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博士（スポーツ科学）

Environmental Approaches for Promoting Physical Activity among Overweight Men

過体重・肥満男性の身体活動促進に向けた環境的アプローチ

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PREFACE

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2. Liao Y, Harada K, Shibata A, Ishii K, Oka K, Nakamura Y, Inoue S, Shimomitsu T. (2012). Association of self-reported physical activity patterns and socio-demographic factors among normal-weight and overweight Japanese Men. *BMC public health,* 12, 278.

3. Liao Y, Harada K, Shibata A, Ishii K, Oka K, Nakamura Y, Sugiyama T, Inoue S, Shimomitsu T. (2011). Joint associations of physical activity and screen time with overweight among Japanese adults. *International Journal of Behavioral Nutrition and Physical Activity,* 8, 131.

4. Liao Y, Harada K, Shibata A, Ishii K, Oka K, Nakamura Y, Inoue S, Shimomitsu T. (2011). Perceived environmental factors associated with physical activity among normal-weight and overweight Japanese men. *International Journal of Environmental Research and Public Health,* 8, 931-943.

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CHAPTER 1

INTRODUCTION

1.1 Obesity epidemic

Raised body mass index (BMI) is associated with an increased risk of morbidity from chronic diseases, as well as with higher health-care costs and lower quality of life (Withrow & Alter, 2011; Centers for Disease Control and Prevention, 2009; Blanchard et al., 2005; Li et al., 2005; Sturm, 2002; Thompson & Wolf, 2001). Health hazard of obesity ($BMI \geq 30 kg/m^2$) has been well-recognized (World Health Organization, 2012), however, recent evidence further indicates that BMI in the overweight range ($30 kg/m^2 > BMI \geq 25 kg/m^2$) is also related to increased risk of cardiovascular diseases, type 2 diabetes mellitus, hypertension, and certain types of cancer (Lewis et al., 2009). An increasing prevalence of obesity has been reported in Western countries, and in those countries, the groups with higher risk of obesity varied by age, gender, and race/ethnicity (U.S. Department of Health and Human Services, 2010; Ogden et al., 2006; Rennie & Jebb, 2005; Thorburn, 2005; Bélanger-Ducharme, 2005; Yoshiike et al., 2002). Compared to the U.S. (where the prevalence of obesity is approximately 30%), the prevalence of obesity in Japan is

much lower (approximately 3%) and has changed little during the last 40 years (Flegal et al., 2010; Kanazawa et al., 2002). However, more recently, the prevalence of overweight adults in Japan has grown to 28.6% in men and 20.6% in women, and men aged 40–49 years had the highest percentage (35.9%) (National Health and Nutrition Survey in Japan, 2008). Therefore, with regard to the obesity epidemic, identifying effective, population-based strategies for preventing weight gain would be a public health priority, not only in Western countries, but also in Japan.

1.2 The dose-response association between physical activity and obesity

Numerous longitudinal and cross-sectional studies have shown that engaging in physical activity is beneficial for the prevention of obesity and overweight (Kimm et al., 2005; Ness et al., 2007; Martinez-Gomez et al., 2010; Ruiz et al., 2006; Gutin et al., 2005; Ekelund et al., 2004; Bernstein et al., 2004; Erlichman et al., 2002; Lee et al., 2012). Based on these findings, the World Health Organization has recommended engaging almost daily in at least 30 minutes of moderate-intensity physical activity for the prevention of obesity and other chronic diseases (World Health Organization, 2004). The association of minimum recommended levels of physical activity [moderate-to-vigorous physical activity at least 30 minutes per day, 5 or more days

per week; ≥150 minutes per week] with lower overweight risks was also found in Japanese adults (Liao et al., 2011a). This study has reported that Japanese adults who met 150 minutes of moderate-to-vigorous physical activity weekly might be available against overweight risks (Liao et al., 2011a). Despite such a benefit, overweight and obese individuals spent less time on physical activity and were less likely than normal-weight individuals to meet the recommended level of physical activity (Ness et al., 2007; Martinez-Gomez et al., 2010; Ruiz et al., 2006; Gutin et al., 2005; Ekelund et al., 2004). Therefore, developing effective strategies to promote physical activity to overweight and obese subgroups is needed to prevent further increases in the obesity rate among populations.

1.3 Behavioral epidemiology framework

The behavioral epidemiology framework, which was proposed by Sallis & Owen (1999), provides a systematic approach to develop, evaluate, diffuse behavioral change intervention to improve population health. Five main research phases are included in the behavioral epidemiology framework: **1) Establish Links between Behaviors and Health, 2) Develop Methods for Measuring the Behavior, 3)**

Identify Factors that Influence the Behavior, 4) Evaluate Interventions to Change the Behavior, 5) Translate Research into Practice.

As mentioned above, the dose-response association between physical activity and obesity is well-established in previous findings. In addition, the short version of International Physical Activity Questionnaire is a measurement for physical activity with good reliability and acceptable criterion validity (Murase et al., 2003), which was recommended for the national prevalence studies (Craig et al., 2003). Therefore, the present study tends to focus on phase 3 of behavioral epidemiology framework and identity the factors that influence physical activity among overweight and obese subgroups. Furthermore, according to behavioral epidemiology framework, there are two purposes in phase 3: the first purpose is to describe socio-demographic correlates of physical activity for identifying characteristics of people who are most in need of physical activity intervention; the second purpose in this phase is to identify other factors (i.e. psychological, social, and environmental) that influence physical activity (Sallis & Owen, 1999). Therefore, the present study aims to find out the socio-demographic subgroups that are most in need of physical activity intervention, as well as other factors associated with physical activity among overweight and obese populations.

1.4 Correlates of physical activity in subgroups

From an ecological perspective, physical activity is a complex behavior that is influenced by individual, psychological, social, and environmental factors (Sallis et al., 2006). According to the behavioral epidemiology framework mentioned above, the identification of factors that influence physical activity would be useful for developing tailored and effective physical activity interventions (Sallis & Owen, 1999). Several systematic reviews have examined the correlates of physical activity among adults and reported several consistent correlates that were associated with higher physical activity participation or engagement (Bauman et al., 2002; Trost et al., 2002; Saelens & Handy., 2008). However, previous studies also found that physical activity correlates differed by subgroups, including gender (Bengoechea et al., 2005; Shibata et al., 2009; Foster et al., 2004) (i.e. social support was associated with physical activity in men, whereas enjoyable scenery was associated with physical activity in women), age (Shigematsu et al., 2009) (i.e. street connectivity and traffic safety were associated with walking in younger adults, whereas non-residential destinations and recreation facilities within walking distance were important for older adults that walk) and race/ethnicity (Kelly et al., 2010; Lee & Im, 2010; Ward et al.,

2006) (i.e. social-cognitive variables were more related to physical activity levels in Caucasian girls, whereas environmental factors were more related to physical activity in African-American girls). Therefore, to further identify the correlates of physical activity by subgroups might be beneficial for designing more effective and tailored physical activity interventions to specific subgroup.

With regard to the correlates of physical activity between BMI subgroups, it could be hypothesized some correlates that might be different to those found in normal-weight individuals. Possible reasons for different correlates could be that overweight and obese populations might be more sensitive at a psychosocial level or in environmental perceptions compared to normal-weight individuals. This could be related to the stigma associated with being obese or discrimination that they experienced during their developing years (U.S. Department of Health and Human Services, 2010; Storch et al., 2007). If the different factors associated with physical activity were associated with body mass index status (i.e. normal-weight, overweight, obese), this would suggest a need to develop specific strategies for physical activity intervention according to BMI status.

Therefore, to enhance the understanding of this important research area, the primary purpose of the chapter 2 was to review the correlates of physical activity among overweight and obese populations in previous studies.

CHAPTER 2

CORRELATES OF PHYSICAL ACTIVITY AMONG OVERWEIGHT AND OBESE POPULATIONS: A REVIEW OF THE LITERATURE

2.1 Purpose

The primary purpose of this review was to identify correlates of physical activity among overweight and obese populations.

2.2 Methods

2.2.1 Search strategies and procedures

Literature searches were conducted for English-and Japanese-language articles published between Jan 2000 and Dec 2010 using PubMed, Medline, Psycinfo and the "Japan Medical Abstract Society". The initial search included entries available from Jan 1990 to the Dec 2010. Because of the low numbers of articles published between 1990 and 2000, the lower bound was modified to be the year 2000 after completing the entire article screening process. Combinations of the following key words were used: ("obesity" OR "overweight") AND ("correlates" OR "factors" OR "determinants") AND ("physical activity" OR "walking" OR "exercise" OR "sports").

In addition, according to the physical activity correlate classifications used in previous studies (Bauman et al., 2002; Trost et al., 2002), the following search terms were added for sociodemographic correlates: (“sociodemographic” OR “demographic” OR “socioeconomic”). For psychological and social correlates, the following search terms were added: (“psychosocial” OR “psychological” OR “social”). For environmental factors, the following search terms were added (“environment” OR “environmental factors” OR “environmental attributes”). After a review of the titles and abstracts, articles were considered relevant if they reported physical activity correlates among overweight and/or obese populations. With regard to selection process, titles and abstracts of articles were reviewed by a reviewer to exclude articles out of scope. Then, the full-text articles in English were reviewed by a reviewer, as well as the articles in Japanese were reviewed by two reviewers. Disagreements between the two reviewers were discussed with the other co-authors for a consensus decision.

2.2.2 Inclusion criteria

The inclusion criteria were (1) English-and Japanese-language articles published in scientific journals; (2) sample size was larger than 50; (3) study was published between Jan 2000 and Dec 2010; (4) outcome variables, such as physical activity

were objectively measured or self-reported; (5) study had independent variables such as individual, psychological, social, and environmental factors; and (6) study had body mass index measures. Specifically, the subjects were classified into either overweight or obese. In addition, based on article selection of the present study was not conducted according to age groups, the recommended levels of physical activity for obesity prevention were not considered for inclusion and/or exclusion criteria.

2.3 Results

For the period Jan 2000 to Dec 2010, the combination of the following search key words: (“obesity” OR “overweight”) AND (“correlates” OR ”factors” OR ”determinants”) AND (“physical activity” OR “walking” OR “exercise” OR “sports”), across the three English-language databases provided 8,980 article hits (PubMed/Medline: 7,661; Psycinfo: 1,319). After reviewing the titles and abstracts of the 8,980 articles, five articles (Blanchard et al., 2005; Ward et al., 2006; De Bourdeaudhuij et al., 2005; Hallal et al., 2008; Morgan et al., 2008) were considered relevant as they examined the association between correlates of PA among overweight or obese populations. In addition, after reviewing the 3,793 article hits from advanced searching for sociodemographic (PubMed/Medline: 609; Psycinfo: 211), psychosocial

(PubMed/Medline: 1,390; Psycinfo: 576) and environmental (PubMed/Medline: 742; Psycinfo: 265) correlates published between Jan 2000 and Dec 2010, three articles (Gesell et al., 2008; Santos et al., 2008; Mota et al., 2009) were also found to meet the inclusion criteria for this review. After searching the combinations of key words in the Japan Medical Abstract Society (N= 251), one Japanese-language article (Tsujishita et al., 2002) was also included in this review.

2.3.1 Characteristics of the studies

A total of nine articles published between Jan 2000 and Dec 2010 were deemed to meet the inclusion criteria for this review. Table 2-1 shows the characteristics of the nine studies ordered according to publication date. Most studies originated from the United States (Blanchard et al., 2005; Ward et al., 2006; Gesell et al., 2008) and Europe (Bourdeaudhuij et al., 2005; Santos et al., 2008; Mota et al., 2009) and there was one each from Brazil (Hallal et al., 2008), Australia (Morgan et al., 2008) and Japan (Tsujishita et al., 2002). The independent variables reported by these studies primarily included individual, psychological, social and environmental correlates. The outcome variable was self-reported total physical activity in all studies except for the studies performed by Morgan et al. (2008) and Tsujishita, et al., (2002). All the studies

used a cross-sectional design.

Regarding the participants used in the nine studies, four of the studies included adults (Blanchard et al., 2005; Hallal et al., 2008; Santos et al., 2008; Tsujishita et al., 2002), three studies focused on adolescents (Ward et al., 2006; Bourdeaudhuij et al., 2005; Mota et al., 2009), two of the three studies only examined the correlates of physical activity among overweight girls (Ward et al., 2006; Mota et al., 2009). In addition, Gesell et al. (2008) examined the correlates of physical activity among 114 overweight children, whereas Morgan et al. (2008) identified the correlates of objectively measured physical activity in 137 obese children.

Table 2-1

Key characteristics of previous studies (ordered according to publication date)

First author (Year)	Country	Independent Variables	Outcome variables	Sample size－N (%)
Tsujishita, et al. (2002)	Japan	Psychosocial correlates	Self-reported change of PA stage	1,014 women; mean age: 54.7 yr · Normal: 431 (42.5%) · Overweight: 583 (57.5%)
Blanchard, et al. (2005)	US	Social ecological correlates	Self-reported total PA	5,914 adults; mean age: ---* · Normal: 1,867 (31.6%) · Overweight: 2,145 (36.3%) · Obese: 1,902 (32.1%)
De Bourdeaudhuij, et al. (2005)	Belgium	Psychosocial correlates	Self-reported total PA	6,078 adolescents; age: 11-19 yr · Normal: 5,563 (91.5%) · Overweight: 515 (8.5%)
Ward, et al. (2006)	US	Social-cognitive and environmental correlates	Self-reported total PA	1,015 girls; mean age: 14.6 yr · Normal: 646 (63.6%) · At risk: 160 (15.8%) · Overweight: 209 (20.6%)
Gesell, et al. (2008)	US	Self-efficacy, belief, and social influence	Self-reported total PA	114 children; mean age: 9.78 yr · Overweight: 114 (100%)
Hallal, et al. (2008)	Brazil	Socio-demographic correlates	Self-reported total PA	3,047 adults; mean age: 43.2 yr · Normal: 1,542 (50.6%) · Overweight: 1,068 (35.1%) · Obese: 437(14.3%)
Santos, et al. (2008)	Portugal	Perceived environmental correlates	Self-reported total PA	7,730 adults; mean age: 38.13 yr · Normal: 3,013 (41.1%) · Overweight: 3,006 (41.0%) · Obese: 1,311 (17.9%)
Morgan, et al. (2008)	Australia	Individual and psychosocial correlates	Objectively measured PA	137 children: mean age: 8.3 yr · Obese: 137 (100%)
Mota, et al. (2009)	Portugal	Perceived environmental correlates	Self-reported total PA	162 Girls; mean age: 14.1 yr · Overweight: 162 (100%)

Abbreviation: Ref, reference; Normal, normal-weight; yr, years; PA, physical activity.

* Not reported.

All studies used a cross-sectional design.

2.3.2 Correlates of physical activity among overweight and obese populations

In order to be consistent with the approaches of previous reviews (Bauman et al., 2002; Trost et al., 2002), factors associated with physical activity among overweight and obese populations were categorized into sociodemographic, psychological, social and environmental correlates (Table 2-2).

(1) Sociodemographic correlates

Three studies examined sociodemographic correlates of physical activity among overweight and obese populations. A negative association between physical activity and age was found in two studies (Hallal et al. 2008; Morgan et al., 2008) although this association was not found in overweight Belgian adolescents (Bourdeaudhuij et al., 2005). In addition, Hallal et al. (2008) reported that overweight women were more likely to be inactive than overweight men and that there was a positive correlation between physical activity and education level in overweight Brazilian adults.

(2) Psychological correlates

Self-efficacy was found to be associated with physical activity among overweight and obese populations in three studies (Blanchard et al., 2005; Ward et al.,

2006; Tsujishita et al., 2002), however this association was not found in other studies (Bourdeaudhuij et al., 2005; Gesell et al., 2008). Perceived benefits (PROS) or barriers (CONS) of PA were also important psychological motivations affecting PA participation. Bourdeaudhuij et al. (2005) identified PROS and CONS of physical activity among normal-weight and overweight adolescents. The results showed that overweight adolescents who perceived physical activity as fun (general attitude) and an opportunity for competition (PROS) were more likely to participate in physical activity, whereas those who reported a lack of interest (CONS) were less likely to engage in physical activity (Bourdeaudhuij et al., 2005). In addition, perceived behavioral control was also a positive psychological correlate of physical activity among overweight adolescent girls (Ward et al., 2006), whereas perceived barriers of decisional balance (CONS) was a negative factor associated with change of physical activity stage among obese women (Tsujishita et al., 2002). No significant associations were observed between physical activity and relaxation from work (PROS), lack of time (CONS), belief about physical activity, health-related quality of life or perceived competence (Bourdeaudhuij et al., 2005; Morgan et al., 2008; Gesell et al., 2008).

(3) Social correlates

Social support has emerged as a consistently important correlate not only in the general population (Bauman et al., 2002) but also in overweight and obese populations (Blanchard et al., 2005; Ward et al., 2006; Bourdeaudhuij et al., 2005). In addition to social support, social influence (Gesell et al., 2008) and sport participation (Ward et al., 2006) were two social correlates of higher physical activity among overweight and obese populations.

(4) Environment correlates

Only perceived environmental correlates of physical activity among overweight and obese populations have been examined. Significant associations between perceived environmental factors and physical activity were found in three studies (Blanchard et al., 2005; Santos et al., 2008; Mota et al., 2009). Two perceived environmental correlates of physical activity were consistently observed. These were, good access to facilities (Blanchard et al., 2005; Mota et al., 2009) and seeing people being active (Santos et al., 2008; Mota et al., 2009). Furthermore, Santos et al., (2008) reported that overweight/obese Portuguese women who perceived the presence of infrastructure, good access to destinations and aesthetics were more likely to be

physically active, whereas perceived neighborhood safety was not associated with physical activity.

Table 2-2

Correlates of physical activity among overweight and obese populations

	Associations with physical activity		
	Positive association	Negative association	No association
Sociodemographic correlates			
Gender (female)		[5]	
Age		[5], [7]	[2]
Educational level	[5]		
Psychological correlates			
Self-efficacy	[1], [3], [9]		[2], [4]
General attitude (Fun)	[2]		
PROS－Competition benefit	[2]		
PROS－Relax from work			[2]
CONS－Lack of time			[2]
CONS－Lack of interest		[2]	
CONS－Decisional balance		[9]	
Belief about physical activity			[4]
Perceived behavioral control	[3]		
Health-related quality of life			[7]
Perceived competence			[7]
Social correlates			
Social support	[1], [2], [3]		
Social influence	[4]		
Sport participation	[3]		
Environment correlates (perceived)			
Access to facilities	[1], [8]		
Infrastructures	[6]		
Access to destinations	[6]		
Seeing people being active	[6], [8]		
Aesthetics	[6]		
Neighborhood safety			[6]

PROS: Perceived benefits; CONS: Perceived barriers

[1]: Blanchard et al., 2005; [2]: De Bourdeaudhuij et al., 2005; [3]: Ward et al., 2006; [4]: Gesell et al., 2008; [5]: Hallal et al., 2008; [6]: Santos et al., 2008; [7]: Morgan et al., 2008; [8]: Mota et al., 2009; [9]: Tsujishita et al., 2006.

2.3.3 Comparison of the correlates between normal-weight and overweight/obese populations

Five studies compared the physical activity correlates between normal-weight and overweight/obese populations, whereas four studies examined physical activity correlates only in overweight/obese populations. The common and different correlates between normal-weight and overweight/obese populations are presented in Table 2-3. Two studies found that the correlates of physical activity between normal-weight and overweight/obese populations were different. These correlates were, access to facilities (Blanchard et al., 2005) (i.e. access to facilities were found to be associated with physical activity in normal-weight adults but not in obese adults) and gender (Hallal et al., 2008) (i.e. gender was a correlate of physical activity only in normal-weight adults but not in overweight/obese adults).The other three studies found no differences in the physical activity correlates among the two groups.

Table 2-3

Correlates of physical activity between normal-weight and overweight/obese populations

	Correlates of physical activity	
First author (Year)	Common correlate	Different correlate
Tsujishita, et al. (2002)	----------	----------
Blanchard, et al. (2005)	Social support Self-efficacy	Access to facilities
De Bourdeaudhuij, et al. (2005)	General attitude (Fun) PROS－Competition benefit Social support CONS－Lack of interest	
Ward, et al. (2006)	Self-efficacy Social support Sport participation Perceived behavioral control	
Gesell, et al. (2008)	----------	----------
Hallal, et al. (2008)	Age Education	Gender
Santos, et al. (2008)	Infrastructures, Access to destinations, Social environment Aesthetics	
Morgan, et al. (2008)	----------	----------
Mota, et al. (2009)	----------	----------

Abbreviation: Ref, reference.

2.4 Discussion

This study reviewed nine articles published between Jan 2000 and Dec 2010 with the aim of clarifying the factors associated with physical activity among overweight and obese populations. The consistently reported correlates of physical activity included sociodemographic, psychological, social and environmental factors and these were observed in numerous settings, ages and gender groups. The factors associated with physical activity among overweight and obese populations were from multiple levels and included age (Hallal et al., 2008; Morgan et al., 2008), self-efficacy (Blanchard et al., 2005; Bourdeaudhuij et al., 2005; Tsujishita et al., 2002), social support (Blanchard et al., 2005; Ward et al., 2006), good access to facilities (Blanchard et al., 2005; Mota et al., 2009) and seeing people being active (Santos et al., 2008; Mota et al., 2009). These findings are important for policy makers and intervention designers for developing effective physical activity intervention strategies.

Despite finding five consistently reported correlates of physical activity that can be used for developing strategies to decrease the overweight/obesity epidemic further research is still required in this area, specifically in non-western countries. However, the need for the development of specific physical activity intervention strategies for

overweight and obese populations remains controversial. Two studies have argued that BMI status should be considered when designing physical activity intervention for overweight and obese individuals (Blanchard et al., 2005; Hallal et al., 2008), whereas other studies have recommended that no specific physical activity strategies are needed for individuals with different weight categories (Ward et al., 2006; Bourdeaudhuij et al., 2005). Moreover, no different physical activity correlates were observed in psychological or social level but in personal characteristics and perceptions of environment between normal-weight and overweight populations. Therefore, these conflicting results suggest that future studies examining physical activity programs for overweight/obese populations should consider BMI as a potential moderator of the correlates of physical activity, especially in personal and perceived environmental levels.

In addition, except for the studies of Morgan et al. (2008) and Tsujishita, et al. (2002), the outcome variable of the other seven articles was self-reported total physical activity. In recent years, the importance of examining correlates of objectively-assessed physical activity and specific physical activity behavior has been emphasized to avoid physical activity reporting bias (Prince et al., 2008) and to better understand the specific physical activity outcome and its associated factors

(Giles-Corti et al., 2005). However, only one study focused on the correlates of objectively-measured physical activity (Morgan et al., 2008) (accelerometers) while no studies have focused on specific self-reported physical activity behavior (such as walking, jogging or cycling) among overweight and obese populations. Therefore, to further identify the correlates of objectively-measured or specific self-reported physical activity behavior between normal-weight and overweight/obese populations should be considered.

Based on the findings of this study, two studies (Blanchard et al., 2005; Ward et al., 2006) identified multiple levels of correlates, four studies (Bourdeaudhuij et al., 2005; Morgan et al., 2008; Gesell et al., 2008; Tsujishita et al., 2002) focused on psychosocial correlates, and two studies (Santos et al., 2008; Mota et al., 2009) examined perceived environmental correlates of physical activity among overweight and obese populations. Although physical activity behavior could be influenced by multiple levels of factors, different types and purposes of physical activity behaviors occur in specific behavioral settings and are expected to be affected by different environmental characteristics (Sallis et al., 2006). In this context, a growing number of recent studies have identified specific physical activity-environment relationships that facilitate or hinder physical activity participation (Saelens & Handy, 2008).

Compared with psychosocial factors, it has been suggested that the manipulation of environmental attributes could provide a long-term impact on physical activity in large populations (Inoue et al., 2009; Sallis & Owen, 2002). According to the findings of this review, Santos et al. (2008) and Mota et al. (2009) identified environmental factors that overweight and obese populations perceive to be related to their physical activity levels. However, in addition to the perceived environmental factors, several objectively-assessed environmental factors (i.e. higher residential density, more land use mix and higher street connectivity) were found to be consistently related to higher levels of physical activity (Saelens & Handy, 2008; Brownson et al., 2009). In particular, recent studies have suggested that examining the levels of discord between perceived and objectively-assessed environmental factors could be a potential opportunity for promoting physical activity behavior change (Gebel et al., 2009; Gebel et al., 2011; Ball et al., 2008). Furthermore, for targeting specific inactive subgroups, several studies have suggested that the environmental factors associated with physical activity differ according to sociodemographic subgroups (Bengoechea et al., 2005; Shigematsu et al., 2009; Hooker et al., 2005; Kamada et al., 2009). To date, no studies have examined objectively-assessed or both perceived and objectively-assessed environmental correlates of physical activity among

normal-weight and overweight populations**.** As a result, future studies should consider examining environmental correlates of physical activity utilizing both perceived and objectively-assessed measurements among populations with different BMI categories.

2.5 Conclusions

For obesity prevention, further research is required, particularly in non-western countries that is aimed at developing effective physical activity interventions for overweight and obese populations. Future studies should examine both perceived and objectively-measured environmental factors associated with specific physical activity behavior. Understanding the impact of these environmental factors on physical activity may have an important impact on the development of effective physical activity interventions for overweight/obese populations.

2.6 Purpose of this dissertation

As identified above, to date, limited studies have aimed at examining physical activity correlates among overweight/obese populations, specifically in non-western countries. In addition, for developing effective physical activity interventions among overweight and obese populations in a long-term impact, to further examine perceived environmental factors associated with specific physical activity behavior is still required in this area. Therefore, the purpose of this study to investigate associated factors of physical activity among overweight Japanese men in following two studies;

1. Associations of self-reported physical activity patterns and socio-demographic factors among normal-weight and overweight Japanese men.
2. Perceived environmental factors associated with physical activity among normal-weight and overweight Japanese men.

CHAPTER 3

SOCIO-DEMOGRAPHIC AND PERCEIVED ENVIRONMENTAL FACTORS ASSOCIATED WITH PHYSICAL ACTIVITY AMONG NORMAL-WEIGHT AND OVERWEIGHT JAPANESE MEN

3.1 Background

A better understanding of factors associated with physical activity is critical in designing relevant policies and effective interventions. In order to develop effective interventions for obesity prevention, a better understanding of the patterns and socio-demographic correlates of physical activity among overweight or obese groups for the first step is critical because this information could help in targeting socio-demographic subgroups that are less likely to engage in sufficient physical activity. A large number of studies have examined physical activity patterns (Beets et al., 2010; Armstrong & Welsman, 2006) and socio-demographic factors associated with physical activity among different populations and inactive subgroups (Bauman et al., 2002; Trost et al., 2002; Inoue et al., 2011; Hallal et al., 2012; Bauman et al., 2012). Regarding overweight and obese populations, some studies observed that the physical activity patterns differed according to weight status (Dorsey et al., 2010;

Davis et al., 2006; Treuth et al., 2007). Similarly, a study conducted on Brazilian adults indicated that socio-demographic variables (e.g., sex and education) associated with self-reported physical activity seem to differ between normal-weight and overweight or obese adults (Hallal et al., 2008). The study suggested that this was due to overweight and obese individuals having different motivations or preferences with respect to physical activity participation compared with normal-weight people.

The importance of further identifying how patterns of physical activity and socio-demographic characteristics differ according to BMI status was highlighted in these previous studies in order to emphasize the effect of physical activity intervention for overweight and obese adults (Dorsey wt al., 2010; Davis et al., 2006; Treuth et al., 2007; Hallal et al., 2008). However, to date few studies have examined physical activity patterns and associated socio-demographic factors stratified by BMI status. Substantial evidence on this issue is necessary for intervention designers and policy makers, especially in Asia, which has faced a growing obesity epidemic in recent years. In addition, previous studies have compared only the time spent in physical activity of different intensities (e.g., moderate- , vigorous-, or moderate- to vigorous-intensity activities) between normal and overweight or obese individuals (Dorsey et al., 2010; Davis et al., 2006; Treuth et al., 2007). However, to date, few

studies have described and compared the behavioral domains (e.g., walking, other type of physical activity) between normal and overweight or obese people.

In addition, from an ecological perspective, the manipulation of environmental attributes would be expected to provide a long-term impact on the physical activity of an associated population (Inoue et al., 2009; Sallis & Owen, 2002). In this context, the association between environmental factors and physical activity behaviors has been reported not only in many countries (Saelens et al., 2008; Sallis et al., 2009; McCormack & Shiell, 2011; Van Dyck et al, 2012) but Japan (Kondo et al., 2009; Inoue et al., 2009; Inoue et al., 2010; Inoue et al., 2011; Hanibuchi et al., 2011; Lee et al., 2011). However, many of these previous studies have been conducted in general populations (Saelens et al., 2008; Bamana et al., 2008). Recent studies have suggested that environmental factors associated with physical activity differ between socio-demographic subgroups, such as men and women (Santos et al., 2008; Bengoechea et al., 2005), older and younger adults (Shigematsu et al., 2009), African-American and white adults (Hooker et al., 2005), and driving and non-driving rural women (Kamada et al., 2009). In addition to these differences, BMI status has been also suggested as a potential moderator for the correlates of physical activity (Hallal et al., 2008). It is important to examine the factors associated with engaging in

physical activity in the overweight subgroup to develop more tailored intervention strategies. However, to date only a Portuguese study has examined the environmental dimensions associated with meeting the physical activity recommendation among overweight/obese women (Santos et al., 2008), although previous studies have consistently observed gender differences in environmental correlates (Santos et al., 2008; Foster et al., 2004).

In order to accumulate more evidence on the socio-demographic and environmental correlates of physical activity among overweight Japanese men, thus, there are two parts in this chapter. Part I determines whether there should be a focus on a particular domain of physical activity behavior and also whether special consideration should be given to individuals most in need of intervention when designing effective physical activity programs for overweight men. Part II examines the differences in perceived environmental factors associated with physical activity among normal-weight and overweight Japanese men.

3.2 Methods

3.2.1 Participants

An Internet-based cross-sectional survey was conducted in January 2009 by a

Japanese Internet-research service company, which holds data, including socio-demographic attributes, on approximately 264,000 adult registrants. This allows the company to target a particular demographic group according to a survey's requirements. The present study sought a sample of approximately 3,000 adults aged between 30 and 59 years, with 500 men and 500 women from three age-groups (30–39, 40–49, and 50–59 years). In all, 9,418 adults were randomly selected from the database and received an e-mail inviting them to participate in this Internet-based survey. The Internet-research service company offered rewards points valued at 40 yen. One U.S. dollar was equivalent to approximately 109 yen at the time. Of these, 3,000 individuals answered the survey questions online (response rate: 31.9%). The study received prior approval from the Ethics Committee of the Faculty of Sports Sciences, Waseda University, Japan.

3.2.2 Socio-demographic variables

In the present study, the socio-demographic variables obtained from the research company included gender, age (categorized as 30–39, 40–49, and 50–59 years), marital status (classified as married and unmarried), educational level (categorized as junior high and high school graduation, two years' college degree or equivalent, and

four years' college or higher degree), job status (classified as full-time and not full-time employment), and household income (categorized as less than 5 million yen, 5–10 million yen, and over 10 million yen).

3.2.3 Perceived environmental measures

The Japanese version of the International Physical Activity Questionnaire-Environmental Module (IPAQ-E) was utilized to measure the perceived environmental factors associated with physical activity. The IPAQ-E questionnaire was originally developed by the International Physical Activity Prevalence Study (IPS), has been used in several countries, and has shown good reliability (Inoue et al., 2009, Bergman et al., 2009; Santos et al., 2009; Oyeyemi et al., 2008; Doerksen et al., 2007). This self-administered questionnaire consists of three sets of items, which include seven core items, four recommended items, and six optional items (IPAQ Homepage). In this study, all 17 items were included using a 4-point Likert scale (strongly agree, somewhat agree, somewhat disagree, and strongly disagree), with the exception of the following two questions: (1) What is the main type of housing in your neighborhood? For this question, the five options were detached single-family housing; apartments with 2–3 stories; mix of single-family

housing and apartments with 2–3 stories; condos with 4–12 stories; and condos with >13 stories. (2) How many household cars or auto bikes are there at your household? This question was open ended. For the analyses, similar to previous studies (Inoue et al., 2009; Ishii et al., 2010], the 17 environmental variables were converted into binary items. Residential density was divided into “detached single-family housing” and “others”, and having household car or auto bikes was classified into “0” and “>0”. Other items were categorized as “agree” (strongly agree and somewhat agree) and “disagree” (somewhat disagree and strongly disagree).

3.2.4 Self-reported physical activity measures

Physical activity was measured by the self-administered, short version of the International Physical Activity Questionnaire (IPAQ-SV), which has been recommended for national prevalence studies (Craig et al., 2003). The IPAQ-SV, which includes seven items, was used to measure the frequency and duration of vigorous-intensity physical activity, moderate-intensity physical activity, and walking-level physical activity for young and middle-aged adults (15–69 years). The test-retest reliability (r = 0.72–0.93) and criterion validity (r = 0.39) of the Japanese version of the IPAQ-SV are good and acceptable (Murase et al., 2003). The total

number of minutes per week in each physical activity category was computed. In the present study, three outcome variables in the IPAQ-SV were calculated: (1) total physical activity—the total number of minutes spent walking and undergoing moderate and vigorous activity; (2) walking—the total number of minutes spent walking; (3) moderate-to-vigorous physical activity (MVPA)—the total number of minutes engaged in moderate-to-vigorous activity. The three outcome variables were dichotomized into <150 minutes and ≥150 minutes according to public-health physical activity recommendations (Haskell et al., 2007).

3.2.5 Body mass index measures

Self-reported height and weight were utilized to calculate the body mass index (BMI; body weight in kilograms divided by the square of the height in meters). Self-reported height and weight, generally has a high correlation with objective measurement (Gorber et al., 2007; Spencer et al., 2002), has been considered as a valid and reliable measurement for middle–aged employed Japanese men (Wada et al., 2005). Participants with a BMI ≥25kg/m^2 were defined as overweight in the present study.

Part I - Association of self-reported physical activity patterns and socio-demographic factors among normal-weight and overweight Japanese men

3.3 Statistical analysis

The data were analyzed from 1,420 men who provided complete information for the study variables. All analyses were stratified by BMI status. Mann–Whitney and chi-square test analyses were used to compare the differences in the time spent in physical activity, identify sample characteristics, and determine the proportional differences in attaining a weekly total of 150 minutes of physical activity, walking, and MVPA between normal-weight and overweight men. Likelihood ratio tests were used to compare models with or without interaction terms between socio-demographic variables and BMI status for the three physical activity outcome variables. If a significant interaction was observed, the sample was categorized according to BMI status. Then, for the subgroup analyses, forced-entry logistic regression analyses were conducted to examine the association between socio-demographic factors and physical activity (separately for total physical activity, walking, and MVPA). Odds ratios (ORs) and 95% confidence intervals (CI) were calculated for each variable. Inferential statistics were performed using SPSS 18.0, and the level of significance was set at $p < 0.05$.

3.4 Results

3.4.1 Characteristics of respondents

Table 3-1 presents the characteristics of the respondents (mean age, 44.4 ± 8.3 years). Of the respondents, 31.1% were overweight, 70.4% were married, 64.4% had an educational level of four years' college or graduate school, 92.0% were in full-time employment, and 49.7% had a household income of between 5 million and 10 million yen. The prevalence of achieving 150 minutes per week of total physical activity was 57.4%.

Table 3-1

Characteristic of respondents

	Total sample	BMI status		*p-value*
		Normal weight men	Overweight men	
Number (%)	1,420	979 (68.9%)	441 (31.1%)	
Age group				0.18
30–39	475 (33.4%)	338 (34.5%)	137 (31.1%)	
40–49	474 (33.4%)	312 (31.9%)	162 (36.7%)	
50–59	471 (33.2%)	329 (33.6%)	142 (32.2%)	
Marital status				0.86
Married	1,000 (70.4%)	688 (70.3%)	312 (70.7%)	
Unmarried	420 (29.6%)	291 (29.7%)	129 (29.3%)	
Educational level				0.36
Junior high/ high school	330 (23.2%)	219 (22.4%)	111 (25.2%)	
2-year college	176 (12.4%)	118 (12.1%)	58 (13.2%)	
4-year college/ graduate school	914 (64.4%)	642 (65.5%)	272 (61.6%)	
Job status				0.77
Full-time job	1,306 (92.0%)	899 (91.8%)	407 (92.3%)	
Not full-time job	114 (8.0%)	80 (8.2%)	34 (7.7%)	
Household income				0.65
<5,000,000 yen	488 (34.4%)	343 (35.0%)	145 (32.9%)	
<10,000,000 yen	706 (49.7%)	481 (49.1%)	225 (51.0%)	
>10,000,000 yen	226 (15.9%)	155 (15.9%)	71 (16.1%)	
Total physical activity				0.16
150 min +	815 (57.4%)	668 (58.6%)	241 (54.6%)	
<150 min	605 (42.6%)	574 (41.4%)	200 (45.4%)	

3.4.2 Differences in PA between normal-weight and overweight men

Table 3-2 shows the mean reported time spent for total physical activity, walking, and MVPA as well as the categorical differences in attaining 150 minutes of total physical activity, walking, and MVPA between normal-weight and overweight men. No significant differences were found in the mean time spent in total physical activity ($p= 0.32$) and walking ($p= 0.79$) as well as in the proportion attaining 150 minutes of total physical activity ($p= 0.16$) and walking ($p= 0.36$) between the two BMI subgroups. However, significant differences were observed in the mean time spent engaged in MVPA ($p= 0.001$) and in the proportion attaining 150 minutes of MVPA ($p= 0.035$) between normal-weight and overweight men. The results revealed that normal-weight men were statistically significantly more likely to engage in MVPA and attain 150 minutes of MVPA than overweight men (26.6% vs. 21.3%, respectively).

Table 3-2

Mean time spent engaged in physical activity and the prevalence of attaining physical activity recommendations according to BMI status

	Total	BMI status		*p*-value
		Normal-weight men	Overweight men	
Mean time spent in total PA, min/week (SD)	330.7 (488.5)	340.4 (488.9)	306.2 (433.0)	0.32
Meet 150 min of total PA per week (%)	57.4%	58.6%	54.6%	0.16
Mean time spent in walking, min/week (SD)	194.0 (302.1)	196.0 (308.4)	189.5 (288.0)	0.79
Meet 150 min of Walking per week (%)	41.8%	41.0%	43.5%	0.36
Mean time spent in MVPA, min/week (SD)	135.8 (298.9)	144.4 (315.5)	116.7 (257.7)	0.001*
Meet 150 min of MVPA per week (%)	24.9%	26.6%	21.3%	0.035*

* Statistically significant ($p < 0.05$); SD = standard deviation
Abbreviation: PA, physical activity; MVPA, moderate-to-vigorous physical activity.

3.4.3 Significance of interactions between BMI status and socio-demographic variables

Regarding total physical activity and walking, a significant interaction was observed between BMI status and household income (p = 0.004 for total PA; p = 0.02 for walking) (Table 3-3). Therefore, subgroup analyses for the associations between socio-demographic correlates and physical activity were conducted among normal-weight and overweight men.

Table 3-3

Significance of interactions between BMI status and socio-demographic variables by binary logistic regression models

	p-value for interaction term with BMI status		
	Total PA	Walking	MVPA (excluding walking)
Socio-demographic variables			
Age group (ref. 30-39 years)			
40-49 years	0.58	0.68	0.99
50-59 years	0.81	0.37	0.49
Marital status (ref. Unmarried)			
Married	0.94	0.24	0.50
Educational level (ref. 4-years college/ graduate school)			
2-years college	0.43	0.61	0.38
Junior high/ high school	0.58	0.48	0.18
Job status (ref. Full-time job)			
Not full-time job	0.83	0.34	0.51
Household income (ref. > 10000000 yen)			
< 10000000 yen	0.76	0.83	0.68
< 5000000 yen	0.004*	0.02*	0.07

Adjusted by age, marital status, educational level, household income, employment status, and BMI status

Abbreviation: PA, physical activity; MVPA, moderate-to-vigorous physical activity.

* Statistically significant ($p< 0.05$)

3.4.4 Socio-demographic correlates of attaining the physical activity recommendations among normal-weight and overweight men

The ORs for attaining 150 minutes of total physical activity, walking, and MVPA are presented in Table 3-4 according to age, marital status, educational level, job status, and household income. As Table 3-4 shows, no significant socio-demographic correlates of total physical activity were observed among both normal-weight and overweight men. For normal-weight men, being married was positively associated with attaining 150 minutes of walking (OR= 1.37; 95% CI= 1.01–1.87) and lower household income was negatively related to attaining 150 minutes of walking (OR= 0.63; 95% CI= 0.41–0.96). No significant socio-demographic variables associated with attaining 150 minutes of walking were found among overweight men.

Table 3-4 also shows that normal-weight men not in full-time employment were more likely to engage in 150 minutes of MVPA (OR= 2.61; 95% CI= 1.55–4.37) than those in full-time employment. Moreover, no significant socio-demographic variables associated with attaining 150 minutes of MVPA were observed among overweight men.

Table 3-4

Socio-demographic correlates of physical activity according to BMI status

	150 minutes of Total PA		150 minutes of Walking		150 minutes of MVPA	
	Normal-weight Men	Overweight Men	Normal-weight Men	Overweight Men	Normal-weight men	Overweight men
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age group						
30-39	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
40-49	0.91 (0.66－1.25)	0.90 (0.56－1.45)	0.98 (0.71－1.35)	0.87 (0.54－1.41)	1.07 (0.75－1.54)	0.85 (0.48－1.49)
50-59	1.05 (0.75－1.46)	1.03 (0.62－1.73)	1.14 (0.82－1.59)	1.10 (0.66－1.83)	1.05 (0.72－1.52)	0.73 (0.39－1.35)
Marital status						
Unmarried	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Married	1.07 (0.79－1.46)	1.00 (0.63－1.57)	1.37 (1.01－1.87)*	1.01 (0.64－1.59)	0.93 (0.65－1.32)	0.87 (0.50－1.51)
Educational level						
4-years college/ graduate school	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
2-years college	0.82 (0.55－1.23)	1.64 (0.90－2.99)	1.01 (0.67－1.53)	1.19 (0.67－2.12)	1.00 (0.63－1.61)	1.43 (0.73－2.80)
Junior high/ high school	0.94 (0.69－1.30)	1.02 (0.64－1.65)	0.88 (0.63－1.21)	0.97 (0.60－1.57)	1.25 (0.88－1.78)	1.39 (0.79－2.45)
Job status						
Full-time job	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Not full-time job	1.45 (0.87－2.43)	0.64 (0.29－1.40)	0.91 (0.55－1.51)	0.74 (0.33－1.65)	2.61 (1.55－4.37) *	0.82 (0.31－2.19)
Household income						
> 10000000 yen	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
< 10000000 yen	0.76 (0.52－1.12)	1.19 (0.68－2.07)	0.76 (0.52－1.10)	1.14 (0.66－1.99)	0.68 (0.46－1.03)	1.22 (0.61－2.44)
< 5000000 yen	0.65 (0.43－1.01)	0.66 (0.35－1.26)	0.63 (0.41－0.96)*	0.76 (0.40－1.45)	0.63 (0.39－1.00)	0.97 (0.43－2.18)

* Statistically significant ($p< 0.05$). Abbreviation: PA, physical activity; MVPA, moderate-to-vigorous physical activity.

3.5 Discussion

This study examined the patterns and socio-demographic correlates of self-reported physical activity among normal-weight and overweight men. The results revealed that both self-reported physical activity patterns and associated correlates in overweight men were different from those in normal-weight men, which is consistent with the findings of previous studies (Hallal et al., 2008, Liao et al., 2011). Our results imply that BMI status should be considered when developing more effective intervention approaches to physical activity among Japanese men.

With regard to the prevalence of attaining 150 minutes per week of total physical activity, walking, and MVPA, no significant differences were found in total physical activity and walking among the BMI subgroups; however, overweight men were significantly less likely to achieve 150 minutes of MVPA than normal-weight men. Numerous studies have reported that overweight or obese individuals spend less time on physical activity and are less likely than normal-weight individuals to meet the minimum recommended level of physical activity (Davis et al., 2006; Treuth et al., 2007, Ness et al., 2007; Martinez-Gomez et al., 2010). However, few studies have stratified physical activity time into walking and MVPA, yet this division provides a better understanding of the patterns of walking and MVPA when developing effective

physical activity intervention strategies. Using objective physical activity measurement, one study showed that overweight or obese children had a distinct pattern of daily MVPA compared with normal-weight children (Dorsey et al., 2010). Furthermore, behavioral preferences for sedentary behavior or light activity have been reported among overweight and obese individuals (Salmon et al., 2003). A possible explanation for the latter result is that owing to their poor physical condition, it may be more difficult for overweight men to engage in MVPA (e.g., leisure-time physical activity, sports, and vigorous types of recreational activities) rather than walking (Dorsey et al., 2010).

In logistic regression models, the interactions between BMI and five socio-demographic variables (age, marital status, educational level, job status, and household income) separately for the three physical activity outcome variables were tested based on likelihood ratio tests. Only household income was revealed as a different socio-demographic correlate of physical activity between normal-weight and overweight men. Consistent with the findings of a Brazilian study (Hallal et al., 2008), we did not observe an interaction between BMI and age. In contrast, an interaction between BMI and education, which was identified in that study (Hallal et al., 2008), was not observed in the present study. In addition, previous studies have indicated that

the adults with a higher household income were more likely to be physically active (Bauman et al., 2002; Trost et al., 2002). However, there has been no discussion or analysis as to whether this association differs according to BMI status. A possible mechanism underlying the observed significance in household income only among normal-weight men is that household income may not be a barrier or facilitator for overweight men to engage in walking compared with normal-weight men. Therefore, the findings of the present study suggest that correlates of specific physical activity may vary according to BMI status.

Furthermore, with regard to socio-demographic correlates, marital status, household income, and employment status were significantly associated with achieving recommended levels of physical activity among normal-weight men, whereas no significant socio-demographic correlates of recommended levels of physical activity were observed among overweight men. Consistent with the findings of a Brazilian study (Hallal et al., 2008), this result indicates that socio-demographic correlates are less important in overweight than in normal-weight men and that other correlates of meeting recommended levels of physical activity may be more important for overweight men, such as psychosocial correlates and environmental factors.

Based on the findings of the present study, encouraging overweight men to engage in walking could be considered a gateway for them to achieve health-enhancing levels of physical activity. More factors associated with walking or other specific MVPA behaviors need to be further identified to develop tailored physical activity for overweight men. In addition, for normal-weight men, the promotion of daily walking (e.g., walking for transportation or recreation) should target unmarried individuals and those with a lower household income, while men with full-time employment should be encouraged to engage in MVPA (e.g., leisure-time PA physical activity, sports, and vigorous types of recreational activities) in their leisure time. Therefore, it is expected that future studies will identify the multiple levels of correlates associated with specific types of physical activity among normal-weight and overweight men.

The present study has some strengths. This study has a large sample size (n=1,420) and specifically focused on a sex subgroup with a higher prevalence of overweight (men). In addition, except for educational level, the distribution of age, marital status, job status, household income, prevalence of overweight, and attaining the total physical activity recommendations was similar to that for the general Japanese population (Ministry of Health, Labour and Welfare, 2009;) Shibata et al.,

2009b, ; Bauman et al., 2009). Therefore, the findings of the present study could provide important implications in that the patterns and socio-demographic correlates of self-reported physical activity differed between normal-weight and overweight men. Future studies are needed to further identify correlates of physical activity by different BMI status in developing tailored physical activity intervention for the overweight population.

3.6 Conclusions

The results revealed that patterns and socio-demographic correlates of self-reported physical activity in overweight men are different from those in normal-weight men. This finding suggests that it is necessary to develop specific strategies for physical activity intervention among overweight men. Socio-demographic correlates of self-reported physical activity may be more important for normal-weight than overweight men. To enhance the health of overweight men, it is important to further examine psychosocial and environmental correlates of physical activity in future studies.

Part II – Perceived environmental factors associated with physical activity among normal-weight and overweight Japanese men

3.7 Statistical analyses

The data were analyzed from 1,420 men who provided complete information for study variables. All analyses were stratified by BMI. Forced-entry adjusted logistic regression for gender, age, marital status, educational level, household income, and employment status was conducted to examine the association between environmental factors and meeting the physical activity recommendation. Adjusted odd ratios and 95% confidence intervals were calculated for each variable. Likelihood ratio tests were used to compare models with or without interaction terms between environmental variables and BMI status. Inferential statistics were performed using SPSS 15.0, and the level of significance was set at $p < 0.05$.

3.8. Results

3.8.1. Perceived environmental factors associated with walking and MVPA (excluding walking) among Japanese men

Table 3-6 shows the results of the adjusted logistic regression analysis in walking and MVPA (excluding walking) among normal-weight and overweight men. Ten significant environmental correlates of walking in normal-weight men and three in overweight men were observed. For normal-weight men, good access to shops (OR = 1.61; 95% CI: 1.24–2.10), good access to public transport (OR = 2.30; 95% CI: 1.57–3.38), good access to recreational facilities (OR = 1.42; 95% CI: 1.09–1.84), seeing people being active (OR = 1.49; 95% CI: 1.15–1.94), aesthetics (OR = 1.74; 95% CI: 1.33–2.29), street connectivity (OR = 1.48; 95% CI: 1.11–1.98), good maintenance of sidewalks (OR = 1.49; 95% CI: 1.14–1.94), good maintenance of bike lanes (OR = 1.58; 95% CI: 1.22–2.04), and presence of destination (OR = 1.61; 95% CI: 1.24–2.10) were significantly associated with engaging in 150 minutes of walking per week. However, having household cars or auto bikes (OR = 0.60; 95% CI: 0.41–0.88) was inversely associated with walking in normal-weight men. For overweight men, environmental factors associated with engaging in 150 minutes of walking per week were good access to recreational facilities (OR = 1.75; 95% CI:

1.18–2.58) and presence of destination (OR = 1.63; 95% CI: 1.10–2.41). Furthermore, lack of safety from crime during the day (OR = 0.48; 95% CI: 0.24–0.94) was negatively related to engagement in 150 minutes of walking per week. Forced-entry, adjusted logistic regression analyses also indicated that connectivity of streets (OR = 1.45; 95% CI: 1.04–2.03) was a positive environmental factor associated with engaging in MVPA (excluding walking) for 150 minutes or more per week for normal-weight men. On the other hand, seeing people being active (OR = 2.27; CI: 1.38–3.75) was positively associated with engaging in MVPA (excluding walking) at the recommended level for overweight men.

Table 3-5 Adjusted model of perceived environmental factors associated with walking and MVPA (excluding walking) among normal-weight and overweight men

	Normal weight (N = 979, 68.9%)				Overweight (N = 441, 31.1%)			
			Walking	MVPA (excluding walking)			Walking	MVPA (excluding walking)
	N	%	Adjusted OR (95% CI)	Adjusted OR (95% CI)	N	%	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Residential density								
High	432	44.1	1.15 (0.89–1.50)	0.77 (0.57–1.03)	180	40.8	1.39 (0.94–2.07)	0.80 (0.49–1.29)
Low	547	55.9	1.00	1.00	261	59.2	1.00	1.00
Access to shops								
Good	553	56.5	1.61 (1.24–2.10)*	1.21 (0.90–1.63)	256	58.0	1.15 (0.78–1.70)	1.31 (0.81–2.11)
Poor	426	43.5	1.00*	1.00	185	42.0	1.00	1.00
Access to public transport								
Good	817	83.5	2.30 (1.57–3.38)*	1.23 (0.82–1.84)	360	81.6	1.17 (0.71–1.91)	1.28 (0.69–2.37)
Poor	162	16.5	1.00*	1.00	81	18.4	1.00	1.00
Presence of sidewalks								
Yes	604	61.7	1.29 (0.98–1.68)	1.04 (0.77–1.40)	267	60.5	1.43 (0.96–2.12)	0.93 (0.58–1.49)
No	375	38.3	1.00	1.00	174	39.5	1.00	1.00
Presence of bike lanes								
Yes	242	24.7	1.12 (0.83–1.51)	1.09 (0.78–1.52)	127	28.8	1.30 (0.85–1.99)	0.74 (0.43–1.26)
No	737	75.3	1.00	1.00	314	71.2	1.00	1.00
Access to recreational facilities								
Good	482	49.2	1.42 (1.09–1.84)*	1.29 (0.96–1.72)	221	50.1	1.75 (1.18–2.58)*	1.54 (0.96–2.47)
Poor	497	50.8	1.00*	1.00	220	49.9	1.00*	1.00
Crime safety at night								
Not safe	237	24.2	0.87 (0.64–1.17)	1.07 (0.77–1.49)	116	26.3	0.80 (0.52–1.25)	1.17 (0.70–1.95)
Safe	742	75.8	1.00	1.00	325	73.7	1.00	1.00
Traffic safety								
Not safe	354	36.2	1.16 (0.89–1.51)	1.03 (0.77–1.39)	159	36.1	1.06 (0.71–1.58)	1.20 (0.74–1.93)
Safe	625	63.8	1.00	1.00	282	63.9	1.00	1.00

Seeing people being active								
Yes	535	54.6	1.49 (1.15–1.94)*	1.32 (0.98–1.77)	250	56.7	1.41 (0.95–2.09)	2.27 (1.38–3.75)**
No	444	45.4	1.00*	1.00	191	43.3	1.00	1.00**
Aesthetics								
Yes	351	35.9	1.74 (1.33–2.29)*	1.29 (0.96–1.74)	149	33.8	1.14 (0.76–1.71)	1.28 (0.79–2.07)
No	628	64.1	1.00*	1.00	292	66.2	1.00	1.00
Connectivity of streets								
Yes	700	71.5	1.48 (1.11–1.98)*	1.45 (1.04–2.03)**	321	72.8	1.05 (0.68–1.62)	0.79 (0.48–1.32)
No	279	28.5	1.00*	1.00**	120	27.2	1.00	1.00
Maintenance of sidewalks								
Good	555	56.7	1.49 (1.14–1.94)*	1.10 (0.82–1.47)	256	58.0	1.11 (0.75–1.64)	0.82 (0.51–1.30)
Poor	424	43.3	1.00*	1.00	185	42.0	1.00	1.00
Maintenance of bike lanes								
Good	479	48.9	1.58 (1.22–2.04)*	1.14 (0.85–1.52)	216	49.0	1.01 (0.69–1.48)	0.90 (0.57–1.43)
Poor	500	51.1	1.00*	1.00	225	51.0	1.00	1.00
Traffic safety for bicyclists								
Not safe	427	43.6	0.96 (0.74–1.24)	0.89 (0.67–1.19)	192	43.5	1.16 (0.79–1.71)	0.92 (0.57–1.47)
Safe	552	56.4	1.00	1.00	249	56.5	1.00	1.00
Crime safety during the day								
Not safe	106	10.8	1.45 (0.96–2.18)	1.10 (0.69–1.74)	46	10.4	0.48 (0.24–0.94)*	0.88 (0.41–1.92)
Safe	873	89.2	1.00	1.00	395	89.6	1.00*	1.00
Presence of destination								
Yes	511	52.2	1.61 (1.24–2.10)*	1.12 (0.83–1.50)	247	56.0	1.63 (1.10–2.41)*	1.22 (0.76–1.96)
No	468	47.8	1.00*	1.00	194	44.0	1.00*	1.00
Household car or auto bikes								
One or more	845	86.3	0.60 (0.41–0.88)*	1.43 (0.91–2.26)	394	89.3	0.54 (0.28–1.02)	1.56 (0.66–3.69)
None	134	13.7	1.00*	1.00	47	10.7	1.00	1.00

Adjusted for age, marital status, educational level, household income, and employment status.

*, ** statistically significant ($p < 0.05$).

Furthermore, significant interactions regarding walking were observed between BMI status and 2 environmental correlates: access to public transport (P = 0.03) and crime safety during the day (P = 0.01) (Table 3-7).

Table 3-6

Significance of interactions between BMI status and environmental variables by binary logistic regression models

	P value for interaction term with BMI status	
	Walking	MVPA (excluding walking)
	P value	*P* value
Residential density (High)	0.46	0.66
Access to shops (Good)	0.16	0.83
Access to public transport (Good)	0.03**	0.94
Presence of sidewalks (Yes)	0.75	0.60
Presence of bike lanes (Yes)	0.67	0.19
Access to recreational facilities (Good)	0.31	0.52
Crime safety at night (Safe)	0.85	0.73
Traffic safety (Safe)	0.65	0.55
Seeing people being active (Yes)	0.76	0.14
Aesthetics (Yes)	0.08	0.70
Connectivity of streets (Yes)	0.18	0.06
Maintenance of sidewalks (Good)	0.22	0.28
Maintenance of bike lanes (Good)	0.06	0.40
Traffic safety for bicyclists (Safe)	0.39	0.76
Crime safety during the day (Safe)	0.01**	0.69
Presence of destination (Yes)	0.99	0.75
Household car or auto bikes (One or more)	0.93	0.66

Adjusted by age, marital status, educational level, household income, employment status and BMI status.

** statistically significant ($p < 0.05$).

3.9 Discussion

In the present study, the perceived environmental attributes were significantly associated with physical activity among normal-weight and overweight Japanese men. The most important finding of the present study was that common environmental correlates of physical activity were observed between normal-weight and overweight men. Three environmental factors, good access to recreational facilities, seeing people being active, and presence of destination, were positively associated with meeting physical activity recommendation by either walking or MVPA (excluding walking). The results suggested that increasing the mix of utilitarian destination, supportive environment for seeing people being active, and convenience of accessing recreational facilities could encourage both normal-weight and overweight men to engage in sufficient physical activity for different purposes. In addition, these factors have been consistently revealed as environmental features related to physical activity among general populations in both Western countries and Japan (Saelens et al., 2008; Ishii et al., 2010; McCormack et al., 2008; Hoehner et al., 2005); this might strengthen the evidence for some common environmental features associated with physical activity among countries with different cultures and environments.

Conversely, access to public transport and safety from crime during the day were revealed as different environmental correlates of physical activity between normal-weight and overweight men based on likelihood ratio tests. This finding indicated that BMI status would be a potential moderator between the perceived environment and physical activity. Different environmental correlates of physical activity between socio-demographic subgroups have been examined in previous studies (Santos et al., 2008; Bengoechea et al., 2005; Shigematsu et al., 2009; Hooker et al., 2005; Kamada et al., 2009). Different socio-demographic correlates of physical activity have also been reported among three BMI groups (Hallal et al., 2008). In addition, a previous study has observed that several perceived environmental factors (infrastructures, access to destinations, social environment and aesthetics) were associated with meeting the recommended physical activity level among overweight/obese women (Santos et al., 2008). However, whether overweight men have different environmental correlates of physical activity than normal-weight men has not been discussed or analyzed as much as they have for women. A possible mechanism underlying the observed significance in perceived good access to public transport among normal-weight men alone is that overweight men are less likely to walk or cycle for transport in their daily lives than normal-weight men, regardless of

the accessibility of public transport within their neighborhoods. Regarding the significant contribution of safety from crime only among overweight and obese men, they might be more sensitive to the presence of crime than normal-weight men because they may more easily experience discriminative and stigmatic treatment in their growing stage (U.S. Department of Health and Human Services, 2010). Another possible reason for this result is that being overweight and the perception of overweight could increase psychological distress (Atlantis & Ball, 2008; Derenne & Beresin, 2006). Especially in Japan, thinness is considered a beauty ideal (Suka et al., 2006) and the percentage of overweight and obesity is relatively lower than other countries (Flegal et al., 2010; Kanazawa et al., 2002). Therefore, social acceptance and sociocultural factors may increase body dissatisfaction and decrease self-esteem in overweight men (Luppino et al., 2010), which may possibly affect them to be more sensitive to the presence of crime and not willing to go outdoors than normal-weight men. Therefore, the perception of an unsafe neighborhood environment might have a negative influence on their physical activity.

The findings of the present study suggest that consideration of not only general environmental correlates but also unique environmental correlates of physical activity among overweight and obese populations promote physical activity more effectively

among these populations when environmental approaches for physical activity interventions are developed. One effective strategy for future environmental interventions aimed at increasing physical activity levels is promoting or changing their awareness of these environmental correlates. In addition, intervention approaches for rearranging or improving these environmental variables could be beneficial. For these approaches, it might be necessary to establish partnerships and collaborations with different sectors or organizations (Global Advocacy Council for Physical Activity website). For example, neighborhood safety could be improved by cooperating with local authorities in organizing community groups to prevent crime. Furthermore, it could also be effective to cooperate with different government departments and non-government agencies (e.g., transportation department, local government, and transportation agencies) to adjust the location of public transport or number of services for transport-related walking.

The finding of the study indicated that the perceived environment-physical activity association was more related to normal-weight men than overweight men; while 11 perceived environmental factors associated with physical activity were found in normal-weight men, only four factors were significantly associated with physical activity in overweight men. This finding has not been reported in previous studies.

Two studies have emphasized a stronger influence of perceived physical activity environment on older adults than on younger adults (Shigematsu et al., 2009), as well as adults with disabilities than those without disabilities (Christensen et al., 2010). There are two implications of this finding. First, compared with normal-weight men, the environmental correlates of physical activity in overweight men were not detected well using IPAQ-E. As a result, objective measurements should be utilized to further examine the association between environmental factors and meeting the physical activity recommendation, especially on the walking behavior of overweight men. The second implication is that other factors (such as psychosocial correlates) might be more strongly associated with physical activity in overweight men than in normal-weight men. Thus, future studies are needed to identify the multiple levels of correlates associated with physical activity among normal-weight an overweight men.

In accordance with results from previous studies (Inoue et al., 2009; Santos et al., 2009), the association of environmental factors from the IPAQ-E results were more related with walking than MVPA (excluding walking) between both normal-weight and overweight men in the present study. These results implied that walking behavior might be influenced more by the neighborhood environment than other types of

physical activity behaviors. For future studies, it might be important to examine other correlates of specific MVPA behaviors.

For overweight men, seeing people being active was the strongest perceived environmental factor positively associated with engaging in 150 minutes of MVPA (excluding walking) per week. In previous studies, seeing people being active has been reported as a positive environmental correlate of being physically active (Santos et al., 2008; Ishii et al., 2010). The implication of the result is that overweight groups may need more social support to engage in MVPA (excluding walking), such as leisure-time physical activity, sports, and recreational activity (Strauss et al., 2001; Gesell et al., 2008; Marquez et al., 2006).

3.10 Conclusions

Both common and different environmental correlates of physical activity were observed among normal-weight and overweight men. The findings of the present study contribute evidence to the literature on moderators between environmental factors and physical activity. Findings from the present study suggested that developing different environmental intervention approaches might be needed to promote PA effectively for overweight populations compared with normal-weight

populations. In addition, compared with normal-weight men, the perceived environmental correlates of physical activity in overweight men were not well defined. Future studies should consider examining multiple levels of correlates associated with different kinds of physical activity by utilizing both perceived and objective measurements among men with different BMI statuses.

CHAPTER 4

COMPREHENDIVE DISCUSSION

The aim of this chapter is to integrate the findings from all studies described in this dissertation. The present dissertation was conducted following two studies; (1) associations of self-reported physical activity patterns and socio-demographic factors among Japanese normal-weight and overweight men; and (2) perceived environmental factors associated with physical activity among normal-weight and overweight men; in order to explore the effective environmental approaches for promoting physical activity among overweight Japanese men.

4.1 Discussions and implications

4.1.1 Self-reported physical activity patterns among normal-weight and overweight men

For developing effective physical activity intervention strategies, one of the main purposes in this dissertation was to better understand self-reported physical activity patterns between normal-weight and overweight Japanese men. In the Part I of Chapter 3, the results have shown that overweight men were significantly less likely

to achieve 150 minutes of MVPA than normal-weight men (21.3% vs. 26.6%; p= 0.035) but no differences in walking. These findings support that overweight individuals are less physically active than normal-weight ones in previous studies (Davis et al., 2006; Treuth et al., 2007; Ness et al., 2007; Martinez-Gomez et al., 2011) and further indicate that overweight men, who may have poor physical condition, were less likely to engage in other types of MVPA (e.g., leisure-time physical activity, sports, and vigorous types of recreational activities) than normal-weight ones. Therefore, the findings of the present study may imply that encouraging overweight men to engage in walking could be considered as a target behavior for them to achieve health-enhancing levels of physical activity.

4.1.2 Socio-demographic factors associated with physical activity among normal-weight and overweight men

Based on the literature review of Chapter 2, to date no studies have identified socio-demographic correlates of physical activity among Japanese men according to BMI status. Therefore, in order to target Japanese overweight men who are most in need of physical activity intervention, in the Part I of Chapter 3, the present study examined this issue among overweight men in comparison of normal-weight ones.

The likelihood ratio test indicated that household income is a different physical activity correlate between overweight and normal-weight men. In addition, logistic regression analyses showed no significant socio-demographic correlates were found among overweight men. Therefore, these findings imply that it is necessary to develop specific strategies for physical activity intervention targeting on whole overweight Japanese men.

4.1.3 Perceived environmental factors associated with physical activity among normal-weight and overweight men

In order to target on whole overweight Japanese men, as discussed in Chapter 2, a better understanding environmental factors could be beneficial to develop physical activity interventions on whole overweight populations. Therefore, the Part II of Chapter 3 aimed to find out what kind of perceived environmental factors are associated with physical activity overweight Japanese men compared with normal-weight ones. In addition to common environmental factors (i.e., good access to recreational facilities, seeing people being active, and presence of destination), the likelihood ratio tests also indicated access to public transport and safety from crime during the day were different environmental correlates of physical activity by BMI

status: access to public transport is associated with walking only in normal-weight men; whereas safety from crime during the day is a specific physical activity correlate for overweight men. Based on the findings, both common and different environmental correlates of physical activity were observed among normal-weight and overweight men. These findings may imply that environmental approach could be an effective strategy for promoting physical activity among overweight men.

To sum up, to develop effective strategy for physical activity promotion on at-risk population—overweight Japanese men, a literature search was conducted to better understand the previous findings in this area. Based on the findings of this review, the hypothesis of the present dissertation is that prevalence and correlates of physical activity might differ by BMI status. Therefore, by conducting two studies, prevalence, socio-demographic and perceived environmental correlates of physical activity were found to be different among normal-weight and overweight Japanese men. These results may verify the hypothesis of the present dissertation, as well as further inform the policy makers and intervention designers that specific environmental approach could be considered for physical activity promotion on whole overweight Japanese men.

4.2 Proposals of promoting physical activity among overweight and obese Japanese men

4.2.1 Leisure-time walking as a target behavior for overweight men to achieve health enhancing levels of physical activity

Based on the results of Part I of Chapter 3, encouraging overweight men to engage in walking could be considered for them to achieve health-enhancing levels of physical activity. In addition, the results of Part II of Chapter 3 showed that overweight men were also found to be less likely to walk for public transportation than normal-weight men, regardless of the perceived accessibility of public transport. Therefore, to integrate the findings from Part I and Part II of Chapter 3, the present dissertation proposed a context-specific behavior—leisure-time walking as a target behavior for overweight men to achieve health-enhancing levels of physical activity.

In the 1990s, walking as a healthful form of physical activity began to receive attention in public health area due to new recommendations that emphasized moderate-intensity physical activity (Lee et al., 2008). Afterwards, evidence for the health benefits of walking has been reported largely from epidemiologic studies, especially walking has been well found to be beneficial for weight loss in several interventions (Murphy et al., 2007; Richardson et al., 2008). Therefore, leisure-time

walking, which can be easily engaged in daily life and has a low risk of injury (Lee et al., 2008; Gomez et al., 2010), was recommended as a target behavior for designing effective physical activity intervention for overweight men.

4.2.2 Develop partnerships for creating a safe environment for whole overweight population to engage in physical activity

Based on the results from Part I of Chapter 3, it is necessary to develop specific strategies for physical activity intervention targeting on whole overweight Japanese men. Furthermore, as mentioned in Chapter 2, environmental approaches are expected to provide a long-term impact on physical activity of large populations (Inoue et al., 2009; Sallis & Owen, 2002). Therefore, the Part II of Chapter 3 aimed to identify to environment-physical activity association and indicated that safety from crime during the day is a unique factor associated with physical activity for overweight men. Therefore, based on the findings from Part I and Part II of Chapter 3, the present dissertation proposed that creating a safe environment on whole overweight population should be considered for physical activity intervention.

Improving or modifying the awareness of environmental correlates is one effective approach for interventions increasing physical activity levels of an

associated population. According to the ecological model, for achieving this approach, several strategies could be considered in individual/psychological, social, physical environmental and policy levels (Global Advocacy Council for Physical Activity, 2010; Salford city council, 2009):

- **Individual/psychological level:** It could be considered to use a handbook to provide information on crime and community safety (i.e. contact numbers of safety agencies and dangerous area could be informed to overweight Japanese men)
- **Social level:** It could be considered to hold campaigns on strengthening awareness of safety or develop prevention and support programs for overweight Japanese men
- **Physical environmental level:** It could be considered to install cameras in key locations or to adjust lighting and accessibility
- **Policy level:** It could be considered to establish partnerships and collaborations with local authorities, community, or organizations to improve neighborhood safety for increasing overweight men to be more willing to go outdoors and physically active.

Several intervention programs found that enhancing awareness of environmental

safety is beneficial for increasing physical activity levels in children (Carver et al., 2008) or adults (King et al., 2006; Heath et al., 2012). Therefore, by establishing partnerships and collaborations with different sectors or organizations, enhancing the perceptions of neighborhood safety would be suggested for overweight men to participate in physical activity.

4.3 Limitation

Some limitations of this dissertation should be considered. First, the study had a cross-sectional design, making it impossible to determine causality. Second**,** the main measurements of the study, which included BMI status, perceived environmental factors, socio-demographic factors, and physical activity, were measured only by means of self-administrated questionnaires, and they could be subject to bias. Self-reported height and weight may cause an underestimation of weight status (Santos et al., 2008) and the utilization of IPAQ-SV may cause the overestimation of PA time (Hallal et al., 2010; Rzewnicki et al., 2003). It may reduce response variability and lead to lower statistical power and underestimation of associations, if participants tend to report their physical activity behavior and weight biased to the optimal direction, (Gunnel et al., 2000; Inoue et al., 2011). In addition, diet, which affects weight, was not assessed in the present study (Mirmiran et al., 2005)**.** Finally, the present study had a limited ability to obtain representative samples because it relied on an Internet-based survey. The respondents to Internet-based surveys may possess certain characteristics, such as being younger, being more educated, having a higher income, having greater access to the Internet, and being more likely to respond to a survey, if they are interested in the survey's content or are attracted by the

incentives offered for participation (Rhodes et al., 2003; Shibata et al., 2009a). Thus, the results of the present study may be less applicable to the general population, particularly among those with a lower level of education.

4.4 Conclusion

In summary, the present results expand the existing limited literature by reporting overweight Japanese men have different physical activity patterns and correlates of physical activity with normal-weight Japanese men. Based on these findings, this dissertation reveals the importance of developing specific physical activity strategy for overweight men and further suggests that leisure-time walking could be a target behavior, as well as developing partnerships for creating a safe environment for whole overweight men to achieve health-enhancing levels of physical activity. This dissertation concludes that enhancing awareness and knowledge of environment could be an important physical activity approach on overweight populations. These results of this dissertation may provide useful information for future research to design physical activity intervention on overweight Japanese men.

4.5. Future suggestions

First, further investigations on overweight populations are still required in order to accumulate additional evidences for promoting physical activity on these at-risks populations. Moreover, such investigation is necessary to consider the utilization of both self-reported and objectively-assessed measures on physical activity (i.e. accelerometer, pedometer) and environmental factors (i.e. Geographic Information System) for further confirming the findings of this dissertation. Additionally, the present study also highlights the need for prospective studies to identify the multi-levels factors (i.e. psychological and social) associated with physical activity behavior among overweight populations. Furthermore, the physical activity intervention designers who aim on overweight populations might be beneficial of designing the programs to enhance overweight populations' awareness and knowledge of neighborhood safety. And the effectiveness of intervention should be evaluated. Finally, identifying the effective recruitment strategies for the overweight populations into the intervention programs is urgently needed for increasing them to achieve recommended level of physical activity on the efficient manner.

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APPENDIX 1

国際標準化身体活動質問票

short, usual, self-administered

以下の質問は､みなさまが日常生活の中でどのように身体活動を行っているか(どのよ うに体を動かしているか) を調べるものです。平均的な１週間を考えた場合、あなたが1 日にどのくらいの時間、体を動かしているのかをお尋ねしていきます。身体活動(体を動 かすこと) とは、仕事での活動、通勤や買い物などいろいろな場所への移動、家事や庭仕 事､余暇時間の運動やレジャーなどのすべての身体的な活動を含んでいることに留意して 下さい。

回答にあたっては以下の点にご注意下さい。

◆**強い身体活動**とは、身体的にきついと感じるような、かなり呼吸が乱れるような活動を意味します。

◆**中等度の身体活動**とは、身体的にやや負荷がかかり、少し息がはずむような活動を意味します。

以下の質問では、**１回につき少なくとも　10　分間以上続けて**行う身体活動について**のみ**考えて、お答え下さい。

質問1a　平均的な1週間では、**強い**身体活動（重い荷物の運搬、自転車で坂道を上ること、ジョギング、テニスのシングルスなど）を行う日は何日ありますか？

□ 週＿＿＿日
□ ない（→質問2aへ）

質問1b　強い身体活動を行う日は、通常、1日合計してどのくらいの時間そのような活動を行いますか？

1日＿＿＿時間＿＿＿分

質問2a　平均的な1週間では、**中等度の**身体活動（軽い荷物の運搬、子供との鬼ごっこ、ゆっくり泳ぐこと、テニスのダブルス、カートを使わないゴルフなど）を行う日は何日ありますか？**歩行やウォーキングは含めないで**お答え下さい。

□　週＿＿＿日
□　ない（→質問3aへ）

質問2b　中等度の身体活動を行う日には、通常、1日合計してどのくらいの時間そのような活動を行いますか？

＿＿＿時間＿＿＿分

質問3a　平均的な1週間では、10分間以上続けて**歩く**ことは何日ありますか？ここで、**歩く**とは 仕事や日常生活で歩くこと、ある場所からある場所へ移動すること、あるいは趣味や運 動としてのウォーキング、散歩など、全てを含みます。

□ 週＿＿＿日
□ ない（→質問3aへ）

質問3b　そのような日には、通常、1日合計してどのくらいの時間歩きますか？

＿＿＿時間＿＿＿分

質問 4　最後の質問は、毎日座ったり寝転んだりして過ごしている時間（仕事中、自宅で、勉強 中、余暇時間など）についてです。すなわち、机に向かったり、友人とおしゃべりをし たり、読書をしたり、座ったり、寝転んでテレビを見たり、といった全ての時間を含み ます。なお、睡眠時間は**含めない**で下さい。

平日には通常1日合計してどのくらいの時間**座ったり寝転んだりして**過ごしますか？

1日＿＿＿時間＿＿＿分

以上です。ご協力ありがとうございました。

【コメント】

IPAQ short version, usual week (2002 年8 月版)にあわせて一部改変済みです。

＜改変内容＞ イントロダクション 歩
行スピードに関する質問の削除 休
日の座業時間に関する質問の削除

引用論文は

１）村瀬訓生、勝村俊仁、上田千穂子、井上茂、下光輝一: 身体活動量の国際標準化－IPAQ日本 語版の信頼性,妥当性の評価－, 厚生の指標, , 49(11), 1-9, 2002

（Murase N., Katsumura T., Ueda C., Inoue S., Shimomitsu T., 2002. Validity and reliability of Japanese version of International Physical Activity Questionnaire. Journal of Health and Welfare Statistics. [In Japanese] 49 (11), 1-9.）

２）Craig C.L., Marshall A.L., Sjöström M., Bauman A.E., Booth M.L., Ainsworth B.E., et al., 2003. Inernational physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 35, 1381-1395.

としてください。 また、スコアリング方法は上記１）をご参照下さい。質問項目の一部削除に伴い、歩行強度の割 りあてメッツ数は3.3**に統一してください。**

Dear Fellow WICies,

In order to better serve you we would like to collect some baseline physical activity data. Please send to CWA at 1010 11th Street, Suite 205, Sacramento, 95814 or fax to 916-448-7826.

No names please!

International Physical Activity Questionnaire

Below are questions about individual's physical activity levels.
Please read the descriptions and answer the questions even if you do not consider yourself to be an active person. Consider all activities, those 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.

Hard physical activity:

Think about all the ***vigorous activities*** which take hard physical effort that you did in the ***last 7 days***. Vigorous activities make you breath harder than normal and may include heavy lifting, aerobic, or fast bicycling. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the ***last 7 days***, on how many days did you do vigorous physical activities?

   _____days/week _____don't know/not sure

2. How much ***total time*** did you usually spend doing ***vigorous physical activities*** on one of those days?

   _____hours/day _____minutes/day _____don't know/not sure

3. If your pattern of activity varies from day to day, how much ***total time*** did you spend over the last 7 days doing ***vigorous physical activity***.

   _____hours/week _____minutes/week _____don't know/not sure

Moderate physical activity:

Think about the activities which take ***moderate physical effort*** that you did in the ***last 7 days***. Moderate physical activity make you breath somewhat harder than normal and may include carrying light loads, bicycling at a regular pace, or doubles tennis. Do not include walking. Again, think about only those physical activities that you did for at least 10 minutes.

See Other Side >>

4. During the ***last 7 days***, on how many days did you do ***moderate physical activities?***
   _____days/week _____don't know/not sure
5. How much ***total time*** did you usually spend doing ***moderate physical activities*** on one of those days?
   _____hours/day _____minutes/day _____don't know/not sure

6. If your pattern of activity varies from day to day or includes multiple tasks, how much ***total time*** did you spend over the last 7 days doing ***moderate physical activity.***
   _____hours/week _____minutes/week ___don't know/not sure

Walking:

Now think about the time you spend ***walking*** in the ***last 7 days***. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise or leisure.

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

   _____days/week _____don't know/not sure

8. How much ***total time*** did you usually spend ***walking*** on one of those days?
   _____hours/day _____minutes/day _____don't know/not sure

9. If your pattern of activity varies from day to day or includes multiple tasks, how much ***total time*** did you spend ***walking*** over the last 7 days?.
   _____hours/week _____minutes/week ___don't know/not sure

Sitting:

Finally, think about the time you spent ***sitting*** on weekdays during the ***last 7 days***. Include time spent at work, at home, while doing course work, and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, sitting or lying down to watch television.

10. During the ***last 7 days*** how much ***total time*** did you usually spend sitting on a week day?

    _____hours/weekday _____minutes/weekday _____don't know

Baseline Data: Date: _____

Age:_____ Sex:_____ Ht:_____ Wt:_____

Chronic disease/complaints Circle:

Diabetes Hypertension High Cholesterol Heart Disease Obesity
Migraine headaches Anxiety
Family/personal history of cancer yes/no | type: _____

Daily activities: _____

_____

_____

APPENDIX 2

International Physical Activity Questionnaire Environmental Module (IPAQ-E)
国際標準化身体活動質問紙環境尺度日本語版(IPAQ 環境尺度日本語版)

以下の質問は、あなた家の近所、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内の環境に関する質問です。

1. あなたの近所の住宅は主にどのようなタイプのものですか。あてはまる番号に○をつけてください。
   1) 一戸建て
   2) 2～3階建てのアパート
   3) 一戸建てと、2～3階建てのアパートが混じっている
   4) 4～12階建てのマンション
   5) 13階建て以上のマンション

以下の文章は、歩くことや自転車に乗ることに関係する、近所の環境について述べたものです。あなたの近隣環境にどの程度あてはまりますか？もっともあてはまる欄1つに○をつけてください。

2. 日用品を買うためのお店や、スーパーマーケット、商店街などが、自宅から簡単に歩いていける範囲に たくさんある。
   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) 非常によくあてはまる

3. バス停、駅などが自宅から歩いて 10～15 分以内にある。
   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) 非常によくあてはまる

4. 近所のほとんどの道路には歩道がある。
   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) 非常によくあてはまる

5. 近所には、自転車専用レーン、歩道兼用の自転車レーンなどのように自転車が通行できるレーンがあ る。

6. 近所には、公園、広場、ウォーキング道路、自転車道路、グラウンド、公営プール、体育館など、無料 あるいは安価に利用できるレクリエーション施設がいくつかある。

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) 非常によくあてはまる

7. 近所では犯罪の危険が高く、夜間に外を歩くのは安全とはいえない。

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) 非常によくあてはまる

8. 近所では交通量が多く、外を歩くことに危険を感じたり、歩くことが楽しくなかったりする。

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) 非常によくあてはまる

9. 近所では運動したり、体を動かしている人を多く見かける。(ここで「運動」や「体を動かす」とは、買い 物、通勤などで歩いたり、ウォーキング、ジョギング、サイクリングや、その他のスポーツをすることを意味し
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) 非常によくあてはまる

10. 近所を歩くと、興味をひかれるもの(きれいな景観、楽しい景観など)がたくさんある。

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) 非常によくあてはまる

11. あなたの家には車やバイクが全部で何台ありますか?

_____台

12. 近所には十字路や交差点がたくさんある。

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 非常
4) によくあてはまる

13. 近所の歩道はよく整備されていて、歩行する上で、障害はない。

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) 非常によくあてはまる

14. 近所の道路はよく整備されていて、自転車の通行上、障害はない。

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) 非常によくあてはまる

15. 近所では交通量が多く、自転車に乗ることに危険を感じたり、自転車に乗ることが楽しくなかったりする。

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) 非常によくあてはまる

16. 近所では犯罪の危険が高く、昼間に外を歩くのは安全とはいえない。

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) 非常によくあてはまる

17. 近所には、銀行、郵便局、医療機関、公共の施設などのような、歩いていける目的地が多い。

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) 非常によくあてはまる

＜備考＞

質問 1-7:基本項目 質

問 8-11:推奨項目

質問 12-17:オプション項目

＜引用文献＞

Inoue S, Murase N, Shimomitsu T, Ohya Y, Odagiri Y, Takamiya T, Ishii, K., Katsumura, T., Sallis, J. F.. Association of physical activity and neighborhood environment among Japanese Adults. Prev Med. 2009, 48, 321-325.

International Physical Activity Prevalence Study
SELF-ADMINISTERED ENVIRONMENTAL MODULE

There is increasing interest in the contextual (environmental) barriers that prevent or limit the opportunity to walk and cycle in areas around where we live and work. Factors that are emerging as important include land use, housing density, accessibility to public transport systems, and perceived safety from traffic and crime. Research in this field is still in its infancy and many other factors are also being researched. Moreover currently there are very few well-developed survey instruments addressing this topic.

The International Physical Activity Prevalence Study (IPS) has developed an optional ENVIRONMENTAL MODULE that can be used to assess the environmental factors for walking and bicycling in your neighborhoods. We offer it for use in the IPS Study in addition to the IPAQ (short form). Countries participating in IPS are encouraged to consider ways in which they can extend their participation and study protocols to include the optional ENVIRONMENTAL MODULE.

The ENVIRONMENTAL MODULE has three sets of carefully chosen items that reflect current thinking in this field and in which the reliability and validity of each item has been assessed. We tried to keep the module as short as possible, include the variables that have already shown to be associated with different levels of activity in different countries, and select items that would be of interest and relevant to all countries regardless of the stage of economic development.

The three sets of items re grouped as follows:

CORE (Items 1-7)
RECOMMENDED (Items 8-11)
OPTIONAL (Items 12-17)

All countries that use the ENVIRONMENTAL MODULE must ask all CORE items. We encourage you to ask as many RECOMMENDED items as possible. If you have space in your survey and if you are interested in the environmental aspects of physical activity, we provide a small set of OPTIONAL items for use. If your country is able to add more questions on different aspects of the environment than provided here, we can provide other tested items (not shown here) and would be willing to help you make a selection.

We recognize it is unlikely that all the items (CORE, RECOMMENDED AND OPTIONAL) will be asked in a country.

Please note - The wording of items and the response scales should not be changed because this will most likely change the meaning of the questions and prohibit comparison between countries. The relevancy and responses to items will vary greatly across countries, so it is critical to document national differences. We provide guidelines at the end of the survey for the translation process and cultural adaptation to make the items relevant to your country and the language spoken.

INTERNATIONAL PREVALENCE STUDY [IPS] ON PHYSICAL ACTIVITY

Think about the different facilities in and around your neighborhood by this we mean the area ALL around your home that you could walk to in 10-15 minutes.

1. What is the main type of housing in your neighborhood?

- 1 ☐ Detached single-family housing
- 2 ☐ Townhouses, row houses, apartments, or condos of 2-3 stories
- 3 ☐ Mix of single-family residences and townhouses, row houses, apartments or condos
- 4 ☐ Apartments or condos of 4-12 stories
- 5 ☐ Apartments or condos of more than 12 stories
- 77 ☐ Don't know/Not sure

The next items are statements about your neighborhood related to walking and bicycling.

2. Many shops, stores, markets or other places to buy things I need are within easy walking distance of my home. Would you say that you…

- 1 ☐ Strongly disagree
- 2 ☐ Somewhat disagree
- 3 ☐ Somewhat agree
- 4 ☐ Strongly agree
- 77 ☐ Don't know/Not sure

3. It is within a 10-15 minutes walk to a transit stop (such as bus, train, trolley, or tram) from my home. Would you say that you…

- 1 ☐ Strongly disagree
- 2 ☐ Somewhat disagree
- 3 ☐ Somewhat agree
- 4 ☐ Strongly agree
- 77 ☐ Don't know/Not sure

4. There are sidewalks on most of the streets in my neighborhood. Would you say that you…

1 ☐ Strongly disagree
2 ☐ Somewhat disagree
3 ☐ Somewhat agree
4 ☐ Strongly agree
88 ☐ Does not apply to my neighborhood
77 ☐ Don't know/Not sure

5. There are facilities to bicycle in or near my neighborhood, such as special lanes, separate paths or trails, shared use paths for cycles and pedestrians. Would you say that you…

1 ☐ Strongly disagree
2 ☐ Somewhat disagree
3 ☐ Somewhat agree
4 ☐ Strongly agree
88 ☐ Does not apply to my neighborhood
77 ☐ Don't know/Not sure

6. My neighborhood has several free or low cost recreation facilities, such as parks, walking trails, bike paths, recreation centers, playgrounds, public swimming pools, etc. Would you say that you…

1 ☐ Strongly disagree
2 ☐ Somewhat disagree
3 ☐ Somewhat agree
4 ☐ Strongly agree
77 ☐ Don't know/Not sure

7. The crime rate in my neighborhood makes it unsafe to go on walks at night. Would you say that you…

1 ☐ Strongly disagree
2 ☐ Somewhat disagree
3 ☐ Somewhat agree
4 ☐ Strongly agree
77 ☐ Don't know/Not sure

8. There is so much traffic on the streets that it makes it difficult or unpleasant to walk in my neighborhood. Would you say that you…

1 ☐ Strongly disagree
2 ☐ Somewhat disagree
3 ☐ Somewhat agree
4 ☐ Strongly agree
88 ☐ There are no streets or roads in my neighborhood
77 ☐ Don't know/Not sure

9. I see many people being physically active in my neighborhood doing things like walking, jogging, cycling, or playing sports and active games. Would you say that you…

1 ☐ Strongly disagree
2 ☐ Somewhat disagree
3 ☐ Somewhat agree
4 ☐ Strongly agree
77 ☐ Don't know/Not sure

10. There are many interesting things to look at while walking in my neighborhood. Would you say you…

1 ☐ Strongly disagree

2 ☐ Somewhat disagree

3 ☐ Somewhat agree

4 ☐ Strongly agree

77 ☐ Don't know/Not sure

11. How many motor vehicles in working order (e.g., cars, trucks, motorcycles) are there at your household?

____Motor Vehicles

77 ☐ Don't know/Not sure

12. There are many four-way intersections in my neighborhood. Would you say that you…

1 ☐ Strongly disagree

2 ☐ Somewhat disagree

3 ☐ Somewhat agree

4 ☐ Strongly agree

88 ☐ There are no streets or roads in my neighborhood

77 ☐ Don't know/Not sure

13. The sidewalks in my neighborhood are well maintained (paved, with few cracks) and not obstructed. Would you say that you…

1 ☐ Strongly disagree

2 ☐ Somewhat disagree

3 ☐ Somewhat agree

4 ☐ Strongly agree

77 ☐ Don't know/Not sure

14. Places for bicycling (such as bike paths) in and around my neighborhood are well maintained and not obstructed. Would you say that you…

1 ☐ Strongly disagree
2 ☐ Somewhat disagree
3 ☐ Somewhat agree
4 ☐ Strongly agree
77 ☐ Don't know/Not sure

15. There is so much traffic on the streets that it makes it difficult or unpleasant to ride a bicycle in my neighborhood. Would you say that you…

1 ☐ Strongly disagree
2 ☐ Somewhat disagree
3 ☐ Somewhat agree
4 ☐ Strongly agree
77 ☐ Don't know/Not sure

16. The crime rate in my neighborhood makes it unsafe to go on walks during the day. Would you say that you…

1 ☐ Strongly disagree
2 ☐ Somewhat disagree
3 ☐ Somewhat agree
4 ☐ Strongly agree
77 ☐ Don't know/Not sure

17. There are many places to go within easy walking distance of my home. Would you say that you…

1 ☐ Strongly disagree

2 ☐ Somewhat disagree

3 ☐ Somewhat agree

4 ☐ Strongly agree

77 ☐ Don't know/Not sure

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