THE RELATIONSHIP BETWEEN SOCIAL ENVIRONMENT AND WALKING LEVELS IN OLDER WOMEN IN HAWAI'I

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Abstract

The purpose of this study was to examine the relationship between physical activity levels and perceptions of the environment by elderly women in Hawaii. Participants (n=144) were surveyed to explore what elderly women do for physical activity, how much activity they perform in a week, if their background affects their physical activity and if their perception of the physical environment affects their level of activity. Results indicated that walking was the most frequent exercise to be reported with 61% of the participants meeting the CDC's recommendation. Walking for transport was associated with distance to the community centers, means of transportation, and geographic barriers. Other findings include walking for leisure was associated with residential density while leisure time physical activity was related to living situation. Gardening was related to lack of parking and cul-de-sacs. Age was related to less activity-friendly environments, less education, and living situation.

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Introduction

The American College of Sports Medicine (1998) estimated that by the year 2030, the number of individuals living in the United States 65 years and older will reach 70 million. They also speculated that individuals 85 years and older will be the fastest growing segment of the population. The population of Hawaii's older adults 60 years and older has grown faster (19%) than the older population nationally (9%) between 1990 and 2000 (State of Hawaii Department of Health Executive Office on Aging, 2006). The State of Hawaii Department of Health Executive Office on Aging (2006) also estimated that 25% of total population or one-in-four individuals in Hawaii will be age 60 or over in 2030.

Many variables, such as genetics, lifestyle, and chronic disease interact to affect the manner in which an individual ages. A salient risk factor in determining the health of older adults is physical inactivity. Thus, promoting the healthy lifestyles of older persons is essential in that it can help them maintain healthy and functionally independent lives, positively influencing their Quality of Life (QOL). This view is consistent with the goals of Healthy People 2010: (1) To increase the quality of years of healthy life, and (2) eliminate health disparities (US Department of Health and Human Services [USDHHS], 2005).

The participation of older adults in regular physical activity and exercise has elicited favorable responses that contribute to "healthy" aging. Some of the benefits include: (1) psychological benefits related to preserved cognitive function, alleviation of depressive symptoms, and increases in perceived QOL; (2) reducing risk factors for disease; (3) increased flexibility and mobility; and (4) offset loss in muscle mass and strength associated with normal aging (American College of Sports Medicine, 1998; Koltyn,

2001).

The Surgeon General's report (1996), reported that despite the research and generally accepted perception of the benefits and importance of exercise, data indicated that fewer than 25% of U.S. adults engaged in regular physical activity at a level that meets the moderate-intensity recommendation. Furthermore, with increasing age, the percentage of sedentary adults tends to increase. According to Schoenborn and Barnes (2002), older women are one of the least active groups in the U.S., with 51% of women aged 65 to 74 and 66% of women aged 75 and older reporting no leisure-time physical activity, compared to 38% of the general population. Hawaii's physical activity data look similar to national trends: older people and women are the most inactive (Hawaii Outcomes Institute, 2005).

Due to the increasing number of older persons across the nation and the low rate of physical activity by older women, finding strategies to increase physical activity participation for older women at the community level is very important. Ahrentzen (2004), suggested *Active Living,* which is a lifestyle that integrates physical activity into daily routines, such as walking or bicycling for transportation, exercise in the park, working in the yard, taking stairs, and using recreational facilities. Such lifestyle interventions have been effective in overcoming adoption and adherence hurdles to regular physical activity (Shepard, 1997). To encourage Active Living, it is important to understand what variables influence the adoption of that lifestyle. It is also essential to identify barriers and create opportunities for this increasingly large group of women to adopt more active living in their daily lives. The physical environment is one variable that has the potential to affect physical activity levels, especially in older women.

Review of Literature

(See appendix A for the Extended Literature Review)

Physical Activity Levels among Older Adults

According to the Centers for Disease Control and Prevention (CDC) (2007c), U.S adults 18 years and older in the United States who participated in recommended levels of physical activity were 45.3% in 2001, 45.9% in 2003, and 48.1% in 2005. Comparable rates in Hawaii were 50.4% in 2001, 50.1% in 2003, and 52.4% in 2005. Older American women 65 years and older who participated in physical activity at a level recommended by the CDC were 32.2% in 2001, 32.1% in 2003, and 36.3% in 2005. For older women in Hawaii, the numbers were 40.6% in 2001, 39.6% in 2003, and 46.5% in 2005.

Although Hawaii's older women exceeded the national average of older women, one of the "Healthy People 2010" objectives has been to increase the proportion of adults who engage in regular moderate or vigorous activity to at least 50% (USDHHS, 2005). As a result, concerted public health efforts at federal, state, and local levels are needed to improve participation in lifestyle physical activity.

Types of Physical Activities among Older Adults

The CDC reported types of physical activities as a national trend in 1998. The results were through population-based National Health Interview Survey in 1998, and reported as being done at least once in the past two weeks. Participants were adults aged 18 and older. The top four types of exercise reported were walking for exercise (43%), gardening (28%), stretching (27%), and weightlifting (16%, see table 4).

Hawaii's state wide research to the nationwide research (1998) was by the American Association of Retired Persons (AARP, 2003) that conducted the Hawaii Health and

Fitness Survey by mail in 2003. Two thousand seven hundred sixty four men and women (response rate was 55%) 50 years old and older from five counties: Hawaii, Honolulu, Kauai, Maui, and other counties responded. They were divided into those two groups, exercising (1817 participants, 66%) and non-exercising (726 participants, 26%).[1] They were asked to indicate what types of physical activities they would consider doing. The top four types of exercise reported were walking (67%), gardening (39%), working out on cardiovascular machines (27%), and weightlifting (25%, see table 4). Younger participants tended to report swimming (50-59: 22%: 60-74: 18%: 75 and older: 14%) or working out on cardiovascular machines (50-59: 31%: 60-74: 27%; 75 and older: 22%), and were significantly more likely than those ages 60 and older to report weightlifting (50-59: 33%: 60-74: 24%; 75 and older: 18%). Members 60 to 74 years old were more likely than those younger to have gardened (50-59: 34%; 60-74: 41%; 75 and older: 40%). Men and women were equally likely to have engaged in each of the top five types of exercise, except with golfing and walking. Men were more likely than women to report golfing (men: 26%; women: 10%), and women reported walking significantly more than men (men: 63%; women: 71%).

Walking was the most popular physical activity and gardening was the second popular activity among people in the both nationwide and statewide studies. Two marked differences were golf and bicycling. The Hawaii study number fifth most popular physical activity was golf compared to nationwide study of basketball. Considerable reasons may be sample differences: in nationwide study, participants included younger

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[1] Data analyses for all exercise-related items from the Hawaiian Fitness Survey included only 92% of the total sample, reasons for omission of the eight percent were not provided.

adults (18 and older), and the AARP included only 50 years and older, so selections of types of physical activities could be different by that. Other remarkable difference was that the Hawaii study showed more varieties of physical activity types than the nationwide study such as paddling and hula dancing.

Profile of Hawaii's Older Adults

Hawaii's older adult population is steadily growing. According to the State of Hawaii Department of Health Executive Office on Aging (2006), several trends are occurring with older persons in addition to their growing numbers in the population. First, Hawaii's older adult population is expected to increase faster than the rest of the total population. Between 2000 and 2020 Hawaii's older adult population will increase by 70% while Hawaii's total population is only expected to increase by 23% over the same time period. The growth in the number of older adults is over three times faster than the growth of the total population (State of Hawaii Department of Health Executive Office on Aging, 2006). More specifically, in 2004, individuals aged 60 years and older in Hawaii numbered 230,929, representing 18% of the total population. Of the adult population aged 18 years and older, older persons comprised 24% of the population. It is also estimated that by the year 2030, the number of individuals 60 years and older living in Hawaii will nearly double and is estimated at 410,450, which is 25% of total population and 33% of adult population (State of Hawaii Department of Health Executive Office on Aging, 2006) .

A second remarkable trend is that the population of Hawaii's older adults 60 years and older has grown faster than the older population nationally between 1990 and 2000 (State of Hawaii Department of Health Executive Office on Aging, 2006). Statistics showed that while Hawaii's older adult population increased 19% between 1990 and 2000, the

national older adult population increased by only nine percent (State of Hawaii Department of Health Executive Office on Aging, 2006).

Third, life expectancy is increasing, with differences by gender and race (State of Hawaii Department of Health Executive Office on Aging, 2006). Hawaii's life expectancy in 2000 was 80 years old which was three years over the national life expectancy of 77 years old. Particularly, in 2000, data showed that life expectancy at birth in Hawaii was 77 years old for males and 83 years old for females. Women outnumbered men in 2000 while their numbers were about the same in 1980 (State of Hawaii Department of Health Executive Office on Aging, 2006). The differences between males and females become greater with advancing age. Among older adults who were 85 years and older, 59% were female and 41% were male (State of Hawaii Department of Health Executive Office on Aging, 2006).

Life expectancy also differs among ethnic groups (State of Hawaii Department of Health Executive Office on Aging, 2006). According to the most recent available data by ethnic group in Hawaii, in 1990, individuals who were Chinese or Japanese tended to live the longest, 83 and 82 years, respectively. For individuals of Filipino ancestry life expectancy was at 79 years and Caucasians at 76 years. Of the ethnic groups, Native Hawaiians had the lowest life expectancy at 74 years (State of Hawaii Department of Health Executive Office on Aging, 2006).

Finally, among both genders older adults 60 and older, 17% lived alone in 2000 with 20% of female older adults 60 and older living alone compared to 12% of males. With women tending to outlive men, it is understandable for them to also be more likely to live alone in their later years (State of Hawaii Department of Health Executive Office on

Aging, 2006).

Relationship between Perception of the Environment and Physical Activity

Several studies have found significant associations between environmental perceptions and physical activity, although none of these studies were conducted in Hawaii. The environmental variables considered can be grouped into four categories: safety, availability and access, and convenience. The studies examined the associations between environmental variables and either leisure-time physical activity or walking.

Safety. One of the largest studies to examine the association between the self-reported safety of the nationhood and physical activity was conducted by the Centers for Disease Control and Prevention (1999). In 1996, data on physical activity were analyzed for 12,767 persons 18 years and over (5320 men and 7447 women) who responded to the Social Context Module included in the 1996 surveys in Maryland, Montana, Ohio, Pennsylvania, and Virginia. Respondents were asked, "How safe from crime do you consider your neighborhood to be?" Possible responses were "extremely safe," "quite safe," "slightly safe," or "not at all safe." Respondents were classified as physically inactive if they reported no physical activity or exercise during the preceding month. Numbers for racial/ethnic groups other than white were combined because, when analyzed separately, data were too small for meaningful analysis. The prevalence of "no activity" among respondents was approximately 30%. The prevalence of physical inactivity was highest among adults aged 65 years and older, women, racial/ethnic minorities, persons with a high school education or less, and persons with annual household incomes of less than $20,000. Overall, higher levels of perceived neighborhood safety were associated with lower levels of physical inactivity; the

differences were greatest among persons aged 65 years old and older (from 38.6% {extremely safe} to 63.1% {not at all safe}) and racial/ethnic minorities (from 29.9% {extremely safe} to 44.6% {not at all safe}). For respondents with more than a high school education, little difference in physical inactivity was noted among persons as a function of perceived neighborhood safety. The prevalence of physical inactivity among men and women differed across neighborhood safety levels among persons aged 18-64 years but not among persons aged 65 years and older. Data stratified by age and sex and controlling for race and education demonstrated an association between neighborhood safety and physical inactivity among older adults (odds ratio=2.3; 95% confidence interval=1.1-4.7). Older adults were over twice as likely to be active if they reported their neighborhood was extremely safe.

Foster, Hillsdon, and Thorogood (2004) conducted a cross-sectional study of 4,157 16-74 year old subjects from England. They found that women who reported concerns about safety during daylight were 47% less likely to report any short walks in the four weeks prior to interview compared to women who did not report safety concerns. No such relationships were found for night-time safety or more frequent walking. There were no relationships between men's perceptions of safety and walking. The authors concluded that women were more concerned than men about walking for utility and in safety.

Availability and Access. A study by DeBourdeaudhuij, Sallis, and Saelens (2003) on a sample of 521 Belgian adults18 to 65 years old (mean age was 41 (± 12.22) years and 48.3% were female) reported that for men and women, the presence of exercise equipment at home and convenience of physical activity facilities were positively correlated with amount of vigorous physical activity. They also reported that land-use

mix (access to shops) was positively associated with recommended levels of leisure-time physical activity and walking for exercise for women only. They found that socio-demographic variables like education, age, and children in the home made a greater contribution to their regression models for all physical activity behaviors than environmental variables.

Huston, Evenson, Bors, and Gizlice (2003) conducted a cross-sectional study to examine associations between perceived neighborhood characteristics, access to places for activity, and leisure-time physical activity in a sample of 1796 adults at least 18 years of age residing in the six counties in North Carolina. Their 133-item questionnaire assessed self-reported leisure-time physical activity and perceptions of neighborhood characteristics (sidewalks, trails, heavy traffic, streetlights, unattended dogs, and safety from crime) and general access to places for physical activity. They found that adults who reported that they had access to places for physical activity were more likely to report any physical activity than adults who reported no access (odds ratio 2.23, 95%). In addition, adults who reported that they had access to walking trails (odds ratio 1.51, 95%) and access to places for physical activity (odds ratio 2.15, 95%) were also more likely to report any physical activity compared to adults who reported no such access. The authors concluded that certain neighborhood characteristics, particularly trails, and access to places for physical activity may be associated with leisure activity levels. Perceived neighborhood environmental factors and access to places for physical activity were strongly associated with race, education, and income.

Convenience. King, Brach, Belle, Killingsworth, Fenton, and Kriska (2003) conducted a cross-sectional study to examine the relationship between physical activity

and (1) convenience of destinations, measured by whether destinations (such as a park, trail, businesses, and services) are within walking distance of the home, and (2) participants' perception of the quality of their neighborhood surroundings for walking, by a self-reported neighborhood "walkability" survey. One hundred forty nine older Caucasian women (mean age was 74.2 years) in a community in southwest Pennsylvania participated. Response rate was 79%. Walking levels, leisure-time physical activity, and features of the neighborhood environment were measured with interviewer-administered questionnaires. Physical activity was measured objectively with a pedometer. Living within a 20-minute walk of a park; biking or walking trail; or department, discount, or hardware store was related to higher pedometer readings ($p < .01$). The authors found that the ability to make utilitarian walking trips from home and the perception of having favorable neighborhood surroundings for walking were associated with increased physical activity levels in older women.

Studies Related to Objective Measures of the Environment and Physical Activity

Several studies have used objectively measured environmental variables. These have included audit or observations of the environment, secondary data (e.g. public or written records or census data), or a Geographical Information System (GIS) which is"a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information" (U.S. Geographic Survey, 2007).

King, Belle, Branch, Simkin-Silverman, Soska, and Kriska (2005) conducted a study to identify objectively measured attributes of the neighborhood environment that may be associated with physical activity levels in one hundred fifty eight overweight Caucasian and African-American postmenopausal women aged 52-62 years. GIS technology was

used to obtain neighborhood-level data, including neighborhood socioeconomic status (SES) indicators, the median year that homes were built, and proximity to businesses and facilities. Physical activity level was measured with pedometers. Low neighborhood socioeconomic status, living in a neighborhood with homes built between 1950 and 1969 (representing an urban form that is more pedestrian-friendly than after 1969), and living within walking distance (1500 m) of specific types of businesses and facilities were positively associated with individuals' physical activity levels measured by a pedometer ($p < 0.05$).

Sallis, Hovell, Hofstetter, Elder, Hackley, Casperse, and Powell (1990) examined the influence of the physical environment on exercise habits. A random sample of 2,053 residents (response rate was 43%) of San Diego, CA, were surveyed regarding exercise habits, whether exercise facilities were free or pay-for-use, and other variables. A grid-map was used to locate and code the respondent's and facilities' addresses, and the authors computed the density of exercise facilities around each respondent's home. Subjects who reported engaging in three or more exercise sessions per week reported a greater density of pay facilities near their homes than did those who reported no exercise sessions.

Theoretical Framework

The theoretical framework for this study was the theory of ecological approaches to increase participation in physical activity (USDHHS, 1996). The main idea is to change people's behavior through changing the environment. This theory emphasizes socio-cultural and physical environmental influences on behavior rather than individual behavior change processes (USDHHS, 1996). To increase adoption of an active lifestyle,

establishing environmental supports and planning environmental design (e.g., transportation disciplines like parks, and bike paths) are important aspects for physical activity promotion (USDHHS, 1996).

There are two key concepts to ecological approaches to increasing healthy behaviors: 1) multiple levels of influence, and 2) mutual influence between people and the social environment (USDHHS, 1996). The first concept emphasizes the five levels of influence for health-related behaviors and conditions. These levels include 1) intrapersonal or individual factors, 2) interpersonal factors, 3) institutional or organizational factors, 4) community factors, and 5) public policy factors (USDHHS, 1996 see Appendix F). Intrapersonal or individual factors are individual characteristics that influence behavior, such as knowledge, attitudes, beliefs, and personality traits. Interpersonal factors are interpersonal processes and primary groups, including family, friends, and peers that provide social identity, support, and role definition. Institutional or organizational factors are rules, regulations, policies, and informal structures, which may constrain or promote recommended behaviors. Community factors are social networks and norms, or standards, which exist, formally or informally among individuals, groups, and organizations. Public policy factors are local, state, and federal policies and laws that regulate or support healthy behaviors for disease prevention, early detection, control, and management (USDHHS, 1996).

The second concept of the ecological perspective suggests that people both influence and are influenced by those around them (USDHHS, 1996). This ecological approach must address all levels of change, reach people at all levels of decision making, and encourage feedback and interaction across levels and people. One advantage of the theory

is that it encompasses several levels in a society. Interventions at worksites, healthcare institutions, and communities that influence these multiple levels may be expected to lead to greater and longer-lasting changes and maintenance of existing health promoting habits (USDHHS, 1996).

Based on the ecological approach, urban planning and transportation researchers have focused on physical activities for transport such as walking and cycling. The amount of those physical activities for transport has increased in "high-walkability" neighborhoods characterized by closeness and connectivity to destinations, good land use-mix (residential and commercial mixed), high population density, pedestrian-friendly facilities (e.g. sidewalks, street lighting, bike paths), and more aesthetic features (e.g. trees, clean streets and sidewalks: Saelens, Sallis, & Frank, 2003; Handy, 1996). It has only been within the last decade that an emphasis has been placed on understanding the impact of physical environmental factors on recreational or leisure-time physical activity (McCormack, Giles-Corti, Lange, Smith, Martin, & Pikora, 2004).

Even though several studies found relationship between environmental variables such as safety (CDC, 1999; Foster et al, 2004), availability and access (DeBourdeaudhuij et al, 2003; Huston et al, 2003), and convenience (King et al, 2003), and physical activity levels, these studies may not be conclusive in different settings, participants, areas, or cultures. In a unique setting like Hawaii, where older women live longer (State of Hawaii Department of Health Executive Office on Aging, 2006), are more active than the national women's average (CDC, 2007c), and live with and among many diverse ethnic groups and cultures (State of Hawaii Department of Health Executive Office on Aging, 2006), how these variables relate to each other has not been examined yet. Thus it was

very interesting to conduct this study to find out the relationship between environment and physical activity levels among older women as a means to increase their physical activity levels. They are the most inactive racial and age group.

The purpose of this study was to examine the relationship between physical activity levels and perceptions of environment by older women. More specific questions were, (1) What do older women do for physical activity? (2) How much physical activity do older women do in a typical week? (3) Do demographic variables affect their physical activity levels, and (4) Does their perception of the physical environment in which they live and walk (i.e., residential density, land use mix for access, street connectivity, infrastructure and safety, etc) affect their physical activity levels?

Methods

Sites

Two community centers (labeled "W" and "M" in this report) in the central area of Oahu were chosen because of large numbers of potential participants. Both community centers have more than 500 senior members and similar kinds of social, educational, leisure, and health programs. Some of the catchment areas of senior members at both community centers overlap with a few members participating at both centers.

Community center W was located in a residential and commercial area that is home to many full-time and part-time residents of the state. It is a private, nonprofit agency that provides a variety of programs for people who live, work, and visits the surrounding area during the week and on weekends. There are about 1,000 primary members and several hundred visitors or part-time members are added annually to the number of primary members. The programs are open to anyone, so participants who attend the programs

come from throughout central Oahu (Waikiki Community Center, 2007). More than 1,000 full-time and part-time residents, ages 55 and older participate in educational, physical, and social and wellness activities (WCC, 2007). The aim of this center is to maintain healthy and independent lifestyles for the senior residents. Many of the seniors who frequent this center have no relatives living nearby and rely on the center's activities to develop neighborly support, social interaction, prevent isolation, and avoid premature decline in health (WCC, 2007).

Community center W offers more than 45 classes each week from Monday to Saturday including: music and dance: line dance, tap dance, piano, hula, ballroom dance, and ukulele:, Health and Wellness: tai chi, yoga, aerobics, kick boxing, health fairs and screenings, cooking demonstrations and speakers, on-site social worker and services, weekly podiatrist visit, massage and chiropractic service,: Educational and Social Activities: bridge, scrabble, mah jong, big band dance, poker for novices, mcbingo, neighbor island trips and cruises, local fun trips and excursions, educational speakers, English as a second language (ESL), and Culture and Arts: Hawaiian culture and language, Japanese crafts, French, Spanish, painting, crochet, lei making, and painting (WCC, 2007).

Community center M is also a private, non-profit agency, but unlike community center W, it is located in a residential area and has more than 500 seniors who are 60 years old and older attending their senior programs (Moiliili Community Center [MCC], 2007). Participants who regularly frequent this center's programs come from approximately an 18 mile radius. Similar to center W, the aim of center M is to give participants a place to gather, socialize, learn, obtain services, and stay active through the

programs (MCC, 2007).

Community center M offers more than 50 classes each week from Monday to Friday (MCC, 2007). The center has recreational, health, and educational activities which include excursions, hikes, seminars, classes, and special events such as: music and dance: karaoke, kenbu-senbu-shigin, line dancing, , minyo dancing, minyo singing, ukulele: Health and Wellness: ki-mind and body coordination, tai chi, rhythm and life exercise, yoga: Educational and Social Activities: scrabble, mah-jongg, soroban, and Culture and Arts: crafts, crochet, knitting, feather lei making, Hawaiian quilt, painting, shodo (MCC, 2007).

Participants

Consistent with the definition of "older adults" adopted by the State of Hawaii Department of Health Executive Office on Aging (2006), all participants in this study were aged 60 years and older. One hundred forty-four older women 60 years and older from community centers, W and M, participated in this study. Additional criteria for recruitment included agreement to participate and attendance in at least one class in one of the two community centers.

Participants were between the ages of 62 and 94 years old (M=77, SD=7.2 See Table 1). Most of the participants identified themselves as Japanese Americans (85.4%), with the remainder identifying being part of the following ethnic groups, White (7.6%), Chinese Americans (3.5%), Korean Americans (1.4%), Filipino Americans (0.7%), Native Hawaiian (0.7%), and Chinese/Japanese (0.7%). Of the 144 participants, 60% had a high school education or lower with 38% having a college education or higher. About

2% of people did not report their educational status. Thirty-eight percent reported living alone, the rest lived with someone (i.e., spouse, other family member, roommate), 49% of them used a car, 31% used public buses and 17% used walking as their primary means of getting to community center W and/or M. Mean travel distance to the community centers was .84 miles by walking, 3.69 miles by bus, and 5.32 miles by car.

Table 1

Sample Characteristics of the 144 Participants

Age	n	%	mean=77 SD=7.2
60-69	27	18.75	(Minimum=62, maximum=94)
70-79	63	43.75	
80-89	45	31.25	
90-99	5	3.47	
Missing	4	2.77	
Education	**n**	**%**	
High School or Less	86	59.72	
College or Higher	54	37.5	
Missing	4	2.78	
Ethnic Group	**n**	**%**	
Japanese	123	85.42	
White	11	7.64	
Chinese	5	3.47	
Korean	2	1.39	
Filipino	1	0.69	

Hawaiian	1	0.69
Chinese Japanese	1	0.69

Living Situation	n	%
Alone	55	38.19
Not Alone	86	59.72
Missing	3	2.08

Transportation to CC	n	%	(mean travel distance=4miles, SD=4.1)
Walk	24	16.67	(mean travel distance by walk=0.84mils)
Walk or Bus	2	1.39	
Walk or Car	1	0.69	
Bus	44	30.56	(mean travel distance by bus=3.69mils)
Bus or Car	3	2.08	
Car	70	48.61	(mean travel distance by car=5.32mils)

Data Collection Procedures

Upon receiving University approval from the Committee on Human Subjects, (see Appendix B), the researcher received permission to conduct the study by the managers at each community center. To build a better relationship with the staff members and potential participants in this study, the researcher visited classes, introduced herself to the people, asked members to participate in her study, and explained the necessity of completing the questionnaires in class.

Participants were asked to complete three questionnaires: 1) International Physical Activity Questionnaire (IPAQ), 2) Abbreviated Neighborhood Environment Walkability

Survey (ANEWS), and a 3) demographic questionnaire with English or Japanese version of consent forms (see Appendix C and D) at the beginning of their classes. All participants were given an explanation on how to complete the questionnaires along with reasons the researcher was conducting the study. About 45 minutes was needed to complete all three questionnaires.

At both the community centers, the three questionnaires were given to volunteers. They were asked to complete them in their classes. The researcher read each question to the participants and collected the questionnaires after they finished them. For those who did not want to answer the questionnaires in their classes, but still wanted to participate, they were asked to take the questionnaires home and return them to the community center when they returned for classes the next week. For those participants who took multiple classes in a week, they were asked to bring them back the next day. One hundred forty four people returned the surveys out of 402 people for a return rate of 36%.[2]

The researcher was at each class to collect questionnaires taken home. Additionally, a box was placed in the office of community center W and M to hold submitted questionnaires. The box was maintained by the staff at each respective center. Submitted questionnaires were collected from the box every morning by the researcher over a period of four months. In the first two months, about 100 people returned the surveys. To raise

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[2] The return rate for the questionnaires would have been better facilitated if they were completed at the center, however, during interactions with the potential participants, some had expressed a preference to complete the questionnaires with the help of assistive devices (e.g., magnifier for print) that they had at home. Some had expressed a preference to complete the questionnaires at home with the help of their family members.

the return rate, the researcher went to both community centers and met some leaders of the classes and asked them to encourage the class members who wanted to participate but did not yet return the questionnaire to return it. They did this for the next two months.

Assessment Instruments

Physical Activity Measurement. The International Physical Activity Questionnaire (IPAQ, 2002) was used to report on the physical activity levels of participants. Participants could choose a questionnaire from an English version or Japanese version (see appendix G and H). The English version was the original version of the IPAQ questionnaire. The Japanese version was translated by the researcher of this study and verified for comprehension and understanding by an English/Japanese bilingual physical activity instructor at community center M.

The International Physical Activity Questionnaire, IPAQ (2002) assesses physical activity undertaken across a comprehensive set of domains including walking for leisure, leisure time moderate physical activity, leisure time vigorous physical activity, domestic and gardening (yard) activities, and work-related physical activity. The forms are structured to provide separate scores for physical activity at moderate-intensity and vigorous-intensity levels (IPAQ, 2002). The questionnaire also asked about time spent being physically active in the last seven days. It includes 27 questions and can be completed within 15 minutes.

The IPAQ questionnaire (2002) was developed by a working group initiated by the World Health Organization (WHO) and CDC. The purpose of the questionnaire was to provide a common instrument that can be used internationally to obtain physical activity surveillance data (IPAQ, 2002). According to IPAQ (2007), validity and reliability studies

using the IPAQ were conducted in 14 research centers in 12 countries on six continents using standardized methods and protocols in 1998-1999. Test-retest correlations clustered around .8, indicating reliable responses between repeat administrations for the IPAQ. Measures from the IPAQ correlated about .30 with accelerometer measures of minutes of moderate, vigorous, walking, and sedentary behaviors. Researchers suggested that IPAQ was comparable in reliability and validity to other self-report measures of physical activity (IPAQ, 2007). It was concluded that the IPAQ instruments are a viable method of monitoring levels of physical activity for populations of 18-69 years of age (IPAQ, 2007).

Environmental Measurement. The Abbreviated Neighborhood Environment Walkability Survey, called ANEWS, one of the IPEN (2007) self-report survey items, was used in this study to measure perceived environmental attributes among older persons that vary in their physical activity level and walkability. Participants could choose a questionnaire in English or Japanese. Both versions were originally created by IPEN. ANEWS has 54 questions and was developed to examine respondents' perception of neighborhood design features hypothesized to be related to physical activity (IPEN, 2007). The questionnaire includes items about types of residences (to assess density), proximity of stores and facilities in the neighborhood, perceived access to these places, street characteristics (to assess connectivity), facilities for walking and cycling, neighborhood aesthetics, and safety regarding traffic and crime (see appendix I and J). It can be completed within 30 minutes.

IPEN (2007) was launched by Dr. Jim Sallis (USA), Dr. DeBourdeaudhuij (Belgium) and Dr. Neville Owen (Australia) at the International Congress of Behavioral Medicine in Mainz, Germany in August 2004. According to IPEN (2007), validity and reliability of

the ANEWS survey has been supported by one of the studies done by Saelens, Sallis, Black and Chen (2003). Their findings showed strong test-retest reliability above .75. The study concluded that the reliability and validity of self-reported neighborhood environment subscales were supported (IPEN, 2007).

Demographic Survey. Participants' personal information was obtained through demographic questions (see appendix K and L). These questionnaires included questions about age, ethnicity, level of education, distance to the community centers from their homes, means of transport to the community center, living situation, and preference of exercise. Level of education was dichotomized as completing college and higher or not completing college and lower. English and Japanese versions were created by the researcher of this study. The Japanese version was verified for comprehension and understanding by an English/Japanese bilingual physical activity instructor at community center M. It could be completed within five minutes.

Data Analysis

Data were analyzed using a statistical package for the social sciences (SPSS) graduate pack 11.5 for windows programs (SPSS, 2002). IPAQ Guidelines for Data Processing and Analysis of the International Activity Questionnaire (2005, see Appendix M) were used to score each variable on the IPAQ physical activity questionnaire. For the IPEN environmental questionnaire, NEWS-A scoring (Cerin, Saelens, Sallis, & Frank, 2006) was used (see Appendix N). A total of 23 variables in three categories, demographic, environmental, and physical activity were investigated. Pearson bivariate correlation analysis was used to examine the relationships between the demographic, environmental and physical activity variables. Demographic variables were age, education, distance to

the community centers from home, living situation, and means for transportation to the centers. Variables related to environmental information were scores for residential density (A), land use mix for diversity (B), land use mix for access (C), street connectivity (D), infrastructure and safety for walking (E), aesthetics (F), traffic hazards (G), crime (H), lack of parking (I), lack of cul-de-sacs (J) hilliness (K), and physical barriers (L). Variables related to physical activity were walking for transportation, walking for leisure, leisure time moderate, leisure time vigorous, house work, gardening, and total physical activity MET. MET is the standard metabolic equivalent to estimate the amount of oxygen used by the body during physical activity. One MET is defined as 1 kilocalorie per kilogram per hour and is the caloric consumption of a person while at complete rest (CDC, 2007b).

Results and Discussion

The purpose of this study was to examine the relationship between physical activity levels and perceptions of environment by older women. More specific questions were, (1) What do elderly women do for physical activity? (2) How much physical activity do elderly women do in a week? (3) Do demographic variables affect their physical activity level, and (4) Does their perception of the residential density, land use mix for diversity, land use mix for accesses, street connectivity, infrastructure and safety, aesthetics, traffic hazards, crime, access to parking, lack of cul-de-sacs, hilliness, physical barriers, and overall quality of their neighborhood surroundings for walking affect their physical activity levels? Each question is addressed below.

What Do Elderly Women Do for Physical Activity?

The older women in this study participated in a range of physical activities from walking to gardening to water activities. Participation in walking was the most frequently reported activity (77%), followed by other (52%), dancing (44%), and gardening (37%, see Table 2). 'Other' activities included Rhythm & Life (a class name), Chi Gong, Luk Tung Kung, Water Exercise, Stretching, Tennis, Korean Exercise, and Golf, but the frequency with which these activities were performed was unclear. Due to 'other' being one of the 12 categories (e.g., walking, hiking, gardening, yoga, jogging, aerobics, dancing, bicycling, weight training, swimming, and other) which respondents could choose from, some people simply marked 'other' but left it blank and some people explained what they did as 'other'.

Table 2: Physical Activities Reported by Participants

Physical Activity	n	%

Walking	111	77
Other	75	52
Dancing	63	44
Gardening	53	37
TaiChi	26	18
Weight	20	14
Aerobics	17	12
Swimming	12	8
Yoga	7	5
Hiking	4	3
Jogging	2	1
Bicycling	1	1
Missing	4	3

Detail of other activity

Rhythm & Life (a class name), Chi Gong, Luk Tung Kung, Water Exercise, Stretching, Tennis, Korean exercise, and Golf

Similar activity types were also reported for people in a study by the CDC (1998) and Hawaii State American Association of Retired Persons (AARP, 2003, see table 7). The top two physical activities selected by Hawaii AARP (2003) and CDC (2003) participants were walking and gardening. Although both the AARP (2003) and CDC (1998) studies also included adults younger than this study's participants as well as males, when data were adjusted for gender and age, walking still ranked as a top physical activity.

Gardening also tended to rank relatively high (AARP, 2003; CDC, 1998). Walking is a popular physical activity among older women and is a finding also supported by other studies (King, Brach, Belle, Killingsworth, Fenton, & Kriska, 2003; Maxwell, Bastani, Vida, & Warda, 2002).

How Much Physical Activity Do Elderly Women Do in a Week?

Interpretation of activity level was obtained by following IPAQ Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (2005, see Appendix H) for scoring. As shown in Table 3, 35% of the participants had a high level, 26% had a moderate level, and 13% had a low physical activity level. Data related to this question were missing from 26% of the questionnaires. The reasons for the missing data are unknown but as suggested by Shadish, Cook and Campbell (2002) and Allison (2002) missing data is higher when "subject burden" is higher or when survey questions are more difficult to interpret. Both may have been factors for the elderly respondents in this study: The International Physical Activity Questionnaire took about 15 minutes to complete and the question on physical activity item asked respondents to estimate across a seven day period.

Physical activity level categories ('low', 'moderate', and 'high') were determined by calculated METS minutes which suggests an estimate of energy expenditure. High levels of physical activity participation was determined by: a) vigorous activity at least three days a week achieving a minimum total physical activity of at least 1500 METS minutes/week, or b) seven or more days a week of any combination of walking, moderate or vigorous activities achieving a minimum total physical activity of at least 3000 METS minutes/week. Moderate levels of physical activity participation was determined by: c)

three or more days of vigorous activity of at least 20 minutes per day, d) five or more days of moderate activity and/ or walking of at least 30 minutes per day, or e) five or more days of any combination of walking, moderate or vigorous activities achieving a minimum total physical activity of at least 600 MET minutes/week. Low levels of physical activity participation were those individuals who did not meet criteria for categories 'high' or 'moderate' (see appendix M). The CDC's (2003) recommendation for lifestyle physical activity is equivalent to criteria provided for moderate levels of physical activity.

Table 3: Physical Activity Levels

Physical Activity Level	n	%
High	51	35
Moderate	37	26
Low	18	13
Missing	38	26

About 61% (high 35% and moderate 26%) of the participants met or exceeded the CDC's recommendation for moderate amounts of lifestyle physical activity. The participants in this study exceeded studies with U.S. older women 65 years and older who participated in physical activity at a level recommended (32.2% in 2001, 32.1% in 2003, and 36.3% in 2005) and older women 65 years and older in Hawaii (40.6% in 2001, 39.6% in 2003, and 46.5% in 2005, CDC, 2007c).

In this study, the total amount of time spent doing physical activities in a week was 98,442 minutes (1,640 hours) calculated by summing activities such as physical activity

at work (4,680 minutes, 78hours or 5%), walking for transport (21,020 minutes, 350 hours or 21%), cycling for transport (60 minutes, 1 hour, too negligible to register as a percentage), gardening (20,620 minutes, 343 hours or 21%), house work (24,337 minutes, 405 hours, 25%), walking for leisure (13,180 minutes, 220 hours or 13%), moderate activity for leisure (8,980 minutes, 150 hours or 9%), and vigorous activity for leisure (5,565 minutes, 93 hours or 6%). It appears much of these participants' physical activity came from activities of daily living (ADL) such as gardening and house work, for transport, and specifically walking for leisure as opposed to other leisure time activities. Guralnik, Fried, Simonsick, Kasper, and Lafferty (1995) reported that most physical activity for older women age 65 years and older who were moderately to severely disabled, but not severely cognitively impaired, and living with no ADL difficulty was related to household chores and walking.

When examining average time spent in physical activity per day, the average time in each of the above categories was coded as physical activity at work (6 minutes), walking for transport (28 minutes), cycling for transport (0 minutes), gardening (28 minutes), house work (33 minutes), walking for leisure (18 minutes), moderate activity for leisure (12 minutes), and vigorous activity for leisure (8 minutes). The CDC's recommendation for physical activity is three or more days of vigorous activity of at least 20 minutes per day, or five or more days of moderate activity and/ or walking of at least 30 minutes per day. The average time the participants in this study spent doing physical activity in a week exceeded the CDC's recommended time. Thus, according to those guidelines the women in this study were considered quite active.

Do Demographic Variables Affect Older Women's Physical Activity Level?

Table 6 shows significant correlations between demographic and environmental variables. These data indicate that older, compared to younger people reported less diversity of land use mix ($r=-.22$, $p\leq.05$), and more traffic hazards ($r=.24$, $p\leq.01$). More older people lived outside of town or residential areas and felt more traffic hazards than younger people. DeBourdeaudhuij et al (2003) found that older people reported less activity-friendly environments, such as less safety from crime and traffic, less availability of sidewalks, and fewer convenient physical activity facilities. The results of DeBourdeaudhuij et al (2003) partially supported the results of this study in that older people reported less activity-friendly environments, such as more traffic hazards. The other result in the current study, that older people reported less diversity of land use mix (e.g. less diversity of destinations such as shops and stores), was not previously reported. It may be possibly mean that older people were living outside of town or simply in residential areas rather than living in centrally located areas which had more mixed use of residential and business spaces.

Age also showed significant negative associations with education ($r=-.40$, $p\leq.01$) and other variables. Older women tended to have had less education than younger women. Actual rates of education in this study were that 37.5% of the older women had a college degree or higher, 59.7% had a high school degree or less (data on education was missing for four subjects; see table 1). In 2000, 31% of those 65 years and older had completed a college degree or higher and 69% had completed a high school degree or less compared to those data in 1990 where only 23% had completed a college degree or higher and 77% had completed high school degree or less (State of Hawaii Department of Health Executive Office on Aging, 2006).

Living situation also showed a significant association with age ($r=-.22$, $p\leq.01$) and crime ($r=.21$, $p\leq.05$). Older women tended to live alone more so than younger women and they tended to feel less safe from crime. This is supported by data from the State of Hawaii Department of Health Executive Office on Aging (2006) in that older women were more likely to live alone in their later years than older men. Relatedly, Foster et al (2004) reported that women were also more concerned about walking for utility and safety than men. It indicates a need for social support for the people who live alone, especially older women who live alone.

Education showed a significant relationship with aesthetics in this study. Higher educated participants reported more interesting things, attractive buildings, and natural sights to look at while walking in their neighborhoods ($r=.26$, $p\leq.01$). It may suggest an important relationship between socioeconomic status and aesthetics. In DeBourdeaudhuij et al's study (2003), there was no relationship between education and aesthetics; however there was a relationship between a higher socioeconomic status and aesthetics. Participants who had a higher socioeconomic status reported better aesthetics in their neighborhood than the people who had a lower socioeconomic status. Considering the difference in the types of participants comprising DeBourdeaudhuij et al's study (2003) and this one more participants in Debourdeaudhuij et al's study had higher educational status than the participants in this study, and they also included younger adults and men. It is possible to say that the results in this study where higher educated women reported better neighborhood aesthetics, was supported. However, socioeconomic status was not examined in this study, so further research is needed.

Distance, means of transportation, and living situation showed significant correlations

with some physical activity related variables such as amount of leisure time moderate physical activity and walking for transport (see Table 4). Distance showed a significant negative correlation with walking for transport ($r=-.25$, $p\leq.05$). Participants who lived further from the community centers reported less walking for transport in a week (see Table 4). Means of transportation showed a significant negative correlation with walking for transport ($r=-.21$, $p\leq.05$). Participants who used a vehicle for transport rather than walking as a means of transportation to the community centers reported less walking for transport in a week (see Table 4). Living situation also showed a significant negative correlation with leisure time moderate physical activity METS ($r=.27$, $p\leq.01$) in a week. Participants who lived alone reported higher amounts of leisure time moderate physical activity METS in a week than the participants who lived with someone (see Table 4).

Table 4

Two-Tailed Pearson Bivariate Correlation between Demographic and PA Variables

	WforT	WforL	Garden	HW	LMode	LVigor	TPA
Age	-0.08	-0.17	0.05	-0.14	-0.09	-0.03	-0.16
Education	-0.06	0.02	-0.06	-0.03	0.16	0.19	0.08
Distance	-0.25*	-0.03	0.16	-0.11	0.06	0.14	0.02
Transportation	-0.21*	-0.12	0.14	-0.07	0.12	-0.04	-0.04
Living Situation	-0.14	0.06	-0.01	0.14	-0.27**	0.04	-0.02

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

W for T - Walking for Transport, W for L - Walking for Leisure, HW - House Work

LMode - Leisure Time Moderate PA, LVigor - Leisure Time Vigorous PA

TPA - Total Amount of PA, Transportation - Means of Transportation

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As table 6 showed, several other significant relationships between demographic and environmental variables but not related to physical activity were found. Distance was significantly associated with means of transportation ($r=.35$, $p\leq.01$). People who lived a further distance from the community center tended to use a car more than the people who lived closer from the community center. Further distance from the community center was related to less residential density ($r=-.22$, $p\leq.05$), less access to destinations ($r=-.23$, $p\leq.05$), and more perceived hilliness ($r=-.28$, $p\leq.01$). Finally, means of transportation was also related to residential density, diversity of land use mix, access to destinations, aesthetics, cul-de-sacs, and hilliness. Higher car use to the community center was related to lower residential density ($r=-.20$, $p\leq.05$), lower diversity of land use mix ($r=-.20$, $p\leq.05$), lower access to destinations ($r=-.28$, $p\leq.01$), better aesthetics ($r=.21$, $p\leq.05$), more cul-de-sacs ($r=-.19$, $p\leq.05$), and more hilliness ($r=-.31$, $p\leq.01$). These results may be explained by differences in settings and geographic areas where other studies were conducted. In addition, there was no literature about a relationship between distances, means of transportation to the facility, and environmental variables in Hawaii. However, it is not surprising that further distance from the community center was related to higher car use, and less walkable environments in which there was less residential density (less number of high buildings), less access to destinations (shopping places or restaurants etc) and more perceived hilliness in Hawaii due to locations of the community centers. Both community centers were located in a part of Oahu which could be considered as having "highly-walk able" neighborhoods, characterized by closeness and connectivity to

destinations, good land use-mix (residential and commercial mixed), high population density, and pedestrian-friendly facilities (e.g. sidewalks, street lighting, bike paths), less parking, cul-de-sacs, and hilliness (Saelens et al., 2003).

In this study, use of a vehicle rather than walking to the community centers was associated with distance, and both use of a vehicle and distance were associated with some less walkable environment variables such as less residential density, less access to the destinations, and more perceived hilliness in this study (see table 6). The living environment of those people who tended to use a car more than walking to get to the community centers tended to live further away from the community centers. The average distance for the people who walked to the community centers in this study was .84 miles or (1352 meters), and less than 20% of participants walked to a community center (see Table 1). These findings were similar to those of King et al (2005), in that living within walking distance (1500 m) of specific types of businesses and facilities was positively associated with levels of physical activity.

DeBourdeaudhuij et al (2003) also suggested that minutes of walking and moderate activity were related to accessibility of shops, facilities, and public transit for women. Salens et al (2003) found a positive association between walking for transport and walkable neighborhoods in which there was high residential density, more diverse destinations, increased access and street connectivity to the destinations. Fenton (2003) suggested the need for building walk able environments that had effective networks of pathways, trails, and lanes, compact and high mixed land use with residential, retail and commercial activities, schools, recreation, and transit accesses, within walking distance to increase people's physical activity levels. Having a community center in walk able

environments is beneficial to increasing the amount of walking for older adults, specifically the women in this study.

Relatedly, participants who lived with someone reported a lower amount of leisure time moderate physical activity METS in a week than participants who lived alone (see Table 4). Living with someone affected leisure time moderate physical activity but not other physical activities. In the study by King, Wilcox, Eyler, and Sallis (2000), similar results were reported where care-giving duties were identified as an important barrier to leisure time physical activity participation among older women. This finding might indicate the potential impact on the role of older women as a caregiver, and the need to identify the types of physical activity that are most appropriate for those in a care-giving situation.

Table 6

Two-Tailed Pearson Bivariate Correlation Between Environment and Demographic Variables

	Educat	Distan	Transp	livingS	A	B	C	D	E	F	G	H	I	J	K	L
Age	(-)0.4**	-0.16	0.03	(-)0.22**	-0.15	(-)0.22*	-0.04	-0.02	-0.12	-0.12	0.24**	-0.01	-0.17	-0.07	0.02	-0.01
Education		0.17	0.14	-0.02	0.03	0.13	0.05	-0.04	0.03	0.26**	-0.08	0.14	-0.06	-0.01	-0.13	-0.05
Distance			0.35**	-0.02	(-)0.22*	-0.09	(-)0.23*	-0.1	0.03	-0.06	0.08	0	-0.1	-0.18	(-)0.28**	-0.06
Transport				0.04	(-)0.2*	(-)0.2*	(-)0.28**	-0.17	0.08	0.21*	0.13	0.03	-0.14	(-)0.19*	(-)0.31**	-0.08
LivingSituation					-0.1	0.15	-0.05	0.04	0.11	0.04	0.1	0.21*	0	-0.04	-0.01	0.06

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

A-Residencial Density, B-Diversity, C-Access, D-Street Connectivity, E-Infrastructure&Safety for Walking, F-Aesthetics, G-Traffic Hazard, H-Crime, I-Lack of Parking, J-Lack of Cul-de-sacs, K-Hilliness, L-Physical Barriers

Transportation-Means of Transportation

Are Perceptions Of Residential Density, Land Use Mix For Diversity, Land Use Mix For Accesses, Street Connectivity, Infrastructure And Safety, Aesthetics, Traffic Hazards, Crime, Lack Of Parking, Lack Of Cul-De-Sacs, Hilliness, Physical Barriers, And Overall

Quality Of Their Neighborhood Surroundings For Walking Associated With Physical Activity Levels?

Several environmental variables showed significant correlations between physical activity variables (see Table 5). There were significant positive correlations between cul-de-sacs (J, $r=.26$, $p\leq.01$), and hilliness (K, $r=.23$, $p\leq.05$) scores, and walking for transport. People who walked more for transport reported less hilliness and cul-de-sacs. These results were contrary to those reported by DeBourdeaudhuij et al (2003) in that the presence of hills was associated with more activity. This could be due to sample and location differences. DeBourdeaudhuij et al (2003) conducted a study with adults in Belgium. Hilliness was a motivation in Belgium, but a barrier in Hawaii for walking for transport. This may also be due to cultural differences in that older adults in Europe such as Holland and Germany tended to walk more than older adults in the U.S. (Ahrentzen, 2004). In European cultures, older adults might prefer walking on hills more than on flat walking paths. This difference needs additional study.

There was also a significant positive correlation between residential density and walking for leisure ($r=.22$, $p\leq.05$). Participants in this study who walked more for leisure reported higher residential density than the people who walked less for leisure. These results differed from those of Saelens et al (2003) and Handy (1996) who found no significant relationship between walking for leisure and walkable neighborhoods in which there was high residential density. However, Fenton (2003) reported high density areas, involving compact patterns of mixed residential and business use buildings, was associated with higher levels of overall physical activity levels but his research did not specifically address walking for leisure. Differences may be attributable to the geological

differences between the study sites (many parks and walking paths are in high residentially dense areas in Hawaii). Additional research is needed.

Gardening showed significant negative correlations between lack of parking (I, $r=-.26$, $p\leq.05$) and cul-de-sacs (J, $r=-.24$, $p\leq.05$) scores. People who had higher amounts of gardening activity reported more parking and more cul-de-sacs, suggesting that they lived in lower density neighborhoods, with more space for outdoor activities. According to Saelens et al (2003), comparing "low-walkable" to "high-walkable" neighborhoods, which were characterized by closeness and connectivity to destinations, good land use-mix (residential and commercial mixed), high population density, and pedestrian-friendly facilities (e.g. sidewalks, street lighting, bike paths), "low-walkable" neighborhoods tended to have more parking and cul-de-sacs than "high-walkable" neighborhoods. This study suggests that people who had higher amounts of gardening activities tended to live in less walkable neighborhoods. It is not surprising that since gardening needs an outside area, houses with an outside area for gardening tend to need more space in the neighborhood. Other environmental variables expected to be related to physical activity in this study were not, such as land use mix, access, neighborhood aesthetics, and perceived safety from crime and traffic. However, Saelens et al (2003) found that "high-walkable" neighborhoods which had higher residential density, land use mix, street connectivity for access, aesthetics, and safety affected physical activity levels. Further specific study will be needed for the relationship between environment and physical activity level.

Table 5

Two-Tailed Pearson Bivariate Correlation Between Environment and PA Variables

	A	B	C	D	E	F	G	H	I	J	K	L
W for T	0.13	0.06	0.18	0.12	0.06	0.02	-0.12	-0.08	0.19	0.26**	0.23*	0
W for L	0.21*	0.17	0.09	-0.09	0.05	0	-0.1	-0.08	0.08	0.07	0.14	-0.07
Gardening	-0.19	-0.1	-0.18	-0.16	0.02	-0.08	-0.01	-0.11	(-)0.26*	(-)0.24*	-0.13	-0.15
HouseW	0.04	0.06	-0.01	-0.15	0.1	0.04	-0.1	-0.08	-0.04	-0.05	0.13	0.04
LModerate	0.02	0.03	0.01	-0.15	-0.12	-0.14	0.07	0.13	0.07	-0.1	0.06	-0.04
LVigorous	0	-0.09	-0.07	0.08	0.02	-0.08	0.17	0.04	0	0.07	-0.11	-0.1
TotalPA	0.07	0.05	0	-0.1	0.04	-0.03	-0.09	-0.12	-0.03	-0.01	0.07	-0.15

** Correlation is significant at the 0.01 lev * Correlation is significant at the 0.05 level (2-tailed).

A-Residencial Density, B-Diversity, C-Access, D-Street Connectivity, E-Infrastructure&Safety for Walking
F-Aesthetics, G-Traffic Hazard, H-Crime, I-Lack of Parking, J-Lack of Cul-de-sacs,
K-Hilliness, L-Physical Barriers
W for T-Walking for Transport, W for L-Walking for Leisure, HouseW-House Work
Lmoderate-Leisure Time Moderate PA, LVigorous-Leisure Time Vigorous PA
Total PA-Total Amount of PA

Summary and Conclusion

Summary

Walking and gardening were the top two physical activities of choice among older women in this study besides dancing and culturally relevant types of physical activities. Sixty one percent of the older women in this study reached or exceeded the CDC's recommendation for physical activity. These women tended to spend most of their time doing gardening, house work and walking. This was a very active group of older women.

There were several findings regarding to walking for transportation. Distance was negatively correlated with walking for transportation in that participants who lived further from the community centers reported less walking for transportation in a week. Additionally, participants who used a vehicle for transportation, rather than walking, also tended to walk less in a week. For those participants who walked for transportation there were significant positive correlations with their walking for transportation and less reports of hills and cul-de-sacs. In other words, their neighborhood may have been more conducive to walking for transportation aside from being relatively close to the community center.

Findings relative to leisure time physical activity included interesting findings. Participants who lived alone reported higher amounts of leisure time moderate physical activity than the participants who lived someone. A caretaking role may be a reason for less leisure time physical activity. Relatedly, there was a significant positive relationship between residential density and walking for leisure. The more likely the neighborhood included or was close to shopping and businesses the more likely participants walked for leisure. In contrast, gardening as a physical activity was negatively related to lack of

parking and cul-de-sacs. People who had higher amounts of gardening activity reported more parking and more cul-de-sacs, suggesting that they lived in lower density neighborhoods, with more space for outdoor activities.

Age was related to perceptions of less activity-friendly environments. Older, compared to younger people reported less diversity of land use mix and more traffic hazards. A greater number of older people tend to live outside of town or residential areas and felt more traffic hazards than younger people. Additionally, age also showed significant negative associations with education. Older women tended to have less education than younger women and they were also more likely to live alone than younger women. However, as a result of older women tending to live alone, they also tended to feel less safe from crime.

Finally, means of transportation was related to residential density, diversity of land use mix, and less access to the destinations, aesthetics, cul-de-sacs, and hilliness. Higher car use to the community center was related to lower residential density, lower diversity of land use mix, and lower access to destinations, better aesthetics, more cul-de-sacs, and more hilliness.

Conclusion

Since walking was the most popular physical activity among older women, society must consider effective promotion of walking for older women. One of the best ways to promote active lifestyles among the elderly is adopting an ecological approach. This approach must address all levels of change, reach people at all levels of decision making, and encourage feedback and interaction across levels and people (USDHHS, 1996). Thus,

an ecological approach to walking promotion could account for far more improvement than approaches that rely on a single level of influence. It is important to consider how to design activity-friendly environments through multi-level interventions such as intrapersonal, interpersonal, community, organizational, and public policy levels.

An approach at the intrapersonal or interpersonal level to increase physical activity levels the CDC (2003) recommends incorporating physical activity into daily routines, such as being active in housework, walking for transportation, participating in community site physical activity programs, and pursuing physically active hobbies and recreational activities. Participants in this study were regularly participating in community centers and incorporated physical activity into their daily routines thus supporting the effectiveness of such a recommendation.

At the community or organizational levels, the results of this study suggest a need for social supports for older women. In this study, participants who lived with someone reported lower amounts of leisure time moderate physical activity as compared to those who lived alone. This finding might indicate the potential impact of the role of older women as a caregiver and the need to identify appropriate types of physical activity most feasible in that type of situation. Belza et al (2004) suggested that features of physical activity programs to enhance participation among ethnically diverse minority older adults included fostering relationships among participants; providing culture-specific exercise; offering programs at residential sites; partnering with and offering classes prior to or after social service programs; educating families about the importance of physical activity for older adults and ways they could help; offering low- or no-cost classes; and involving older adults in program development.

At the public policy level, designing activity-friendly environments and communities can be one strategy to promote active lifestyles as walking for transport was affected by environmental factors in this study, such as distance to the community centers, means of transportation, and geographic barriers. The design of residential neighborhoods relative to closer proximity to shops and businesses, safe routes to access shops and businesses, as well as walkable routes (e.g., little to no hills) should be taken into account relative to environmentally motivated physical activity promotion.

According to the Surgeon General's Report (1996), with increasing age, the percentage of sedentary adults tends to increase and older women tend to be one of the least active groups in the U.S. Given this finding, additional specific age-related and gender related issues such as declining acuity of senses, changes in gait and balance, or loss of stamina must be considered when promoting walking and designing activity-friendly environments for sedentary older women (Ahrentzen, 2004). In this regard, the President's Council on Physical Fitness and Sports (2006) suggests the need for louder crossing signals and increased lighting for impaired hearing and vision, eliminating hazards such as uneven sidewalks and high curbs, and placing more resting places for loss of stamina. Considering the characteristics and needs of older women, how we design communities is an important subject. For environmental factors that affected physical activity levels such as distance to the community centers, means of transportation, and geographic barriers in this study, establishing transportation systems to favorite facilities and businesses, and making access to those favorite facilities and businesses easy would also be an effective way to promote physical activities for older women.

Recommendations for Future Research

In future studies assessing physical activity in especially Asian groups it would be important to include culturally specific activities such as cultural dances, tai-chi, Chi Gong, or Luk Tung Kung, on survey instruments. Physical activities should not be limited to those only found in the mainstream or those mostly done by younger individuals. Reliance on self-reported information for physical activity could also be a limitation even though it is a well validated method of data collection. Participants, especially older ones, may not be able to accurately remember the amount or frequency of their participation. One suggestion is use of objective measures such as accelerometers or pedometers to measure physical activity levels more objectively.

Huston et al (2003) concluded that perceived neighborhood environmental factors and access to places for physical activity were strongly associated with race, education, and income. In this study, socioeconomic variables such as race and income were not considered. For further research, including racial or ethnic comparisons and financial information could be examined for their effect on physical activity participation.

Relatedly, the participants in this study were relatively active because they were already participating in physical activity promotional facilities and programs. Another study that included sedentary people who do not participate at community centers or those that participate regularly in more sedentary activities could be included.

Finally, the response rate in this study was relatively low (36%). Considerable reasons for this may have been length of the questionnaires. Use of the short version of questionnaires may have been helpful and have provided more complete answers by the older women; however the longer versions would help make results more accurate. Thus,

it would be important to consider length of time and amount of information collected at one time. The participants in this study did want to help though the length of the questionnaires or number requested they complete at one time may have been too much. Separating the questionnaires relative to their being completed over time may be a more productive approach than asking participants to complete all of them at one time.

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Appendix A

Literature Review

Literature Review

Prevalence of Physical Activity among Older People

According to the CDC (2007c), U.S adults 18 years and older in the United States who participated in recommended levels of physical activity were 45.3% in 2001, 45.9% in 2003, and 48.1% in 2005. Comparable rates in Hawaii were 50.4% in 2001, 50.1% in 2003, and 52.4% in 2005. Older American women 65 years and older who participated in physical activity at a level recommended by the CDC were 32.2% in 2001, 32.1% in 2003, and 36.3% in 2005. For older women in Hawaii, the numbers were 40.6% in 2001, 39.6% in 2003, and 46.5% in 2005. The National Ageing Research Institute (2003) reported that most common lifestyle physical activity was indoor-household tasks 91%, walking 81%, and outdoor activities including gardening 77% among older men and women.

Although Hawaii's older women exceeded national average of older women, one of "Healthy People 2010" objectives has been to increase the proportion of adults who engage in regular moderate or vigorous activity to at least 50% (USDHHS, 2005). As a result, concerted public health efforts at federal, state, and local levels are needed to improve participation in lifestyle physical activity.

Physical Inactivity in Older People in the U.S.

Although the beneficial effect of physical activity is widely known and is supported by a large amount of evidence, few older persons regularly participate in physical activity. According to Ahrentzen (2004), inactivity is not a consequence of age. Her study concluded that walking among older persons constituted a significant mode of transportation in most wealthy countries except the U.S. For example, in Ahrentzen's

study (2004), walking accounted for 35% of all journeys by older men and 40% by older women in Great Britain in 1995; compared to 19% of younger men's journeys and 27% of younger female's journeys. In comparing the travel patterns of the older persons in Holland, Germany, and the U.S., a quarter of all trips of Dutch older persons were by bicycle, compared to 11% for German older persons, and .2% for American. Walking constituted 19% of Dutch older persons' trips, compared to 39% of German, and 6% of American (Ahrentzen, 2004). Some other environmental factors (e.g., such as convenience, accessibility, and safety) might affect American older persons' physical inactivity (Ahrentzen, 2004). These results suggest that environmental variables may be important in promoting an active lifestyle for American older women.

Special Concerns and Conditions among Older Persons in the U.S.

Older persons are a heterogeneous group, because they have particular physiological and psychological characteristics that may diminish their ability to regularly engage physical activities. The aging process generates a number of special concerns and conditions that potentially affect the nature and desirability of active living for older persons. Ahrentzen (2004) summarized several issues relevant to older persons' participation in physical activity:

1. Health: Particular health and physiological and psychological problems increase in older persons, such as forgetfulness, dementia, osteoporosis and reduced muscle and bone mass; chronic pain associated with arthritis and rheumatism; declining sensory perception; and slower reflexes and walking gait, fear of personal accidents such as slipping on ice or wet pavement, falling or being hit by a car.

2. Reduced engagement in utilitarian and recreational activity: work-related travel tends to decrease with age and time spent in many other everyday activities also decreases. Discretionary time tends to increase with age as well.
3. Meaning of activities: The meaning of engaging in particular activities changes. Due to increasing their discretionary time, it may be easier to incorporate active living into everyday routines with more inherent meaning (e.g. gardening that involves the nurturing or maintaining of living species, or walking to do an errand or bird watch rather than riding a stationary bicycle. We need to consider what meanings are important to elderly (e.g.: sense of history of one's place and one's community; nurturing future generations; need for social connections which may be greater as social involvement in organized settings, such as work, lessens or as the number of family members at home dwindles; connection to the natural world through plants and pets; as well as other cultural meanings).
4. Automobile use and meaning: motorized transportation is related to an older person's active lifestyle. It is important to understand how American car culture is associated with difficulties of active living among older persons. In 1997, nationwide, more than 90% of all trips made by the elderly were by car. They relied upon the car for a large percentage of their trips. Many of the elderly believe that the automobile provides higher levels of security, comfort, status, and convenience than other forms of transportation. Traveling by car may be increasingly problematic as one advance in age

because of impaired reflexes.

5. Environmental conditions affecting health: hyperthermia or hot weather hazard, hypothermia or cold weather hazard, and crime. Older persons are more likely than younger people to face attackers who are strangers. They are also more often than younger persons to be attacked at or near their homes.

These conditions play complex roles in promoting or hindering active living styles among older persons (Ahrentzen, 2004). To promote active living to older persons, it is also important to address their special concerns and conditions.

Barriers to Physical Exercise among Older Adults

According to Crombie, Irvine, Williams, McGinnis, Slane, Alder, and McMurdo (2004), the most powerful deterrent was lack of interest (odds ratio = 7.8). Other factors included lack of daily access to a car, shortness of breath, joint pain, dislike of going out alone or in the evening, perceived lack of fitness, lack of energy, doubting that exercise can lengthen life, not belonging to a group and doubting that meeting new people is beneficial. They conducted a study on the barriers to physical activity among older persons from 16 general practices in Dundee, Scotland. Four hundred nine randomly selected older people (65-84 years), who lived independently, were interviewed at home (46% response rate). Levels of knowledge about the specific health benefits of physical activity were high. Almost all participants (95%) believed that physical activity was beneficial and 79% believed that they did enough to keep healthy. However, 36% did no leisure time physical activity and a further 17% did less than 2 hours per week. Eleven

factors that exerted significant independent effects on levels of leisure time physical activity were identified.

In another study, Belza, Walwick, Shiu-Thornton, Schwartz, Taylor, and LoGerfo (2004) examined the barriers and facilitators to physical activity and exercise among underserved, ethnically diverse older adults in seven ethnic-specific focus groups: American Indian/Alaska Native, African American, Filipino, Chinese, Latino, Korean, and Vietnamese in the Seattle area in the US. Seventy-one older adults were recruited through community agencies. Groups were conducted in the participants' primary language and ranged in size from 7–13 participants. Mean age was 71.6 years (range from 52 to 85 years; SD + 7.39). Results suggested that features of physical activity programs that enhance participation among ethnically diverse minority older adults included fostering relationships among participants; providing culture-specific exercise; offering programs at residential sites; partnering with and offering classes prior to or after social service programs; educating families about the importance of physical activity for older adults; offering low- or no-cost classes; and involving older adults in program development. Walking was the exercise of choice across all ethnic groups. Other factors influencing physical activity were weather, transportation, and personal safety. Belza et al. (2004) concluded that findings from this study suggest strategies for culture- specific programming of community-based physical activity programs are important.

King, Wilcox, Eyler, & Sallis (2000) reported a study about personal and environmental barriers associated with physical inactivity among 2912 older women who were 40 years and older and from these ethnic groups; White, Black, American-Alaskan Native, and Hispanic groups. Data were national widely collected by telephone through

Behavioral Risk Factor Surveillance Survey (BRFSS) from July 1996 through June 1997. The response rate was 87.3%. Factors associated with inactivity were American Indian ethnicity, older age, less education, lack of energy, lack of hills, in one's neighborhood, absence of enjoyable scenery, and infrequent observation of others exercising in one's neighborhood. Care-giving duties and lacking of energy to exercise ranked among the top four most frequently reported barriers among all ethnic groups (King et al, 2000).

Types of Physical Activities Among Older Adults

CDC reported types of physical activities as a national trend in 1998. The results were through population-based National Health Interview Survey in 1998, and reported as being done at least once in the past two weeks. Participants were adults aged 18 and older. The top four types of exercise reported were walking for exercise (43%), gardening (28%), stretching (27%), and weightlifting (16%, see table 4). Other details were unclear.

Hawaii's state wide research to the nationwide research (1998) was by the American Association of Retired Persons (AARP, 2003) that conducted the Hawaii Health and Fitness Survey by mail in 2003. Two thousand seven hundred sixty four men and women (response rate was 55%) 50 years old and older from five counties: Hawaii, Honolulu, Kauai, Maui, and other counties responded. They were divided into those two groups, exercising (1817 people, 66%) and non-exercising (726 people, 26%). They were asked to indicate what types of physical activities they would consider doing. The top four types of exercise reported were walking (67%), gardening (39%), working out on cardiovascular machines (27%), and weightlifting (25%, see table 4). Members aged 50 to 59 were more likely than those 75 and older to report swimming (50-59: 22%: 60-74: 18%: 75 and older: 14%) or working out on cardiovascular machines (50-59: 31%: 60-

74: 27%; 75 and older: 22%), and were significantly more likely than those ages 60 and older to report weightlifting (50-59: 33%: 60-74: 24%; 75 and older: 18%). Members 60 to 74 years old were more likely than those younger to have gardened (50-59: 34%; 60-74: 41%; 75 and older: 40%). Men and women were equally likely to have engaged in each of the top five types of exercise, except with golfing and walking. Men were more likely than women to report golfing (men: 26%; women: 10%), and women reported walking significantly more than men (men: 63%; women: 71%).

Maxwell, Bastani, Vida, & Warda (2002) reported types of physical activities among 487 older low income Filipino women through various community based organizations and churches in Los Angels County in 2002 (92% response rate). Purpose of this study was to describe the pattern of physical activity among older Filipino-American women and a physical activity intervention specifically designed for this group. Results of this study were that most frequently reported physical activity were walking (79%), stretching (75%), dancing (56%), and gardening or yard work (49%, Maxwell et al, 2002).

Guralnik, Fried, Simonsick, Kasper, and Lafferty (1995) reported the frequency of participation in five physical activities (such as walking, household chores, outdoor chores, dancing, and regular exercise programs) among 1,002 older women age 65 years and older who were moderately to severely disabled, but not severely cognitively impaired, and living in the community in Baltimore, Maryland. Data of those participants who were moderate level of disabled with no ADL difficulty (n=343) were shown bellow. Approximately 69% of participants reported performing some type of physical activity in the past 2 weeks. The most common activity was household chores (47%), followed by walking for exercise (36.2%), regular exercise programs (14.3%), out door chores

(12.6%) and dancing (6.2%). The levels of participation in any physical activity were similar to general population of older women. While the majority of these women engaged in some kinds of physical activity, much of it was related to household chores and walking.

Profile of Hawaii's Older Adults

Hawaii's older adult population is steadily growing. According to the State of Hawaii Department of Health Executive Office on Aging (2006), several trends are occurring with older persons in addition to their growing numbers in the population. First, Hawaii's older adult population is expected to increase faster than the rest of the total population. Between 2000 and 2020 Hawaii's older adult population will increase by 70% while Hawaii's total population is only expected to increase by 23% over the same time period. The growth in the number of older adults is over three times faster than the growth of the total population (State of Hawaii Department of Health Executive Office on Aging, 2006). More specifically, in 2004, individuals aged 60years and older in Hawaii numbered 230,929, representing 18% of the total population. Of the adult population aged 18 years and older, older persons comprised 24% of the population. It is also estimated that by the year 2030, the number of individuals living in Hawaii 60 years and older will nearly double and is estimated at 410,450, which is 25% of total population and 33% of adult population (State of Hawaii Department of Health Executive Office on Aging, 2006) .

A second remarkable trend is that the population of Hawaii's older adults 60 years and older has grown faster than the older population nationally between 1990 and 2000 (State of Hawaii Department of Health Executive Office on Aging, 2006). Statistics showed that while Hawaii's older adult population increased 19% between 1990 and 2000, the

national older adult population increased by only nine percent (State of Hawaii Department of Health Executive Office on Aging, 2006).

Third, life expectancy is increasing, with differences by gender and race (State of Hawaii Department of Health Executive Office on Aging, 2006). Hawaii's life expectancy in 2000 was 80 years old which was three years over the national life expectancy of 77 years old. Particularly, in 2000, data showed that life expectancy at birth in Hawaii was 77 years old for males and 83 years old for females. Women outnumbered men in 2000 while their numbers were about the same in 1980 (State of Hawaii Department of Health Executive Office on Aging, 2006). The differences between males and females become greater with advancing age. Among older adults who were 85 years and older, 59% were female and 41% were male (State of Hawaii Department of Health Executive Office on Aging, 2006).

Life expectancy also differs among ethnic groups (State of Hawaii Department of Health Executive Office on Aging , 2006). According to the most recent available data by ethnic group in Hawaii, in 1990, individuals who were Chinese or Japanese tended to live the longest, 83 and 82 years, respectively. For individuals of Filipino ancestry life expectancy was at 79 years and Caucasians at 76 years. Of the ethnic groups, Native Hawaiians had the lowest life expectancy at 74 years (State of Hawaii Department of Health Executive Office on Aging, 2006).

Finally, among both genders older adults 60 and older, 17% lived alone in 2000 with 20% of female older adults 60 and older living alone compared to 12% of males. With women tending to outlive men, it is understandable for them to also be more likely to live alone in their later years (State of Hawaii Department of Health Executive Office on

Aging, 2006).

Other remarkable trends are regarding to language, financial, and education. Twelve percent of older people 65 and older did not speak English well in 2000. Older women were more likely to be poverty than older men in 1999. Among 60 years and older people in poverty, 62% were female, 53% had at least one disability, and 40% live alone. Finally, more older people had obtained formal education than previousely. In 2000, 16% of older people 65 years and older had completed a 4-year college degree, 15 % had completed some college degree, 34% had completed high school degree, and 35% had completed less than high school degree, compared to those data in 1990 in that only 11% had completed a 4-year college degree, 12% had completed some college degree, 26% had completed high school degree, and 51% had completed less than high school degree (State of Hawaii Department of Health Executive Office on Aging, 2006).

Measures of Urban Form

According to Humpel, Owen, and Leslie (2002), recent reviews identify a relatively small number of studies that have applied an ecological approach to investigate the association between objective and perceived physical environmental attributes and physical activity behaviors. However, conceptualization and operationalization of the theory has yet to be established and only recently have empirical data been reported (Humpel, et al., 2002). Urban form is defined as particular attributes of the neighborhood related to its structure and connectivity. These characteristics include residential density, land-use mix, connectivity, and neighborhood character (Saelens, Sallis, Black, and Chen, 2003).

The International Physical Activity and the Environment Network (IPEN, 2004)

developed to provide a set of well-developed instruments that could be used internationally to obtain comparable estimates of environment relative to walkability based on urban form design. Two studies using the IPEN questionnaires to measure the relationship between neighborhood environments and physical activity were found.

DeBourdeaudhuij, Sallis, and Saelens (2003), conducted a study using the International Physical Activity Questionnaire (IPAQ), a demographic questionnaire and the IPEN questionnaire with a sample of 521 Belgian adults18 to 65 years old (mean age was 41 (± 12.22) years and 48.3% were female). The purpose of the research was to investigate the variance in sitting, walking, and moderate and vigorous physical activity that was associated with neighborhood design and recreational environmental variables. IPAQ was used to quantify physical activity in the past 7 days. The following results were found: 1). Walking and moderate activities were related to sidewalks and access to shops and public transportation facilities and 2). Vigorous physical activity was related to access to activity supplies and recreational facilities. The study concluded that both neighborhood design and recreational environmental variables had small but significant associations with multiple types of physical activity in a sample of Belgian adults. In addition, they reported that self-reported leisure-time physical activity and vigorous physical activity were not associated with residential density or land use. Vigorous physical activity was associated with presence of more physical activity equipment in the home and more convenient physical activity facilities. They also reported that land-use mix (access to shops) was positively associated with recommended levels of leisure-time physical activity and walking for exercise for women only. (DeBourdeaudhuij et al, 2003).

Saelens, Sallis, Black, and Chen (2003) surveyed 107 persons 18-65 years old. The

participants completed a survey on their neighborhood environment on two occasions. Physical activity was assessed by self-report questionnaire and accelerometer measures. The results showed that measures of neighborhood characteristics had moderate to high test-retest reliabilities. Residents of high-walkability neighborhoods reported higher residential density, land use mix, street connectivity, aesthetics, and safety. High-walkability neighborhood had a mostly grid like street pattern, with short block lengths and few cul-de-sacs, which is indicative of greater street connectivity. Low-walkability neighborhood had longer block lengths, a mixture of grid like and curvilinear street patterns, and more cul-de-sacs. Participants in high-walkability neighborhoods had more than 70 minutes of physical activity and lower obesity prevalence than did residents of low-walkability neighborhoods. The study concluded that the reliability and validity of self-reported neighborhood environment subscales were supported. They also found no observed difference between neighborhoods regarding self-reported walking for exercise, self-reported leisure-time physical activity, or accelerometer-measured vigorous physical activity.

Relationship between Perception of the Environment and Physical Activity

Several studies have found significant associations between environmental perceptions and physical activity, although none of these studies were conducted in Hawaii. The environmental variables considered can be grouped into four categories: safety, availability and access, convenience and gender difference. The studies examined the associations between environmental variables and either leisure-time physical activity or walking.

Safety. One of the largest studies to examine the association between the self-

reported safety of the nationhood and physical activity was conducted by Centers for Disease Control and Prevention (1999). In 1996, data on physical activity were analyzed for 12,767 persons 18 years and over (5320 men and 7447 women) who responded to the Social Context Module included in the 1996 surveys in Maryland, Montana, Ohio, Pennsylvania, and Virginia. Respondents were asked, "How safe from crime do you consider your neighborhood to be?" Possible responses were "extremely safe," "quite safe," "slightly safe," or "not at all safe." Respondents were classified as physically inactive if they reported no physical activity or exercise during the preceding month. Numbers for racial/ethnic groups other than white were combined because, when analyzed separately, data were too small for meaningful analysis. The prevalence of "no activity" among respondents was approximately 30%. The prevalence of physical inactivity was highest among adults aged 65 years and older, women, racial/ethnic minorities, persons with a high school education or less, and persons with annual household incomes of less than $20,000. Overall, higher levels of perceived neighborhood safety were associated with lower levels of physical inactivity; the differences were greatest among persons aged 65 years old and older (from 38.6% {extremely safe} to 63.1% {not at all safe}) and racial/ethnic minorities (from 29.9% {extremely safe} to 44.6% {not at all safe}). For respondents with more than a high school education, little difference in physical inactivity was noted among persons as a function of perceived neighborhood safety. The prevalence of physical inactivity among men and women differed across neighborhood safety levels among persons aged 18-64 years but not among persons aged 65 years and older. Data stratified by age and sex and controlling for race and education demonstrated an association between neighborhood

safety and physical inactivity among older adults (odds ratio=2.3; 95% confidence interval=1.1-4.7). Older adults were over twice as likely to be active if they reported their neighborhood was extremely safe.

Foster, Hillsdon, and Thorogood (2004) conducted a cross-sectional study of 4,157 16-74 year old subjects from England. They found that women who reported concerns about safety during daylight were 47% less likely to report any short walks in the four weeks prior to interview compared to women who did not report safety concerns. No such relationships were found for night-time safety or more frequent walking. There were no relationships between men's perceptions of safety and walking. The authors concluded that women were more concerned than men about walking for utility and in safety.

Availability and Access. A study by DeBourdeaudhuij, Sallis, and Saelens (2003) on a sample of 521 Belgian adults18 to 65 years old (mean age was 41 (± 12.22) years and 48.3% were female) reported that for men and women, the presence of exercise equipment at home and convenience of physical activity facilities were positively correlated with amount of vigorous physical activity. They found that socio-demographic variables like education, age, and children in the home made a greater contribution to their regression models for all physical activity behaviors than environmental variables.

Huston, Evenson, Bors, and Gizlice (2003) conducted a cross-sectional study to examine associations between perceived neighborhood characteristics, access to places for activity, and leisure-time physical activity in a sample of 1796 adults at least 18 years of age residing in the six counties in North Carolina. Their 133-item questionnaire assessed self-reported leisure-time physical activity and perceptions of neighborhood characteristics (sidewalks, trails, heavy traffic, streetlights, unattended dogs, and safety

from crime) and general access to places for physical activity. They found that adults who reported that they had access to places for physical activity were more likely to report any physical activity than adults who reported no access (odds ratio 2.23, 95%). In addition, adults who reported that they had access to walking trails (odds ratio 1.51, 95%) and access to places for physical activity (OR 2.15, 95%) were also more likely to report any physical activity compared to adults who reported no such access. The authors concluded that certain neighborhood characteristics, particularly trails, and access to places for physical activity may be associated with leisure activity levels. Perceived neighborhood environmental factors and access to places for physical activity were strongly associated with race, education, and income.

Convenience. King, Brach, Belle, Killingsworth, Fenton, and Kriska (2003) conducted a cross-sectional study to examine the relationship between physical activity and (1) convenience of destinations, measured by whether destinations (such as a park, trail, businesses, and services) are within walking distance of the home, and (2) participants' perception of the quality of their neighborhood surroundings for walking, by a self-reported neighborhood "walkability" survey. One hundred forty nine older Caucasian women (mean age was 74.2 years) in a community in southwest Pennsylvania participated. Response rate was 79%. Walking levels, leisure-time physical activity, and features of the neighborhood environment were measured with interviewer-administered questionnaires. Physical activity was measured objectively with a pedometer. Living within a 20-minute walk of a park; biking or walking trail; or department, discount, or hardware store was related to higher pedometer readings ($p < .01$). The authors found that the ability to make utilitarian walking trips from home and the perception of having

favorable neighborhood surroundings for walking were associated with increased physical activity levels in older women.

Gender difference. Several studies have examined gender differences in the correlations between perceived environmental factors and physical activity. Bengoecheal, Spence, and McGannon (2005) conducted their research on how gender differences may affect physical activity patterns of individuals among Canadian adults 18 years and older. They found gender-relevant differences in the ways individuals perceive their physical environments are associated with amount of leisure-time physical activity. Foster, Hillsdon, and Thorogood (2004), conducted a study on how adults' perceptions of the social and physical environment related to their self-reported walking behavior. The study was conducted among English adults from16 years to 74 years old, and concluded that women seemed to be more concerned about walking for utility and safety than men. This limited amount of research suggests the need for further study on the relationship between social and physical environment, and walking levels among older women.

Studies Related to Objective Measures of the Environment and PA

Several studies have used objectively measured environmental variables. These have included audit or observations of the environment, secondary data (e.g. public or written records or census data), or a Geographical Information System (GIS) which is 'a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information (U.S. Geographic Survey, 2007).'

King, Belle, Branch, Simkin-Silverman, Soska, and Kriska (2005) conducted a study to identify objectively measured attributes of the neighborhood environment that may be associated with physical activity levels in one hundred fifty eight overweight Caucasian

and African-American postmenopausal women aged 52-62 years. GIS technology was used to obtain neighborhood-level data, including neighborhood socioeconomic status (SES) indicators, the median year that homes were built, and proximity to businesses and facilities. Physical activity level was measured with pedometers. Low neighborhood socioeconomic status, living in a neighborhood with homes built between 1950 and 1969 (representing an urban form that is more pedestrian-friendly than after 1969), and living within walking distance (1500 m) of specific types of businesses and facilities were positively associated with individuals' physical activity level measured by pedometer ($p < 0.05$).

Sallis, Hovell, Hofstetter, Elder, Hackley, Casperse, and Powell (1990) examined the influence of the physical environment on exercise habits. A random sample of 2,053 residents (response rate was 43%) of San Diego, CA, were surveyed regarding exercise habits, whether exercise facilities were free or pay-for-use, and other variables. A grid-map was used to locate and code the respondent's and facilities' addresses, and the authors computed the density of exercise facilities around each respondent's home. Subjects who reported engaging in three or more exercise sessions per week reported a greater density of pay facilities near their homes than did those who reported no exercise sessions.

Needs of Building Walkable Environments

Fenton (2003) suggested needs of building walkable environments by encompassing all levels of interventions to increase people's daily physical activity levels. There were five main points to promote the ideas: 1) needs of effective networks of the pathways, trails, and lanes, 2) needs of compact and high mixed land use with residential, retail and

commercial activities, schools, recreation, and transit accesses, within walking distance, 3) needs of safe environments from crime and traffic by increasing lighting, separating walkways from travel lanes and slow traffic speeds, 4) needs of making buildings near the street with obvious entrances, parking, and many windows to increase the visibility, and 5) needs of including all levels of people, experts, interventions, and policy makers to build an pedestrian friendly environment to make long-term, large-scale change.

Appendix B:
Approval for Research
Protection of Human Subjects
Assurance Identification/ IRB Certification/Declaration of Exemption
University of Hawaii at Manoa Research Services

OMB No. 0990-0263

Protection of Human Subjects
Assurance Identification/IRB Certification/Declaration of Exemption
(Common Rule)

Policy: Research activities involving human subjects may not be conducted or supported by the Departments and Agencies adopting the Common Rule (56FR28003, June 18, 1991) unless the activities are exempt from or approved in accordance with the Common Rule. See section 101(b) of the Common Rule for exemptions. Institutions submitting applications or proposals for support must submit certification of appropriate Institutional Review Board (IRB) review and approval to the Department or Agency in accordance with the Common Rule. Institutions must have an assurance of compliance that applies to the research to be conducted and should submit certification of IRB review and approval with each application or proposal unless otherwise advised by the Department or Agency.

1. Request Type	2. Type of Mechanism	3. Name of Federal Department or Agency and, if known, Application or Proposal Identification No.
[ ] ORIGINAL [ ] CONTINUATION [X] EXEMPTION	[ ] GRANT [ ] CONTRACT [ ] FELLOWSHIP [ ] COOPERATIVE AGREEMENT [ ] OTHER:	
4. Title of Application or Activity "The Relationship Between Social Environment and Walking Levels in Older Women in Hawaii"		5. Name of Principal Investigator, Program Director, Fellow, or Other Megumi Nagira

6. Assurance Status of this Project *(Respond to one of the following)*

[X] This Assurance, on file with Department of Health and Human Services, covers this activity:
Assurance Identification No. F-3926, the expiration date September 23, 2008 IRB Registration No. IORG0000169

[ ] This Assurance, on file with *(agency/dept)*_____, covers this activity.
Assurance No._____, the expiration date_____ IRB Registration/Identification No._____*(if applicable)*

[ ] No assurance has been filed for this institution. This institution declares that it will provide an Assurance and Certification of IRB review and approval upon request.

[X] Exemption Status: Human subjects are involved, but this activity qualifies for exemption under Section 101(b), paragraph 2.

7. Certification of IRB Review (Respond to one of the following IF you have an Assurance on file)

[ ] This activity has been reviewed and approved by the IRB in accordance with the Common Rule and any other governing regulations.
by: [ ] Full IRB Review on (date of IRB meeting) _____ or [ ] Expedited Review on (date)
[ ] If less than one year approval, provide expiration date _____

[ ] This activity contains multiple projects, some of which have not been reviewed. The IRB has granted approval on condition that all projects covered by the Common Rule will be reviewed and approved before they are initiated and that appropriate further certification will be submitted.

8. Comments

CHS #15134

9. The official signing below certifies that the information provided above is correct and that, as required, future reviews will be performed until study closure and certification will be provided.	10. Name and Address of Institution University of Hawaii at Manoa 2444 Dole Street, Bachman Hall Honolulu, HI 96822
11. Phone No. *(with area code)* (808) 956-5007 12. Fax No. *(with area code)* (808) 956-8883 13. Email: dendle@hawaii.edu	
14. Name of Official William H. Dendle	15. Title Compliance Officer
16. Signature	17. Date March 22, 2007

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Appendix C
Agreement to Participate Form
English

CONSENT FORM

The Relationship between Social Environment and Walking Levels in Older Women in Hawaii

Hi, my name is Megumi Nagira and I am a graduate student at the University of Hawaii at Manoa in the Department of Kinesiology and Leisure Science. I am pursuing a graduate degree with an emphasis in Physical Education and have been working with Dr. Julienne Maeda, my advisor for this study.

This research study will examine the relationship between older women's perceptions of their environment and their physical activity levels. Female participants age 60 and older living in Hawaii and attend classes at one of two community centers will be asked to participate. Participation in this study is entirely voluntary. Your decision whether or not to participate will not affect current relationships you have with the community center you attend. If you decide to participate, you are free to withdraw at any time without any penalty.

Procedures:
As a participant, you will be asked to complete three kinds of questionnaires: a physical activity questionnaire, an environmental questionnaire, and a demographic questionnaire. It should take approximately 30 minutes to complete all three.

Confidentiality:
Research data will be confidential to the extent allowed by law. Agencies with research oversight, such as the UH Committee on Human Studies, have the authority to review research data. All of your responses on the questionnaires will be kept private. Additionally, I will not ask you to include your name on the questionnaires. All research records will be shredded once this study has been completed.

Contacts and Questions:
If you have any questions, you may call me at (808) 780-5122, or email to nagira@hawaii.edu. You can also contact to my advisor, Dr. Julienne Maeda, at the University of Hawaii in the Department of Kinesiology and Leisure Science, at (808)956-3810, or julienne@hawaii.edu.

If you have any questions or concerns about your rights as a participant, you may contact with the Committee on Human Studies, 2540 Maile Way Spalding Hall 253 Honolulu, HI 96822; Phone: 808.956.5007; Email: uhirb@hawaii.edu.

Please keep this page for you reference and return the second signature page if you are interested in being a participant in this study.

The Relationship between Social Environment and Walking Levels in Older Women in Hawaii

Section 1.01Consent Form

Section 1.02

Section 1.03 **Certifications**

I certify that I have read and that I understand this form and that I have been given satisfactory answers to all questions concerning my participation, the procedures for this project and other matters. I also understand that participation is voluntary and that I am free to withdraw my participation at any time without penalty.

Statement of Consent:

I have read the above information. I have asked questions and have received satisfactory answers. I consent to participate in the study.

Name (Printed):_____

Signature:_____

Date: _____

Appendix D
Agreement to Participate Form
Japanese

同意書

ハワイの高齢者の歩行量と環境についての研究

こんにちは。私は、ハワイ大学身体運動とレジャー科学学部の大学院生、柳楽　恵（なぎら　めぐみ）です。特に体育の部門にて修士号取得予定にあり、ジュリエン・マエダ教授にアドバイザーとして、この研究に関する助言を頂いています。

この研究は、高齢者の女性の間で、住んでいる環境がどれだけ日常の運動量に影響するかの関係を調べるものです。参加者はハワイに住んでいる６０歳以上の女性です。この研究は自由参加です。参加するかしないかの決断が、今後のあなたのハワイ大学との関係やコミュニティセンターとの関係に影響することはありません。あなたが質問に答えたくない場合や、途中でやめたい場合は、自由に棄権できます。

手順:

この研究に同意された場合、３種類の質問書、１つは住んでいる環境について、２つ目は運動量について、３つ目は個人的情報に対しての質問書を記入していただきます。３種類の質問書全部にかかる時間は、およそ３０分程度だと思われます。

機密性:

この研究の情報は、法律の定める範囲にて機密とされます。研究を監督する部署、ハワイ大学ヒューマン・スタディ委員会は、研究の情報を概観する権限を持ちます。これらの書類は、私的に保管されます。その上、あなたの名前を質問書に記入する事はありません。全ての研究の記録は、研究が終わり次第細かく切断されて処分されます。

質問と連絡先:

質問があれば、いつでも柳楽の携帯電話、（８０８）７８０－５１２２かイーメール、nagira@hawaii.edu までご連絡ください。又は、ハワイ大学身体運動とレジャー科学学部、Julienne　Maeda（ジュリエン・マエダ）教授、Julienne@hawaii.edu、（８０８）９５６－３８１０までご連絡ください。

もしあなたが、研究者以外にこの研究への質問や心配事がある場合、あなたは自由に、Committee on Human Studies, 2540 Maile Way Spalding Hall 253 Honolulu, HI 96822; Phone: 808.956.5007; Email: uhirb@hawaii.edu.
に連絡することができます。

もしあなたがこの研究への参加に興味をお持ちの場合は、このページは参考の為に保管を、そして二枚目の署名のページを提出してください。

ハワイの高齢者の歩行量と環境についての研究

Section 1.04　同意書

Section 1.05 証明

私は、この計画への参加に関する質問や、必要な手順等の十分な説明を受け、この同意書を理解した事を証明します。私は又、この研究は自由参加で、いつでも自由に棄権できることを理解しています。

同意声明:

私はこの研究に関しての情報を読みました。私は私が質問したい事についてすべて答えを得ることができました。私は、この研究に参加する事に、同意します。

氏名 (楷書):_____

署名:_____

日付: _____

Appendix E
Tables 1-6

Table 1: Demographic Information for Participants

Age	n	%	mean=77 SD=7.2
60-69	27	18.75	(Minimum=62, maximum=94)
70-79	63	43.75	
80-89	45	31.25	
90-99	5	3.47	
Missing	4	2.77	
Education	**n**	**%**	
High School or Less	86	59.72	
Collage or Higher	54	37.5	
Missing	4	2.78	
Ethnic Group	**n**	**%**	
Japanese	123	85.42	
White	11	7.64	
Chinese	5	3.47	
Korean	2	1.39	
Philippine	1	0.69	
Hawaiian	1	0.69	
Chinese Japanese	1	0.69	
Living Situation	**n**	**%**	

Alone	55	38.19
Not Alone	86	59.72
Missing	3	2.08

Transportation to CC	n	% (mean travel distance=4miles, SD=4.1)
Walk	24	16.67 (mean travel distance by walk=0.84mils)
Walk or Bus	2	1.39
Walk or Car	1	0.69
Bus	44	30.56 (mean travel distance by bus=3.69mils)
Bus or Car	3	2.08
Car	70	48.61(mean travel distance by car=5.32mils)

Table 2: Physical Activities Reported by Participants

Physical Activity	n	%
Walking	111	77
Other	75	52
Dancing	63	44
Gardening	53	37
TaiChi	26	18
Weight	20	14
Aerobics	17	12
Swimming	12	8
Yoga	7	5
Hiking	4	3
Jogging	2	1
Bicycling	1	1
Missing	4	3

Detail of other activity

Rhythm & Life (a class name), Chi Gong, Luk Tung Kung, Water Exercise, Stretching, Tennis, Korean exercise, and Golf

Table 3: Physical Activity Levels

Physical Activity Level	n	%
High	51	35
Moderate	37	26
Low	18	13
Missing	38	26

Table 4

Two-Tailed Pearson Bivariate Correlation between Demographic and PA Variables

	WforT	WforL	Garden	HW	LMode	LVigor	TPA
Age	-0.08	-0.17	0.05	-0.14	-0.09	-0.03	-0.16
Education	-0.06	0.02	-0.06	-0.03	0.16	0.19	0.08
Distance	-0.25*	-0.03	0.16	-0.11	0.06	0.14	0.02
Transportation	-0.21*	-0.12	0.14	-0.07	0.12	-0.04	-0.04
Living Situation	-0.14	0.06	-0.01	0.14	-0.27**	0.04	-0.02

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

W for T - Walking for Transport, W for L - Walking for Leisure, HW - House Work

LMode - Leisure Time Moderate PA, LVigor - Leisure Time Vigorous PA

TPA - Total Amount of PA, Transportation - Means of Transportation

Table 5

Two-Tailed Pearson Bivariate Correlation Between Environment and PA Variables

	A	B	C	D	E	F	G	H	I	J	K	L
W for T	0.13	0.06	0.18	0.12	0.06	0.02	-0.12	-0.08	0.19	0.26**	0.23*	0
W for L	0.21*	0.17	0.09	-0.09	0.05	0	-0.1	-0.08	0.08	0.07	0.14	-0.07
Gardening	-0.19	-0.1	-0.18	-0.16	0.02	-0.08	-0.01	-0.11	(-)0.26*	(-)0.24*	-0.13	-0.15
HouseW	0.04	0.06	-0.01	-0.15	0.1	0.04	-0.1	-0.08	-0.04	-0.05	0.13	0.04
LModerate	0.02	0.03	0.01	-0.15	-0.12	-0.14	0.07	0.13	0.07	-0.1	0.06	-0.04
LVigorous	0	-0.09	-0.07	0.08	0.02	-0.08	0.17	0.04	0	0.07	-0.11	-0.1
TotalPA	0.07	0.05	0	-0.1	0.04	-0.03	-0.09	-0.12	-0.03	-0.01	0.07	-0.15

** Correlation is significant at the 0.01 lev * Correlation is significant at the 0.05 level (2-tailed).

A-Residencial Density, B-Diversity, C-Access, D-Street Connectivity, E-Infrastructure&Safety for Walking
F-Aesthetics, G-Traffic Hazard, H-Crime, I-Lack of Parking, J-Lack of Cul-de-sacs,
K-Hilliness, L-Physical Barriers
W for T-Walking for Transport, W for L-Walking for Leisure, HouseW-House Work
Lmoderate-Leisure Time Moderate PA, LVigorous-Leisure Time Vigorous PA
Total PA-Total Amount of PA

Table 6

Two-Tailed Pearson Bivariate Correlation Between Environment and Demographic Variables

	Educat	Distan	Transp	livingS	A	B	C	D	E	F	G	H	I	J	K	L
Age	(-)0.4**	-0.16	0.03	(-)0.22**	-0.15	(-)0.22*	-0.04	-0.02	-0.12	-0.12	0.24**	-0.01	-0.17	-0.07	0.02	-0.01
Education		0.17	0.14	-0.02	0.03	0.13	0.05	-0.04	0.03	0.26**	-0.08	0.14	-0.06	-0.01	-0.13	-0.05
Distance			0.35**	-0.02	(-)0.22*	-0.09	(-)0.23*	-0.1	0.03	-0.06	0.08	0	-0.1	-0.18	(-)0.28**	-0.06
Transport				0.04	(-)0.2*	(-)0.2*	(-)0.28**	-0.17	0.08	0.21*	0.13	0.03	-0.14	(-)0.19*	(-)0.31**	-0.08
LivingSituation					-0.1	0.15	-0.05	0.04	0.11	0.04	0.1	0.21*	0	-0.04	-0.01	0.06

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

A-Residencial Density, B-Diversity, C-Access, D-Street Connectivity, E-Infrastructure&Safety for Walking, F-Aesthetics, G-Traffic Hazard, H-Crime, I-Lack of Parking, J-Lack of Cul-de-sacs, K-Hilliness, L-Physical Barriers

Transportation-Means of Transportation

Table 7

Comparison of Types of Leisure Time Physical Activities

Members of CC W & M (n=144)		Members of AARP (n=1817)		CDC National Adults 18&Older	
Physical Activity	%	Physical Activity	%	Physical Activity	%
Walking	77	Walking	67	Walking for Exercise	43
Other	52	Gardening	39	Gardening	28
Dancing	44	WorkOut	27	Stretching	27
Gardening	37	Weight	25	Weight	16
Tai Chi	18	Golf	19	Bicycling	12
Weight	14	Swimming	18	Jogging	11
Aerobics	12	Other	15	Stair Climbing	7
Swimming	8	Running	9	Aerobic Dancing	6
Yoga	5	Aerobics	8	Basketball	6
Hiking	3	Hiking	8	Swimming	6
Jogging	1	Dancing	7	Golf	5
Bicycling	1	Yoga	6	Bowling	3
		Bicycling	6	Tennis	2
		Tai Chi	5	Volleyball	2
		Tennis	5	Football	2
		Bowling	4	Soccer	1
		Paddling	3		

Hula	2
Base or Softball	1

Appendix F

Figure 1: An Ecological Perspective: Levels of Influence

Figure 1: An Ecological Perspective: Levels of Influence

Concept	Definition
Intrapersonal Level	Individual characteristics that influence behavior, such as knowledge, attitudes, beliefs, and personality traits
Interpersonal Level	Interpersonal processes and primary groups, including family, friends, and peers that provide social identity, support, and role definition
Community Level	Rules, regulations, policies, and informal structures, which may constrain or promote recommended behaviors
Organizational Level	Social networks and norms, or standards, which exist as formal or informal among individuals, groups and organizations
Public Policy Level	Local, state, and federal policies and laws that regulate or support healthy actions and practices for disease prevention, early detection, control, and management

Source: Adapted from U.S. Department of Health and Human Services (1996).

Appendix G
PHYSICAL ACTIVITY QUESTIONNAIRE
English

PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

1) PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

(ii) ☐ Yes

☐ No → ***Skip to PART 2: TRANSPORTATION***

The next questions are about all the physical activity you did in the **last 7 days** as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

_____ **days per week**

☐ No vigorous job-related physical activity → ***Skip to question 4***

3. How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work?

_____ **hours per day**
_____ **minutes per day**

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

_____ **days per week**

☐ No moderate job-related physical activity ➡ ***Skip to question 6***

5. How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work?

_____ **hours per day**
_____ **minutes per day**

6. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

_____ **days per week**

☐ No job-related walking ➡ ***Skip to PART 2: TRANSPORTATION***

7. How much time did you usually spend on one of those days **walking** as part of your work?

_____ **hours per day**
_____ **minutes per day**

a) PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram?

_____ **days per week**

☐ No traveling in a motor vehicle ➡ ***Skip to question 10***

9. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

_____ **hours per day**
_____ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐

No bicycling from place to place → ***Skip to question 12***

11. How much time did you usually spend on one of those days to **bicycle** from place to place?

_____ **hours per day**
_____ **minutes per day**

12. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No walking from place to place → ***Skip to PART 3: HOUSEWORK,HOUSE MAINTENANCE, AND CARING FOR FAMILY***

13. How much time did you usually spend on one of those days **walking** from place to place?

_____ **hours per day**
_____ **minutes per day**

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging **in the garden or yard**?

_____ **days per week**

☐ No vigorous activity in garden or yard → ***Skip to question 16***

15. How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

_____ **days per week**

☐ No moderate activity in garden or yard → ***Skip to question 18***

17. How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

_____ **days per week**

☐ No moderate activity inside home → ***Skip to PART 4: RECREATION, SPORT AND LEISURE-TIME PHYSICAL ACTIVITY***

19. How much time did you usually spend on one of those days doing **moderate** physical activities inside your home?

_____ **hours per day**
_____ **minutes per day**

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

_____ **days per week**

☐ No walking in leisure time → ***Skip to question 22***

21. How much time did you usually spend on one of those days **walking** in your leisure time?

_____ **hours per day**
_____ **minutes per day**

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming **in your leisure time**?

_____ **days per week**

☐ No vigorous activity in leisure time → ***Skip to question 24***

23. How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time?

_____ **hours per day**
_____ **minutes per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis **in your leisure time**?

_____ **days per week**

☐ No moderate activity in leisure time → ***Skip to PART 5: TIME SPENT SITTING***

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?
_____ **hours per day**
_____ **minutes per day**

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

_____ **hours per day**
_____ **minutes per day**

27. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekend day**?

_____ **hours per day**
_____ **minutes per day**

This is the end of the questionnaire, thank you for participating.

Appendix H
PHYSICAL ACTIVITY QUESTIONNAIRE IN JAPANESE

日常的な運動の頻度、強度、種類に関する質問表

私は人々が日常生活の中で行う運動の性質について興味があります。この質問表は、貴方が過去７日間に、運動することに費やした時間についてお伺いするものです。貴方が自分自身を活発に運動するほうではないと思われた場合でも、それぞれの質問にお答えください。運動については、職場、家事、庭仕事、移動手段、余暇での運動、又はレクリエーションやスポーツの範囲でお考えください。

貴方が過去７日間に行った全ての**活発な運動**と**適度な運動**についてお考えください。**活発な運動**とは、一生懸命活動し呼吸が通常よりも激しくなる状態。**適度な運動**とは、緩やかな活動により呼吸が通常よりも多少荒い状態を言います。

第１部：仕事に関する運動

第１部では、貴方の仕事についてお伺いします。これは、有給の仕事、農作業、ボランティア、又はその他の貴方が家の外でやった無給の仕事等を含みます。しかし、家事、庭仕事、家の手入れ、家族の世話等の仕事は、無給の仕事の中には含みません。これらについては、第３部にてお伺いします。

1. 貴方は最近有給の仕事又は無給の仕事を家の外で持っていますか？

(iii) ☐ はい

☐ いいえ → **第２部：交通手段へ飛ぶ**

次の質問は、貴方が過去７日間に、有給の職場か無給の職場にて行った全ての運動についてです。これは仕事場へ行くときと帰るときの移動は含みません。

2. 過去７日間に、貴方は**貴方の仕事の中で**、何日**活発な運動**をしましたか？重い物を持ち上げる、地面を掘り起こす、激しい建築作業、又は階段の上り下りの作業の中から最低でも１０分間持続した作業だけを選んでお答えください。

_____ 日/１週間

☐ 職場でまったく活発な運動をしなかった → **４に飛ぶ**

3. 貴方は実際に、一日何時間職場にて**活発な運動**をしましたか？

_____ 時間/１日
_____ 分/１日

4. 過去７日間に、貴方は**貴方の仕事の中で**、何日**適度な運動**をしましたか？軽い物を運ぶような動作を最低１０分間継続した場合のみをお考えください。この動作に歩行運動やウォーキングは含まれません。

_____ 日/１週間

☐ 職場でまったく適度な運動をしなかった → **６に飛ぶ**

5. 貴方は実際に、その１週間の内で、１日何時間、職場にて**適度な運動**をしまし

たか？

_____ 時間/１日
_____ 分/１日

6. 過去７日間に、貴方は仕事の中で何日、最低１０分間継続して歩きましたか？仕事へ行くときと、仕事から帰るときに行った歩行は含まないでください。

_____ 日/１週間

☐ 職場でまったく歩かなかった ➡ 第２部：移動手段へ飛ぶ

7. 貴方は実際に、その１週間の内で、１日何時間、職場にて歩行又はウォーキングをしましたか？

_____ 時間/１日
_____ 分/１日

a) 第２部：移動手段としての運動

次の質問は貴方が、例えば職場、お店、又は映画館など、ある場所から場所へどうやって移動するかについてです。

8. 過去７日間、貴方は何日電車、バス、車、トラムなどといった原動機付き乗り物に乗って移動しましたか？

_____ 日/１週間

☐ 原動機付き乗り物で移動しなかった ➡ １０へ飛ぶ

9. 貴方は実際に、その１週間の内で、１日何時間、電車、バス、車、トラム、その他の原動機付き乗り物に乗って移動しましたか？

_____ 時間/１日
_____ 分/１日

ここでは、貴方が職場にて、職場から又は職場への移動、職場での仕事の為の移動、又は職場内での場所から場所への移動の時に行った、自転車をこぐ事とウォーキングのみについてお考えください。

10. 過去７日間に、貴方は何日、場所から場所に移動する為に、最低１０分間継続して自転車をこぎましたか？

_____ 日/１週間

☐

場所から場所への移動でまったく自転車は使わなかった → １２へ飛ぶ

11. 貴方は実際に、その１週間の内で、１日何時間、自転車をこいで場所から場所へ移動しましたか？

_____ 時間/１日
_____ 分/１日

12. 過去７日間に、貴方は何日、場所から場所に移動する為に、最低１０分継続して歩きましたか？

_____ 日/１週間

☐ 場所から場所への移動でまったく歩かなかった → 第３部：家事、家の手入れ、家族の世話に飛ぶ

13. 貴方は実際に、その１週間の内で、１日何時間、歩いて場所から場所へ移動しましたか？

_____ 時間/１日
_____ 分/１日

第３部：家事、家の手入れ、家族の世話

ここでは、貴方が過去７日間に家のまわりにて行った、家事、ガーデニング、庭仕事、家の手入れ、そして家族の世話に関する運動についてお伺いします。

14. 貴方は、過去７日間に、何日最低１０分間継続して活発な運動をしましたか？ここでは、家のまわりや庭で行う、重い物を持ち上げる、木を切る、雪かき、又は地面を掘り下げるような激しい運動のみについてお考えください。

_____ 日/１週間

☐ 家の周りや庭でまったく活発に運動しなかった → １６に飛ぶ

15. 貴方は実際に、その１週間の内で、１日何時間、家のまわりや庭で活発な運動をしましたか？

_____ 時間/１日
_____ 分/１日

16. 過去７日間に、貴方は家のまわりか庭で、何日適度な運動をしましたか？軽い物を運ぶような動作や、掃き掃除、窓掃除、庭掃除のような軽い運動を最低１０分間継続した場合のみをお考えください。

_____ 日/1週間

☐ 家のまわりや庭でまったく適度な運動をしなかった → １８に飛ぶ

17. 貴方は実際に、その１週間の内で、１日何時間、家のまわりや庭で適度な運動をしましたか？

_____ 時間/1日
_____ 分/1日

18. 過去７日間に、貴方は家の中で、何日適度な運動をしましたか？軽い物を運ぶような動作や、窓掃除、床掃除、掃き掃除のような軽い運動を最低１０分間継続した場合のみをお考えください。

_____ 日/1週間

☐ 家の中でまったく適度な運動をしなかった → 第４部：レクリエーション、スポーツ、そして余暇での運動

19. 貴方は実際に、その１週間の内で、１日何時間、家の中で適度な運動をしましたか？

_____ 時間/1日
_____ 分/1日

第４部：レクリエーション、スポーツ、そして余暇での運動

ここでは、貴方が過去７日間にレクリエーション、スポーツ、エクササイズ、又は余暇として行った、全ての運動についてお伺いします。ここでは、今までに答えていただいた内容の運動は含みません。

20. 過去７日間に、貴方は貴方の余暇時間に、何日最低１０分継続して歩きましか？今までに答えていただいた内容の歩行運動か、ウォーキングは含みません。

_____ 日/1週間

☐ 余暇時間にまったく歩かなかった → ２２へ飛ぶ

21. 貴方は実際に、その１週間の内で、１日何時間、余暇時間に歩行運動又は、ウォーキングをしましたか？

_____ 時間/1日

_____ 分/１日

22. 過去７日間に、貴方は余暇時間の中で、何日活発な運動をしましたか？エアロビクスや、ランニング、速く自転車をこぐ、速く泳ぐといった激しい運動を最低１０分間継続した場合のみをお考えください。

_____ 日/１週間

☐ 余暇時間にまったく活発な運動をしなかった → ２４に飛ぶ

23. 貴方は実際に、その１週間の内で、１日何時間、余暇時間の中で活発な運動をしましたか？

_____ 時間/１日
_____ 分/１日

24. 過去７日間に、貴方は余暇時間の中で、何日適度な運動をしましたか？自転車普通にこいだり、自分のペースで泳いだり、テニスでダブルスをするといった適度な運動を最低１０分間継続した場合のみをお考えください。

_____ 日/１週間

☐ 余暇時間にまったく適度な運動をしなかった → 第５部：座って過ごした時間へ飛ぶ

25. 貴方は実際に、その１週間の内で、１日何時間、余暇時間の中で適度な運動をしましたか？
_____ 時間/１日
_____ 分/１日

第５部：座って過ごした時間

最後に、貴方が、習い事や余暇時間に、座って過ごした時間についてお伺いします。これは、机に向かったり、友人を訪問したり、読書や、テレビを見たりして、座ったり寝転んだりした時間を含みます。今までに答えていただいた内容の、例えば原動機付き乗り物に乗って座っているといった状態は含みません。

26. 貴方は実際に、その１週間の内で、平日（土日を除く）１日何時間、座って過ごしましたか？

_____ 時間/１日
_____ 分/１日

27. 貴方は実際に、その１週間の内で、週末（土日のみ）１日何時間、座って過ごしましたか？

_____ 時間/１日
_____ 分/１日

質問はこれで終わりです。ご協力大変ありがとうございました。

Appendix I
Environmental Questionnaire
English

ANEWS

We would like to find out more information about the way that you perceive or think about your neighborhood. Please answer the following questions about your neighborhood and yourself.

D. Types of residences in your neighborhood

Please circle the answer that best applies to you and your neighborhood.

1. How common are detached single-family residences in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

2. How common are townhouses or row houses of 1-3 stories in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

3. How common are apartments or condos 1-3 stories in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

4. How common are apartments or condos 4-6 stories in your immediate neighborhood?

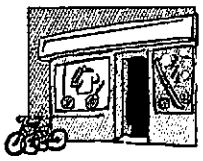
1	2	3	4	5
None	A few	Some	Most	All

5. How common are apartments or condos 7-12 stories in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

6. How common are apartments or condos more than 13 stories in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All



E. Stores, facilities, and other things in your neighborhood

About how long would it take to get from your home to the nearest businesses or facilities listed below if you walked to them? Please put only one check mark (√) for each business or facility.

	1-5 min	6-10 min	11-20 min	20-30 min	30+ min	don't know
example: gas station	1. ____	2. ____	3. √	4. ____	5. ____	6. ____
1. convenience/small grocery store	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
2. supermarket	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
3. hardware store	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
4. fruit/vegetable market	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
5. laundry/dry cleaners	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
6. clothing store	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
7. post office	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
8. library	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
9. elementary school	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
10. other schools	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
11. book store	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
12. fast food restaurant	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
13. coffee place	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
14. bank/credit union	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
15. non-fast food restaurant	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
16. video store	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
17. pharmacy/drug store	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
18. salon/barber shop	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
19. your job or school (check here ____ if not applicable)	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____

	1-5 min	6-10 min	11-20 min	20-30 min	30+ min	don't know
20. bus or train stop	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
21. park	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
22. recreation center	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____
23. gym or fitness facility	1. ____	2. ____	3. ____	4. ____	5. ____	6. ____

F. Access to services

Please circle the answer that best applies to you and your neighborhood. Both local and within walking distance mean within a 10-15 minute walk from your home.

1. Stores are within easy walking distance of my home.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. Parking is difficult in local shopping areas.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There are many places to go within easy walking distance of my home.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

4. It is easy to walk to a transit stop (bus, train) from my home.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

5. The streets in my neighborhood are hilly, making my neighborhood difficult to walk in.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

6. There are major barriers to walking in my local area that make it hard to get from place to place (for example, freeways, railway lines, rivers).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

G. Streets in my neighborhood

Please circle the answer that best applies to you and your neighborhood.

1. The streets in my neighborhood do not have many cul-de-sacs (dead-end streets).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. The distance between intersections in my neighborhood is usually short (100 yards or less; the length of a football field or less).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There are many alternative routes for getting from place to place in my neighborhood. (I don't have to go the same way every time.)

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

You're making great progress.....keep it up!

H. Places for walking and cycling

Please circle the answer that best applies to you and your neighborhood.

1. There are sidewalks on most of the streets in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. Sidewalks are separated from the road/traffic in my neighborhood by parked cars.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There is a grass/dirt strip that separates the streets from the sidewalks in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

I. Neighborhood surroundings

Please circle the answer that best applies to you and your neighborhood.

1. There are trees along the streets in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. There are many interesting things to look at while walking in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There are many attractive natural sights in my neighborhood (such as landscaping, views).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

4. There are attractive buildings/homes in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

J. Neighborhood safety

Please circle the answer that best applies to you and your neighborhood.

1. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. The speed of traffic on most nearby streets is usually slow (30 mph or less).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. Most drivers exceed the posted speed limits while driving in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

4. My neighborhood streets are well lit at night.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

5. Walkers and bikers on the streets in my neighborhood can be easily seen by people in their homes.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

6. There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

7. There is a high crime rate in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

8. The crime rate in my neighborhood makes it unsafe to go on walks during the day.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

9. The crime rate in my neighborhood makes it unsafe to go on walks <u>at night</u>.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

Appendix J
Environmental Questionnaire
Japanese

ANEWS in JAPANESE

C. 近所の環境に関する質問

以下の質問は、あなたの家の近所、すなわち自宅から10～15分程度で歩いて行くことができる範囲の環境に関する質問です。もっともよくあてはまる選択肢一つに○をつけてください。

１．まったくない ２．少しある ３．そこそこにある ４．かなりある ５．全てがそうである

１．　あなたの家の周りには一戸建てはどのくらいありますか。
(１．まったくない ２．少しある ３．そこそこにある ４．かなりある ５．全てがそうである)
２．　あなたの家の周りには1階から3階建てのアパート、マンションはどのくらいありますか。
(１．まったくない ２．少しある ３．そこそこにある ４．かなりある ５．全てがそうである)
３．　あなたの家の周りには4階から6階建てのアパート、マンションはどのくらいありますか。
(１．まったくない ２．少しある ３．そこそこにある ４．かなりある ５．全てがそうである)
４．　あなたの家の周りには7階から12階建てのアパート、マンションはどのくらいありますか。
(１．まったくない ２．少しある ３．そこそこにある ４．かなりある ５．全てがそうである)
５．　あなたの家の周りには13階建て以上のアパート、マンションはどのくらいありますか。
(１．まったくない ２．少しある ３．そこそこにある ４．かなりある ５．全てがそうである)

あなたの家から最も近くにあるお店や施設まで、歩いてどのくらいかかりますか。一つだけ選んであてはまる択肢に○をつけてください。

１．1-5分 ２．6-10分 ３．11-20分 ４．21-30分 ５．31分以上 ６．わからない

１．　コンビニ/小さな食料・日用品の店――――――――――――（１・２・３・４・５・６）
２．　スーパーマーケット――――――――――――――――――――（１・２・３・４・５・６）

３．　金物屋――――――――――――――――――――――（１・２・３・４・５・６）
４．八百屋/くだもの屋――――――――――――――――――（１・２・３・４・５・６）
５．クリーニング店、コインランドリー――――――――――――（１・２・３・４・５・６）
６．衣料品店――――――――――――――――――――――（１・２・３・４・５・６）
７．郵便局 ――――――――――――――――――――――（１・２・３・４・５・６）
８．図書館――――――――――――――――――――――（１・２・３・４・５・６）
９．小学校――――――――――――――――――――――（１・２・３・４・５・６）
１０．小学校以外の学校――――――――――――――――――（１・２・３・４・５・６）
１１．書店――――――――――――――――――――――（１・２・３・４・５・６）
１２．ファーストフード店（ハンバーガー屋、牛丼屋、立ち食いそば屋など）（１・２・３・４・５・６）
１３．喫茶店――――――――――――――――――――――（１・２・３・４・５・６）
１４．銀行――――――――――――――――――――――（１・２・３・４・５・６）
１５．飲食店・レストラン（ファーストフード以外）――――――――――（１・２・３・４・５・６）
１６．ビデオ店／レンタルビデオ店――――――――――――――（１・２・３・４・５・６）
１７．薬局・ドラッグストア――――――――――――――――――（１・２・３・４・５・６）
１８．美容院・床屋――――――――――――――――――――（１・２・３・４・５・６）
１９．あなたの職場・あなたの学校――――――――――――――（１・２・３・４・５・６）
（☐ 通勤も通学もしていない場合はここにチェック☑）
２０．バス停あるいは駅――――――――――――――――――（１・２・３・４・５・６）
２１．公園――――――――――――――――――――――（１・２・３・４・５・６）
２２．公民館・地域センター・レクリエーションセンター――――――――（１・２・３・４・５・６）
２３．体育館・スポーツジム――――――――――――――――――（１・２・３・４・５・６）

もっともよくあてはまる選択肢一つに○をつけてください。 ここで、「近所」「歩いていける範囲」とは自宅から歩いて10-15分以内で行ける範囲を意味します。

１．全くあてはまらない ２．ややあてはまらない ３．ややあてはまる ４．とてもよくあてはまる

１．　ほとんどの買い物は近所のお店で済ませることができる。――――（１・２・３・４）
２．　自宅から簡単に歩いて行ける範囲にお店がいくつかある。――――（１・２・３・４）
３．　近所で買い物をするところでは車を停めることが難しい。――――（１・２・３・４）
４．　近所には、商店、郵便局、公共施設などのような、歩いていける目的地が多い。

（１・２・３・４）
５．　駅、バス停などが自宅から簡単に歩いていける範囲にある。――――（１・２・３・４）
６．　近所には坂が多く、歩くのが大変だ。――――――――――――（１・２・３・４）
７．　近所には谷・丘が多く、目的地まで行く経路が限定される。――――（１・２・３・４）

最もよくあてはまる選択肢一つに○をつけてください。

１．全くあてはまらない ２．ややあてはまらない ３．ややあてはまる ４．とてもよくあてはまる

１．　近所の通りには、行き止まりは少ない。――――――――――（１・２・３・４）
２．　近所では、交差点から交差点までの間隔は短い（100メートル以下程度）。（１・２・３・４）
３．　近所では、目的地に行くのにいろいろな経路がある（いつも同じ経路を使う必要はない）。
（１・２・３・４）

最もよくあてはまる選択肢一つに○をつけてください。

１．全くあてはまらない ２．ややあてはまらない ３．ややあてはまる ４．とてもよくあてはまる

１．　近所のほとんどの道には歩道がある。――――――――――（１・２・３・４）
２．　近所の歩道は、ガードレールや段差で車道と区別されている。－（１・２・３・４）

3．　近所の歩道と車道の間には駐車スペースがある。――――――（１・２・３・４）
4．　近所の歩道は、芝生、植え込み等で車道と隔てられている。――（１・２・３・４）
5．　近所で自転車に乗ることは安全である。――――――――――（１・２・３・４）

最もよくあてはまる選択肢一つに○をつけてください。

１．全くあてはまらない ２．ややあてはまらない ３．ややあてはまる ４．とてもよくあてはまる

1．　近所の通り沿いに木が植えられている。――――――――――（１・２・３・４）
2．　近所を歩いていると、見ていて楽しい物がたくさんある。――――（１・２・３・４）
3．　近所には魅力的な自然の景色が多い。――――――――――（１・２・３・４）
4．　近所には魅力的な家や建物が多い。――――――――――（１・２・３・４）

あなたの近所について、最もよくあてはまる選択肢一つを選んでください。

１．全くあてはまらない ２．ややあてはまらない ３．ややあてはまる ４．とてもよくあてはまる

1．　自宅周辺の通りは交通量が多いため、歩くことが難しかったり、楽しくなかったりする。
（１・２・３・４）
2．　自宅周辺を通る車は、ゆっくりと走っている。――――――――――（１・２・３・４）
3．　近所を走る車のほとんどは、制限速度を超えている。――――――――（１・２・３・４）
4．　近所の通りは、夜でも十分に明るい。――――――――――――――（１・２・３・４）
5．　近所では、歩行者や自転車は、家々の中から簡単に見ることができる
（通りには多くの視線がある）。――――――――――――――――――（１・２・３・４）
6．　近所の交通量の多い通りには、歩行者のために横断歩道、信号機がある。－（１・２・３・４）

7．　近所は犯罪率が高い。――――――――――――――――――――――（１・２・３・４）
8．　近所は犯罪率が高く、昼間でも安全に歩くことができない。――――――――（１・２・３・４）
9．　近所は犯罪率が高く、夜間は安全に歩くことができない。――――――――（１・２・３・４）
１０．近所は十分に安全で、10歳の子供でも昼間は一人で歩かせることができる。（１・２・３・４）

Appendix K
Demographic Information
English

Demographic Information

1. Age ····· years old

2. Education (did you completed ·····? Please check one of them.)

☐ Completed college and higher ☐ Not completed college and lower

3. Ethnicity

☐ White ☐ Korean
☐ Chinese ☐ Native Hawaiian
☐ Filipino ☐ Other ( )
☐ Japanese

4. Physical Disability to Move in Daily Life (if any....)

☐ Arthritis
☐ Osteoporosis
☐ Weak Eye Sight or Eye Problem
☐ Wheelchair
☐ Other Problem to Move ( )

5. Approximately, how far is the community center from your house?

_____Miles or _____Km

6. How do you come to the community center?

☐ Walking
☐ Bicycling
☐ Car
☐ Public Transportation ( )
☐ Other ( )

7. Do you live alone? ☐ Yes ☐ No

8. What kinds of physical activity do you normally do in your daily life? Please check every activity which you think you do.

☐ Walking	☐ Bicycling
☐ Hiking	☐ Dancing
☐ Gardening	☐ Weight Lifting
☐ Yoga	☐ Tai chi
☐ Aerobics	☐ Swimming
☐ Jogging	☐ Other ( )

9. Among the activities in which you chose, which activities do you prefer to do the best? Please list them in order below.

1. ( )
2. ( )
3. ( )

Appendix L
Demographic Information
Japanese

個人統計の情報

1. 年齢 …… 才

2. 学歴（最終学歴を下記より１つお選びください）

- ☐ 短大、専門学校又は大学以上
- ☐ 高校以下

3. 民族グループ

- ☐ 白人
- ☐ 韓国人
- ☐ 中国人
- ☐ ハワイ
- ☐ フィリピン人
- ☐ その他 （　　）
- ☐ 日本人

4. 日常生活の動作に対する身体的障害（もしあれば・・・）

- ☐ 関節炎
- ☐ 骨粗しょう症
- ☐ 弱視又は目に関する障害
- ☐ 車椅子
- ☐ その他（　　）

5. あなたの家は、およそどれくらいコミュニティセンターから離れていますか？

____ マイル　又は　____ Km

6. あなたはどうやってコミュニティセンターまで来ますか？

- ☐ 歩き
- ☐ 自転車
- ☐ 車
- ☐ 公共の交通機関（　　）
- ☐ その他（　　）

7. あなたは一人暮らしですか？ ☐ はい ☐ いいえ

8. あなたは１日の中で主にどんな運動をしますか？当てはまるものすべてにチェックをしてください。

☐	ウォーキング	☐	サイクリング
☐	ハイキング	☐	ダンス
☐	ガーデニング	☐	筋力トレーニング
☐	ヨガ	☐	太極拳
☐	エアロビクス	☐	水泳
☐	ジョギング	☐	その他（　　）

9. あなたが選んだ運動の中でどの運動を一番好んで行いますか？あなたが質問７にて選んだ運動を、よくやる順番に並べてください。

１．（　　）
２．（　　）
３．（　　）

Appendix M
Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ)

Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) – Short and Long Forms

November 2005

Contents

1. Introduction

This document describes recommended methods of scoring the data derived from the telephone / interview administered and self-administered IPAQ short and long form instruments. The methods outlined provide a revision to earlier scoring protocols for the IPAQ short form and provide for the first time a comparable scoring method for IPAQ long form. Latest versions of IPAQ instruments are available from www.ipaq.ki.se.

Although there are many different ways to analyse physical activity data, to date there is no formal consensus on a 'correct' method for defining or describing levels of physical activity based on self–report population surveys. The use of different scoring protocols makes it very difficult to compare within and between countries, even when the same instrument has been used. Use of these scoring methods will enhance the comparability between surveys, provided identical sampling and survey methods have been used.

2. Uses of IPAQ Instruments

IPAQ short form is an instrument designed primarily for population surveillance of physical activity among adults. It has been developed and tested for use in adults (age range of 15-69 years) and until further development and testing is undertaken the use of IPAQ with older and younger age groups is not recommended.

IPAQ short and long forms are sometimes being used as an evaluation tool in intervention studies, but this was not the intended purpose of IPAQ. Users should

carefully note the range of domains and types of activities included in IPAQ before using it in this context. Use as an outcome measure in small scale intervention studies is not recommended.

3. Summary Characteristics of IPAQ Short and Long Forms

1. IPAQ assesses physical activity undertaken across a comprehensive set of domains including:
a. leisure time physical activity
b. domestic and gardening (yard) activities
c. work-related physical activity
d. transport-related physical activity;
2. The IPAQ **short** form asks about three specific types of activity undertaken in the four domains introduced above. The specific types of activity that are assessed are walking, moderate-intensity activities and vigorous-intensity activities.
3. The items in the **short** IPAQ form were structured to provide separate scores on walking, moderate-intensity and vigorous-intensity activity. Computation of the total score for the short form requires summation of the duration (in minutes) and frequency (days) of walking, moderate-intensity and vigorous-intensity activities. Domain specific estimates cannot be estimated.
4. The IPAQ **long** form asks details about the specific types of activities undertaken within each of the four domains. Examples include walking for transportation and moderate-intensity leisure-time activity.
5. The items in the **long** IPAQ form were structured to provide separate domain specific scores for walking, moderate-intensity and vigorous-intensity activity within each of the work, transportation, domestic chores and gardening (yard) and leisure-time domains. Computation of the total scores for the long form requires summation of the duration (in minutes) and frequency (days) for all the types of activities in all domains. Domain specific scores or activity specific subscores may be calculated. Domain specific scores require summation of the scores for walking, moderate-intensity and vigorous-intensity activities within the specific domain, whereas activity-specific scores require summation of the scores for the specific type of activity across domains.

4. Overview of Continuous and Categorical Analyses of IPAQ

Both categorical and continuous indicators of physical activity are possible from both IPAQ forms. However, given the non-normal distribution of energy expenditure in many populations, it is suggested that the continuous indicator be presented as median minutes/week or median MET–minutes/week rather than means (such as mean minutes/week or mean MET-minutes/week).

4.1 Continuous Variables

Data collected with IPAQ can be reported as a continuous measure. One measure of the volume of activity can be computed by weighting each type of activity by its energy requirements defined in METs to yield a score in MET–minutes. METs are multiples of the resting metabolic rate and a MET-minute is

computed by multiplying the MET score of an activity by the minutes performed. MET-minute scores are equivalent to kilocalories for a 60 kilogram person. Kilocalories may be computed from MET-minutes using the following equation: MET-min x (weight in kilograms/60 kilograms). MET-minutes/day or MET-minutes/week can be presented although the latter is more frequently used and is thus suggested.
Details for the computation for summary variables from IPAQ short and long forms are detailed below. As there are no established thresholds for presenting METminutes, the IPAQ Research Committee propose that these data are reported as comparisons of median values and interquartile ranges for different populations.

4.2 Categorical Variable: Rationale for Cut Point Values
There are three levels of physical activity proposed to classify populations:
1. Low
2. Moderate
3. High

The algorithms for the short and long forms are defined in more detail in Sections 5.3 and 6.3, respectively. Rules for data cleaning and processing prior to computing the algorithms appear in Section 7.
Regular participation is a key concept included in current public health guidelines for physical activity.[1] Therefore, both the total volume and the number of days/sessions are included in the IPAQ analysis algorithms.
The criteria for these levels have been set taking into account that IPAQ asks questions in all domains of daily life, resulting in higher median MET-minutes estimates than would have been estimated from leisure-time participation alone. The criteria for these three levels are shown below.
Given that measures such as IPAQ assess total physical activity in all domains, the "leisure time physical activity" based public health recommendation of 30 minutes on most days will be achieved by most adults in a population. Although widely accepted as a goal, in absolute terms 30 minutes of moderate-intensity activity is low and broadly equivalent to the background or basal levels of activity adult individuals would accumulate in a day. Therefore a new, higher cutpoint is needed to describe the levels of physical activity associated with health benefits for measures such as IPAQ, which report on a broad range of domains of physical activity.

'High'
This category was developed to describe higher levels of participation. Although it is known that greater health benefits are associated with increased levels of activity there is no consensus on the exact amount of activity for maximal benefit. In the absence of any established criteria, the IPAQ Research Committee proposes a measure which equates to approximately at least one hour per day or more, of at least moderate-intensity activity above the basal level of physical activity Considering that basal activity may be considered to be equivalent to approximately 5000 steps per day, it is proposed that "high active" category be

considered as those who move at least 12,500 steps per day, or the equivalent in moderate and vigorous activities.
This represents at least an hour more moderate-intensity activity over and above the basal level of activity, or half an hour of vigorous-intensity activity over and above basal levels daily. These calculations were based on emerging results of pedometers studies.[2]
This category provides a higher threshold of measures of total physical activity and is a useful mechanism to distinguish variation in population groups. Also it could be used to set population targets for health-enhancing physical activity when multidomain instruments, such as IPAQ are used.

1 Pate RR, Pratt M, Blair SN, Haskell WL , Macera CA, Bouchard C et al. Physical activity and public health. A recommendation
from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of American Medical Association* 1995; 273(5):402-7. and U.S. Department of Health and Human Services. *Physical Activity and Health: A*
Report of the Surgeon General. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The Presidents' Council on Physical Fitness and Sports:
Atlanta, GA:USA. 1996.
2 Tudor-Locke C, Bassett DR Jr. How many steps/day are enough? Preliminary pedometer indices for public health. Sports
Med. 2004;34(1):1-8.

'Moderate'
This category is defined as doing some activity, more than the low active category. It is proposed that it is a level of activity equivalent to "half an hour of at least moderate-intensity PA on most days", the former leisure time-based physical activity population health recommendation.

'Low'
This category is simply defined as not meeting any of the criteria for either of the previous categories.

5. Protocol for IPAQ Short Form

5.1 Continuous Scores

Median values and interquartile ranges can be computed for walking (W), moderateintensity activities (M), vigorous-intensity activities (V) and a combined total physical activity score. All continuous scores are expressed in MET-minutes/week as defined below.

5.2 MET Values and Formula for Computation of MET-minutes/week

The selected MET values were derived from work undertaken during the IPAQ Reliability Study undertaken in 2000-2001[3]. Using the Ainsworth et al. Compendium
(*Med Sci Sports Med* 2000) an average MET score was derived for each type of activity. For example; all types of walking were included and an average MET value for walking was created. The same procedure was undertaken for moderate-intensity activities and vigorous-intensity activities. The following values continue to be used for the analysis of IPAQ data: Walking = 3.3 METs,

Moderate PA = 4.0 METs and Vigorous PA = 8.0 METs. Using these values, four continuous scores are defined:
Walking MET-minutes/week = 3.3 * walking minutes * walking days
Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days
Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days
Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous METminutes/ week scores.

5.3 Categorical Score
Category 1 Low
This is the lowest level of physical activity. Those individuals who not meet criteria for Categories 2 or 3 are considered to have a 'low' physical activity level.
3 Craig CL,Marshall A , Sjostrom M et al. International Physical Activity Questionnaire: 12 country reliability and validity *Med Sci Sports Exerc* 2003;August

Category 2 Moderate
The pattern of activity to be classified as 'moderate' is either of the following criteria:
a) 3 or more days of vigorous-intensity activity of at least 20 minutes per day
OR
b) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day
OR
c) 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum Total physical activity of at least 600 MET-minutes/week. Individuals meeting at least one of the above criteria would be defined as accumulating a minimum level of activity and therefore be classified as 'moderate'.
See Section 7.5 for information about combining days across categories.

Category 3 High
A separate category labelled 'high' can be computed to describe higher levels of participation.
The two criteria for classification as 'high' are:
a) vigorous-intensity activity on at least 3 days achieving a minimum Total physical activity of at least 1500 MET-minutes/week
OR
b) 7 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 3000 MET-minutes/week.
See Section 7.5 for information about combining days across categories.

5.4 Sitting Question in IPAQ Short Form
The IPAQ sitting question is an additional indicator variable of time spent in sedentary activity and is not included as part of any summary score of physical activity. Data on sitting should be reported as median values and interquartile ranges.

To-date there are few data on sedentary (sitting) behaviours and no well-accepted thresholds for data presented as categorical levels.

6. Protocol for IPAQ Long Form

The long form of IPAQ asks in detail about walking, moderate-intensity and vigorous intensity physical activity in each of the four domains. Note: asking more detailed questions regarding physical activity within domains is likely to produce higher prevalence estimates than the more generic IPAQ short form.

6.1 Continuous Score

Data collected with the IPAQ long form can be reported as a continuous measure and reported as median MET-minutes. Median values and interquartile ranges can be computed for walking (W), moderate-intensity activities (M), and vigorous-intensity activities (V) within each domain using the formulas below. Total scores may also be calculated for walking (W), moderate-intensity activities (M), and vigorous-intensity activities (V); for each domain (work, transport, domestic and garden, and leisure) and for an overall grand total.

6.2 MET Values and Formula for Computation of MET-minutes

Work Domain

Walking MET-minutes/week at work = 3.3 * walking minutes * walking days at work
Moderate MET-minutes/week at work= 4.0 * moderate-intensity activity minutes * moderate-intensity days at work
Vigorous MET-minutes/week at work= 8.0 * vigorous-intensity activity minutes * vigorous-intensity days at work
Total Work MET-minutes/week =sum of Walking + Moderate + Vigorous MET-minutes/week scores at work.

Active Transportation Domain

Walking MET-minutes/week for transport = 3.3 * walking minutes * walking days for transportation
Cycle MET-minutes/week for transport= 6.0 * cycling minutes * cycle days for transportation
Total Transport MET-minutes/week = sum of Walking + Cycling MET-minutes/week scores for transportation.

Domestic and Garden [Yard Work] Domain

Vigorous MET-minutes/week yard chores= 5.5 * vigorous-intensity activity minutes * vigorous-intensity days doing yard work (**Note**: the MET value of 5.5 indicates that vigorous garden/yard work should be considered a moderate-intensity activity for scoring and computing total moderate intensity activities.)
Moderate MET-minutes/week yard chores= 4.0 * moderate-intensity activity minutes * moderateintensity days doing yard work
Moderate MET-minutes/week inside chores= 3.0* moderate-intensity activity minutes * moderateintensity days doing inside chores.
Total Domestic and Garden MET-minutes/week =sum of Vigorous yard + Moderate yard + Moderate inside chores MET-minutes/week scores.

Leisure-Time Domain

Walking MET-minutes/week leisure = 3.3 * walking minutes * walking days in leisure
Moderate MET-minutes/week leisure = 4.0 * moderate-intensity activity minutes * moderate-intensity days in leisure
Vigorous MET-minutes/week leisure = 8.0 * vigorous-intensity activity minutes * vigorous-intensity

days in leisure
Total Leisure-Time MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores in leisure.

Total Scores for all Walking, Moderate and Vigorous Physical Activities

Total Walking MET-minutes/week = Walking MET-minutes/week (at Work + for Transport + in Leisure)
Total Moderate MET-minutes/week total = Moderate MET-minutes/week (at Work + Yard chores + inside chores + in Leisure time) + Cycling Met-minutes/week for Transport + Vigorous Yard chores MET-minutes/week
Total Vigorous MET-minutes/week = Vigorous MET-minutes/week (at Work + in Leisure)
Note: Cycling MET value and Vigorous garden/yard work MET value fall within the coding range of moderate-intensity activities.

Total Physical Activity Scores

An overall total physical activity MET-minutes/week score can be computed as:
Total physical activity MET-minutes/week = sum of Total (Walking + Moderate + Vigorous) METminutes/ week scores.
This is equivalent to computing:
Total physical activity MET-minutes/week = sum of Total Work + Total Transport + Total Domestic and Garden + Total Leisure-Time MET-minutes/week scores.
As there are no established thresholds for presenting MET-minutes, the IPAQ Research Committee proposes that these data are reported as comparisons of median values and interquartile ranges for different populations.

6.3 Categorical Score

As noted earlier, regular participation is a key concept included in current public health guidelines for physical activity.[4] Therefore, both the total volume and the number of day/sessions are included in the IPAQ analysis algorithms. There are three levels of physical activity proposed to classify populations – 'low', 'moderate', and 'high'. The criteria for these levels are the same as for the IPAQ short [described earlier in Section 4.2]

Category 1 Low

This is the lowest level of physical activity. Those individuals who not meet criteria for Categories 2 or 3 are considered 'low'.

Category 2 Moderate

The pattern of activity to be classified as 'moderate' is either of the following criteria:
d) 3 or more days of vigorous-intensity activity of at least 20 minutes per day
OR
e) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day
OR

4 Pate RR, Pratt M, Blair SN, Haskell WL , Macera CA, Bouchard C et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of American Medical Association* 1995; 273(5):402-7. and U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General.* Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The Presidents' Council on Physical Fitness and Sports: Atlanta, GA:USA. 1996.

f) 5 or more days of any combination of walking, moderate-intensity or vigorousintensity activities achieving a minimum Total physical activity of at least 600 MET-minutes/week.
Individuals meeting at least one of the above criteria would be defined as accumulating a moderate level of activity. See Section 7.5 for information about combining days across categories.

Category 3 High
A separate category labelled 'high' can be computed to describe higher levels of participation.
The two criteria for classification as 'high' are:
a) vigorous-intensity activity on at least 3 days achieving a minimum Total physical activity of at least 1500 MET-minutes/week
OR
b) 7 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 3000 MET-minutes/week.
See Section 7.5 for information about combining days across categories.

6.4 IPAQ Sitting Question IPAQ Long Form
The IPAQ sitting question is an additional indicator variable and is not included as part of any summary score of physical activity. To-date there are few data on sedentary (sitting) behaviours and no well-accepted thresholds for data presented as categorical levels. For the sitting question 'Minutes' is used as the indicator to reflect time spent in sitting rather than MET-minutes which would suggest an estimate of energy expenditure.
IPAQ long assesses an estimate of sitting on a typical weekday, weekend day and time spent sitting during travel (see transport domain questions).

Summary sitting variables include
Sitting Total Minutes/week = weekday sitting minutes* 5 weekdays + weekend day sitting minutes* 2 weekend days
Average Sitting Total Minutes/day = (weekday sitting minutes* 5 weekdays + weekend day sitting minutes* 2 weekend days) / 7
Note: The above calculation of 'Sitting Total' excludes time spent sitting during travel because the introduction in IPAQ long directs the responder to NOT include this component as it would have already been captured under the Transport section. If a summary sitting variable including time spent sitting for transport is required, it should be calculated by adding the time reported (travelling in a motor vehicle) under transport to the above formula. Care should be taken in reporting these alternate data to clearly distinguish the 'total sitting' variable from a 'total sitting – including transport' variable.

7. Data Processing Rules
In addition to a standardized approach to computing categorical and continuous measures of physical activity, it is necessary to undertake standard methods for the cleaning and treatment of IPAQ datasets. The use of different approaches and rules would introduce variability and reduce the comparability of data.

There are no established rules for data cleaning and processing on physical activity.
Thus, to allow more accurate comparisons across studies IPAQ Research Committee has established and recommends the following guidelines:

7.1 Data Cleaning

I. Any responses to duration (time) provided in the hours and minutes response option should be converted from hours and minutes into minutes.
II. To ensure that responses in 'minutes' were not entered in the 'hours' column by mistake during self-completion or during data entry process, values of '15', '30', '45', '60' and '90' in the 'hours' column should be converted to '15', '30', '45', '60' and '90' minutes, respectively, in the minutes column.
III. In some cases duration (time) will be reported as weekly (not daily) e.g., VWHRS, VWMINS. These data should be converted into an average daily time by dividing by 7.
IV. If 'don't know' or 'refused ' or data are missing for time or days then that case is removed from analysis.
Note: Both the number of days *and* daily time are required for the creation of categorical and continuous summary variables

7.2 Maximum Values for Excluding Outliers

This rule is to exclude data which are unreasonably high; these data are to be considered outliers and thus are excluded from analysis. All cases in which the sum total of all Walking, Moderate and Vigorous time variables is greater than 960 minutes (16 hours) should be excluded from the analysis. This assumes that on average an individual of 8 hours per day is spent sleeping.
The 'days' variables can take the range 0-7 days, or 8, 9 (don't know or refused); values greater than 9 should not be allowed and those cases excluded from analysis.

7.3 Minimum Values for Duration of Activity

Only values of 10 or more minutes of activity should be included in the calculation ofsummary scores. The rationale being that the scientific evidence indicates that episodes or bouts of at least 10 minutes are required to achieve health benefits.
Responses of less than 10 minutes [and their associated days] should be re-coded to'zero'.

7.4 Truncation of Data Rules

This rule attempts to normalize the distribution of levels of activity which are usually skewed in national or large population data sets.
In IPAQ short - it is recommended that all Walking, Moderate and Vigorous time variables exceeding ' 3 hours' or '180 minutes' are truncated (that is re-coded) to be equal to '180 minutes' in a new variable. This rule permits a maximum of 21 hours of activity in a week to be reported for each category (3 hours * 7 days).
In IPAQ long – the truncation process is more complicated, but to be consistent with the approach for IPAQ short requires that the variables total Walking, total Moderateintensity and total Vigorous-intensity activity are calculated and then, for

each of these summed behaviours, the total value should be truncated to 3 hours (180 minutes).
When analysing the data as categorical variable or presenting median and interquartile ranges of the MET-minute scores, the application of the truncation rule will not affect the results. This rule does have the important effect of preventing misclassification in the 'high' category. For example, an individual who reports walking for 10 minutes on 6 days and 12 hours of moderate activity on one day could be coded as 'high' because this pattern meets the '7 day" and "3000 MET-min" criteria for 'high'. However, this uncommon pattern of activity is unlikely to yield the health benefits that the 'high' category is intended to represent.
Although using median is recommended due to the skewed distribution of scores, if IPAQ data are analysed and presented as a continuous variable using mean values, the application of the truncation rule will produce slightly lower mean values than would otherwise be obtained.

7.5 Calculating MET-minute/week Scores
Data processing rules 7.2, 7.3, and 7.4 deals first with excluding outlier data, thensecondly, with recoding minimum values and then finally dealing with high values.
These rules will ensure that highly active people remain classified as 'high', while decreasing the chances that less active individuals are misclassified and coded as 'high'.
Using the resulting variables, convert time and days to MET-minute/week scores [see above Sections 5.2 and 6.2; METS x days x daily time].

7.6 Calculating Total Days for Presenting Categorical Data on Moderate and High Levels
Presenting IPAQ data using categorical variables requires the total number of 'days' on which all physical activity was undertaken to be assessed. This is difficult because frequency in 'days' is asked separately for walking, moderate-intensity and vigorousintensity activities, thus allowing the total number of 'days' to range from a minimum of 0 to a maximum of 21'days' per week in IPAQ short and higher in IPAQ long. The IPAQ instrument does not record if different types of activity are undertaken on the same day.
In calculating 'moderately active', the primary requirement is to identify those individuals who undertake activity on at least '5 days'/week [see Sections 4.2 and 5.3]. Individuals who meet this criterion should be coded in a new variable called "*at least five days*" and this variable should be used to identify those meeting criterion b) at least 30 minutes of moderate-intensity activity and/or walking; and those meeting criterion c) any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of 600 MET-minutes/week.
Below are two examples showing this coding in practice:
i) an individual who reports '2 days of moderate-intensity' and '3 days of walking' should be coded as a value indicating "*at least five days*";

ii) an individual reporting '2 days of vigorous-intensity', '2 days of moderateintensity' and '2 days of walking should be coded as a value to indicate *"at least five days"* [even though the actual total is 6].
The original frequency of 'days' for each type of activity should remain in the data file for use in the other calculations.
The same approach as described above is used to calculate total days for computing the 'high' category. The primary requirement according to the stated criteria is to identify those individuals who undertake a combination of walking, moderate-intensity and or vigorous-intensity activity on at least 7 days/week [See section 4.2].
Individuals who meet this criterion should be coded as a value in a new variable toreflect *"at least 7 days"*.
Below are two examples showing this coding in practice:
i) an individual who reports '4 days of moderate-intensity' and '3 days of walking' should be coded as the new variable *"at least 7 days"*.
ii) an individual reporting '3 days of vigorous-intensity', '3 days moderateintensity' and '3 days walking' should be coded as *"at least 7 days"* [even though the total adds to 9] .

8. Summary algorithms
The algorithms in Appendix 1 and Appendix 2 to this document show how these rules work in an analysis plan, to develop the categories 1 [Low], 2 [Moderate], and 3 [High] levels of activity.

IPAQ Research Committee
November 2005

APPENDIX 1
At A Glance
IPAQ Scoring Protocol (Short Forms)
Continuous Score
Expressed as MET-min per week: MET level x minutes of activity/day x days per week
Sample Calculation
MET levels MET-minutes/week for 30 min/day, 5 days
Walking = 3.3 METs 3.3*30*5 = 495 MET-minutes/week
Moderate Intensity = 4.0 METs 4.0*30*5 = 600 MET-minutes/week
Vigorous Intensity = 8.0 METs 8.0*30*5 = 1,200 MET-minutes/week

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TOTAL = 2,295 MET-minutes/week
Total MET-minutes/week = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days)
Categorical Score- three levels of physical activity are proposed
1. Low
• No activity is reported **OR**
• Some activity is reported but not enough to meet Categories 2 or 3.
2. Moderate
Either of the following 3 criteria

• 3 or more days of vigorous activity of at least 20 minutes per day **OR**
• 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day **OR**
• 5 or more days of any combination of walking, moderate-intensity or vigorousintensity activities achieving a minimum of at least 600 MET-minutes/week.

3. High

Any one of the following 2 criteria
• Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week **OR**
• 7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week

Please review the full document "Guidelines for the data processing and analysis of the International Physical Activity Questionnaire" for more detailed description of IPAQ analysis and recommendations for data cleaning and processing [www.ipaq.ki.se].

APPENDIX 2

At A Glance

IPAQ Scoring Protocol (Long Forms)

Continuous Score

Expressed as MET-minutes per week: MET level x minutes of activity/day x days per week

Sample Calculation

MET levels MET-minutes/week for 30 min/day, 5 days

Walking at work= 3.3 METs 3.3*30*5 = 495 MET-minutes/week
Cycling for transportation= 6.0 METs 6.0*30*5 = 900 MET-minutes/week
Moderate yard work= 4.0 METs 4.0*30*5 = 600 MET-minutes/week
Vigorous intensity in leisure= 8.0 METs 8.0*30*5 = 1,200 MET-minutes/week

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TOTAL = 3,195 MET-minutes/week
Domain Sub Scores
Total MET-minutes/week at **work** = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days) at work
Total MET-minutes/week for **transportation** = Walk (METs*min*days) + Cycle (METs*min*days) for transportation
Total MET-minutes/week from **domestic and garden** = Vig (METs*min*days) yard work + Mod (METs*min*days) yard work + Mod (METs*min*days) inside chores
Total MET-minutes/week in **leisure-time** = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days) in leisure-time Walking, Moderate-Intensity and Vigorous-Intensity Sub Scores
Total **Walking** MET-minutes/week = Walk MET-minutes/week (at Work + for Transport + in Leisure)
Total **Moderate** MET-minutes/week = Cycle MET-minutes/week for Transport + Mod METminutes/ week (Work + Yard chores + Inside chores + Leisure) + Vigorous Yard chores METminutes
Note: The above is a total moderate activities only score. If you require a total of all moderate-intensity physical activities you would sum Total Walking and Total Moderate
Total **Vigorous** MET-minutes/week = Vig MET-minutes/week (at Work + in Leisure)
Total Physical Activity Score

Total Physical Activity MET-minutes/week = **Walking** MET-minutes/week + **Moderate** METminutes/ week + Total **Vigorous** MET-minutes/week
Continued.....

Also
Total Physical Activity MET-minutes/week = Total MET-minutes/week (at Work + for Transport + in Chores + in Leisure)

Categorical Score- three levels of physical activity are proposed

1. Low
No activity is reported **OR**
a. Some activity is reported but not enough to meet Categories 2 or 3.

2. Moderate
Either of the following 3 criteria
a. 3 or more days of vigorous-intensity activity of at least 20 minutes per day **OR**
b. 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day **OR**
c. 5 or more days of any combination of walking, moderate-intensity or vigorousintensity activities achieving a minimum of at least 600 MET-min/week.

3. High
Any one of the following 2 criteria
• Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week **OR**
• 7 or more days of any combination of walking, moderate- or vigorous- intensity activities accumulating at least 3000 MET-minutes/week

Please review the full document "Guidelines for the data processing and analysis of the International Physical Activity Questionnaire" for more detailed description of IPAQ analysis and recommendations for data cleaning and processing [www.ipaq.ki.se].

Appendix N

NEWS-A scoring

NEWS-A scoring

Subscale A: Residential density (higher score denoting higher walkability)

A1. How common are detached single-family residences in your immediate neighborhood?
A2. How common are townhouses or row houses of 1-3 stories in your immediate neighborhood?
A3. How common are apartments or condos 1-3 stories in your immediate neighborhood?
A4. How common are apartments or condos 4-6 stories in your immediate neighborhood?
A5. How common are apartments or condos 7-12 stories in your immediate neighborhood?
A6. How common are apartments or condos more than 13 stories in your immediate neighborhood?

Responses:
None (1) A few (2) Some (3) Most (4) All (5)

Score on subscale A = A1 + (12 * A2) + (10 * A3) + (25 * A4) + (50 * A5) + (75 * A6)

Subscale B: Land-use mix – diversity (higher score denoting higher walkability)

B1. Convenience/small grocery store
B2. Supermarket
B3. Hardware store
B4. Fruit/vegetable market
B5. Laundry/dry cleaners
B6. Clothing store
B7. Post office
B8. Library
B9. Elementary school
B10. Other schools
B11. Book store
B12. Fast food restaurant
B13. Coffee place
B14. Bank/credit union
B15. Non-fast food restaurant
B16. Video store
B17. Pharmacy/drug store
B18. Salon/barber shop
B19. Your job or school
B20. Bus or trolley stop
B21. Park
B22. Recreation center
B23. Gym or fitness facility

Responses:
1-5 min(5) 6-10 min(4) 11-20 min(3) 21-30 min(2) 31+ min(1) don't know (1)

Note: A 'don't know' response is coded as a "1" because if it is not known whether the facility is within walking distance, the actual walk is likely more than 31 minutes.
Score on subscale: Mean of items

Alternative scoring: For some purposes it may be useful to tally the number of stores or facilities within a 5, 10, or 20-minute walk.

Subscale C: Land-use mix – access (higher score denoting higher walkability)
C1. Stores are within easy walking distance.
C2. There are many places to go within walking distance at my home.
C3. It is easy to walk to a transit stop (bus, train) from my home.

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale C = (C1 + C2 + C3) / 3

Subscale D: Street connectivity (higher score denoting higher walkability)
D1. The distance between intersections in my neighborhood is usually short.
D2. There are many alternative routes for getting from place to place in my neighborhood.

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale D = (D1 + D2) / 2

Subscale E: Infrastructure and safety for walking (higher score denoting higher walkability)
E1. There are sidewalks on most of the streets in my neighborhood..
E2. Sidewalks are separated from the road/traffic in my neighborhood by parked cars.
E3. There is a grass/dirt strip that separates the streets from the sidewalks in my neighborhood.
E4. My neighborhood is well lit at night.
E5. Walkers and bikers on the streets in my neighborhood can be easily seen by people in their homes.
E6. There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighborhood.

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale E = (E1 + E2 + E3 + E4 + E5 + E6) / 6

Subscale F: Aesthetics (higher score denoting higher walkability)
F1. There are trees along the streets in my neighborhood.
F2. There are many interesting things to look at while walking in my neighborhood.
F3. There are many attractive natural sights in my neighborhood.
F4. There are attractive buildings/homes in my neighborhood.

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale F = (F1 + F2 + F3 + F4) / 4

Subscale G: Traffic hazards (higher score denoting lower walkability)
G1. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in my neighborhood.
G2. The speed of traffic on most nearby streets is usually slow.
G3. Most drivers exceed the posted limits while driving in my neighborhood.

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale G = (G1 + 5 - G2 + G3) / 3

Subscale H: Crime (higher score denoting lower walkability)
H1. There is a high crime rate in my neighborhood.
H2. The crime rate in my neighborhood makes it unsafe to go on walks during the day.
H3. The crime rate in my neighborhood makes it unsafe to go on walks at night.

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale H = (H1 + H2 + H3) / 3

Single-item subscale I: Lack of parking (higher score denoting higher walkability)
I1. Parking is difficult in local shopping areas.

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale I = I1

Single-item subscale J: Lack of cul-de-sacs (higher score denoting higher walkability)
J1. The streets in my neighborhood do not have many cul-de-sacs.

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale J = J1

Single-item subscale K: Hilliness (higher score denoting lower walkability)
K1. The streets in my neighborhood are hilly, making my neighborhood difficult to walk in.

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale K = K1

Single-item subscale L: Physical barriers (higher score denoting lower walkability)
L1. There are major barriers to walking in my neighborhood that make it hard to get from place to place (for example, freeways, railway lines, rivers, canyons, hillsides).

Responses:
Strongly disagree (1) Somewhat disagree (2) Somewhat agree (3) Strongly agree (4)

Score on subscale L = L1

Appendix O

List of Physical Activities: World Health Organization (2002)

List of Physical Activities: World Health Organization (2002)

Q4030-4038:

Appendix A4.4: List of Physical Activities

MODERATE **Physical Activities**	**VIGOROUS** **Physical Activities**
Involve moderate physical effort	**Involve hard physical effort**
This make you breathe somewhat harder than normal	**This makes you breathe much harder than normal**
Examples: • **Cleaning** • **Farming** • **Painting/plastering** • **Gardening** • **Swimming**  • **Climbing stairs**	**Examples:** • **Carrying heavy loads** • **Heavy construction** • **Digging** • **Shovelling** • **Sawing wood**  • **Running** • **Strenuous sports**