

# ENVIRONMENT AND AGING IN JAPAN

## A Review of Recent Research

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**ABSTRACT:** Over the past 30 years, environment and behavior research in Japan has paralleled the international growth of the field. Unfortunately, despite noteworthy periodic efforts to cross-culturally bridge language barriers between English- and Japanese-speaking researchers, public policy makers, planning and design practitioners, and students specializing in this subject area, significant communication obstacles persist. In response, a literature review is presented of recent research in Japan on the subject of environment and aging. The review spans a 17-year period (1985-2002). The objective is to enhance international communication, stimulate collaborative work, and foster appreciation of the broad parameters of the dramatic trends in aging occurring globally.

**Keywords:** *environment; aging; Japan; translation; research; design*

**Environment and aging has evolved** over the past 3 decades to become a distinct subspecialty within the field of environment and behavior. Research and professional practice activities have expanded, resulting in a broadened

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manifold of concerns. Issues addressed by researchers, practitioners, and public policy makers range among the design of therapeutic environments for persons with dementia (Calkins, 1988; Cohen & Weisman, 1991; Day, Carreon, & Stump, 2000), significant advancements in theory (Lawton, 1980; 1985), universal design (Preiser & Ostroff, 2000), and postoccupancy evaluations on emerging building types for the aged, such as assisted living facilities (Regnier, 1997). The vast majority of this work has been the result of interdisciplinary collaboration. In fact, it is arguable that this subspecialty, with its vast English-language literature, is perhaps the most mature of any within the interdisciplinary field of environment and behavior.

Aging, of course, is a phenomena not isolated to any one nation, language, or culture. Nations around the globe are attempting to cope with unprecedented numbers of persons who will live longer than ever before in human history. In response to this pervasive trend, the generation of new knowledge in environment and aging is occurring around the globe, with cross-cultural language barriers continuing to pose significant challenges to those who conduct work in this area. In many instances, a form of unintentional egocentricity ensues by default. In many instances, the increasing dominance of English as a universal business language has had deleterious effects on researchers seeking to learn about recent advancements occurring in non-English-speaking cultures. The subspecialty of environment and aging has not been immune to this condition. Japan is a case in point.

In Japan, the Man-Environment Research Association (MERA) functions in parallel with the North America-based Environmental Design Research Association (EDRA). Annual and semiannual meetings take place at various locations within Japan. Across the field in general, a strong tradition of interdisciplinary Japanese research has evolved over the past 30 years, resulting in a vast Japanese-language literature consisting of textbooks, research reports, conference proceedings, doctoral dissertations, and peer-reviewed journal articles. Numerous Japanese researchers and research-oriented architects are conducting work in the area of environment and aging. Many of these individuals, although well-known in their field in their home country, remain unknown beyond Japan. Recently, somewhat-successful steps have been taken to break through the language barrier, notably the international MERA

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conference held in 1997 at the University of Tokyo (Takahashi, 1997). Further efforts, however, are necessary, on a more consistent basis, for the advancement of the international research and professional practice community. The intent of this discussion is therefore to enhance international communication, to stimulate collaborative cross-cultural work, and to foster appreciation of the global dimensions of the dramatic trends in aging taking place in many societies, Japan notwithstanding.

The following discussion consists of a review of the recent Japanese literature on environment and aging. This review covers January 1985 to April 2002, a 17-year span. The review was conducted while the first author was in residence at the University of Tokyo in 2002, made possible through a fellowship sponsored by the Japan Society for the Promotion of Science (JSPS).<sup>1</sup> Publications and reports, including books, conference proceedings, and journal articles culled from the extensive body of Japanese-language literature on environment and behavior, were perused. A process that could have been overwhelming was made far more coherent and manageable by electing to draw upon the concise format developed by Day et al. (2000) in their comprehensive review of empirical research on the therapeutic design of environments for persons with dementia. Specifically, the format of their Table 1, which aptly summarized the various studies reviewed, their scope, and findings, has been directly adapted to the present discussion. Ironically, and presumably attributable to the language-barrier dilemma, Day and her colleagues opted to include only English-language sources in their review.

## RESULTS

Table 1 presents the publications chosen for inclusion in the literature review, with key background information and findings presented. These consist of the description of the topic and scope of the study, the concept of the environment expressed in the work, the focus of the study, the research design and sample, outcome measures of well-being, physical environment features, and major findings of environmental impact on well-being. The vast majority of studies centered on design or physical environment features that make extensive use of behavioral mapping methods. This framework is adapted from Day et al. (2000). Only peer-reviewed publications are included, thereby narrowing an initial list of more than 150 publications to the 109 reported below. This decision was made to ensure compatibility and equivalency in quality with comparable English, peer-reviewed publications.

*(text continues on p. 64)*

**TABLE 1**  
**Summary of Recent Japanese-Language Studies in Environment and Aging**

<i>Concept of Environment; Focus of Study</i>	<i>Research Design; Sample</i>	<i>Outcome Measures of Well-Being</i>	<i>Physical Environment Features</i>	<i>Major Finding(s) of Environmental Impact on Well-Being</i>
<i>1. Activities of Daily Living</i>				
Hashimoto, Yatogo, & Nomura (2000) D/DF.	Quasi-Experiment; 17 residents living independently; survey.	Five groups relative to rate and types of bath-taking.	Unremodeled versus remodeled bathrooms.	The bathing experience consists of four factors: age, types of movement, bathing methods, and priorities in remodeling initiatives.
Inoue, Toyama, Otaki, Ohara, Tachibana, & Koga (1999) D/DF.	Longitudinal study; 36 residents in nursing home studied across four years; survey.	Influence of room relocation upon activities of daily living (ADL).	Group living, private bedroom.	Room relocation within facility caused significant reorganization of one's room environment. Social spaces used differently before and after relocation.
Ishikawa, Yatogo, & Nomura (1998) G/EC.	329 residents in 12 "Silver Peer" multiunit dwellings built by Tokyo Metropolitan Government; survey.	Assessment of health status; utilization of services.	Publicly assisted apartments.	Feedback obtained for future applications. Emphasis on meals, bathing, health status, use of in-home care services.
Miyajima & Nishimura (2001) G/EC.	Quasi-experiment; actigram and sleep diary, 82 individuals in home settings, 96 in non-institutional care; survey.	Sleep-activity patterns relative to health status.	Dwelling unit.	Persons with low health status exhibit narrowest range of daily activities and spend the most time bedridden.
Ohno, Koide, Kuno, Mano, & Yamaha (1998) G/EC.	Quasi-experiment; two groups of 25 compared, one in heated and one group in nonheated pre-post changing rooms in winter conditions in skilled nursing facilities (SNF); survey.	Effect of heating equipment on residents' changing room and bathing behavior.	Temperature levels.	High discomfort levels and blood levels recorded in cold condition. Subjects immersed in hot bath condition for longer periods, exhibited increased blood pressure and skin temperatures compared to subjects in heated pre-bathing condition.
Yamada, Ashizawa, Takemiya, & Ueno (2001) G/EC.	Quasi-experiment; 93 residents in two SNF; survey.	Effect of configuration and size of dayroom on social activity.	Group living units; architectural attributes	Daily activities influenced by common areas supportive of multiple subsystems of social activity.

Yang, Shirabe, & Ueno (1994) G/EP.	Quasi-experiment; 63 inpatients in geriatric rehabilitation; survey.	Recuperation of aged inpatients.	Geriatric units; therapy settings.	Patterns classified into five levels of ability, from highly active to least active.
<i>2. Adult Day Care</i>				
Honjo, Mitsuhashi, & Fujimoto (1999) G/EC.	Quasi-experiment; 15 primary and secondary schools assessed; survey.	Intergenerational contact.	Vacant classrooms.	System-wide policies recommended to promote adult day care centers in unoccupied classrooms in schools; determined by health status and age of participants.
Ogawa (1995) G/EC.	Quasi-experiment; daycare programs; survey.	Utilization of services, health status.	Architectural setting.	Five types of care centers recommended, from urban centers providing highest level of services, to rural centers providing minimal services.
<i>3. Dementia</i>				
Ishii, Toyama, & Nagasawa (1997) D/DF.	Quasi-experiment; four special care units (SCU): Unit 1: 15 residents; Unit 2: 12 residents; Unit 3: 13 residents; Unit 4: 14 residents; survey.	Behavioral mapping at 10 minute intervals; residents' activities of daily living.	Living rooms, kitchens and day rooms, private bedrooms.	Operational policies influence use of space. Common spaces are most important throughout day. Private bedrooms related to use of common space; mixture of acute with nonacute residents has therapeutic effect on highly cognitively impaired residents.
Ishii, Yan, Toyama, Tachibana, & Nagasawa (1999) G/EC.	Quasi-experiment; SCU: 9 residents in Komorebi-no-ie. Behavioral mapping at 10 minute intervals for 9 days; survey.	Residents' ADL and use of common spaces.	Group living areas; private bedrooms, communal baths, laundry, and kitchen.	Common spaces essential in ADL behaviors. Individual differences prominent. Privacy affordances provide respite opportunities. Role model for SCU group homes in Japan.

(continued)

TABLE 1 (continued)

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Kanno, Yuda, & Honma (1990) G/EP.	Quasi-Experiment; residents with dementia classified; survey.	Cognitive and functional abilities; family support.	SCU features.	5.02% of total prefectural population with dementia is institutionalized; additional 4.40% with dementia resides at home compared to total aged population.
Kanno, Homma, & Yuda (1992) D/DF.	Quasi-experiment; 10 residents in home care selected from sample of 130 in rural city.	Cognitive and physical ability; wandering behavior; family support.	Interior and adjacent outdoor spaces.	Nursing care effectiveness is related to the level of physical support present in the home environment.
Kanno (1994) G/EC.	Quasi-experiment; 36-month study of 423 residents of city; 7 case studies; survey.	Level of care.	Functional support in home-care settings: size, privacy, bathing, kitchen.	Social support and nursing care needs for persons with dementia are on dramatic rise.
Kanno, Homma, & Onoda (1995) G/EC.	Quasi-experiment; survey of 631 with dementia living independently in urban setting.	Comparison of sample to government data for the aged.	Size of residence, private versus shared bedroom, activity space indoors and outdoors.	Recommended home-based services and architectural guidelines to ensure minimum care standards are met.
Matsubara, Adachi, Akagi, Funahashi, Hayata, Suzuki, & Kita (2001) D/DF.	Quasi-experimental; 14 residents with dementia transferred to freestanding SCU. Behavioral mapping, sociometry.	Length of conversations pre- and postrelocation.	Modification of bedroom furnishings.	Residents interact more in settings where allowed to arrange own furnishings in private bedroom. Increase in 15-plus minute conversations postrelocation compared to premove condition.
Nagahara, Ishii, & Matsumoto (1998) LS.	Six residents with dementia in group home; 50 inpatients with dementia in psychiatric ward in district hospital; survey.	Personalization behavior.	Unit configuration, open ward versus private bedroom, access to outdoors, room size.	More individualized care in group home setting and greater engagement in ADL, more social interaction; shorter walking distances for staff.
Obara, Matumoto, & Toyama (1994) D/DF.	Case study of 34 persons with dementia in home care settings; survey.	Residents' assessment of preferred architectural attributes.	Size, type of residence, outdoor space, bathing, bedroom, kitchen.	Provide home-like qualities in institutional care settings, modeled on residents' prior residence. Privacy and personal space needs of utmost priority to residents.

Ohashi, Mizuno, & Otaki (2000) D/DF	Quasi-experiment; 31 home-based residents with dementia; survey.	Family members' modifications to home, ADL.	Furniture, door signage, call safety system, reminiscence items, common space, and kitchen.	73 modifications classified in six groups; 38 scenarios for implementation identified.
Suzuki, Toyama, & Miura (2001) D/DF	Quasi-experiment; 22 residents in SCU; behavioral mapping repeated at 2-, 4-, 6-, and 8-month intervals; survey.	Residents' patterns of use.	Private rooms, daylight, nature, color, noise.	Common spaces adjacent to private bedrooms not frequently used initially. Later, residents adapted by broadening scope of social activity and territorial behavior.
Suzuki, Toyama, & Miura (2002) G/EC.	Quasi-experiment; 10 residents with dementia; 18 staff in SCU group home; behavioral mapping repeated at 2-, 4-, and 6-month intervals; survey.	Residents' and staff patterns of verbal communication, territoriality.	Private rooms, noninstitutional attributes.	Spatial arrangement of private rooms influenced staff and resident roles and interactions. Personal choice associated with increase in residents' ADL.
Yan, Ishii, Tachibana, Toyama, & Nagasawa (2000) D/DF.	Quasi-experiment; 14 residents with dementia in group residence; survey.	Residents' assessment of new building, ADL recorded, patterns of use.	Private bedrooms, baths, common spaces, kitchen, laundry, patio/garden.	Spatial diversity, room options, and flexible furnishings influence lifestyle diversity. Private bedrooms and common space equally important in adaptation process.
Yan, Ishii, Toyama, Tachibana, & Nagasawa (1999) D/DF and EP.	Quasi-experiment; 12 residents with dementia in group residence; survey.	Role of care philosophy in residents use of facility and ADL.	Private bedrooms, common spaces, kitchen, laundry, patio/garden.	After 6 months in new setting, residents became more independent and autonomous. Staff promoted increased interactions among residents and less dependence of residents on staff.
<i>4. Employment Settings</i>				
Asanuma, Taniguchi, & Amano (1996) G/EP.	Quasi-experiment; 259 residents in urban context; survey.	Utilization of family medical services.	No. of clinics; type, size, location.	Density of service facilities in community and location influences utilization of services. Differences in service utilization between metro Tokyo and Nagano City identified.

(continued)

TABLE 1 (continued)

Concept of Environment; Focus of Study	Research Design; Sample	Outcome Measures of Well-Being	Physical Environment Features	Major Finding(s) of Environmental Impact on Well-Being
Inoue, Ohara, & Otaki (2001) G/EC.	Quasi-experiment; 39 residents interviewed.	No. of residents engaged in work in local community.	Type of job, location, distance from home.	Employment and volunteer work promotes social interaction. Opportunity to choose work and time commitment associated with high satisfaction.
Masada, Kakitsuba, & Tsuesaki (1998) G/EP.	Quasi-experiment; survey.	Psychological and physiological stress.	Size of building.	Spaces assessed as unsafe associated with frequent accidents. Training measures recommended to minimize workplace accidents.
Nagata, Lee, & Sasaki (2000) G/EC.	Quasi-experiment; 370 aged workers (60+); 430 workers age 40-49; survey.	Workers' physical and mental performance.	Condition, furnishings, equipment.	Aged workers' work setting requirements differ from younger cohorts. Fundamental changes in policies and in work settings recommended.
Sakurai & Maturi (1999) D/DF.	Quasi-experiment; 119 disabled elderly; survey.	Work performance of disabled persons in small scale workshop settings.	Size, location, equipment.	Profile developed of ideal work setting conditions for the disabled aged.
<i>5. Hospice/Palliative Care</i>				
Ishii & Matsumoto (1995) G/EP.	Quasi-experiment; 284 nursing homes surveyed in Tohoku region. Second stage survey of 58 facilities.	Length of stay; care options.	Hospital-based palliative care units (PCU), homes, beds, range, and type of rooms designated for palliative care.	Length of terminal care approximately 4 weeks. 45% of residents died in hospital-based hospice PCU and 35% in nursing home. Observation room at center of care, additional support spaces for staff and family members recommended.

Matsumoto, Yamamoto, Odaka, Takemiya, & Yosida (1993) G&D/ES.	Quasi-experiment; All 93 PCU facilities in Japan surveyed.	Use of amenities provided for patient, staff, and family.	Size of facility, configuration, size of patient rooms, baths, social space, rooms for staff and family.	Majority of PCU housed in acute care hospitals (89%). Dedicated PCU recommended in all prefectural community hospitals and construction of freestanding hospice.
Takemiya & Matsumoto (1993) D/DF.	Cross-sectional survey of 3 hospital-based PCU.	Patient and staff satisfaction.	Size, no. of rooms, daylight, colors, furnishings, bathing, contact with nature, nursing station distance.	Most inpatients live near hospital, length of stay less than 3 months, private rooms and private bathing area necessary. In semiprivate bedrooms staff require additional workspace.
Yamamoto, Takemiya, Matsumoto, Ito, & Toyama (1997) D/DF/EC.	Evaluation; behavioral observation survey across 24-hour period across 5 days in one hospital-based PCU.	Patterns of use and work activities of nursing staff.	PCU configuration, size, circulation routes, patient, family members, and staff work space.	One third of time spent with patient: eating, hygiene, counseling, medication, and therapy treatment. Direct contact increases significantly at night. Frequency of PCU room visits comparable to all patients in hospital.
Yoshida, Matsumoto, Takano, & Ishii (1996) G/PB.	Quasi-experiment; survey of all cancer patients in Tohoku region based on annual health statistics.	No. of patients admitted to hospital PCU versus remaining at home or in SNF.	No. of hospital-based PCU, location, bed capacity.	Intraregional differences identified; increasing no. of terminally ill admitted to district central hospital-based PCU in recent years.
6. <i>Independent Living</i>				
Asanuma, Taniguchi, & Amano (2001) G/EC.	Longitudinal study; 1989 and 1999, 114 residents; survey.	Satisfaction and use of residence.	Changes/nonchanges, type of renovations.	Changes in family structure and size determine decision to renovate architectural setting.
Gen & Yokoyama (2001) G/PB.	Literature review.	Self-determination and housing satisfaction.	Private units and cohousing options; community-based features.	Increased public assistance programs advocated to promote independent living and cohousing options.

(continued)

TABLE 1 (continued)

<i>Concept of Environment; Focus of Study</i>	<i>Research Design; Sample</i>	<i>Outcome Measures of Well-Being</i>	<i>Physical Environment Features</i>	<i>Major Finding(s) of Environmental Impact on Well-Being</i>
Kodama (1986) D/DF.	Quasi-experiment; empirically-based multiattribute checklists drawn from 44 facilities in Metro Tokyo; survey.	Utility of scales assessed in 3 case studies.	Architectural features, safety, prosthetic aids.	Developed and pretested 159-item index for assessing residential facilities for the aged and 112-item index on lifestyle, health status, and community care options.
Koga & Takahashi (1997) D/DF.	Literature review.	Case studies.	"Jouza," "koza," and "sewaza" in dwelling.	Analysis of the function of three traditional housing concepts in conditional housing concepts in temporary private residences for the aged.
Majima (1995) G/EC.	Archival census data; demographics.	Lifestyle preferences in housing.	Housing types.	No. of households in Hokkaido with elderly members and single elderly rapidly increasing; most reside in owner-occupied dwelling.
Masunaga & Togashi (2001) D/DF.	Quasi-experiment; 90 couples; survey.	Private and semiprivate bedroom options and use of futon versus Western style beds.	Architectural setting.	Sleeping arrangements determined often by size of rooms in dwelling, whether Japanese or Western in design, and if walls or floors adaptable.
Masunaga, Yonehara, & Togashi (2002) D/DF.	Quasi-experiment; 63 residents; survey.	Use of space.	Size of dwelling, flooring, screening, no. of rooms, architectural precedent.	Profile of home activities of single aged persons in urban development corporation rental units: "yukuza" (sitting on floor) and "ibasho" (leisure activity rooms) are preferred features in dwelling. Traditional amenities advocated in design.

Matsumoto (1987) G/EC/EP.	Census data in one Tokyo district (Ikebukuro).	Patterns of use.	Condition of traditional housing, size, type.	Most aged reside in owner-occupied homes in intergenerational households with children's family, unlike tenants in rental units. Revised and expanded housing redevelopment policies advocated. Evaluation of federal home remodeling grant program for the elderly.
Minowa, Hayashi, Naka, Otaki, Ohara, Sato, Kano, Maekawa, & Horihata (1997) G/P.	Quasi-experiment; 52 residents in Tokyo neighborhood surveyed.	Residents' adaptation to renovated dwelling.	Bathing room and equipment.	Increase in group activity and social interactions in congregate housing.
Miura, Toyama, Sakagami, Wabuchi, & Kobayashi (2000) D/DF.	Quasi-experiment; 26 residents in congregate housing; survey.	Residents' attitudes.	Private bedroom, size.	Residents' function successfully with increase in physician visits across time; relates to difficulty experienced in readapting to bathing room in private-home setting.
Ogawa (1998) D/DF.	Longitudinal study: 52 residents at four intervals, 1979-1994; survey.	Frequency of visits to physicians, adaptation to former residence	Bathing room and equipment	Residents satisfied with dwelling if supportive of one's physical abilities.
Saito & Toyama (2000) G/EC.	Quasi-experimental; 44 residents surveyed.	Residents' autonomy.	Size, furnishings, equipment.	Small dwellings preferred in nonintergenerational situations.
Sawada (2001) D/DF.	Quasi-experiment; 14 residents in multifamily housing complex; survey.	Residents' adaptation of housing without children in dwelling.	Bedrooms, living room, hobby-activity room, use of outdoors.	Analysis of 1988 National Housing Survey. Multigenerational households have highest density per square meter, longest length of continuous occupancy.
Sonoda (1992) G/EC.	Cross-sectional survey; national.	Ratio of aged owner-occupants to renter-occupants; overcrowding.	Condition of dwelling, age, size, density.	

(continued)

TABLE 1 (continued)

Concept of Environment; Focus of Study	Research Design; Sample	Outcome Measures of Well-Being	Physical Environment Features	Major Finding(s) of Environmental Impact on Well-Being
Torikai & Sumita (1995, 1998) D/DF.	Quasi-experiment; surveys of 26 residents in 6 shared houses (1995); 32 residents in 4 sets of houses on shared lots (1998).	Patterns of communication, personal autonomy.	Size of rooms, type, adjacencies, adjacent outdoor space, windows, views.	Preference for separate bedrooms between generations, shared living rooms and kitchens accepted, often adapted to bedrooms. Young families prefer independent dwelling where feasible, adjacent to parents autonomous residence.
Tseng, Endoh, & Morinaga (2001) G/PP.	Quasi-experiment; 52 respondents; photograph-based survey.	Perceptions of dwelling, meaning.	Sustainable housing attributes.	Visual database effective in recording and assessing residents' needs and values. Redevelopment guidelines put forth for older housing based on sustainability protocol.
<i>7. Lighting</i>				
Ishibashi, Yatogo, & Nomura (1998) D/DF.	Experiment; 62 respondents in 3 groups; young adult, middle aged, elderly; survey.	Environmental assessment of 14 scenes/conditions, cognition.	Lighting types and design.	Four factor-analytic dimensions identified: comfort level, activity type, degree of coherence, calmness. Age-related differences influenced by cognitive rather than visual acuity factors. Elderly cohort physiologically more susceptible to deleterious effects of glare, less accepting of visual discomfort compared to younger cohort.
Mochizuki, Iwata, Tsukami, & Kimura (2000) D/DF.	Experiment; 41 elderly and 38 young adult respondents.	Comparative assessment of light sensitivity.	Glare, comfort/discomfort.	

Author(s) and Year	Sample	Method	Findings	Implications
Asaka, Kurosawa, Komuro, Izumi, (1995) D/DF.	Quasi-experiment; 405 physically disabled respondents; survey.	Transfer capability level, anxiety, stress.	Stairs, curbs, pedestrian crossings.	Group with highest frequency of activity experience anxiety when doing so. Occupants' dwellings generally do not promote access to outdoors.
Asanuma, Amano, & Taniguchi (1997, 1998) G/EP.	Cross-sectional survey; 243 urban elderly residents in high-rise housing.	Utilization of leisure setting as a function of physical ability.	Housing, parks	Five types of leisure activities and typology of leisure activities identified.
Makino & Imai (1999) G/EC.	Quasi-experiment; 32 residents in private dwellings; survey.	Frequency of trips within community.	Range, type, quality.	The dwelling is the center of leisure activity. Few parks and recreational facilities attuned to the needs of the aged in many communities.
Muronaga & Morizumi (2001) G/EC.	Quasi-experiment; 63 urban elderly residents; survey.	Outdoor activity patterns.	Type of activity, location from home, transportation, land use.	Person-trip assessment scale developed, applicable to individual or aggregate level of analysis. Age, gender, travel mode, purpose of trip and employment status relate to use of parks and related recreational settings.
Ogawa (1999) D/DF.	Quasi-experiment; 35 residents with 15 years or more in same dwelling; survey.	Residents' leisure and exercise activities.	Japanese-style recreational facilities, gymnasiums.	Older residents remain indoors, rely least on community-based activity centers.
Saito & Nishimura (1998) G/EC.	Cross-sectional survey; 69 residents in nursing home; interviews and survey.	Social exchange inside and outside dwelling, ADL.	Location, mode of transportation, local shopping.	Semiprivate rooms and distance from former home affects social interactions and outdoor activity patterns.

(continued)

TABLE 1 (continued)

Concept of Environment; Focus of Study	Research Design; Sample	Outcome Measures of Well-Being	Physical Environment Features	Major Finding(s) of Environmental Impact on Well-Being
Saito, Toyama, & Suzuki (2000) G/EC.	Quasi-experiment; 31 residents in independent dwellings; 26 residents in nursing home; survey.	Residents' engagement in activity outdoors.	Distance from residence, type, duration.	Interest in outdoor activities varies, institutional settings lacking social interaction inhibit outdoor behav- iors. Regardless of settings, oldest respondents engage least in activ- ities outdoors.
Tachibana & Takahashi (1999) D/DF.	Quasi-experiment; 124 residents; survey.	Respondents' ADL indoors and outdoors.	Types of outdoor space, multiunit residence, neighborhood attributes.	Public to private territorial hierar- chies exist in dwelling unit related to the distance from main entrance to building. Traditional neighbor- hoods with nearby outdoor spaces are used more than outdoor spaces surrounding mid- and high-rise complexes.
Tanaka, Noguuchi, & Majima (2001) D/DF.	Quasi-experiment; 2 poststroke, 3 nondisabled, behavioral observation; interviews.	Activity outdoors, heart rate change, task difficulty, disability level.	Elevators, stairs, ramps, entrances.	Sleep stairs and ramps associated with heart rate change while leav- ing and entering dwelling.
Tobari, Takemiya, & Ueno (2001) G/EF.	Quasi-experiment; 216 residents in Tohoku region; survey.	Resident ADL.	Type, range, location of community-based facilities.	Facilities lacking in region for meaningful social interaction outdoors and recreational activity.
Yang, Funahashi, Kita, & Lee (1998) G/EC.	Quasi-experiment.	Use of parks, presence of children, type, range of behavior.	Location, type, cleanliness.	Three types of park experiences identified: multiple activity, recreational-amusement, nature involvement.
<i>9. Privacy and Personalization</i>				
Asaka, Kurosawa, & Izumi (1996) D/DF.	Quasi-experiment; 501 physically disabled residents; Hokkaido; survey.	Bath-taking options in the home.	Interior circulation paths, room adjacencies.	The route from the bedroom and l- iving room to the toilet and bathing area should not be in vicinity of the front door.

Hamasaki & Endoh (2001) D/DF.	Quasi-experiment; interviews with 24 residents in skilled nursing facility.	Involvement, user choice, control.	Layout, size, color, windows, furnishings.	Participatory design workshop is an effective tool to involve residents in renovation process.
Hayashi, Otake, & Hayashi (1999) D/DF.	Quasi-experiment; 123 residents in two nursing homes, survey, behavioral mapping.	Privacy-seeking, personal space, territorial markers.	Bedroom, furnishings, artwork, personal items.	Opportunities for personalization of bedroom associated with high level of resident satisfaction. Flexible spaces and furnishings preferred, as are buffers between private and semi-private space.
Imai & Maeda (1993) D/DF.	Quasi-experiment; 52 patients in four-bed rooms in three hospital geriatric units and two nursing homes. Surveys and behavioral mapping.	Room personalization, territorial markers.	Position changes of bed and bedside table, adjacencies.	Most personal artifacts are placed on bedside table. Most bedside tables placed between beds; side between beds is highest activity zone; opposite side for private use.
Imai, Inukai, & Ito (1992) G/EC.	Quasi-experiment; 456 patients in nine hospital wards and two SNF; survey.	Patterns of use.	Layout, size, room types.	Time spent out of bedroom/ward dependent upon quality and size of day rooms.
Inoue, Toyama, Otake, & Ohara (1998) D/DF.	Quasi-experiment; 123 residents in four SNF; survey.	Quality of staff care, residents' ADL.	Private bedroom, semi-private bedroom, activity rooms.	Single room promotes higher level of personal care versus semi-private rooms.
Iriuchijima (2000) G/EC.	Quasi-experiment; residents in nine SNF in Gunma Prefecture; survey.	Cognitive stress.	Unit design, layout, size.	Rating scale developed to measure cognitive stress experienced by residents. Four primary factor-analytic dimensions identified.
Kakizawa, Ishii, Nagasawa, & Yamashita (1997) D/DF.	Quasi-experiment; 63 residents in nursing home; 12-month study; behavioral mapping.	Residents, social behavior, group identification.	Private bedrooms, activity spaces.	Design guidelines for public spaces in nursing home need to center on the promotion of socialization.
Kodama (1988) G/EC.	Quasi-experiment; 377 residents in eight SNF in Tokyo; survey.	Residents' dissatisfaction; complaints.	Unit layout, condition, upkeep, room size.	Bedroom adjacency to social spaces is critical design variable. Residents with lesser health status and female residents express higher dissatisfaction. Settings with effective wayfinding aids, spaces for privacy, and storage yield fewest complaints.

(continued)

TABLE 1 (continued)

<i>Concept of Environment; Focus of Study</i>	<i>Research Design; Sample</i>	<i>Outcome Measures of Well-Being</i>	<i>Physical Environment Features</i>	<i>Major Finding(s) of Environmental Impact on Well-Being</i>
Miura, Takemiya, & Ueno (1999) D/DF.	Quasi-experiment; 43 residents in skilled nursing facility, behavioral observation, survey.	Residents ADL.	Bedroom, common space, views, daylight.	Lifestyle typology identified based on transactions with physical setting; adequate personal bedside space influences outlook.
Mori & Taniguchi (2002) D/DF.	Quasi-experiment; 12 residents in SNF; survey.	Personalization behaviors, territoriality.	Private room, personal artifacts, furnishings.	The private bedroom is a refuge, not a social activity hub; personaliza- tion measures establish scale, boundaries, and home-like ambiance.
Nishino, Ishii, & Nagasawa (2001) D/DF.	Quasi-experiment; 42 residents in skilled nursing facility; survey.	ADL, patterns of use, territoriality.	Private room, common spaces, furnishings.	Five levels of usage of common areas identified, related to ADL. Types of personal space, territorial gestures, and spatial orientation movements classified.
Tachibana (2001) D/DF/EC.	Quasi-experiment; residents in 3 SNF; interview survey.	Meaning, patterns of use.	Private room, common spaces.	Staff care philosophies differ between facilities in conjunction with residents' abilities, attitude, and spatial proprietorship. Least independent residents least encouraged to personalize.
Tachibana, Toyama, Takahashi, & Koga (1997) D/DF.	Quasi-experiment; 36 residents in skilled nursing facility, interview.	Post-relocation adaptation.	Private room, personal artifacts, furnishings.	Four types of personalization behav- iors identified: spatial, personal, social, and temporal. Self-identity centered on personal space imperatives in private room. No. and range of personal items increased in new setting.

Terakawa, Toyama, & Miura (2001) D/DF.	Quasi-experiment; 22 residents in assisted living facility, interview.	Room sharing behavior.	Semiprivate room.	One resident tended to dominate the room while each established a personal space zone. More frequent interactions occur with non-roommates in facility than with roommate. Physical barriers and government care practices combine to discourage functional independence. Design guidelines to promote recreational activity.
Wang, Kakehi, & Nagasawa (2001) D/DF and EP.	Quasi-experiment; 13 residents; medical history, survey, interview.	Bedriddenness, health status.	Home, bedroom, physical barriers.	
Watanabe & Takizawa (1997, 1998) D/DF.	Quasi-experiment; 14 residents in SNF; videotape, mapping, survey.	Leisure behaviors and activities.	Indoor common space	
Yang, Ueno, & Kakehi (1994) G/EC.	Quasi-experiment; 46 patients in three rehab hospitals; 63 residents in four SNF and three congregate care centers; survey.	Patterns of use.	Unit layout, size, age, condition, range of room types.	Seven behavioral patterns identified by care level, 23 care-setting-activity patterns identified.
Yi & Taniguchi (2001) G/EC.	Quasi-experiment; residents in 6 SNF in Japan and Korea; survey.	Cultural determinants.	Private and semiprivate space.	In private room facilities most socialization occurs in common areas, opposite occurs in semiprivate room facilities. More staff intervention occurs in all-private bedroom facilities.
<i>10. Relocation</i>				
Adachi, Kameya, Akagi, & Hashimoto (2001) D/DF.	Quasi-experiment; 28 residents in renovated SNF facility; 16 residents relocated to new facility; survey.	Patterns of use, adaptation.	Bedroom, social activity rooms.	Residents spend longer periods of time in private bedroom during renovation. Residents relocated to new facility spend less time in private room. Health status influences outcome in both scenarios.

(continued)

TABLE 1 (continued)

Concept of Environment; Focus of Study	Research Design; Sample	Outcome Measures of Well-Being	Physical Environment Features	Major Finding(s) of Environmental Impact on Well-Being
Lee, Kataoka, & Suzuki, (1998, 1999) D/DF.	Quasi-experiment; 108 households; survey.	Adaptation, relocation.	Independent living residence.	40% of residents visited their former residence more than once per month to maintain social relationships. 42% remained in new residence more than one year. Others moved to SNF as health status decreased.
Ohara & Suzuki (1992) D/DF.	Quasi-experiment; 95 residents in two independent living facilities; survey, interview.	Adaptation to new residence, comparative assessment.	Prerelocation, postrelocation settings.	Social activity and ADL decrease following relocation. Prerelocation antecedents influence postmove behavior and outlook.
Suzuki (1997) G/EC.	Longitudinal study; residents in Nagoya; 1981, 1994 census data.	Rate of residential relocation; households with elderly persons.	Residence size, age, upkeep.	No. of households relocated with aged members increased by 47%. Ten relocation scenarios identified, most sought to be near children and families in newer residence. Multigenerational household housing shortage on horizon.
<i>11. Stairs and Safety</i>				
Ebihara & Kakegawa (1999) D/DF.	Experiment; evacuation simulation model tested in five case studies.	Effectiveness of fire egress measures.	Emergency egress features.	Simulation model developed to assess occupants' egress ability and tracking movements. Case studies confirmed method's utility in detection of spread of smoke.
Inoue, Kimura, & Tomita (2001) D/DF.	Quasi-experiment; 24 aged respondents compared to 31 middle-age respondents; observation; survey.	Impact force on surface, duration, foot pressure distribution.	Flat floor, stairway, sloped surface.	Older respondents 1.8 longer impact time; locus of knees among aged discontinuous and unstable while walking compared to younger cohort. Certain sloped surfaces least negotiable.

Lee, Munakata, & Nagata (2002) D/DF.	Experiment; 25 aged and 25 young respondents; 25 color photographs evaluated; survey-interview.	Perception of safety and ease of use.	Staircases in rail stations, negotiation, visual factors.	Factor analytic dimensions: spaciousness, ease of access, exertion level, and aesthetic appearance. Between-group differences in exertion level and aesthetic preferences identified. Shortage of trained staff a key problem in evacuation protocol. Unable to evacuate residents rapidly. Inconsistent enforcement of codes, episodic overcrowding of common spaces.
Murai, Shida, Yatogo, & Nomura (2002) D/DF.	Quasi-experiment; 54 SCU residents in four case studies; survey.	Disaster management readiness index for facilities.	Stairs safety, smoke, visual and audio alarm detectors, size of rooms, and egress routes.	Fatal falls on stairs analyzed based on 1950-1989 national mortality statistics. Aging process a major cause of stair accidents (1992a). Design recommendations (1992b). Assessment of 42 scenarios of tread and riser dimensions in a stair-case. Certain footwear associated with increase in injury in certain tread-riser combinations.
Nagata (1992a, 1992b) G/EC/EP.	National mortality data (1992a); observation of 46 aged persons (1992b); survey.	Injury, mortality.	Stair treads, risers.	Visual acuity identified as major cause of stair accidents, followed by morbidity impairment.
Nagata (1994) D/DF.	Quasi-experiment; 10 young men, 10 young women, 10 male elderly subjects; survey.	Injury.	Stair treads, risers.	Users strive to adapt to unsafe stair conditions, acute attentional capabilities of high importance; design standards advocated.
Nunata & Naci (1995) D/DF.	Experiment; 24 aged respondents; interview.	Stairs visibility, visual perception.	Staircases.	
Oshima & Uno (1999) D/DF.	Quasi-experiment; 90 respondents ranging in age; videotape analysis/survey.	Perception of safety, movement behavior while ascending-descending.	Stairs.	

(continued)

TABLE 1 (continued)

Concept of Environment; Focus of Study	Research Design; Sample	Outcome Measures of Well-Being	Physical Environment Features	Major Finding(s) of Environmental Impact on Well-Being
Satoh (1990) D/PB.	Quasi-experiment; 92 residents in one SNF; survey.	Self-managed escape behaviors in fire emergency.	Unit layout, size, corridors, stairs, exits, windows, alarm, and detection systems.	Composite evaluation scale developed to predict occupants' escape capability in fire emergency. 100% occupants evacuated during day, only partial evacuation at night, as neighborhood residents' assistance was necessary. Code problems were identified. Guidelines put forth.
<i>12. Universal Design/Wayfinding</i>				
Adachi & Araki (1992, 1993) D/DF/PB.	Experiment; 7 elderly with dementia, 10 with developmental disability, 10 nonimpaired elderly; survey; Experiment; 24 wheelchair users, 18 nonwheelchair users; observation.	Eye fixation behavior, navigation of route, videotape analysis.	Corridor, stair, signage.	Electronic active signage promoted for wayfinding versus passive signage. Redundant cued electronic signage preferred. Decision-making time does not differ between groups; nonwheelchair users have restrictive repertoire of information, greater compensatory behaviors exhibited.
Chibana (1998) D/DF.	Experiment; 24 wheelchair users, 18 nonwheelchair users; observation.	Eye fixation behavior, wheelchair users, street crossing behavior.	Intersection, traffic signal.	Safety, cost, ease of maintenance key priorities. Persons with hip, leg disabilities in greatest need of elevator in home.
Hashimoto & Ito (1995) D/DF.	Quasi-experiment; observation of six families with aged members in Tokyo; survey of 299 aged, handicapped respondents in Koriyama City; survey.	Elevator usage in home, user needs.	Elevator, size, condition.	

Saito & Toyama (2000a, 2000b, 2000c) D/DF.	Quasi-experiment; residents in SNF; interview, survey, behavioral observation.	Mobility of wheelchair users, navigation behavior, ADL.	Wayfinding.	Navigational speed of aged wheelchair-bound users was 25% that of nonage cohort. Technically advanced wheelchairs more responsive to needs of aged, resulting in faster trips, related to lower cognitive stress.
Yatogo & Nomura (1996) D/DF.	Quasi-experiment; 27 families with aged members; interview, survey.	Perceptions of safety, patterns of use.	Home-based hoists, table lift, stair lift, elevator.	Lift devices decreased the physical workload of family caregivers. No. of accidents low. Home renovation costs prohibitive in many cases. Perception of unsafe conditions often unwarranted.
Yatogo, Nomura, & Tanaka (2001) G/EP.	Literature review; survey, interviews.	User needs.	Physical and perceptual barriers in home setting.	Evaluation of market demand for home-based assistive technology appliances and equipment for the aged.

NOTE: Concept of Environment; D = Discrete; G = Global; FS = Feasibility Study; Focus of Study; DF = Design Features; EC = Environmental Comparison; EP = Environmental Policy; LS = Longitudinal Study; PB = Problem Behaviors.

Every item reported in Table 1 has only been published in Japanese Kanji text. Each item was perused by the first author, in tandem with Japanese colleagues in Tokyo and with the second author, upon the first author's return to the United States.

Initially, nearly one thousand articles and related publications were perused to cull only those on the topic of environment and aging. Twelve content areas were arrived at through a three-step process. This consisted of lengthy discussions, with difficult decisions necessary to place a given study in one category when it was arguably equally relevant to more than one category. The resultant twelve categories are: (a) activities of daily living, (b) adult day care, (c) dementia, (d) employment settings, (e) independent living, (f) lighting, (g) hospice/palliative care, (h) outdoor leisure activities and health-promoting behavior, (i) privacy and personalization, (j) relocation, (k) stairs and safety, and (l) universal design and wayfinding. The studies are reported according to section heading, alphabetically. The authors assume full responsibility for the absence of any study or project that might inadvertently have been overlooked or omitted. Due to the aforementioned challenges posed by language, and lack of access to sources, no claim of comprehensiveness can be made.

*Activities of daily living.* Activities of daily living (ADL) generally consist of personal hygiene, dressing, undressing, eating, and related routine daily activities. The bathing experience in Japanese culture remains of central importance as both a leisure and a hygienic activity. The bathing process expresses a typology of use (i.e., range of movement, method of bathing, length, participants, and whether assistance is required). These factors are of increasing importance in independent living settings (Hashimoto, Yatogo, & Nomura, 2000). Similarly, higher discomfort and blood pressure levels are associated with cold-air bathing conditions, where longer periods of time are spent in the water compared to those who bathe in preheated conditions (Ohno et al., 1998).

Aged patients in rehabilitation care were classified into five levels of ADL-ability (Yang, Shirabe, & Ueno, 1994). The size of the dayroom in skilled nursing facility (SNF) is related to the range of ADL engaged in by residents (Yamada et al., 2001). Patterns of sleep activity are influenced by health status and by whether one resides in an assisted living setting or in a private home (Miyajima & Nishimura, 2001). An examination of health status among 329 residents in public-sponsored housing in Tokyo found that additional support of residents' ADL should include meal support, bathing, and improved home health care services (Ishikawa, Yatogo, & Nomura, 1998). Relocation within a SNF has a significant effect on the

amount of time spent in one's room, a disruptive effect on reorganization of personal artifacts, and influences use or nonuse of social activity spaces (Inoue et al., 1999).

*Adult day care.* Adult day care services for the aged are being established in countries around the globe. Typically, programs are neighborhood-based and may be housed in a freestanding building or in mixed-use settings such as churches, malls, housing complexes, wellness centers, or health care institutions. In a study of 15 Japanese primary and secondary schools, it was found that vacant classrooms afford amenity when converted to use as adult day care centers (Honjo, Mitsuhashi, & Fujimoto, 1999). A prior study identified five types of care centers, ranging from dense urban locations to rural, unified by a continuum of support services (Ogawa, 1995). Both studies concluded with site planning and design recommendations.

*Dementia.* Fourteen studies are reported in Table 1 whose focus was on environment-behavior transactions in care settings for persons with dementia. Of these, two focused on home care settings, seven on special care unit (SCU) settings in institutions, and five on group-home-based SCU settings. In home-based settings, it was found that the level of nursing support needed is directly dependent upon support provided by the physical setting (Kanno, Honma, & Yuda, 1992). In a study of family household members' modifications to residences occupied by an individual with dementia, 73 modifications were classified into one of six types of adaptive measures (Osahi, Mizuno, & Otaki, 2000). In a study of 631 persons with dementia living independently with their families, the need for home health care was found to be rising dramatically (Kanno, 1994; Kanno, Honma, & Onoda, 1995). Personal space needs in the home care setting are of equal importance to those in institutional care settings (Obara, Matumoto, & Toyama, 1994).

Prefecture-level (state-level) public sector trends indicate that the number of persons with dementia and in need of SCU-based care is increasing rapidly in Japan (Kanno, Yuda, & Honma, 1990). A mixture of acute and nonacute dementia patients in SCU settings was found to be preferable from an organizational standpoint (Ishii, Toyama, & Nagasawa, 1997). Residents tend to stay in or near to their bedroom upon first entering a SCU. Then, after a period of weeks, they venture more frequently into the zone of common activity spaces, thereby expanding their home range (Suzuki, Toyama, & Miura, 2001). Personal choice and the capability to control one's own bedroom furnishings and personal artifacts results in a higher level of resident responsiveness (Suzuki, Toyama, & Miura, 2002).

In one study of residents' use of space after relocation to a new SCU facility, residents exhibited a renewed interest in arranging their personal artifacts in their bedroom. They spent significantly more time in their bedroom relative to prior to relocation (Matsubara et al., 2001). The comparative advantages of SCU group home settings versus prefecture-operated district psychiatric wards for dementia patients are considerable (Nagahara, Ishii, & Matsumoto, 1998). Spatial diversity, room furnishing options, and privacy profoundly influence lifestyle diversity and adaptation in persons with dementia (Yan et al., 1999, 2000).

*Employment settings.* These studies address aspects of the work setting as well as the older person's performance level and health status. Elderly building maintenance workers experience increased fatigue and back pain as a result of frequent mishaps occurring while at work. Training and workplace design recommendations aim to minimize such mishaps (Masada, Kakitsuba, & Tsuesaki, 1998). In a study of 370 workers aged 60 and older, compared to a group of 430 workers aged 40 to 49, the older cohort's work performance improved when workplace policies and aspects of the physical setting were specifically attuned to their sphere of capabilities (Nagata, Lee, & Sasaki, 2000). Attributes of ideal work settings for the aged have been published from this perspective (Sakurai & Matui, 1999). A study of the utilization of medical services among the aged in two major urban areas (Tokyo and Nagano City) indicates that the number of choices closest to one's home, and their distance, is tied to one's use of health care services to treat workplace-incurred injuries (Asanuma, Taniguchi, & Amano, 1996). Similarly, the number of older persons in the community workforce working as volunteers is a function of the travel distance between work and home and of the ability to choose among job options (Inoue, Ohara, & Otaki, 2001).

*Hospice/palliative care.* The hospice movement in Japan is rapidly expanding. As of 2000, there were 80 hospital-based palliative care units (PCU) in the country and 11 freestanding hospices in a nation of 126 million people (Kenchiku-Sekkei-Shiryō, 2001). The majority of the 11 architecturally freestanding facilities are hospital-affiliated, located in close proximity to their sponsoring institution, usually on the same premises or campus, although the hospital-based care model dominates the hospice-care landscape (Matsumoto et al., 1993). In 1994, the length of stay in hospice in the Tohoku region was approximately four weeks, and the choice of hospice care versus traditional nursing home care remained highly dependent on cost, cultural norms, household size, and the distance of the hospice from home (Ishii & Matsumoto, 1995). Architectural sources of staff and resident satisfaction

have been identified, together with daily patterns of use and activity. This has occurred for staff, care recipient, and family members, resulting in the articulation of detailed design guidelines for PCU (Takemiya & Matsumoto, 1993; Yamamoto et al., 1997). In addition, regional access to hospice care differs widely. This results in widely varying utilization of PCU services. This has led to calls for a nationally based care network extending to all reaches of the country (Yoshida et al., 1996).

*Independent living.* Independent living work has focused on four areas. First, research on architectural adaptations to the private dwelling has reinforced the primacy of the family in choosing what features of the physical setting are modified to provide a supportive environment for an aged family member (Asanuma, Taniguchi, & Amano, 2001). Often, nonbedrooms are adapted to be used as sleeping quarters for an aged family member or for the families of offspring (Torikai & Sumita, 1995, 1998). Sleeping arrangements are prescribed by the size of bedrooms in the dwelling, and this determines if an aged person sleeps on a futon or on a western-style bed. Traditional shoji screen walls continue to be preferred by the aged in home settings (Masunaga & Togashi, 2001). Minowa et al. (1997) concluded that bath-bathing room renovations are among the most problematic of all home modifications, based on an analysis of a national home remodeling grant program for the aged. In a longitudinal study of residents discharged from nursing homes, re-adapting to the bathroom at home poses the greatest challenge in one's ADL (Ogawa, 1998). Small dwellings, sans offspring and grandchildren at home, are preferred as they afford more opportunities for privacy and spatial modifications compared to larger dwellings with intergenerational households (Sawada, 2001).

Second, congregate housing and assisted living residences promote functional independence and increased social activity when rooms are large enough to support personal space and adaptive needs (Miura et al., 2000; Saito & Toyama, 2000c). Third, studies in housing satisfaction and public policy call for increased federal support to promote independent living at home and in cohousing settings (Gen & Yokoyama, 2001). Results of the 1988 National Housing Survey indicated that intergenerational households have the highest density per square meter with the longest continuous length of occupancy as these dwellings are handed down from one generation to the next due to excessive housing costs (Sonoda, 1992). Koga and Takahashi (1997) analyzed the enduring traditions of *jouza*, *koza*, and *sewaza* (housing concepts) in the residential milieu of the aged. Masunaga, Yonehara, and Togashi (2002) reaffirm residents' preference for *yukaza* (sitting on the floor) and *ibasho* (leisure rooms) among the aged. Majima (1995) analyzed census

data to learn that households with aged members are dramatically increasing in Hokkaido, and most residents in intergenerational households with offspring and their families reside in owner-occupied dwellings. The opposite is the case in rental units (Matsumoto, 1987). Fourth, with respect to research methods, Kodama (1986) developed a 159-item index on architectural attributes, safety, and prosthetic aids and a 112-item index on health status in the assessment of residential care options. In a study of 52 elderly residents in public-assisted independent housing (Tseng, Endoh, & Morinaga, 2001), photographic sampling proved effective in documenting and assessing residents' housing needs.

*Lighting.* Research on the topic of lighting related to the aged has been conducted in recent years. In an experiment involving 62 respondents divided into 3 subgroups, 4 factor-analytic dimensions were identified, centered on human comfort and aesthetic concerns (Ishibashi, Yatogo, & Nomura, 1998). In a comparative assessment of light sensitivity among a cohort of 41 aged subjects compared to a younger cohort of 38 younger adults, glare, discomfort, and eye fatigue was a far greater concern with the aged group. Aged persons are less accepting of visual discomfort and glare caused by high levels of artificial illumination (Mochizuki et al., 2000).

*Outdoor leisure activities and health-promoting behavior.* The 11 studies in this section center on 2 concerns: functional issues associated with the negotiation of the urban environment and outdoor health-promoting activities. In the first, the elderly experience considerable stress and anxiety when outdoors in the urban environment. Moreover, the typical dwelling in a high-rise building does not promote easy access to the outdoors unless one leaves the building (Asaka et al., 1995), and few options exist nearby in dense urban areas (Makino & Imai, 1999). A person-trip assessment scale was developed based on a survey of 63 residents of urban mid- and high-rise buildings (Muronaga & Morozumi, 2001). The size of the SNF, and of the bedroom specifically, combined with the distance from one's former home, influences social activity patterns and outdoor behavior, with small rooms resulting in greater trips outdoors among the aged (Saito & Nishimura, 1998; Saito, Toyama, & Suzuki, 2000). Mobility assistance devices, ample time to complete one's task, and the absence of steep slopes and staircases result in a low heart-rate change while entering or leaving one's dwelling (Tanaka, Noguchi, & Majima, 2001).

As for leisure activities outdoors and health promoting behaviors, a typology of such behaviors has been identified based on a survey of 243

aged urban residents (Asanuma, Amano, & Taniguchi, 1997; Asanuma, Taniguchi, & Amano, 1998). In a study of 35 residents who had lived in the same private dwelling for more than 15 years and who were 85 and older, the oldest tend to remain indoors and rely least on community-based recreational settings (Ogawa, 1999). The aged in Japan tend to prefer traditional low-rise wood-built neighborhoods compared to newer high-rise complexes, and they assess them in relation to historic precedent (Tachibana & Takahashi, 1999). Older residents' ADL in the outdoor milieu are limited in many situations due to too few community amenities including parks and forest preserves for social activity, exchange, contact with children, and communality with the natural environment (Tobari, Takemiya, & Ueno, 2001; Yang et al., 1998).

*Privacy and personalization.* There are three general areas of research in recent years on this subject. First, a study of 501 physically disabled aged persons analyzed interior circulation routes and room adjacencies in subjects' private dwellings, with the bedroom and bathing area and connecting paths identified as the most essential rooms in terms of residential satisfaction (Asaka, Kurosawa, & Izumi, 1996). Government policies have been found to impede functional independence among older persons residing with families at home (Wang, Kakehi, & Nagasawa, 2001). Often, in assisted living residences, one of the occupants of a semiprivate room territorially dominates the space (Terakawa, Toyama, & Miura, 2001).

A second area of inquiry has been privacy-seeking behavior relative to design features in SNF. Flexible space, which allows for personalization of bedrooms, is preferred (Hayashi, Otaki, & Hayashi, 1999; Mori & Taniguchi, 2002). The position of the bed and bedside table has a positive effect on satisfaction (Imai & Maeda, 1993; Miura, Takemiya, & Ueno, 1999). Design guidelines promote social interaction, which results from residents' bedrooms located in close proximity to dayrooms (Kakizawa et al., 1997). Typologies of behavioral patterns of use were developed in relation to optimal SNF bedroom layout, size, furnishings, and colors (Hamasaki & Endoh, 2001; Yang, Ueno, & Kakehi, 1994). Leisure activities and corresponding architectural space requirements have been the subject of SNF design guidelines (Watanabe & Takizawa, 1997, 1998). Use of the common areas in one's bedroom, and to a lesser extent throughout the group home SCU environment, has been shown to center on the range and placement of personal artifacts, furnishings, and territorial gestures (Nishino, Ishii, & Nagasawa, 2001). Following relocation to a new SNF, personalization behaviors are intensified early on (Tachibana et al., 1997; Tachibana, Toyama, & Takahashi, 1999). Staffing policies are modified in response

(Tachibana, 2001). Accordingly, all private-room SNF settings afford a higher level of personal care compared to semiprivate SNF facilities (Inoue et al., 1998).

In a cross-cultural investigation of environments in Japan and Korea, a higher level of staff intervention is required in all private-room SNF (Yi & Taniguchi, 2001). The size of dayrooms directly influences resident satisfaction (Imai, Inukai, & Ito, 1992; Kodama, 1988). Lastly, a set of codified rating scales has been developed to ascertain residents' cognitive stress in relation to key SNF architectural attributes (Iriuchijima, 2000).

*Relocation.* The practice in Japan of relocating residents to a new SNF setting has been examined to some extent (Lee, Kataoka, & Suzuki, 1998, 1999). In a comparative investigation between a group of residents whose facility was renovated in-place, versus a relocated cohort, the former group spent significantly more time in their rooms than the relocated residents (Adachi et al., 2001). In another study, social interaction and time spent in dayrooms decreased following relocation (Ohara & Suzuki, 1992). In a longitudinal study of elderly residents in Nagoya, the number of households who had relocated between 1981 and 1984 increased by 47%. Ten relocation scenarios were identified. The acute shortage of adequately spacious housing to meet the needs of multigenerational households is anticipated in the coming years as a result of the graying of Japanese society (Suzuki, 1997).

*Stairs and safety.* Recent work has centered on the relationship among stairs, personal injury, and emergency preparedness. On the subject of stair-floor-ramp safety, Inoue, Kimura, and Tomita (2001) identified types of surfaces that are least negotiable to the aged based on analysis of foot pressure distribution on various types of surfaces, with ramps causing the most mishaps. One study yielded factor-analytic dimensions articulating staircase perceptions, perceived safety, and aesthetic considerations as being of paramount importance to aged persons attempting to negotiate extremely crowded rail stations (Lee, Munakata, & Nagata, 2002). Fatal falls on stairs were analyzed using national data from 1950 to 1989, with the aging process cited as a major cause of death (Nagata, 1992a, 1992b). Nagata (1994) measured the effect of 42 riser-tread proportional combinations, concluding that certain types of footwear frequently worn by the aged are accident inducing. Poor visual acuity has been determined to be a principal cause of stair mishaps, followed by mobility impairment (Nunota & Naoi, 1995), despite the effort of elderly users to strive to avoid mishaps (Oshima & Uno, 1999).

On the topic of emergency response, Ebihara and Kakegawa (1999) developed a simulation model to assess nursing home residents' egress abilities and movement in emergency evacuation situations. Satoh (1990) developed a composite evaluation scale to predict occupants' escape capability in fire emergencies, and design guidelines were presented. Many nursing homes in Japan have an inadequate number of staff to cope with emergency situations, and code enforcement with SNF management is sporadic and nonuniform throughout the nation (Murai et al., 2002).

*Universal design and wayfinding.* Universal design has been the subject of recent research in Japan. Elevators in the home are of potential therapeutic benefit to the aged because many dwellings are multilevel or built on sloping sites (Hashimoto & Ito, 1995). Lift devices in private dwellings have been demonstrated to decrease the physical demand on family caregivers, and perceptions of their lack of safety are unwarranted (Yatogo & Nomura, 1996). The market in Japan is rapidly expanding for high-tech assistive living appliances and new design features in homes to expand the reach of universal design. Demand, however, greatly outstrips supply at present (Yatogo, Nomura, & Tanaka, 2001).

Recent work on wayfinding has identified electronically active types of egress signage as more beneficial than passive types of signage in interior residential settings for the aged (Adachi & Araki, 1992; 1993). At outdoor traffic signaled intersections, average response time and compensatory behaviors differ significantly between wheelchair-bound users and others (Chibana, 1998). The navigational speed of wheelchair users in SNF settings is only 25% that of nonwheelchair users, with navigation all the more difficult due to unnecessary and stressful circulation paths and travel distances (Saito & Toyama, 2000a, 2000b, 2000d, 2000e).

## DISCUSSION AND CONCLUSIONS

There is much to learn from recent Japanese research on environment and aging. This rapidly growing body of work affords valuable insight on multiple interpretive levels. First, in a broad context, cross-cultural work is warranted to compare Japanese and Western health care practices and building traditions with respect to the aged. Traditional practices and norms, and the effects of contemporary trends, afford fascinating insight. Architectural settings and room types unique to Japanese culture, such as the functions of bathing as a hygienic, social, and spiritual modality in treatment and therapy,

are worthy of inquiry. The aesthetic meaning and functions of the wall and floor plane are currently being reaffirmed in health care environments. The traditional shoji screen and tatami are key architectural elements in the Kokura Rehabilitation Hospital in Kyushu (Yasui, 2002). Rooftop gardens are becoming common in urban hospitals. Japanese innovations in inter-generational housing also are of interest internationally.

Such experiments, reinterpreted through the lens of emerging building technologies, are being explored in tandem with an increasing emphasis on the design and construction of sustainable health care environments in Japan. This is driven by the need to conserve extremely scarce land and natural resources. Japanese innovations in mixed-use, "transprogramic" buildings for health care and other functions in dense urban settings provide a model for the world (Buntrock, 2002). Such innovations will undoubtedly continue to have profound influence on the planning and design of environments for the aged. Japan is poised to emerge as a world leader in the coming years in the synthesis of architecture with emerging assistive living technologies and appliances, including robotics (Stewart, 2002). Perhaps most instructive is the timelessly inspired respect for and incorporation of nature in many health care settings for the aged in Japan (Kenchiku-Sekkei-Shiryō, 2001), a nation experiencing the most rapidly aging society on earth (Ogawa, 1997).

Societal aging has become a global phenomenon. Cross-cultural collaboration, empirical or otherwise, should be encouraged by whatever means possible. It should be of utmost priority with respect to the planning, design, and management of institutional and home-centered care environments for the aged. In the coming years the creation of therapeutically designed environments for aging populations cannot be dominated by any single government, society, or linguistically dominant group. It is hoped that this and future translational efforts will help to unlock chronic language barriers which persist globally.

## NOTES

1. The JSPS is an international faculty-exchange organization operated under the auspices of the Japanese Government's Ministry of Health and the Monbusho Foundation, Tokyo. A debt of gratitude is owed to many Japan-based members of MERA, whose suggestions of pertinent research reports, books, and journal articles proved invaluable in this literature review.

2. No review of this literature has been published, to date, in the Japanese language. Over 90% of the publications included in Table 1 were published in the Japanese-language *Journal of Architecture, Planning and Environmental Engineering*, a publication of the *Architectural Institute of Japan*.

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