indoor physical activity facilities on campus was related to more residents participating in physical activity (Table 9). As expected, more residents participated in a particular activity if the related physical activity facility was present. For example, in campuses where an indoor exercise classroom or an indoor fitness room is present, resident participation in aerobics is almost double (at all three levels of care) that of campuses without these facilities. A similar trend is seen with the presence of indoor swimming pools or warm water therapy pools and participation in swimming and water aerobics; or presence of physical therapy room and participation in physical therapy. Though the presence of any particular indoor physical activity facility does not

TABLE 9. Relationship Between Presence of Indoor PA Facility and Participation in PA

Campuses where indoor PA facilities are present more/less residents are likely to participate in activities	Indoor physical activity facility											
	Indoor exercise classroom		Indoor fitness room		Indoor swimming pool		Indoor warm water therapy pool		Dance studio		Physical Therapy room	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Average % of IL residents engaging in...												
Walk on own	75	66	NS		74	65	NS		NS		NS	
Aerobics	7	14	3	12	NS		NS		NS		NS	
Swimming	6	10	NS		4	16	6	14	7	16	5	8
Golf	4	7	2	6	5	7	NS		5	16	NS	
Dance	3	6	1	5	NS		NS		4	19	NS	
Shuffleboard	2	5	NS		NS		NS		NS		NS	
Yoga	NS		NS		NS		NS		2	7	NS	
Bowling	NS		NS		NS		NS		2	25	NS	
Tai chi	NS		NS		NS		NS		3	10	NS	
Water aerobics	4	7	2	6	3	11	4	10	NS		3	6
Physical Therapy	NS		4	7	6	9	NS		NS		4	8
Average % of AL residents engaging in...												
Aerobics	5	11	3	8	NS		NS		NS		NS	
Physical Therapy	NS		6	10	8	13	NS		NS		15	22
Average % of NC residents engaging in...												
Aerobics	2	6	NS		NS		NS		NS		NS	
Average % of IL residents walking to meals	NS		79	90	NS		NS		NS		NS	
Average % of NC residents walking to meals	NS		NS		NS		NS		NS		24	31

seem to be related to overall participation in PA (30 minutes of PA 3 times a week), the presence of indoor fitness rooms is associated with more IL residents walking to meals on a regular basis and the presence of physical therapy rooms with more NC residents walking to meals. This may be related to a stronger emphasis on fitness and restorative care in such communities.

Relationship Between Number of Indoor PA Facilities on Campus and Participation in PA

The number of indoor physical activity facilities present on campus is related to residents at all three levels of care participating in different types of PA (Table 10). Campuses with more indoor PA facilities tend to have more IL residents participating in swimming, water aerobics, golf, tennis, aerobics and physical therapy, dance, tai chi, bowling and yoga. However, fewer IL residents walked on their own in such campuses. Campuses with more indoor PA facilities also tend to have more AL residents participating in swimming, yoga and aerobics and NC residents participating in swimming, water aerobics, tennis, aerobics and

TABLE 10. Relationship Between Number of Indoor PA Facilities on Campus and Resident Participation in PA

Campuses with more indoor physical activity facilities on campus tend to have more residents participating in PA... (in descending order of strength of relationship among IL residents)	Pearson's R correlation		
	Independent Living (IL) residents	Assisted Living (AL) residents	Nursing Care (NC) residents
Average % of residents engaging in....			
Swimming	.47	.37	.22
Water aerobics	.41	NS	.12
Golf	.28	NS	NS
Tennis	.23	NS	.16
Aerobics	.20	.13	.12
Physical therapy	.19	NS	NS
Dance	.14	NS	NS
Tai chi	.13	NS	NS
Walk on their own	-.13	NS	NS
Bowling	.11	NS	NS
Yoga	.11	.16	NS
Walk as part of a club	NS	NS	NS
Shuffleboard	NS	NS	.14
Average % of residents walking to meals on a regular basis...	.12	NS	NS

shuffleboard. Especially of interest is the fact that the number of indoor PA facilities is strongly related to residents at all levels of care participating in swimming. The relationship between the number of indoor physical activity facilities on campus and participation in swimming (AL and IL) and water aerobics (IL and NC) exists even after controlling for the age of residents and number of physical activity programs offered on campus, though the relationship is weakened when these factors are taken into account.

DISCUSSION

Physical activity behavior is a complex phenomenon and several different factors influence participation in PA. This project is one of very few studies exploring the relation between building and site level factors and participation in physical activity among older adults in residential facilities. Our goal was to understand what types of resources were available in these campuses and whether the presence of resources could actually be linked to residents being physically active.

This article suggests that the presence of individual facilities and features as well as the actual number of facilities present is related to the resident participation in physical activity. Specifically, we found that campuses with certain outdoor features had more residents participating in different types of activities. For example, campuses with walking paths, gardens or outdoor lawn bowling areas had more independent living residents participating in walking clubs. We also found a significant relationship between the visibility of courtyards on campus and participation in walking clubs. This begins to suggest that in campuses where natural outdoor features are present on site and are visible, more people may participate in a social physical activity such as a walking club. The nature of the survey tool did not allow for further exploration of the connection between visibility and participation in physical activity. However the tentative findings from this study and observations from case studies that suggest that designing outdoor areas that are easily visible from public and circulation areas within buildings increases participation in physical activity deserve further exploration.

The study also found that campuses with more outdoor features are likely to have more residents participating in a range of different activities. This remained true after controlling for age of residents, but not when number of physical activity programs on campus was introduced as a control variable. A similar trend was seen with the presence and

number of indoor physical activity facilities on campus and the participation in physical activities. The number of IL residents participating in swimming and water aerobics was significantly related to number of indoor physical activity facilities on campus even after controlling for age of residents and number of programs offered on campus, though the relationship was somewhat weakened. The study exemplifies the complexity of physical activity behavior and the difficulty in isolating the influence of the environment on physical activity behavior. CCRCs that encourage physical activity are likely to build and maintain more physical amenities that support physical activities as well as conducting a greater number of organized activities. As shown in this study, the relationship between physical design and PA was weakened or made insignificant when controlling for age or programming. This suggests that the interaction among person-level characteristics, physical design and organizational factors (programming) provides a better, if more complex, understanding of PA factors than looking at any one set of measures alone. The social ecological model posits just this—that these different factors influence physical activity behavior and also influence each other. As an exploratory study, this paper begins to identify how the availability of resources at the building and site level may be related to participation in physical activity. However, there is need for more focused studies that assess how the presence of resources at the building and site level influences participation in physical activity.

The nature of causation between the physical environment and activity is complex and we do not assert that if you build it they will come. Rather, the physical environment appears to be a facilitator that allows motivated staff and residents to work together to become more physically active.

LIMITATIONS

Several factors need to be considered in this study. While the AAHSA members of the team pre-tested the questionnaire for comprehension and relevance, this study depends on report of community managers and other staff which might not be accurate. Campus staff and management do not have a complete picture of the full range of activities in which residents participate. This is particularly true of IL residents, who are more likely to engage in physical activity off campus on their own. The study does not include the perspective of residents. The response rate is quite high for studies of this type, but remains only slightly over

50% and the nature of AAHSA's database did not allow us to compare the characteristics of responders and non-responders.

The physical activity outcome measure of at least 30 minutes a day for at least three times per week is a high criterion to set for this population. With this measure we do not capture physical activity levels of less frequency or duration. The list of specific physical activities used as outcome measures tends to focus more on programmed, organized physical activities. The list also excludes numerous other types of physical activities that older adults may participate in on a weekly basis (e.g., bicycling, gardening, etc.) that may be done alone or as part of a group.

FUTURE DIRECTIONS

Focus Groups with Residents

The survey reflects the perspectives of management and staff at communities. Focus groups with residents would provide insights about resident perceptions of the outdoor and indoor features available on campus. Further, focus groups with residents may help in better understanding how the visibility of outdoor and indoor features may encourage or motivate residents to be physically active.

In-Depth Case Studies

More in-depth case studies in a few communities would enable objective measurement of actual resident physical activity levels as well as resident use of physical activity resources and outdoor features. For example, participation in walking clubs is associated with the presence of outdoor landscaped areas on campus. The use of outdoor spaces for social physical activities such as walking clubs can be assessed in greater detail through case studies.

Checklist

The above activities and the survey results could inform the development of a comprehensive checklist for CCRCs and other housing providers of physical design features and programming that might encourage physical activity among residents. The checklist would provide

a basis for providers and architects to assess their communities and to target potential changes that may increase physical activity.

NOTE

1. We computed the response rate according to the methods described in the American Association for Public Opinion Research's document, *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, 2004.

REFERENCES

- AAHSA. (2005). The continuing care retirement communities 2004 profile. Washington, DC: Association of Homes and Services for the Aging (AAHSA).
- Booth, M. L., Owen, N., Bauman, A., Clavisi, O., & Leslie, E. (2000). Social-cognitive and perceived environment influences associated with physical activity in older Australians. *Preventive Medicine*, 31(1), 15-22.
- Brownson, R., Housemann, R. A., Brown, D. R., Jackson-Thompson, J., King, A. C., Malone, B. R. et al. (2000). Promoting physical activity in rural communities: Walking trail access, use, and effects. *American Journal of Preventive Medicine*, 18(3), 235-241.
- Carnegie, M. A. B., Marshall, A.L. Mohsin, M. Westley-Wise, V. Booth, M.L. (2002). Perceptions of the physical environment, stage of change for physical activity, and walking among Australian adults. *Research Quarterly for Exercise & Sport*, 73(2), 146.
- Fletcher, G., Balady, G., Blair, S., Blumenthal, J., Caspersen, C., Chaitman, B., Epstein, S., Sivarajan Froelicher, E., Froelicher, V., Pina, I., & Pollock, M. (1996). Statement on Exercise. Benefits and Recommendations for Physical Activity Programs for All Americans: A Statement for Health Professionals by the Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology. American Heart Association. *Circulation*, 94, 857-862.
- Howell, S. (1980). Designing for aging: Patterns of use. Cambridge, MA: MIT Press.
- King, A. C. (2001). Interventions to promote physical activity by older adults. *The Journals of Gerontology*, 56a (Supplement: Nutrition, Physical Activity, and Quality of Life in.), 34-46.
- King, A. C., Rejeski, W. J., & Buchner, D. M. (1998). Physical activity interventions targeting older adults: A critical review and recommendations. *American Journal of Preventive Medicine*, 15(4), 316-333.
- Parker, D., & Joseph, A. (2003). Creating environments to promote physical activity among older adults. Poster presented at the EDRA 34/2003 People Shaping Places Shaping People, Minneapolis.
- Pate, R. & Pratt, M. (1995). Physical activity and public health. *JAMA: Journal of the American Medical Association* (Vol. 273, pp. 402): American Medical Association.
- Regnier, V. (1994). Assisted living housing for the elderly: Design innovations from the United States and Europe. New York: Van Nostrand Reinhold.
- Robert Wood Johnson Foundation (2000). The national blueprint on physical activity among adults age 50 and older.
- Sanders, J. (1997). Continuing care retirement communities: A background and summary of current issues. Washington, DC: Office of the Assistant Secretary for Planning and Evaluation.
- Satariano, W. A., & McAuley, E. (2003). Promoting physical activity among older adults: From ecology to the individual. *American Journal of Preventive Medicine*, 25(3, Supplement 2), 184-192.
- Shephard, R. J. (1997). Aging, physical activity, and health. Champaign, IL: Human Kinetics.
- Singh, M. A. F. (2002). Exercise comes of age: Rationale and recommendations for a geriatric exercise prescription. *The Journals of Gerontology*, 57A(5), M262-M282.
- Takano, T., Nakamura, K., & Watanabe, M. (2002). Urban residential environments and senior citizens' longevity in megacity areas: The importance of walkable green spaces. *Journal of Epidemiology and Community Health*, 56, 913-918.
- USDHHS. (1996). Physical activity and health: A report of the surgeon general. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.
- Zimring, C., Joseph, A., Nicoll, G. L., & Tsepas, S. (2005). Influences of building design and site design on physical activity: Research and intervention opportunities. *American Journal of Preventive Medicine*, 28(2, Supplement 2), 186-193.