早稲田大学審査学位論文

博士（スポーツ科学）

Exploring Effective Strategies for Promoting Physical Activity among Japanese Junior High School Students

日本人中学生における身体活動推進方策の検討

２０１４年１月

早稲田大学大学院　スポーツ科学研究科

何　莉

HE, Li

研究指導教員：　岡　浩一朗　教授

ACKNOWLEDGEMENT

I would like to express my gratitude to all those who gave me the possibility to complete this dissertation.

I am very grateful to my supervisor, Professor Koichiro Oka, for his continual guidance and support. He is one who led me into the world of behavioral medicine. Without him, I could not successfully finish this dissertation and could not have the opportunity to be successful in the future.

I would also like to gratefully and sincerely thank to Dr. Ai Shibata, who has been my great advisor. Without her great guidance, generous support, and extreme patience and tolerance, I would never have been able to accomplish this process.

I really want to thank Dr. Kaori Ishii for her emotional and tangible support. She is always behind me through the ups and downs in the whole three years. Dr. Shibata and Dr. Ishii not only teach me how to conduct scientific research, how to write scientific papers, but show me the strong and beauty of excellent women as well.

I would like to give my heartfelt thanks to my lovely 83 families, and my sweet friends for their thousands of love, understanding, encouragement and support throughout this dissertation work. Life is so beautiful because of all of you.

Finally, I dedicate this dissertation to my grandfather-in-law, my grandfather, and my uncle. You are always in my heart.

A.L. H.

Oct. 2013

PREFACE

Part of the findings presented in this thesis has been published as follows:

1. He L, Ishii K, Shibata A, Adachi M, Nonoue K, Oka K. (2013). Patterns of physical activity outside of school time among Japanese junior high school students. *J Sch Health*, 83, 623-630

2. He L, Ishii K, Shibata A, Adachi M, Nonoue K, Oka K. (2013).Mediation effects of social support on relationships of perceived environment and self-efficacy with school-based physical activity: a structural equation model tailored for Japanese adolescent girls. *Open Journal of Preventive Medicine,* 3(1), 42-50

3. He L, Ishii K, Shibata A, Adachi M, Nonoue K, Oka K. (2013). Direct and indirect effects of multilevel factors on school-based physical activity among Japanese adolescent boys. *Health*, 5(2), 245-252

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INTRODUCTION

Adolescence is a critical period of development characterized by a challenging array of biological, cognitive, and social changes which should be given high attention (Berk, 2005). Globally, nearly two-thirds of premature deaths and one-third of the total disease burden in adults are associated with unhealthy behaviors that began in youth like a lack of physical activity (World Health Organization, 2012). Evidence shows that engaging in recommended levels of physical activity is an important component for the maintenance of a healthy body (Janssen & LeBlanc, 2010; Strong et al., 2005). Physically active adolescents are not only less likely to suffer from numerous health risks such as coronary heart disease, high blood pressure and diabetes (Janssen & LeBlanc, 2010; Strong et al., 2005), but also have lower rates of depression and are more likely to maintain their weight (Togashi et al., 2002). Furthermore, there is an increased likelihood that individuals will remain active as adults if they are physically active during childhood or adolescence (Hallal et al., 2006). For example, in a 21-year longitudinal study conducted by Telama et al. (2005), a high level of physical activity from the ages of 9 to 18 was found to be significantly related to a high level of adult physical activity. Similarly, Trudeau et al. (2004) observed that total physical activity, intense physical activity, light organized physical activity, and non-organized physical activity among adults was significantly associated with their physical activity in childhood and adolescence. Thus, the enhancement of physical activity in children and adolescents is of great importance for the adult physical activity, and through it, for the promotion of public health of general population.

To obtain health benefits, World Health Organization (2010) recommend people aged 5–17 years should accumulate at least 60 minutes of moderate to vigorous physical activity daily.

Amounts of physical activity greater than 60 minutes provide additional health benefits (World Health Organization, 2010). However, throughout the world, the majority of children and adolescents are insufficiently active for disease prevention, and there is a steep decline in physical activity throughout adolescence (Biddle & Mutrie, 2008; Butcher et al., 2008; Department of Health and Human Services, U.S., 2012; Nader et al., 2008; Townsend et al., 2012). In a study using accelerometer, Kahn et al. (2008) observed an increase (from 8 to 11 hours per week) in American girls' physical activity up to age 13 years, and then a decrease to about 8.5 hours per week at age 18 years. The boys started higher (about 10 hours per week), stayed mostly steady until age 13-14 years, and then declined to about 7 hours per week at age 18 years. In Japan, the national survey data revealed approximately 30% of teenagers not participating in sports and physical activities and participating in less than one time in a week in 2010 (Sasakawa sports foundation, 2012). Only 33% of teenagers engage in sports and activities at least 7 times per week (Sasakawa sports foundation, 2012). Particularly, the daily time in physical activities outside of school (including sports, playing and lessons) and the opportunities for daily physical activity in Japanese teenagers decreased remarkably when they enter into junior high schools (Benesse Educational Research and Development Center, 2009; Nakano et al., 2013). Therefore, there is a need to increase the participation in physical activity in adolescents, especially in the junior high school students.

In order to increase the engagement in physical activity among Japanese junior high school students, the development of effective intervention strategies is required. Before developing effective intervention strategies, it is important to know what the target physical activity is and what kind of factors related to the target physical activity (Sallis et al., 2000b). In terms of the target physical activity, because students might accumulate the 60 minutes of daily

physical activity in different time segments (e.g., lunch recess, class break, after or before class) and locations (e.g., school or home); physical activity occurring in each time-and/or location-context might be a target physical activity. However, in the last decade, studies mainly focus on the duration or pattern of physical activity within a day or week at different intensities and compare the patterns of physical activity between weekdays and weekends (Biddle et al., 2009; Gavarry et al., 2003; Jago et al., 2005; Pearson et al., 2009; Ridgers et al., 2006; Steele et al., 2010; Trost et al., 2002; Treuth et al., 2007; Troiano et al., 2008). Only a small number of studies have examined the locations for participation in physical activity and the specific time segments in a day in which physical activity is performed among junior high school students (Gorely et al., 2007; Gidlow et al., 2008; Gonzalez-Suarez et al., 2009; Graham et al., 2011; Pate et al., 2010; Ridgers et al., 2005; Ridgers et al., 2012). In the studies identified, they have focused on one or two specific contexts only. These include class break, lunch-recess, non-location context like after-school, or non-time-context like home-based physical activity (Gorely et al., 2007; Gidlow et al., 2008; Gonzalez-Suarez et al., 2009; Graham et al., 2011; Pate et al.,2010; Ridgers et al., 2005). The problem is that limited studies have been attempted to comprehensively describe physical activity patterns in a range of specific contexts. A better understanding of the physical activity participation in various contexts is important. This information helps to (1) capture the variations in physical activity behavior, (2) target appropriate contexts for the implementation of interventions. Therefore, more evidence is needed to examine the physical activity participation in a variety of contexts to ascertain the specific contexts in which strategies for promoting adolescent physical activity could be most effective.

In terms of the factors related to physical activity, it is well known that physical activity is influenced by the interactions of multilevel factors (Sallis et al., 2006). Each factor might

influence physical activity directly or indirectly (Dishman et al., 2009). Comprehensively understanding the direct and indirect influences of multilevel factors with physical activity may guide to develop effective interventions (Baron & Kenny, 1986; Lubans et al., 2008; Salmon et al., 2009). However, previous studies lack assessment of both the direct and indirect influences of multilevel factors on physical activity occurring in specific contexts (Ferreira et al., 2006; Ridgers et al., 2012; Stanley et al., 2012). Existing studies on this topic mainly examine the direct association of factors with context-specific physical activity (**Appendix 1**). The contexts examined including: after-school (Bocarro et al., 2012; Gracia Marco et al., 2010; Haerens et al., 2009; La Torre et al., 2006), lunch-recess (Hohepa et al., 2007; Khunti et al., 2007), class break (Khunti et al., 2007), and whole daily recess including lunch-recess and break (Haug et al., 2008; Hauget et al., 2009; Haug et al., 2010; Nichol et al., 2009). Factors directly associated with those physical activities were identified from multilevel including personal, social, and environmental as well as policy factors. However, none of studies have conducted in Asian countries. In particular, age, gender, self-efficacy, availability of facilities at school and support from parents (e.g., parents physical activity behavior) and friends (e.g., number of active friends) were observed to be related with physical activity among junior high school students (Khunti et al., 2007; Hohepa et al., 2007; Haug et al., 2008; Haug et al., 2009; Haug et al., 2010; Haerens et al., 2009; Bocarro et al., 2012). Testing not only the direct but also the indirect influences of these factors with the context-specific physical activity in Japanese junior high school students would contribute to the literature on this topic and be interesting because the school education system, the policy and the social culture in Japan is different from the western countries.

Moreover, among the previous studies, the influences of physical environment tend to be restricted to the examination of facility availability only, rather than a broader range of

environmental attributes such as safety and availability or accessibility of equipment (Bocarro et al., 2012; Haug et al., 2008; Haug et al., 2009; Haug et al., 2010; Nichol et al., 2009). Examining the direct and indirect influences of other specific environmental attributes, such as safety and equipment availability or accessibility, might provide more practical and policy-relevant information for school staffs and policy-makers. Similarly, as for the social environmental factors with physical activity, although social support was the most frequently examined social variables, the existing studies on the effects of social support limited to parents and friends only (Hohepa et al., 2007; Bocarro et al., 2012; Haerens et al., 2009; La Torre et al., 2006). There is none of studies investigating the effects of teachers' support. Support from teachers may result in increased likelihood of students being active in school because teachers are one of the important sources of support for the life development of children and adolescents and one of the most components of school (Berk, 2005). Therefore, understanding the direct and indirect influences of teacher support would be necessary.

In summary, to develop effective approaches for promoting physical activity, a comprehensive understanding of the patterns of physical activity participation in various contexts and both the direct and indirect influences of multilevel factors on physical activity is required. Therefore, the present dissertation explored the approaches to increase the engagement in physical activity among Japanese junior high school students on the basis of the two following studies.

PURPOSE

As illustrated above, the dissertation was aimed to explore approaches for promoting physical activity among junior high school students on the basis of results in the following two investigations: 1) patterns of physical activity participation in various behavioral contexts, and 2) associations of multi-level factors in relation with the physical activity targeted. The specific purpose of each investigation was:

1. Patterns of Context-specific Physical Activity

In this part, the dissertation was aimed to describe the current patterns of physical activity participation in different contexts and examine the possible gender and grade differences in it to identify the target physical activity among Japanese junior high school students.

2. Associations of Multilevel Factors with Context-specific Physical Activity

Based on the first investigation, the current investigation was aimed to understand both the direct and indirect associations of selected individual (Body mass index, self-efficacy), social (Social support from family, friend, and teachers) and environmental factors (facility, equipment, and safety) with the target physical activity identified.

METHODS

1. Participants and Data Collection

Data for the present dissertation were obtained from a cross-sectional survey of adolescent lifestyle conducted in Oct.-Nov. 2010. Participants were students (aged 12-15 years old) attending a public junior high school in Okayama city, Japan. A total of 761 students agreed to participate in this survey and returned questionnaire, including 344 girls. They were invited to complete a self-report questionnaire investigating lifestyle including non-curricular physical activity amount in specific context and the individual, social and environmental correlates of their lifestyle behavior during a class time. Information on demographic such as age, gender and grade were collected with this questionnaire. For consistency, one teacher was asked to explain the questionnaire to each class. Informed consent was obtained from all participants and schools. Participation was voluntary, and confidentiality of the participants was ensured. Informed consent was obtained from all participants, their guardian and the school. The study protocol was approved by the Research Ethics Committee of Waseda University.

2. Measurements

2.1 Anthropometric and demographic information

Information on participants' age, grade and gender were collected with the physical activity measurement in the self-report questionnaire. Weight and height were measured with a height and weight measuring scale. Body mass index (BMI) was calculated from the ratio weight/height^2 (kg/m^2) and weight status was classified by BMI ranges specific for age and gender. Participants were divided into underweight, normal weight, overweight and obesity categories, using the standard criteria specific for age and gender (Cole et al., 2000).

2.2 Context-specific physical activity

Five items were developed to measure physical activity patterns at out of class time. It was prepared by referring to previous studies and was suitable for Japanese adolescents (Sirard et al., 2008). The questionnaire asked participants about their average duration of physical activity each day (min/day), and frequency (days/week) in a usual week with respect to contexts inside and outside of school. Each context is thought to provide a unique opportunity for students to be physically active. In detail, two questions measured school-based physical activity: physical activity at school after class (inside school referring to activities at school after-class hours during weekdays), and physical activity during lunch recess (lunch recess). Three questions were prepared to measure physical activity outside of school: outside-school during total leisure-time (Total LTPA, including outside of school physical activity during weekdays and weekends), outside-school after-class (outside school, including the outside-school physical activity after-class hours during weekdays) and home-based physical activity (home-based, including physical activity at home in weekdays and weekends).

Before detailed descriptions of each question, the participants were provided with a general description ‘please write down how often in a usual week and how long per day you engaged in physical activities such as sports, exercise or play that can be done at or outside of school, active transportation, or household chores and so on’. Some examples of activities were listed at the end of each question to help students better understand it. An example item was the following: ‘After class, how often and how long each time do you engage in physical activities at school, including playing with friends and sports clubs?’ Total weekly physical activity time (min/week) was calculated with frequency per week and duration per day. Then outcome variables for each physical activity variable included frequency (days/week), daily minutes and weekly minutes.

2.3 School physical environmental variables

Based on a previous instrument (Robert-Wilson et al., 2007), 10 items were used to assess three factors of school physical environment. The three factors were 1) 'equipment' (3 items), examining the accessibility or usability of physical equipment (e.g., There is enough equipment for activities at school); 2) 'facilities' (4 items), measuring the accessibility or usability of physical activity facilities (e.g., The school grounds are big enough for activities); and 3) 'safety' (3 items), investigating perceived safety of physical activity equipment and facilities (e.g., It is safe to engage in physical activity on the grounds and in the gym at school). All items were rated on a four-point scale from 1) strongly disagree to 4) strongly agree. The factorial reliability (equipment: Cronbach α=0.71; facilities: Cronbach α=0.75; and safety: Cronbach α=0.83) of this scale was confirmed by respondents.

2.4 Social environmental variables: social support

In terms of social support for physical activity, participants were asked to rate support from three sources on a four-point scale from 1) not supportive at all to 4) strongly supportive for the following question: 'How do you rate support for engaging in physical activity from 1) family, 2) teachers at school and 3) friends at school?'.

2.5 Psychological variable: self-efficacy

The measure of self-efficacy related to physical activity (i.e., belief in one's ability to be active relative to peers) (Ryan & Dzewaltowski, 2002) contained 1 item with responses ranging from 1) strongly disagree to 4) strongly agree. The statement was 'I am able to do physical activities/exercises/sports better than my friends.'

3. Statistical Analysis

3.1 Patterns of context-specific physical activity

Of the 761 adolescents who returned the questionnaire, 47 participants (6.2%) had incomplete demographic or anthropometric data and were excluded from further analysis. No significant differences were found in the age, gender, and BMI of participants between the excluded data and the final sample.

Descriptive statistics were used to describe the characteristics of participants. Independent sample t-tests were applied to test for gender differences in physical activity patterns for days per week, daily minutes, and weekly minutes in each setting. Grade differences in each of the physical activity variables for the five settings were investigated using analysis of variance (ANOVA). The statistical significance was set at $p < .05$. All statistical analyses were performed with Statistical Package for Social Science version 17.0 (SPSS) software.

3.2 Associations of multilevel factors with context-specific physical activity

Structural equation modeling (SEM) analysis with maximum likelihood estimation in Amos 17.0 was performed to test the direct and indirect associations of multilevel factors with physical activity among boys and girls respectively. The size of the final sample was adequate to estimate the models in both boys and girls (North Carolina State University, 2012).

The original proposed model that led to a good model fit of the final model is described below. The measurement model included (a) three latent variables of physical environment: equipment (3 indicators), facilities (4 indicators) and safety (3 indicators); (b) relations between latent variables and their indicators and (c) correlations between the three latent environmental factors. The structural model included (a) paths from perceived physical equipment, facilities and safety and BMI to perceived self-efficacy and self-reported physical activity; (b) path from self-

efficacy to each source of social support and (c) paths from self-efficacy and three sources of social support to physical activity.

Model fit was assessed using the goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), root mean square error of approximation (RMSEA) and Akaike information criterion (AIC). GFI and AGFI are used to measure how well the model fits the data, which varies from 0 to 1, with .90 indicating an acceptable model fit and 0.95 indicating a good model fit (Kline, 1998; Schumacker & Lomax, 2004). RMSEA is a measure of the discrepancy between a population-based model and a hypothesized model assessed per degree of freedom. There is good model fit if the RMSEA is less than or equal to 0.05, with the upper limit of confidence interval less than 0.08 and the lower 90% confidence limit including or close to 0 (Schumacker & Lomax, 2004). A lower AIC value for a model reflects a better-fitting model compared with competing models (Hamparsum, 1987). A model was considered to fit the data when the following criteria were met: GFI > 0.90, AGFI > 0.90 (AGFI<GFI), RMSEA< 0.05 and a lower AIC value than competing models. A p value less than 0.05 was considered statistically significant.

To adjust the original specified model, new free parameters were added based on the modified indices before the Wald test that deleted all non-significant free parameters to increase model fitness. Then only significant causal paths with corresponding standardized regression coefficients (β) were shown in the figures of final structural models that demonstrated a good model fit. With the standardized regression coefficients, the magnitude of each factor could be directly compared with other factors in the model.

RESULTS

1. Patterns of Context-specific Physical Activity

1.1 Participant characteristics

Demographic and anthropometric characteristics of the population into analysis are presented in **Table 1**. The mean age of participants was 13.5 years (SD=0.95, range 12-15 years). The majority of participants were classified as normal weight, only 7.4% of participants were overweight, and 4.3% were obese.

1.2 Gender differences in the patterns of context-specific physical activity

Table 2 presents independent t-test statistics for the physical activity variables. The frequency, daily and weekly time of physical activity was significantly higher for boys than girls in all contexts except the daily minutes of total leisure-time physical activity (p=.226). However, both boys and girls spent only a few minutes per week in physical activity during lunch time. In addition, most students in both genders were classified into either engaging in physical activity on no days, or every day, in all contexts. This polarized trend was most clear in the inside-school context. The frequency of reporting no days of participation in physical activity in the total leisure-time was 17.5% (Boys 11.9%, Girls 23.5%), inside-school was 53.5% (Boys 42.0%, Girls 65.6%), outside school was 47.9% (Boys 42.4%, Girls 53.9%), lunch recess was 75.5% (Boys 70.8%, Girls 80.5%), and home-based was 35.0% (Boys 32.7%, Girls 37.5%).Whereas the frequency of reporting being engaged in physical activity every day was 11.5% (Boys 14.3%, Girls 8.5%) total leisure-time, 29.3% (Boys 38.0%, Girls 20.1%) inside school, 12.9% (Boys 16.2%, Girls 9.5%) outside school, 12.8% (Boys 16.6%, Girls 8.8%) at lunch recess, and 15.4% (Boys 16.8%, Girls 13.8%) at home.

Table 1

Participants' demographic and anthropometric characteristics

	Total (N=714)	Boys (N=372)	Girls (N=342)
	Mean ± SD	Mean ± SD	Mean ± SD
Age	13.5 ± 0.9	13.5 ± 1.0	13.4 ± 0.9
Height (cm)	158.6 ± 7.7	161.7 ± 8.2	155.3 ± 5.4
Weight (kg)	48.7 ± 10.4	50.3 ± 11.7	47.0 ± 8.5
BMI	19.3 ± 3.4	19.1 ± 3.7	19.4 ± 3.1
Grade (N, %)			
Grade 1	243 (34.0)	123 (33.1)	120 (35.1)
Grade 2	249 (34.9)	128 (34.4)	121 (35.4)
Grade 3	222 (31.1)	121 (32.5)	101 (29.5)
Weight Status (N, %)			
Underweight	42 (5.9)	28 (7.5)	14 (4.1)
Normal weight	588 (82.4)	298 (80.1)	290 (84.8)
Overweight	53 (7.4)	27 (7.3)	26 (7.6)
Obese	31 (4.3)	19 (5.1)	12 (3.5)

N: number; SD: standard deviation.

Table 2

Independent t-test statistics for physical activity variables by gender (Mean ± SD)*

	Gender		Sig. (2-tailed)
	Boys	Girls	
Total LTPA			
Days	3.0 ± 2.3	2.2 ± 2.1	<0.001
Daily minutes	102.7 ± 81.6	94.1 ± 92.2	0.226
Min. per week	364.9 ± 422.0	278.0 ± 375.4	0.008
Inside School			
Days	2.4 ± 2.3	1.4 ± 2.1	<0.001
Daily minutes	62.6 ± 65.4	32.7 ± 54.7	<0.001
Min. per week	267.9 ± 310.0	136.3 ± 253.4	<0.001
Outside School			
Days	1.7 ± 1.9	1.2 ± 1.7	<0.001
Daily minutes	46.9 ± 56.4	38.0 ± 54.3	0.049
Min. per week	137.8 ± 206.5	90.1 ± 159.4	0.002
Lunch Recess			
Days	1.1 ± 1.9	0.6 ± 1.5	0.001
Daily minutes	3.3 ± 6.9	2.2 ± 6.1	0.046
Min. per week	12.4 ± 29.2	6.5 ± 20.9	0.005
Home-Based			
Days	2.6 ± 2.6	2.2 ± 2.5	0.039
Daily minutes	31.9 ± 32.4	26.7 ± 32.0	0.042
Min. per week	130.7 ± 182.6	89.3 ± 139.4	0.001

* Numbers of respondents to each domain of physical activity are not always equal because of missing data. The significance level were set at $p<0.05$.

1.3 Grade differences in the patterns of context-specific physical activity

Table 3 shows results from the ANOVAs used to investigate differences in the physical activity variables by grade among boys. Significant grade differences were observed in all of the physical activity variables except the frequency of total leisure-time physical activity and all three time variables in lunch-recess and home-based contexts. From multiple comparisons, those in the third grade were significantly less active in all physical activity variables than the other two grades. No significant differences in physical activity variables were found between grade1 and grade2 participants among the five contexts. Moreover, lunch-recess physical activity was consistently low from grade 1 to grade 3 among boys. In all contexts, the majority of boys in each grade were polarized into either participating in physical activity on no days, or every day. Meanwhile, the frequency of boys who participated in inside-school and outside-school physical activity everyday largely decreased, while the frequency of no daily participation increased from grade 2 to grade 3.The frequency of reporting no daily participation in physical activity among three grades (grade 1, 2, and 3) was 7.2%, 13.0%, and 15.5% for total leisure-time, 30.0%, 37.4%, and 58.7% for inside-school, 33.0%, 44.0%, and 50.0% for outside-school, 72.1%, 67.3%, and 73.1% for lunch-recess, and 32.4%, 33.3%, and 32.4% for home-based physical activity. Those reporting daily physical activity in these contexts were 13.5%, 21.3%, and 8.2% for total leisure-time, 53.6%, 47.7%, and 12.8% for inside-school, 17.4%, 22.0% and 9.1% for outside-school, 15.4%, 20.6%, and 13.9% lunch-recess, and 15.3%, 19.7%, and 15.3% home-based physical activity, for each of grades 1, 2, and 3, respectively.

Table 3

Boys: ANOVA statistics of physical activity variables by grade (Mean ± SD)

	Grade 1	Grade 2	Grade 3	F	Sig.
Total LTPA					
Days	3.2 ± 2.1	3.2 ± 2.5	2.6 ± 2.0	3.00	0.051
Daily minutes [A,]	118.3 ± 88.1	107.9 ± 79.4[***]	82.4 ± 73.4[**]	5.57	0.004
Min. per week [A]	407.0 ± 440.2	425.7 ± 464.6[***]	265.4 ± 338.4[**]	4.67	0.010
Inside School [A]					
Days	3.1 ± 2.3	2.8 ± 2.3[***]	1.2 ± 1.8[**]	25.20	<0.001
Daily minutes	79.9 ± 64.9	73.3 ± 70.2[***]	34.8 ± 51.3[**]	15.98	<0.001
Min. per week	355.9 ± 315.6	342.3 ± 342.2[***]	108.6 ± 189.9[**]	24.13	<0.001
Outside School [A]					
Days	1.9 ± 1.8	1.9 ± 2.0	1.3 ± 1.6[**]	3.92	0.021
Daily minutes	56.9 ± 58.9	49.3 ± 60.6	35.2 ± 47.7[**]	4.07	0.018
Min. per week	153.6 ± 200.5	171.4 ± 248.2[***]	91.1 ± 156.3[**]	4.47	0.012
Lunch Recess					
Days	1.0 ± 1.9	1.2 ± 2.0	1.0 ± 1.8	0.68	0.506
Daily minutes	3.0 ± 6.3	3.7 ± 7.2	3.1 ± 7.1	0.33	0.719
Min. per week	10.0 ± 21.6	14.8 ± 31.4	12.4 ± 33.2	0.66	0.518
Home-Based					
Days	2.5 ± 2.5	2.8 ± 2.7	2.5 ± 2.5	0.45	0.640
Daily minutes	29.3 ± 28.3	35.5 ± 36.8	31.1 ± 31.6	1.04	0.356
Min. per week	114.1 ± 158.2	154.4 ± 210.0	123.3 ± 174.5	1.48	0.229

[A] Significant grade difference of physical activity variables among boys ($p<0.05$)

[*] Significant difference between grade 1 and grade 2 for boys ($p<0.05$)

[**] Significant difference between grade 1 and grade 3 for boys ($p<0.05$)

[***] Significant difference between grade 2 and grade 3 for boys ($p<0.05$)

Numbers of respondents to each domain of physical activity are not always equal because of missing data.

For girls' total leisure-time physical activity and home-based physical activity, there were no significant differences in frequency per week among grades. However, girls in grade 3 had significantly fewer daily and weekly minutes of total leisure-time physical activity than those in the other two grades. For home-based physical activity, girls in grade 1 accumulated significantly more daily and weekly minutes than those in higher grades (**Table 4**). The frequency and daily minutes of outside-school physical activity among grade 3 girls were significantly lower than those of girls in grade 1, although there were no significant differences in weekly minutes of physical activity among grades (p=.086). Regarding the inside-school context, girls in grade 3 were significantly less active than those in the other two grades for all three physical activity variables. In the lunch-recess context, similar to boys, time spent in physical activity was consistently low for all grades among girls, and there were no significant differences in all three physical activity variables among grades. Furthermore, as it was for boys, a polarized trend was found in each context of physical activity among girls. In the inside-school context (at school after hours), the frequency of girls who participated in physical activity every day decreased with increasing grade, whereas those reporting no daily physical activity increased. The frequency of reporting no daily physical activity among three grades (grade 1, 2, and 3) in each of contexts were 21.4%, 18.7%, and 31.9% for total leisure-time, 53.2%, 63.6%, and 83.3% for inside-school, 42.0%, 53.3%, and 69.7% for outside-school, 78.7%, 79.4%, and 83.9% for lunch-recess, and 29.8%, 42.2% and 41.6% for home-based physical activity, respectively. Those reporting daily engagement in physical activity in these contexts were 8.5%, 10.3%, and 6.6% for total leisure-time, 34.2%, 21.5% and 1.1% for inside-school, 9.8%, 12.4% and 5.6% for outside-school, 6.5%, 11.8%, and 8.0% for lunch-recess, and 12.3%, 17.4% and 11.2% for home-based physical activity, respectively.

Table 4

Girls: ANOVA statistics for physical activity variables by grade (Mean ± SD)

	Grade 1	Grade 2	Grade 3	F	Sig.
Total LTPA					
Days	2.3 ± 2.1	2.4 ± 2.1	1.8 ± 2.1	2.15	0.119
Daily minutes [B]	107.0 ± 90.7	106.0 ± 96.4[§§§]	63.7 ± 82.5[§§]	6.78	0.001
Min. per week [B]	304.9 ± 361.2	352.7 ± 457.6[§§§]	156.7 ± 234.9[§§]	6.96	0.001
Inside School [B]					
Days	2.0 ± 2.4	1.5 ± 2.2[§§§]	0.4 ± 1.0[§§]	17.69	<0.001
Daily minutes	49.2 ± 62.8	33.0 ± 53.6[§§§]	12.5 ± 36.3[§§]	11.57	<0.001
Min. per week	218.5 ± 302.6	141.9 ± 256.4[§§§]	31.6 ± 109.1[§§]	14.23	<0.001
Outside School					
Days [B]	1.5 ± 1.7	1.2 ± 1.7	0.8 ± 1.4[§§]	4.75	0.009
Daily minutes [B]	49.6 ± 57.9	34.2 ± 50.1	28.2 ± 52.4[§§]	4.15	0.017
Min. per week	116.8 ± 162.2	80.7 ± 154.2	68.5 ± 159.0	2.47	0.086
Lunch Recess					
Days	0.6 ± 1.4	0.7 ± 1.6	0.5 ± 1.4	0.44	0.646
Daily minutes	2.8 ± 7.3	1.8 ± 5.2	1.9 ± 5.4	0.93	0.397
Min. per week	8.7 ± 25.6	4.8 ± 14.7	5.8 ± 20.3	0.98	0.378
Home-Based					
Days	2.3 ± 2.3	2.3 ± 2.7	1.9 ± 2.3	1.13	0.326
Daily minutes [B]	34.3 ± 35.6[§]	21.7 ± 29.2	23.1 ± 28.8[§§]	5.04	0.007
Min. per week [B]	122.2 ± 176.2[§]	71.5 ± 115.9	69.2 ± 101.2[§§]	4.99	0.007

[B] Significant grade difference of physical activity variables among girls ($p<0.05$)

[§]Significant difference between grade 1 and grade 2 for girls ($p<0.05$)

[§§]Significant difference between grade 1 and grade 3 for girls ($p<0.05$)

[§§§]Significant difference between grade 2 and grade 3 for girls ($p<0.05$)

Numbers of respondents to each domain of physical activity are not always equal because of missing data.

2. Associations Multilevel Factors with Context-specific Physical Activity

2.1 Participant characteristics

There were 280 girls (mean age=13.44, SD = 0.93) and 300 boys (mean age = 13.5, S.D. = 0.96) with complete data entering into the structural equation model analysis. Mean height and weight of girls were 155.37 cm (SD = 5.32) and 46.98 kg (SD = 8.72), respectively. The majority of adolescent girls had normal weight (5≤BMI< 85 percentile, n = 236, 84.3%). Mean height and weight of boys were 161.85 cm (S.D. = 8.06) and 50.30 kg (S.D. = 11.77), respectively. Same as girls, the majority of boys had normal weight (5 ≤ BMI < 85 percentile, n = 236, 78.7%). More information about characteristics of the studied variables is provided in **Table 5**.

Table 5

Characteristics of participants and outcome physical activity variables presented in the model

	Girls (N=280)	Boys (N=300)
	Mean ± SD	Mean ± SD
Age	13.4 ± 0.9	13.5 ± 1.0
Height	155.4 ± 5.3	161.9 ± 8.1
Weight	47.0 ± 8.7	50.3 ± 11.8
BMI	19.4 ± 3.1	19.1 ± 3.8
Lunch-recessPhysical Activity	8.5 ± 26.7	16.8 ± 35.9
After-class Physical Activity	138.9 ± 259.1	283.0 ± 319.0
Grade (N, %)		
Grade 1	99 (35.4)	98 (32.7)
Grade 2	96 (34.3)	98 (32.7)
Grade 3	85 (30.4)	104 (34.7)
Weight Status (N, %)		
Underweight	12 (4.3)	27 (9.0)
Normalweight	236 (84.3)	236 (78.7)
Overweight	22 (7.9)	21 (7.0)
Obesity	10 (3.6)	16 (5.3)

N: number; SD: standard deviation.

2.2 Associations of multilevel factors with lunch-recess physical activity

Girls. The final structural model for lunch-recess physical activity among girls in **Figure 1** demonstrated a good model fit (GFI = 0.95, AGFI = 0.93, RMSEA = 0.02 [90% confidence interval = 0.00–0.04]). The recalculation of the model after addition and deletion of free parameters reduced the AIC value from 780.95 to 215.56. During lunch recess, perceived friend support (β = 0.11) was found to have a direct positive effect on girls' physical activity. Self-efficacy (β = 0.04) indirectly influenced physical activity through friend support. With respect to the influences of school environmental factors, perceived equipment exhibited a direct negative effect (β = – 0.15) on physical activity. The total effects of perceived facilities (β = 0.01) and safety (β = –0.01) on physical activity were fully mediated by self-efficacy and friend support. Equipment was identified as the most influential environmental factor related to physical activity. There were no significant associations of BMI, family support or teacher support with physical activity.

Boys. The final structural model for lunch-recess physical activity among boys in **Figure 2** demonstrated a good model fit (GFI = 0.96, AGFI = 0.93, RMSEA = 0.03 [90% confidence interval = 0.004–0.045]). The value of AIC was reduced from 815.83 to 204.70 after the model modifications. During lunch recess, self-efficacy (β = 0.13) directly and positively affected physical activity. The standardized coefficients for the indirect effect of perceived facilities, safety, and BMI through self-efficacy was –0.03, 0.03 and –0.02, respectively. Their effect sizes on physical activity were generally low. Perceived equipment and social support had neither direct nor indirect effects on lunch-recess physical activity. Self-efficacy was the most important factor and mediator affecting lunch-recess physical activity among boys.

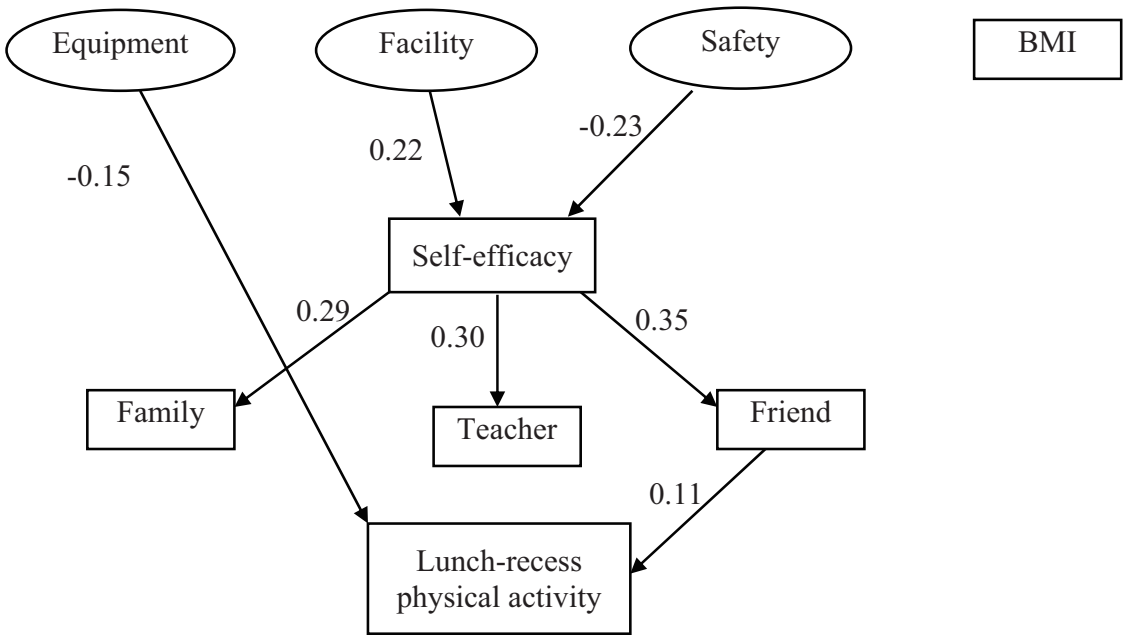

Figure 1. Effects of personal, social and environmental factors on lunch-recess physical activity among girls. Only statistically significant paths are shown in the figure. The significance level were set at $p<0.05$. BMI: body mass index; Family: family support; Teacher: teacher support; Friend: friend support

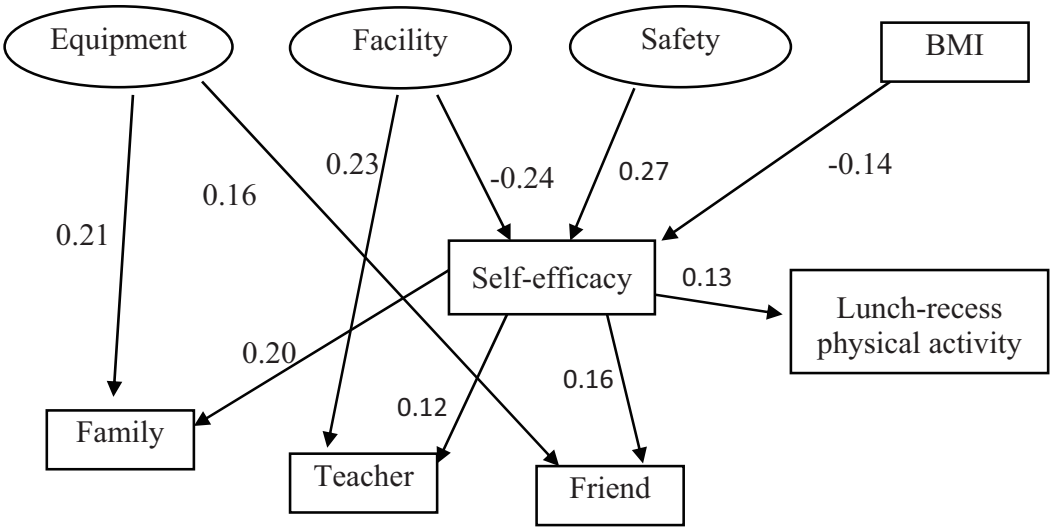

Figure 2. Effects of personal, social, and physical environmental factors on lunch-recess physical activity among boys. Only statistically significant paths are indicated in the figure. The significance level was set at $p < 0.05$. Digitals in each path represent standardized path coefficients. BMI: body mass index; Family: family support; Teacher: teacher support; Friend: friend support.

2.3 Associations of multilevel factors with after-class physical activity

Girls. The final structural equation model for after-class physical activity among girls in **Figure 3** also demonstrated a good model fit (GFI = 0.95, AGFI = 0.93, RMSEA = 0.03 [90% confidence interval = 0.00–0.04]). The AIC value was reduced from 842.24 to 219.74 after the model modifications. In the final structural model, perceived equipment, teacher support and BMI failed to exhibit direct or indirect effects on physical activity. Perceived facilities (β = 0.02) and safety (β = – 0.02) were found to indirectly affect physical activity through self-efficacy and family support or friend support. Their effect sizes on physical activity were generally low. The standardized indirect effect of self-efficacy on physical activity through family and friend support was 0.09. Support from friends (β = 0.16) and family (β = 0.13) were found to directly affect physical activity. The final model identified friend support as the most influential factor directly affecting physical activity at school during after-class hours.

Boys. The final structural model for after-class physical activity among boys presented in **Figure 4** demonstrated a good model fit (GFI = 0.95, AGFI = 0.93, RMSEA = 0.03 [90% confidence interval = 0.017–0.047]). The recalculation of the model after addition and deletion of free parameters reduced the AIC value from 859.15 to 237.16. Family support (β = 0.28) was identified as the most influential factor directly affecting physical activity during after-class hours. Self-efficacy (β = 0.06) and perceived equipment (β = 0.04) indirectly affected physical activity through family support. The path coefficient for the indirect positive effects of perceived safety on physical activity through self-efficacy and family support was 0.02. The total effects of facilities (β = –0.14) on physical activity were partially mediated by self-efficacy and family support. The path coefficient for the indirect negative effects of facilities through self-efficacy and family support on physical activity was –0.02. BMI (β = –0.01) indirectly affected physical activity through self-efficacy and family support.

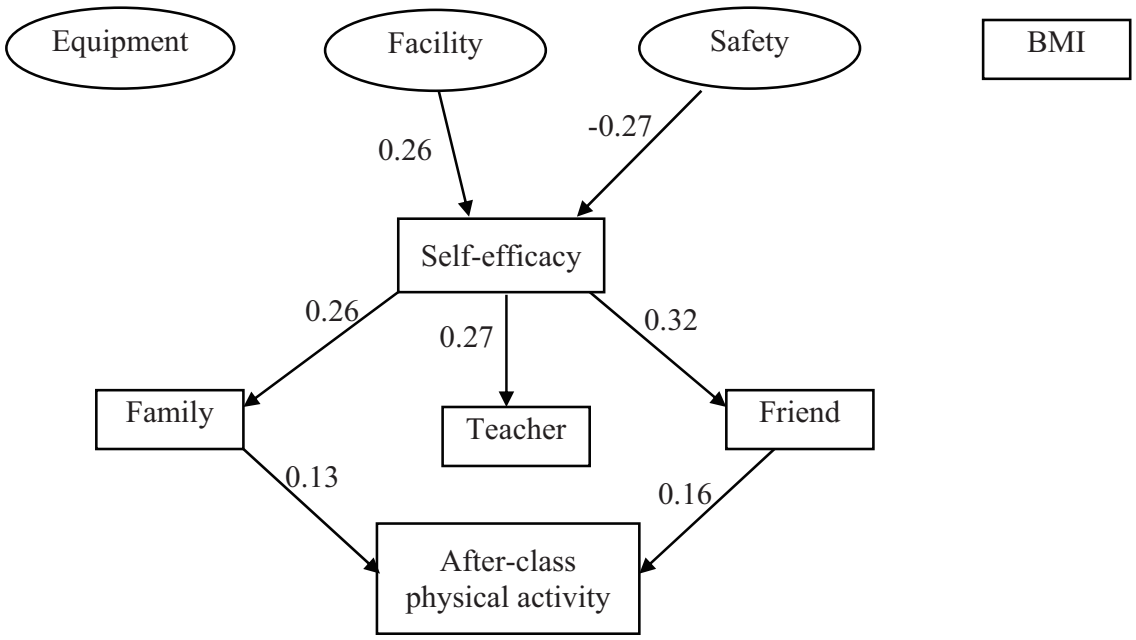

Figure 3. Effects of personal, social and environmental factors on after-class physical activity among girls. Only statistically significant paths are shown in the figure. The significance level were set at $p<0.05$. BMI: body mass index; Family: family support; Teacher: teacher support; Friend: friend support

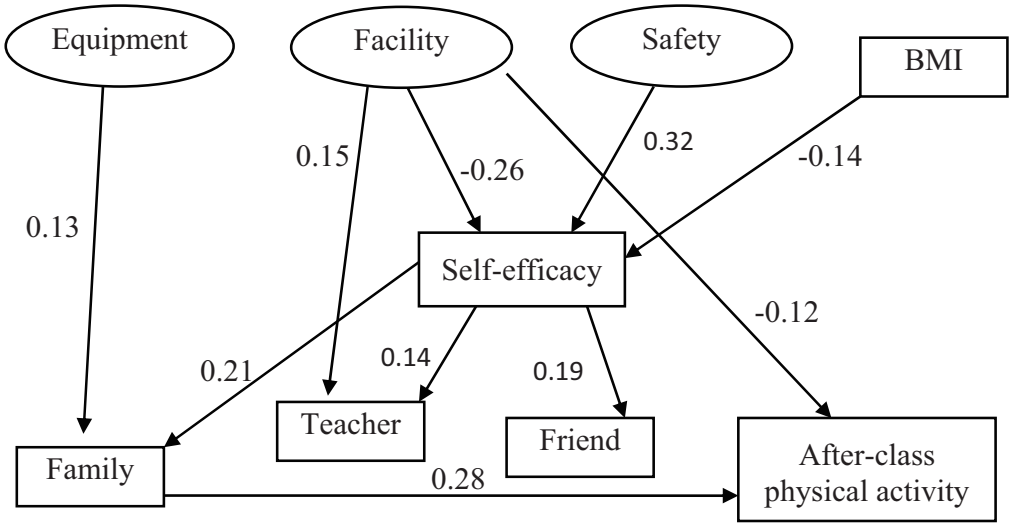

Figure 4. Effects of personal, social, and physical environmental factors on after-class physical activity among boys. Only statistically significant paths are indicated in the figure. The significance level was set at $p < 0.05$. Digitals in each path represent standardized path coefficients. BMI: body mass index; Family: family support; Teacher: teacher support; Friend: friend support.

DISCUSSION

This chapter integrated the findings from all studies described in this dissertation. In order to explore effective approaches for promoting physical activity among Japanese junior high school students, the present dissertation was conducted the following two studies: (1) measuring the patterns of physical activity participation in specific context out of class among Japanese junior high school students; (2) examining the direct and indirect associations of personal, social and environmental factors with physical activity in the targeted contexts.

1. Patterns of Context-specific Physical Activity

Existing studies on patterns of physical activity behavior lack assessment of context-specific physical activity participation and possible gender or grade differences in it (Biddle et al., 2009; Gavarry et al., 2003; Gorely et al., 2007; Gidlow et al., 2008; Gonzalez-Suarez et al., 2009;Treuth et al., 2007; Ridgers et al., 2011). The current study allows for comparison with other pattern studies, and contributes to the literature on youth physical activity patterns by describing gender and grade differences of context-specific physical activity patterns.

First of all, Japanese adolescent boys participated in physical activity more often and much longer than girls each week in all potential contexts for promoting physical activity. This is similar to findings from other countries, although direct comparisons are hindered by the different measurements, samples, and approaches to defining the pattern of physical activity used (Mota et al., 2003; Riddoch et al., 2004). The significant gender differences observed in the first study confirms that different models for activities should be developed for boys and girls.

Moreover, the present study indicated that students in grade 3 were the least active, which is in good agreement with many other studies observing that younger youth are more active than older ones (Aznar et al., 2011; Brodersen et al., 2007; Nader et al., 2008; Riddoch et al., 2004; Samdal et al., 2006). Differences in each context-specific physical activity behavior were observed across three grades in the present study, significantly in the inside-school context for both genders, outside-school context for boys, and home-based context for girls. This finding indicated that each context should and can be intervened in to promote overall physical activity among adolescents, especially the inside-school contexts for both genders. According to social ecological theory (Sallis et al., 2002), physical activity behavior is dependent on the function of personal, social and environmental factors. Therefore, for promoting physical activity, comprehensive explorations of the multiple factors that potentially impact the engagement in the context-specific physical activity for students of different grades are clearly warranted in future research.

With regard to age-related changes in context-specific physical activity, Pate et al. (2010) observed that grade 8 girls are less likely than grade 6 girls to engage in activities at home and are more likely to be physically active in the school or community environment. They assumed that organized activities at school and in the community may be more available and accessible to older girls. However, the current study found that Japanese girls and boys were less active at school with advancing grade. This is possible because high grade students in Japan might have less time participating in extracurricular sports clubs or organized activities at school (Benesse Educational Research and Development Center, 2009).

Furthermore, the current finding regarding lunch-recess physical activity is different from previous studies. Previous findings indicated that the lunch break is an active period of

moderate-to-vigorous intensity physical activity for youth during weekdays (Page et al., 2005). On the contrary, the majority of studied Japanese students were physically inactive during lunch recess. A shorter lunch time period (approximately 45 min) in Japanese junior high schools than other countries may partly account for this inconsistency between previous studies and the current study. Regardless, because the rates of participation in lunch-recess activities were very low for both boys and girls, there is a scope for physical activity promotion during such time. Collectively, considering the significant differences across three grades in physical activity after-class within the school environment and little lunch-recess physical activity among both genders, understanding the environmental and personal factors that potentially impact physical activity at school should be a high priority.

Overall, the present results imply that interventions to promote physical activity effectively for boys and girls can be implemented in the same contexts, provided that gender-or grade-specific strategies for behavioral change are applied. At the individual level, each examined context should be intervened in to increase adolescents' physical activity. At the population level, considering that interventions should be conducted in contexts that will maximize access to the targeted population group and that have the potential to facilitate behavior change, schools are thought to be ideal places for implementation of interventions to improve physical activity among adolescents (Naylor & McKay, 2009; Pate et al., 2006). Compared with home or neighborhood, school can provide the greatest opportunities for increasing the overall physical activity level of youth.

In Japan, school enrollment rate for compulsory junior high school education is almost 100% (99.97% in 2010) (Ministry of Education, Culture, Sports, Science and Technology, 2011). On about 200 school days a year, students spend much of their day at school and have many

opportunities for daily activity. School offers opportunities for physical activity throughout the day through physical education, recess periods, or after-school programs. Unlike the U.S. (National Association for Sport and Physical Education & American Heart Association. 2010), national policy requires physical education, which is named as 'health and physical education' in Japan, to be provided as a compulsory course in junior high schools to develop physically educated individuals (Ministry of Education, Culture, Sports, Science and Technology, Japan, 2009). Similar to their counterparts in other countries, Japanese junior high students are required to attend physical education classes around twice a week for about 45 minutes each time. Physical education class alone might not guarantee student to meet the recommend physical activity level for a healthy body. Therefore, in addition to the exploration of quality physical education, identifying factors which could be intervened in to promote physical activity at school out of class (e.g. enrichment of extracurricular sports clubs or environmental modification) (Fuller et al., 2011; Nichol et al., 2009), are necessary to be examined and implemented because it would also be helpful to develop sports skills and active lifestyle and prevent a decrease in physical activity amount and participation with advancing grade. From the present findings, to promote physical activity among Japanese junior high school students in school environment, a better understanding of personal, social and school physical environmental factors related with lunch-recess and after-class physical activity at school could be beneficial and should be given first priority to investigate.

2. Associations of Multi-level Factors with Context-specific Physical Activity

Based on the results of the first study, it is necessary to develop strategies or programs to encourage students being active during lunch recess and after-class hours in school environment.

Therefore, the second investigation examined the direct and indirect influences of perceived school physical environment, social support, self-efficacy and BMI on lunch-recess and after-class physical activity in school in junior high school girls and boys separately. Some previous studies have been found to examine both direct and indirect influences of factors on physical activity, but they were limited to use overall physical activity as dependent variable, and to be tailored for adolescent girls or whole population (Dishman et al., 2004; Dishman et al., 2005; Dishman et al., 2010; Lubans et al., 2012; Motl et al., 2005; Motl et al., 2007). In this respect, the current study is, perhaps, the first to examine the direct and indirect influences of multilevel factors on lunch-recess and after-class physical activity at school among junior high school boys and girls.

With regard to the direct influences of personal, social and environmental factors on physical activity, first of all, the present study indicated that self-efficacy might be more important for boys but not for girls in the lunch-recess context. This finding suggests that different approaches for physical activity should be developed for boys and girls in the lunch-recess context. Specifically, increasing self-efficacy might be a means of directly increasing boys' physical activity while increasing perceptions of friend support might be a means of directly increasing girls' physical activity during lunch recess. Because boys often do competitive activities while girls often engage in socializing behaviors, this finding is understandable (Blatchford et al., 2003).

For the influences of self-efficacy on physical activity, some previous studies have observed that self-efficacy directly affect adolescent girls' physical activity, although the domain of physical activity examined was different from previous studies (Dishman et al., 2009; Lubans et al., 2012; Motlet al., 2005; Motl et al., 2007; Salmon et al., 2009; Trostet al., 2003; Van der

Horst et al., 2007; Wu et al., 2003). However, in the current study, self-efficacy did not directly affect physical activity among girls, regardless of contexts. The inconsistency between previous studies and the current finding might be attributed to aspects of self-efficacy measured. The present study focused on the self-efficacy in performance of activities; previous studies primarily examined barriers self-efficacy. Ryan et al. (2002) found that the impacts of different types of self-efficacy (e.g., barriers self-efficacy, performance self-efficacy and asking self-efficacy) on physical activity were different. Thus, future studies should include more aspects of self-efficacy and test those possibilities. Additionally, the present finding might further confirm the study of Dishman et al. (2009) suggesting that physical activity interventions designed to enhance self-efficacy might be especially needed during preadolescence for adolescent girls. Therefore, to gain a complete understanding of the relationship between self-efficacy and context-specific physical activity in girls, future studies should follow changes in self-efficacy throughout primary and junior high school.

For the influences of friend support on physical activity, the present study indicated that friend support was not only directly influence the lunch-recess but also the after-class physical activity in girls. Some previous studies have demonstrated similar findings on moderate-to-vigorous physical activity during non-school-time and mean daily physical activity in adolescent girls (Duncan et al., 2005; Hohepa et al., 2007; Jago et al., 2012; Lytle et al., 2009; Patnode et al., 2010; Wu et al., 2003). Collectively, findings suggest that developing strategies to encourage or assist with friends' physical activity behaviors can be beneficial in promoting physical activity in adolescent girls, regardless of contexts. To enhance the opportunities to be active for girls with friends, for example, it might be useful to consider providing a wide variety of attractive activity

or sports programs which are appropriate for girls (e.g., dance, aerobics, yoga) at school (Heath et al., 2012).

One more interesting finding with regard to the direct influences of multilevel factors on physical activity was that family support might be more important for after-class but not lunch-recess physical activity in school for both girls and boys. This finding was explicable based on the substantial reliance of adolescents on the support from parents. Previous studies suggest that parents mainly act as a 'gate keeper' by allowing them participating in organized activities or sports clubs or providing instrumental support (e.g., transportation and providing access to equipment) during after-class hours (Alderman et al., 2010; Welk et al., 2003). Boys and girls may follow their friends in joining activities, but assistance from family (e.g., assisting with fees for equipment and uniform) is necessary to remove barriers to being active, especially in early adolescence (Duncan et al., 2005; Hsu et al., 2011; Ornelas et al., 2007; Trost et al., 2003). In addition, the emotional support (approval or praise for behaviors, or talking about activities frequently) from parents might also be important to motivate adolescents to be active (King et al., 2008). For instance, the latest national report regarding family effects on junior high students' exercise habits showed that across Japan, 40.8% of junior high boys and 30.9% of girls talked about physical activities with their families at least once weekly (Ministry of Education, Culture, Sports, Science and Technology, 2010a). Regardless, this study indicates that increasing perceived family support might serve as a beneficial strategy for increasing physical activity among boys and girls during after-class hours. To increase the effectiveness of interventions through family and friend support, more in-depth research should examine preferred types of physical activity in different contexts, and to identify types of support (e.g., encouragement or tangible assistance) in association with context-specific physical activity.

Interestingly, contrary to the hypothesis, for both adolescent boys and girls, the present study found that teacher support was not significantly important for lunch-recess and after-class physical activity. This non-significant association was understandable because physical activity becomes a free choice at out of class time. Teachers' influence may be more significant in physical education courses rather than in free time behavioral choices. In Japan, approximately 61.2% of junior high school girls and 85.7% of boys join in their school's extracurricular sports clubs during after-school hours (Ministry of Education, Culture, Sports, Science and Technology, 2010a). However, only 0.7% of girls and 0.8% of boys are motivated by teachers (Ministry of Education, Culture, Sports, Science and Technology, 2010a). 26.4% of girls and 22% of boys report that they take part in extracurricular sports clubs because of their friends and family (Ministry of Education, Culture, Sports, Science and Technology, 2010a).

In terms of the indirect influences of multilevel factors on physical activity, this dissertation indicated that environmental factors had indirect effects on physical activity in lunch-recess and after-class at school through self-efficacy and social environmental factors in boys and girls. However, environmental factors specific to self-efficacy for boys and girls were different in the present study. Moreover, the present study indicate that self-efficacy directly influence the lunch-recess physical activity for boys, the friend support for girls' lunch-recess physical activity, the family support for boys' after-class physical activity in school, and both the family and friend support for girls' after-class physical activity in school. Therefore, the findings of the present study imply that different environmental interventions for increasing perceptions of support and self-efficacy should be developed for boys and girls.

Specifically, the dissertation provide basis for targeting perceived facility accessibility as a possible means of increasing self-efficacy and perceptions of friend and family support, and

perhaps ultimately increasing physical activity among girls. This information highlights the importance of increasing information channels regarding available or accessible facilities at school among girls. Additionally, the present study indicates that increasing the awareness and information of accessible equipment (e.g., balls) after class and safety of school recourse for physical activity in both contexts might increase boys' perceptions of family support and self-efficacy. This highlights the necessity of increasing awareness and information among boys of school equipment and safety for physical activity. Overall, the present findings highlight the necessity of increasing perceptions among students of school resources for physical activity and if necessary, improving the objective environment to be more activity-friendly at school. In the future, more in-depth research is required to manipulate perceptions of the physical environment to observe changes in self-efficacy and perceptions of social support and physical activity.

As for the direct and indirect influences of physical environment, previous research mainly focused on the direct influences and has revealed significant direct and positive influences of some school environmental characteristics (e.g., availability of play equipment and facilities like playing fields) on recess physical activity at school or overall physical activity level (Colabianchi et al., 2011; Durant et al., 2009; Haug et al., 2008; Haug et al., 2010; Kirby et al., 2012; Prins et al., 2010). There is little research on the indirect influences of perceived equipment accessibility and safety with regard to physical activity. While they are interested in the neighborhood environment with regard to overall physical activity, and are limited to the adolescent girls (Motl et al., 2005; Motl et al., 2007). A previous study investigated the direct and indirect influences of the quality, accessibility and availability of the physical activity facilities at school (Lubans et al., 2012). But that study found that the perceived physical activity facilities at school directly influenced the total physical activity among adolescent girls and

mediated the influences of self-efficacy on physical activity. Therefore, the present study contributes to the development of school-based strategies by providing new information about the influences of school physical environment on physical activity.

To better understand the influences of physical environment and physical activity, two interesting findings of the present study which were contrary to assumption should be examined further. First, some negative associations of physical environment with physical activity were found in the present study. In particular, for girls, perceived equipment and safety had a negative effect on self-efficacy and lunch-recess and after-class physical activity. For boys, perceived facility had a negative relationship with self-efficacy and physical activity. These findings might be accounted for by inaccurate measures of the physical environment. Some previous studies have shown that the agreement between perceived and objectively measured environment is often poor. In addition, the relationship between objective and self-report measures of physical environment and physical activity is inconsistent among adolescents (McCormack et al., 2004; Maddison et al., 2010). Therefore, future research is needed to test whether perceptions of equipment and safety match objective measurements to clarify the influences of environment on physical activity. Second, the present study observed the context differences in the influences of equipment on physical activity for boys and girls. This difference might be explained by the fact that students are often involved in different types of physical activity in different time periods during weekdays (Stanley et al., 2011). Accordingly, further studies should take types of activities into account to better understand how the physical environment affects preferred types of activities during different time periods.

Finally, with regard to the indirect influences of multilevel factors on physical activity, it was interesting that boys and girls differed on the effects of BMI on physical. In the present

dissertation, BMI had no significant influence on girls' physical activity, while boys with higher BMI were less active than those with lower BMI because they perceived less self-efficacy and family support. BMI is one of the most studied biological markers of body weight and shape. Evidence from systematic reviews have shown that there is no consistent association between BMI and adolescent girls' physical activity level, with the majority of studies reporting either a small negative or no correlation (Biddle et al., 2005; Sallis et al., 2000; Van der Horst et al., 2007). The small or non-significant effects of BMI may suggest that other potentially body weight-and shape-related factors like body image need to be assessed in future behavioral models for girls. Different from BMI, the construct of body image measured physical appearance attitudinally. It consists of subjective feelings and beliefs on one's own appearance (e.g., body dissatisfaction) (Thompson et al., 1999) and perceptions of how the body moves and functions, or what the body can "do" (Abbott et al., 2011). Culture and social norms may influence perceptions of poor and ideal body image. Also girls tend to be more concerned about their physical appearance than boys during adolescence. It is logistically to think that body image rather than BMI is more likely to reflect variances of physical activity or other weight-related behavior in adolescent girls (Biddle et al., 2005; Rauste-von Wright, 1989). Therefore, it would be worthwhile including the construct of body image in future models for girls' physical activity. Moreover, based on the findings about effects of BMI on boys' physical activity, it is suggested in the future to examine the interventional effects of self-efficacy and family support on physical activity in overweight or obese boys. Considering that factors influencing physical activity might be different in those overweight, obese, or of normal weight, more research is needed to explore correlates / determinants of physical activity in overweight and obese adolescents. This could

facilitate the development of effective strategies for promoting physical activity among this specific at-risk group.

3. Proposals of Promoting Physical Activity among Japanese Junior High School Students

Based on the results of the first section, the present dissertation proposed lunch-recess and after-class physical activity in school as target behavior for junior high school students to achieve health-enhancing levels of physical activity. In Japan, providing organized extracurricular activities and adding appropriate recess time at school is encouraged in junior high schools (Ministry of Education, Culture, Sports, Science and Technology, 1998). However, the dissertation observed that participants were not active during lunch recess. Therefore there is plenty of scope for physical activity promotion in lunch recess at school. With regard to the role of recess (including lunch recess and class break), previous studies have well supported the benefits of recess upon the development of school-aged children (Dobbins et al., 2013). Recess, which is as a break in the school day and a time away from cognitive tasks, affords the student a time to rest, play, imagine, move, and socialize on a daily basis in many countries around the world. Following recess, students are more attentive and better able to perform cognitively. In addition, recess helps children to develop social skills that are not acquired in the more structured classroom environment. Therefore, children should be encouraged to be physically active during recess; it should be considered to complement for, physical education classes. As most adolescents attend school and many schools do not limit the opportunities of being active during lunchtime, this time of the day has the potential to achieve health enhancing levels of physical activity (Parrish et al., 2013).Thus, developing strategies increasing the physical activity during lunch recess could be considered.

In addition, after-class physical activity participation in school was found to be decreased sharply with grade advancing for both boys and girls, compared with other contexts. Therefore, after-class physical activities were recommended as a target behavior for preventing the decline in physical activity across adolescence. Recent national data show that after-school represents the most important source of daily physical activity (76.6–92.2%) for both Japanese junior high school girls and boys, whereas recess (including lunch-recess and class break) accounted for 8.9-24.8% of daily physical activity for girls and boys (Ministry of Education, Culture, Sports, Science and Technology, Japan, 2010a). After-class, approximately 61.2% of girls and 85.7% of boys join in school's extracurricular sports clubs (Ministry of Education, Culture, Sports, Science and Technology, Japan, 2010a). But the rates of participating in extracurricular sports clubs declines with grade (Benesse Educational Research and Development Center, 2009). Evidence for the health benefits of extracurricular sports' programs on students' academic and physical performance as well as mental health has been well demonstrated (Ara et al., 2006; Fredricks & Eccles, 2008). Therefore, developing strategies increasing the participation of physical activity after-class, especially the extracurricular sports clubs could be considered.

To develop specific strategies for physical activity during lunch-recess and after-class hours in school environment, based on the results of second investigation, the present dissertation proposed that increasing boys' self-efficacy and girls' perceived friend support should be considered for lunch-recess physical activity intervention. Moreover, increasing perceived support from family should be considered for after-class physical activity intervention in both genders. And increasing perceived support from friends could also be considered for increasing the engagement in after-class physical activity in school for girls. Furthermore, the finding that school environment matters for student's perceptions of social support and the self-

efficacy can inform the development of environmental level interventions for increasing students' self-efficacy and social support. This is a novel aspect of the study. The models exhibited in the present study are consistent with the social cognitive theory and is explicable. Social cognitive theory recognizes that self-efficacy can have indirect influences on behavior by fostering the search for social support or by influencing how people view environment that facilitate or impede physical activity (Dishman et al., 2009). Thus, the relationship of self-efficacy with physical activity might be mediated by perceptions of social support. Meanwhile, environment will reciprocally have influence on self-efficacy and behavior because adolescents might acquire much self-efficacy from the environment around them (Schunk & Meece, 2005). Therefore, environment has indirect influences on behavior by the self-efficacy.

From the present study, for example, an intervention designed to promote girls' perceived social support would benefit from the effort to promote perceptions of available or accessible facilities at school, regardless of contexts. In this respect, girls who perceive facility is easy to use and is wide enough for performing activities would be more likely to secure support from friends and families (e.g., be more confident in asking parents or friends allowing them do activities or to be active with them). Therefore, increasing the information channels about the available facilities at school or developing appropriate school-policy which enhance the access to facilities (e.g., expanded hours of operation), among students could be considered (Heath et al., 2012; Sallis et al, 2003). For example, it could be considered held media-based information campaigns (e.g., print, audiovisual, or broadcast media programs) at school in physical education class, recess time, after-class or open school day to announce the availability or operation of facilities. Additionally, improving the perceptions of accessible equipment and safety is one effective approach to enhance boys' self-efficacy and perceived family support for physical

activity in both lunch-recess and after-class context. The present study assessed the perceptions of safety about the facilities and equipment at school and the equipment accessibility. Boys acquire much self-efficacy if they perceived that the facilities and equipment is safe to use and if the equipment is easy and enough to use. Therefore, strategies to increase the awareness and knowledge of the safety and the equipment accessibility or availability could be considered (De Boudeaudhuji et al., 2011; Haerens et al., 2007; Parrish et al., 2013). There are various strategies that might be used to increase the safety of facilities and equipment. For example, a monthly report which may contain the updated news of regular maintenance of facilities could be considered to be delivered to students and parents. In addition, adopting the safety examination of the equipment before activities could be encouraged by students, which make them feel safety of the equipment.

4. Strengths & Limitations

The present dissertation was one of the first studies attempted to identify physical activity patterns in various context-specific settings and context-specific correlates of physical activity in Japanese adolescents. Specifically, the present study extended previous research by simultaneously measuring direct and indirect effects of multilevel contributing factors on context-specific physical activity rather than overall physical activity level. Several sources of social support and various school physical environmental attributes were examined concurrently. Moreover, the present study contributed to studies about adolescents by exploring behavioral models tailored for specific gender. Finally, the present dissertation used SEM, which was helpful in exploring potential mediators that can be intervened upon, and allowed the examination of relative contributions of factors that explain physical activity behavior.

However, several limitations are worth noting. First, the cross-sectional data that permitted only estimates of between-person relations among variables is hard to develop the causal link. Therefore, interventional designs or prospective studies based on the current findings are warranted in the future. Second, the list-wise deletion adopted in the structural equation model analysis that may have biased the data findings. Third, the generalizability of findings beyond the study location may be limited because data were collected from a single school. To estimate the representativeness of respondents, the prevalence of participants with different weight status was compared with those in a national survey. The prevalence of boys and girls with normal weight in the present study was 80.1% and 84.8%, respectively, whereas in the national survey of physical fitness, athletic capacity, and exercise habits in 2010 (junior high school) (Ministry of Education, Culture, Sports, Science and Technology, Japan. 2010b), 89.9% of boys and 88.9% of girls in junior high school had normal weight. Moreover, 12.4% of boys and 11.1% of girls were overweight and obese in the present study, while the national survey found that 8.4% of boys and 7.4% of girls were overweight and obese, respectively. This indicates that the participants of this study were slightly different from the general population. Therefore, it is likely that the patterns of physical activity behavior and structural models in this dissertation would fit counterparts across the country. One more limitation of this study is the use of a self-report measure of physical activity and school physical environmental variables, which is subject to error and bias (Welk et al., 2000). Further studies should attempt to combine existing objective and subjective measures to investigate patterns and correlates of context-specific physical activity more accurately. Although self-report questionnaires often provide detailed information regarding the type and context of physical activity, inaccurate estimation of physical activity could not be avoided because of adolescents' limited ability to accurately recall

their frequency and duration (Armstrong & Welsman, 2006; Sirard & Pate, 2001).Another limitation is the current study did not include an examination of the intensity of physical activity. Thus, it is impossible to determine whether the students engaged in physical activity at sufficient intensity levels for health or not. Future studies need to use a combination of subjective and objective measurements to fully describe activity patterns with different intensities.

5. Conclusion

In summary, the present study reports patterns of physical activity participation in specific contexts and comprehensively understands the direct and indirect influences of multilevel factors with such physical activity among Japanese junior-high-school students. Finding have shown that the patterns of physical activity and impacts of variables on physical activity depended on the context and gender, which implies that the development of effective interventions for promoting physical activity should be tailored for specific contexts and consider the gender differences. Regardless, based on these findings, this dissertation highlights the importance of developing specific physical activity strategy for junior high school students in the school environment during non-curricular time periods, and supports the development of school-based physical activity intervention programs meeting specific needs of junior high school boys and girls regardless of age. This dissertation concludes that increasing the awareness and knowledge of the school physical activity environment in the interventions for enhancing the self-efficacy and the support of friends and families in junior high school students could be an important physical activity approach to achieve health-enhancing levels of physical activity among such subgroup. The current results may provide useful information for researchers as well

as policy makers, both at school and the national level, to design effective interventions or policy among such subgroup.

6. Research Directions in the Future

Further investigations on junior high school students are still required in order to accumulate additional evidences for promoting lunch-recess and after-class physical activity among them. Such investigation is necessary to consider the utilization of both self-reported and objective measures on physical activity (i.e., accelerometer) and environmental factors (i.e. geographic information system and observation) for further confirming the findings of this dissertation. Additionally, more in-depth research is needed to examine preferred types of physical activity in different contexts, and to identify types of support (e.g., encouragement or tangible assistance), other aspects of self-efficacy as well as other body-weight related factors except of BMI (i.e., body image) in association with context-specific physical activity. Finally, the dissertation also highlights the need for interventional or longitudinal study designs to confirm the multi-level determinants associated with physical activity among junior high school students.

REFERENCES

1. Ara I, Vicente-Rodriguez G, Perez-Gomez J, Jimenez-Ramirez J, Serrano-Sanchez JA, Dorado C, & Calbet JAL. (2006). Influence of extracurricular sport activities on body composition and physical fitness in boys: A 3-yearlongitudinal study. *Int J Obes.,* 30, 1062–71.
2. Armstrong N, & Welsman JR. (2006). The physical activity patterns of European youth with reference to methods of assessment. *Sports Med.,* 36(12), 1067-86.
3. Alderman BL, Benham-Deal TB, & Jenkins JM. (2010). Change in parental influence on children's physical activity over time. *J Phys Act Health,* 7, 60-7.
4. Abbott BD, & Barber BL. (2011). Differences in functional and aesthetic body image between sedentary girls and girls involved in sports and physical activity: Does sport type make a difference? *Psychol Sport Exerc.,* 12, 333-42.
5. Aznar S, Naylor PJ , Silva P, Perez M, Angulo T, Laguna M, Lara MT, & Lopez-Chicharro J. (2011). Patterns of physical activity in Spanish children: A descriptive pilot study. *Child Care Health Dev.,* 37(3), 322-8.
6. Baron R, & Kenny D. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *J Pers Soc Psychol.*, 51, 1173-82.
7. Blatchford P, Baines E, & Pellegrini A. (2003). The social context of school playground games: sex and ethnic differences, and changes over time after entry into junior school. *Br J Dev Psychol*., 21, 481-505.
8. Berk LE. (2005). Infants, children and adolescents (5th Edition). Allyn & Bacon Inc., Bosten.

9. Biddle SJH, Whitehead SHO, Donovan TM, & Nevill ME. (2005). Correlates of participation in physical activity for adolescent girls: A systematic review of recent literature. *J Phys Act Health,* 2, 423-34.
10. Biddle SJH, & Mutrie N. (2008). Psychology of Physical Activity: Determinants, well-being and interventions (2nd Edition). Routledge.
11. Biddle SJH, Gorely T, Marshall SJ, & Cameron N. (2009). The prevalence of sedentary behavior and physical activity in leisure time: A study of Scottish adolescents using ecological momentary assessment. *Prev Med.,* 48(2), 151-55.
12. Brodersen HN, Steptoe A, Boniface DR, & Wardle J. (2007). Trends in physical activity and sedentary behaviour in adolescence: Ethnic and socioeconomic differences. *Br J Sports Med.,* 41(3), 140-4.
13. Butcher K, Sallis JF, Mayer JA, & Woodruff S. (2008). Correlates of physical activity guidelines compliance for adolescents in 100 U.S. cities. *J Adolesc Health,* 42, 360-8.
14. Benesse Educational Research and Development Center. (2009). Time use survey after-school. Available at: http://berd.benesse.jp/berd/center/open/report/houkago/2009/hon/index.html.(Assessed October 28, 2013)
15. Bocarro JN, Kanters MA, Cerin E, Floyd MF, Casper JM, Suau LJ, & Mckenzie TL. (2012). School sport policy and school-based physical activity environments and their association with observed physical activity in middle school children. *Health Place,* 18(1), 31-8.
16. Cole T, Bellizzi M, Flegal K, & Dietz W. (2000). Establishing a standard definition for child overweight and obesity worldwide: International survey. *BMJ.,* 320(7244), 1240-3.

17. Colabianchi N, Maslow AL, & Swayampakala K. (2011). Features and amenities of school playgrounds: A direct observation study of utilization and physical activity levels outside of school time. *Int J Behav Nutr Phys Act.,* 8, 32.

18. Craggs C, Corder K, van Sluijs EMF, & Griffin SJ. (2011). Determinants of change in physical activity in children and adolescents: A systematic review. *Am J Prev Med.,* 40(6), 645–58.

19. Dishman RK, Motl RW, Saunders R, Felton G, Ward DS, Dowda M, & Pate RR. (2004). Self-efficacy partially mediates the effect of a school-based physical activity intervention among adolescent girls. *Prev Med.,* 38, 628-36.

20. Dishman RK, Motl RW, Saunders R, Felton G, Ward DS, Dowda M, & Pate RR. (2005). Enjoyment mediates effects of a school-based physical activity intervention. *Med Sci Sports Exerc.,* 37(3), 478-87.

21. Dishman RK, Saunders RP, Motl RW, Dowda M, & Pate RR. (2009). Self-efficacy moderates the relation between declines in physical activity and perceived social support in high school girls. *J Pediatr Psychol.,* 34(4), 441-51.

22. Dishman RK, Dunn AL, Sallis JF, Vandenberg RJ, & Pratt CA. (2010). Social-cognitive correlates of physical activity in a multi-ethnic cohort of middle-school girls: Two-year prospective study. *J Pediatr Psychol.,* 35(2), 188-98.

23. Duncan S, Duncan T, & Strycker L. (2005). Sources and types of social support in youth physical activity. *Health Psychology,* 24, 3-10.

24. DurantN, HarrisSK, Doyle S, Person S, Saelens BE, Kerr J, Norman GJ, & Sallis JF. (2009). Relation of school environment and policy to adolescent physical activity. *J Sch Health,* 79(4), 153-9.

25. Ding D, Sallis JF, Kerr J, Lee S, & Rosenberg DE. (2011). Neighborhood environment and physical activity among youth: A review. *Am J Prev Med.,* 41(4), 442–55.

26. De Bourdeaudhuij I, Van Cauwenberghe E, Spittaels H, Oppert JM, Rostami C, Brug J, Van Lenthe F, Lobstein T, & Maes L. (2011). School-based interventions promoting both physical activity and healthy eating in Europe: A systematic review within the HOPE project. *Obes Rev.,* 12(3), 205-16.

27. Department of Health and Human Services. (2012). Physical Activity Guidelines for Americans Midcourse Report Subcommittee of the President's Council on Fitness, Sports & Nutrition. Physical Activity Guidelines for Americans Midcourse Report: Strategies to Increase Physical Activity among Youth. Washington DC, U.S.

28. Dobbins M, Husson H, DeCorby K, & LaRocca RL. (2013). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. Cochrane Database of Systematic Reviews, Issue 2.

29. Edwardson CL, & Gorely T. (2010). Parental influences on different types and intensities of physical activity in youth: A systematic review. *Psychol Sport Exerc.,* 11, 522-35.

30. Fairclough S, & Stratton G. (2005). Physical activity levels in middle and high school physical education: A review. *Pediatr Exerc Sci.,* 17, 217-36.

31. Ferreira I, van der Horst K, Wendel-Vos W, Kremers S, van Lenthe FJ, & BrugJ. (2006). Environmental correlates of physical activity in youth: A review and update. *Obesity,* 8, 129–54.

32. Fredricks JA, & Eccles JS. (2008). Participation in extracurricular activities in the middle school years: Are there developmental benefits for African American and European American youth? *J Youth Adolescence,* 37, 1029–43.

33. Fuller D, Sabiston C, Karp I, Barnett T, & O'Loughlin J. (2011). School sports opportunities influence physical activity in secondary school and beyond. *J Sch Health,* 81(8), 449-54.

34. Fitzgerald A, Fitzgerald N, & Aherne C. (2012). Do peers matter? A review of peer and/or friends' influence on physical activity among American adolescents. *J Adolesc.,* 35(4), 941-58.

35. Gavarry O, Giacomoni M, Bernard T, Seymat M, & Falgairette G. (2003). Habitual physical activity in children and adolescents during school and free days. *Med Sci Sports Exerc.,* 35(3), 525-31.

36. Gustafson SL, & Rhodes RE. (2006). Parental Correlates of Physical Activity in Children and Early Adolescents. *Sports Med.,* 36 (1), 79-97.

37. Gorely T, Marshall SJ, Biddle SJH, & Cameron N. (2007). Patterns of sedentary behaviour and physical activity among adolescents in the United Kingdom: Project STIL. *J Behav Med.,* 30(6), 521-31.

38. Gidlow CJ, Cochrane T, Davey R, & Smith H. (2008). In-school and out-of-school physical activity in primary and secondary school children. *J Sports Sci.,* 26(13), 1411-9.

39. Gonzalez-Suarez CB, & Grimmer-Somers K. (2009). Physical activity pattern of prepubescent Filipino school children during school days. *J Sch Health,* 79(7), 304-11.

40. Gracia-Marco L, Tomas C, Vicente-Rodriguez G, Jimenez-Pavon D, Rey-Lopez JP, Ortega FB, Lanza-Saiz R, & Moreno LA. (2010). Extra-curricular participation in sports and socio-demographic factors in Spanish adolescents: The AVENA study. *J Sports Sci.,* 28(13), 1383-9.

41. Graham DJ, Schneider M, & Dickerson SS. (2011). Environmental resources moderate the relationship between social support and school sports participation among adolescents: A cross-sectional analysis. *Int J Behav Nutr Phys Act.*, 8, 34.

42. Hamparsum B. (1987). Model selection and Akaike's information criterion (AIC): The general theory and its analytical extensions. *Psychometrika.*, 52, 345-70.

43. Hallal PC, Victora CG, Azevedo MR, & Wells JCK. (2006). Adolescent physical activity and health: A systematic review. *Sports Med.,* 36(12), 1019-30.

44. Haerens L, De Bourdeaudhuij I, Maes L, Cardon G, & Deforche B. (2007). School-based randomized controlled trial of a physical activity intervention among adolescents. *J Adolesc Health*. 40(3), 258-65.

45. Hohepa M, Scragg R, Schofield G, Kolt GS, & Schaaf D. (2007). Social support for youth physical activity: Importance of siblings, parents, friends and school support across a segmented school day. *Int J Behav Nutr Phys Act.,* 8(4), 54.

46. Haug E, Torsheim T, & Samdal O. (2008). Physical environmental characteristics and individual interests as correlates of physical activity in Norwegian secondary schools: The health behaviour in school-aged children study. *Int J Behav Nutr Phys Act.,* 5, 47.

47. Haug E, Torsheim T, & Samdal O. (2009). Local school policies increase physical activity in Norwegian secondary schools. *Health Promot. Int.,* 25 (1), 63-72.

48. Haug E, Torsheim T, Sallis JF, & Samdal O. (2010). The characteristics of the outdoor school environment associated with physical activity. *Health Educ Res.,* 25(2), 248-56.

49. Haerens L, Craeynest M, Deforche B, Maes L, Cardon G, & Bourdeaudhuij ID. (2009). The contribution of home, neighbourhood and school environmental factors in explaining physical activity among adolescents. *J Environ Public Health,* 2009, 320-72.

50. Hsu YW, Chou CP, Nguyen-Rodriguez ST, McClain AD, Belcher BR, & Spruijt-Metz D. (2011). Influences of social support, perceived barriers, and negative meanings of physical activity on physical activity in middle school students. *J Phys Act Health,* 8(2), 210-9.

51. Hearst MO, Patnode CD, Sirard JR, Farbakhsh K, & Lytle LA. (2012). Multilevel predictors of adolescent physical activity: A longitudinal analysis. *Int J Behav Nutr Phys Act.,* 6(9), 8.

52. Heath GW, Parra DC, Sarmiento OL, Andersen LB, Owen N, Goenka S, Montes F, Brownson RC, & Lancet Physical Activity Series Working Group. (2012). Evidence-based intervention in physical activity: Lessons from around the world. *Lancet*, 380(9838), 272-81.

53. Jago R, Anderson C, Baranowski T, & Watson K. (2005). Adolescent patterns of physical activity differences by gender, day, and time of day. *Am J Prev Med.,* 28(5), 447-52.

54. Jago R, Page AS, & Cooper AR. (2012). Friends and physical activity during the transition from primary to secondary school. *Med Sci Sports Exerc.,* 44(1), 111-7.

55. Janssen I, & LeBlanc AG. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act*., 7(40).

56. Kline RB. (1998). Principle and practice of structural equation modeling. Guilford, New York.

57. Khunti K, Stone MA, Bankart J, Sinfield PK, Talbot D, Farooqi A, & Davies MJ. (2007). Physical activity and sedentary behaviours of South Asian and White European children in inner city secondary schools in the UK. *FamPract.,* 24(3), 237-44.

58. Kahn JA, Huang B, Gillman MW, Field AE, Austin SB, Colditz GA, & Frazier AL. (2008). Patterns and determinants of physical activity in U.S. adolescents. *J Adolesc Health,* 42, 369-77.

59. King KA, Tergerson JL, & Wilson BR. (2008). Effect of social support on adolescents' perceptions of and engagement in physical activity. *J Phys Act Health,* 5(3), 374-84.

60. Kirby J, Levin KA, & Inchley J. (2012). Associations between the school environment and adolescent girls' physical activity. *Health Educ Res.*, 27(1), 101-14.

61. La Torre G, Masala D, De Vito E, Langiano E, Capelli G, Ricciardi W, & PASES collaborative group. (2006). Extra-curricular physical activity and socioeconomic status in Italian adolescents.*BMC Public Health,* 31(6), 22.

62. Lytle LA, Murray DM, Evenson KR, Moody J, Pratt CA, Metcalfe L, & Parra-Medina D. (2009). Mediators affecting girls' levels of physical activity outside of school: Findings from the trial of activity in adolescent girls. *Ann Behav Med.,* 38(2), 124-36.

63. Lubans DR, Foster C, & Biddle SJH. (2008). A review of mediators of behavior in interventions to promote physical activity among children and adolescents. *Prev Med.*, 47(5), 463-70.

64. Lubans DR, Okely AD, Morgan PJ, Cotton W, Puglisi L, & Miller J. (2012). Description and evaluation of a social cognitive model of physical activity behaviour tailored for adolescent girls. *Health Educ Res.,* 27(1), 115-128.

65. Ministry of Education, Culture, Sports, Science and Technology, Japan. (1998).Guide for secondary education. Available at: http://www.mext.go.jp/a_menu/shotou/cs/1320061.htm. (Accessed September 10, 2013).

66. Ministry of Education, Culture, Sports, Science and Technology, Japan. (2009). The course of study in junior high school. Available at: http://www.mext.go.jp/b_menu/shuppan/sonota/990301c.htm;

http://www.mext.go.jp/component/a_menu/education/micro_detail/__icsFiles/afieldfile/2011/04/11/1298356_8.pdf (English version). (Accessed February 7, 2012).

67. Ministry of Education, Culture, Sports, Science and Technology, Japan. (2010a). 2010's national survey result of physical and athletic capacity and exercise habits. http://www.mext.go.jp/component/a_menu/sports/detail/__icsFiles/afieldfile/2010/12/16/1300103_5.pdf. (Accessed February 7, 2012).
68. Ministry of Education, Culture, Sports, Science and Technology, Japan. (2010b). 2010 national survey result of physical and athletic capacity and exercise habits: (4) physical fitness and BMI. Available at:http://www.mext.go.jp/component/a_menu/sports/detail/__icsFiles/afieldfile/2010/12/16/1300270_4_1.pdf. (Accessed February 7, 2012).
69. Ministry of Education, Culture, Sports, Science and Technology, Japan. (2011). 2011 handbook of statistics: (1) school education. Available at: http://www.mext.go.jp/b_menu/toukei/002/002b/1305705.htm. (Accessed February 7, 2012).
70. McKenzie TL, Marshall SJ, Sallis JF, & Conway TL. (2000). Leisure-time physical activity in school environments: An observational study using SOPLAY. *Prev Med.,* 30,70-7.
71. Mota J, Santos P, Guerra S, Ribeiro J, & Duarte J. (2003). Patterns of daily physical activity during school days in children and adolescents. *Am J Hum Biol.,* 15(4), 547-53.
72. McCormack G, Giles-Corti B, Lange A, Smith T, Martin K, & Pikora TJ. (2004). An update of recent evidence of the relationship between objective and self-report measures of the physical environment and physical activity behaviors. *J Sci Med Sport,* 7, 81-92.

73. Motl RW, Dishman RK, Ward DS, Saunders RP, Dowda M, Felton G, & Pate RR. (2005). Perceived physical environment and physical activity across one year among adolescent girls: Self-efficacy as a possible mediator? *J Adolesc Health,* 37(5), 403-408.

74. Motl RW, Dishman RK, Saunders RP, Dowda M, & Pate RR. (2007). Perceptions of physical and social environment variables and self-efficacy as correlates of self-reported physical activity among adolescent girls. *J Pediatr Psychol.,* 32(1), 6-12.

75. Maddison R, Jiang Y, Hoorn SV, Mhurchu CN, Exeter D, & Utter J. (2010). Perceived versus actual distance to local physical-activity facilities: Does it really matter? *J Phys Act Health,* 7(3), 323- 332.

76. Nader PR, Bradley RH, Houts RM, McRitchie SL, & O'Brien M. (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA*., 300(3), 295-305.

77. Naylor PJ, & McKay HA. (2009). Prevention in the first place: Schools a setting for action on physical activity. *Br J Sports Med.,* 43, 10-13.

78. Nichol ME, Pickett W, & Janssen I. (2009). Associations between school recreational environments and physical activity. *J Sch Health,* 79(6), 247-54.

79. National Association for Sport and Physical Education & American Heart Association. (2010). 2010 shape of the nation report: status of physical education in USA. Available at:http://www.aahperd.org/naspe/publications/upload/Shape-of-the-tion-Revised2PDF.pdf. (Accessed February 7, 2012).

80. North Carolina State University. (2012). Structural equation modeling: Statnotes. Available at: http://faculty.chass.ncsu.edu/garson/PA765/structur.htm. (Accessed Jan 10, 2012).

81. Nakano T, Kasuga K, Murase T, & Suzuki K. (2013). Changes in healthy childhood lifestyle behaviors in Japanese rural areas. *JSch Health,* 83, 231-238.

82. Ornelas IJ, Perreira KM, & Ayala GX. (2007). Parental influences on adolescent physical activity: A longitudinal study. *Int J Behav Nutr Phys Act.,* 4, 3.

83. Page A, Cooper A, Stamatakis E, Foster LJ, Crowne EC, Sabin M, & Shield JPH. (2005). Physical activity patterns in no obese and obese children assessed using minute-by-minute accelerometry. *Int J Obes.,* 29(9), 1070-6.

84. Pate RR, Davis MG, Robinson TN, Stone EJ, FAHA MPH, McKenzie TL, & Young JC. (2006). Promoting physical activity in children and youth: A leadership role for schools-a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in collaboration with the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing. *Circulation,* 114(11), 1214-24.

85. Pugliese J, & Barbara T. (2007). Parental socialization of child and adolescent physical activity: A meta-analysis. *J Fam Psychol.,* 21(3), 331-43.

86. Pearson N, Atkin AJ, Biddle SJH, Gorely T, & Edwardson C. (2009). Patterns of adolescent physical activity and dietary behaviours. *Int J Behav Nutr Phys Act.,* 6, 45.

87. Pate RR, Sallis JF, Ward DS, Stevens J, Dowda M, Welk GJ, Young DR, Jobe JB, & Strikmiller PK. (2010). Age-related changes in types and contexts of physical activity in middle school girls. *Am J Prev Med.,* 39(5), 433-9.

88. Patnode CD, Lytle LA, Erickson DJ, Sirard JR, Barr-Anderson D, & Story M. (2010). The relative influence of demographic, individual, social, and environmental factors on physical activity among boys and girls. *Int J Behav Nutr Phys Act.,* 3(7), 79.

89. Prins RG, van Empelen P, Velde SJT, Timperio A, van Lenthe FJ,Tak NI, Crawford D, Brug J, & Oenema A. (2010). Availability of sports facilities as moderator of the intention-sports participation relationship among adolescents. *Health Educ Res.,* 25(3), 489-497.

90. Parrish AM, Okely AD, Stanley RM, & Ridgers ND. (2013). The effect of school recess interventions on physical activity: A systematic review. *Sports Med.,* 43(4), 287-99.

91. Rauste-von Wright M. (1989). Body image satisfaction in adolescent girls and boys: A longitudinal study. *J Youth Adolesc.,* 18, 71-83.

92. Ryan G, & Dzewaltowski D. (2002). Comparing the relationships between different types of self-efficacy and physical activity in youth. *Health Education & Behavior,* 29, 491-504.

93. Riddoch CJ, Bo AL, Wedderkopp N, Harro M, Klasson-Heggebo L, Sardinha LB, Cooper AR, & Ekelund U. (2004). Physical activity levels and patterns of 9-and15-year-old European children. *Med Sci Sports Exerc*., 36, 86-92.

94. Ridgers ND, Stratton G, & Fairclough SJ. (2005). Assessing physical activity during recess using accelerometry. *Prev Med.,* 41, 102-7.

95. Ridgers ND, Stratton G, & Fairclough S. (2006). Physical activity levels of children during school playtime. *Sports Med.,* 36(4), 359-71.

96. Ridgers ND, Saint-Maurice PF, Welk GJ, Siahpush M, & Huberty J. (2011). Differences in physical activity during school recess. *J Sch Health,* 81(9), 545-51.

97. Ridgers ND, Salmon J, Parrish AM, Stanley RM, & Okely AD. (2012). Physical activity during school recess: A systematic review. *Am J Prev Med.*, 43(3), 320-8.

98. Ridgers ND, Timperio A, Crawford D, Salmon J. (2012). Five-year changes in school recess and lunchtime and the contribution to children's daily physical activity. *Br J Sports Med.*, 46,741-46.

99. Robert-Wilson J, Levesque L, & Holden RR. (2007). Development of a questionnaire assessing school physical activity environment. *Meas Phys Educ Exerc Sci.,* 11, 93-107.

100. Sallis JF, Prochaska J, & Taylor W. (2000a). A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc.,* 32(5), 963-75.

101. Sallis JF, Owen N, & Fotheringham MJ. (2000b). Behavioral epidemiology: a systematic framework to classify phases of research on health promotion and disease prevention. *Ann Behav Med.*, 22(4), 294-8.

102. Sallis JF, Conway TL, Prochaska JJ, McKenzie TL, Marshall SJ, & Brown M. (2001). The association of school environments with youth physical activity. *Am J Public Health,* 91, 618-20.

103. Sallis JF, McKenzie TL, Conway TL, Elder JP, Prochaska JJ, Brown M, Zive MM, Marshall SJ, & Alcaraz JE. (2003). Environmental interventions for eating and physical activity: A randomized controlled trial in middle schools. *Am J Prev Med*. 24(3), 209-17.

104. Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, & Kerr J. (2006). An ecological approach to creating active communities. *Annu Rev Public Health*, 27, 297-322.

105. Sirard J, & Pate R. (2001). Physical activity assessment in children and adolescents. *Sports Med.,* 31(6), 439-54.

106. Sirard JR, Nelson MC, Pereira MA, & Lytle LA. (2008). Validity and reliability of a home environment inventory for physical activity and media equipment. *Int J Behav Nutr Phys Act.,* 5, 24.

107. Schumacker RE, & Lomax RG. (2004). A beginner's guide to structural equation modeling (2nd Edition). Lawrence Erlbaum Associates, Mahwah.

108. Schunk DH, & Meece JL. (2005). Chapter 3, self-efficacy development in adolescents. In the Book: Self-efficacy Beliefs of Adolescents. Page 71-96.

109. Strong W, Malina R, Blimkie C, Daniels SR, Dishman RK, Gutin B, Hergenroeder, AC, Must A, Nixon PA, Pivarnik JM, Rowland T, Trost S, & Trudeau F. (2005). Evidence based physical activity for school-age youth. *J Pediatr.,* 146(6),732-37.

110. Samdal O, Tynjälä J, Roberts C, Sallis JF, Villberg J, & Wold B. (2006). Trends in vigorous physical activity and TV watching of adolescents from 1986 to 2002 in seven European countries. *Eur J Public Health,* 17(3), 242–8.

111. Salmon J, Brown H, & Hume C. (2009). Effects of strategies to promote children's physical activity on potential mediators. *Int J Obes (Lond).,* 33(Suppl 1), S66-73.

112. Stalsberg R, & Pedersen AV. (2010). Effects of socioeconomic status on the physical activity in adolescents: A systematic review of the evidence. *Scand J Med Sci Sports.,* 20(3), 368-83.

113. Steele RM, van Sluijs EMF, Sharp SJ, Landsbaugh JR, Ekelund U, & Griffin SJ. (2010). An investigation of patterns of children's sedentary and vigorous physical activity throughout the week. *Int J Behav Nutr Phys Act.,* 7, 88.

114. Stanley RM, Ridley K, & Olds TS. (2011). The type and prevalence of activities performed by Australian children during the lunchtime and after school periods. *J Sci Med Sport,* 14(3), 227-32.

115. Stanley MR, Kate R, & Dollman J. (2012). Correlates of children's time-specific physical activity: A review of the literature. *Int J Behav Nutr Phys Act*., 9, 50.

116. Sasakawa Sports Foundation. 2012. The 2012 SSF National Sports-Life Survey of Young People. Sasakawa Sports Foundation.

117. Thompson JK, Heinberg LJ, Altabe MN, & Tantleff-Dunn S. (1999). Exacting beauty: Theory, assessment, and treatment of body image disturbance. American Psychological Association, Washington DC. US.

118. Trost S, Pate R, Sallis J, Freedson PS, Taylor WC, Dowda M, & Sirard JR. (2002) Age and gender differences in objectively measured physical activity in youth. *Med Sci Sports Exerc.,* 34(2), 350-5.

119. Trost SG, Sallis JF, Pate RR, Freedson PS, Taylor WC, & Dowda M. (2003). Evaluating a model of parental influence on youth physical activity. *Am J Prev Med.,* 25(4), 277-82.

120. Togashi K, Masuda H, Rankinen T, Tanaka S, Bouchard C, & Kamiya H. (2002). A 12-year follow-up study of treated obese children in Japan. *Int J Obes Relat Metab Disord*., 26(6), 770-7.

121. Trudeau F, Laurencelle L, & Shephard RJ. (2004). Tracking of physical activity from childhood to adulthood. *Med Sci Sports Exerc.*, 36(11), 1937-43.

122. Telama R, Yang X, Viikari J, Välimäki I, Wanne O, & Raitakari O. (2005). Physical activity from childhood to adulthood: A 21-year tracking study. *Am J Prev Med.*, 28(3), 267-73.

123. Treuth MS, Catellier DJ, Schmitz KH, Pate RR, Elderr JP, McMurray RG, Blew RM, Yang S, & Webber L. (2007). Weekend and weekday patterns of physical activity in overweight and normal-weight adolescent girls. *Obesity,* 15(7), 1782-8.

124. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, & Mcdowell M. (2008). Physical activity in the united states measured by accelerometer. *Med Sci Sports Exerc.,* 40(1), 181-88.

125. Townsend N, Bhatnagar P, Wickramasinghe K, Scarborough P, Foster C, & Rayner M. (2012). Physical activity statistics 2012. British Heart Foundation: London.

126. Uijtdewilligen L, Nauta J, Singh AS, Mecelen WV, Twisk JWR, Van der Horst K, & Chinapaw MJM. (2011). Determinants of physical activity and sedentary behaviour in young people: A review and quality synthesis of prospective studies. *Br J Sports Med.,* 45(11), 896-905.

127. Van der Horst K, Paw MJ, Twisk JW, & Van Mechelen W. (2007). A brief review on correlates of physical activity and sedentariness in youth. *Med Sci Sports Exerc.,* 39(8), 1241-50.

128. Welk GJ, Corbin CB, & Dale D. (2000). Measurement issues in the assessment of physical activity in children. *Research Quarterly for Exercise and Sport,* 71, 49 –73.

129. Welk G, Wood K, & Morss G. (2003). Parental influences on physical activity in children: An exploration of potential mechanisms. *Pediatr Exerc Sci.,* 15, 19-33.

130. Wu T, Pender N, & Noureddine S. (2003). Gender differences in the psychosocial and cognitive correlates of physical activity among Taiwanese adolescents: A structural equation modeling approach. *Int J Behav Med.,* 10(2), 93-105.

131. Wong BY, Faulkner G, & Buliung R. (2011). GIS measured environmental correlates of active school transport: A systematic review of 14 studies. *Int J Behav Nutr Phys Act.* 6, 8-39.

132. World Health Organization. (2010). Global recommendation on physical activity for health. 2010. Available at: http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf. (Accessed July 27, 2012)

133. World Health Organization. Fact sheet on adolescent health. (2012). Available at: http://www.wpro.who.int/mediacentre/factsheets/docs/fs_201202_adolescent_health/en/index.html. (Assessed May 07, 2013)

APPENDIX 1

A Review of Literature about Correlates of Non-curricular Physical Activity in School

2.1 Background

Literature describing physical activity correlates in adolescents is extensive. Among the high quality reviews have been found, most of them have used overall physical activity level as dependent variable without considering the location and time segments of a day in which is performed (Biddle et al., 2005; Craggs et al., 2011; Ding et al., 2011; Edwardson et al., 2010; Ferreira et al., 2006; Fitzgerald et al., 2012; Gustafson et al., 2006;Pugliese et al., 2007; Ridgers et al., 2012; Sallis et al., 2000; Stalsberg et al., 2010; Stanley et al., 2012; Uijtdewilligen et al., 2011; Van der Horst et al., 2007; Wong et al., 2011). The physical activity behavior in specific context might be different, for example, after school time at home vs. after school time at school, which imply that associations of factors with physical activity vary according to different location as well as time. Therefore, while these reviews are useful for understanding correlates that influence adolescent habitual physical activity, applying these findings to understand influences on specific physical activity behaviors in different context may be less useful as the correlates may not be applicable to the specific context under investigation (Stanley et al., 2012). Similarly, using these correlates in intervention design may reduce the effectiveness of interventions to promote physical activity (Ridgers et al., 2012; Stanley et al., 2012).

Ferreira et al (2006), Stanley et al. (2012) and Ridgers et al. (2012) conducted reviews of context-specific physical activity. Among the three reviews, Ferreira et al. reviewed environmental correlates using physical activity performed in the home, school and neighborhood settings as dependent variable. However, this review did not include the psychological or behavioral domains of the ecological model, exposing an important gap in the

review literature. Stanley et al. synthesized the correlates of time-specific physical activity (e.g. after school and school break time) in both observational and experimental studies. But this review focused solely on primary school students, and did not examine the physical activity occurring at school during after-school hours. Ridgers et al. systematically summarized the correlates of children's and adolescent's physical activity during school recess periods. But this review consider whole general and special (e.g., autistic spectrum disorders, attention deficit disorders) children and adolescents aged 5-18 year without considering the differences between primary and junior or high school students and the special needs or characteristic in special people. The diversity in research design, theoretical approaches, measurement approaches, target population groups, physical activity outcomes, analytical approaches and correlates investigated across the literature makes it difficult to understand the evidence and to draw appropriate conclusion (Stanley et al., 2012). Importantly, considering the emerging evidence of context-specific correlates, there is a need to alter the way reviewing the current correlate literatures, which can be helpful to inform the refinement of interventions and guide the different sectors to develop action plans or policy.

Thus, the purpose of the present review was to summarize the published evidence regarding correlates/determinants of non-curricular physical activity at school in junior high school years (aged 12-15 year old), discuss the limitations of previous studies, and explore what problems remain to be solved among the studies of correlates/determinants of physical activity occurring at school. To improve the effectiveness of interventions it may be necessary to understand the key factors that influence physical activity in specific contexts, such as location and time-specific context (Stanley et al., 2012). Thus this review focuses on the time-specific context of non-curricular physical activity (i.e., recess, after-school, before school) in school.

This review could be helpful to inform the refinement of non-curricular physical activity interventions, help the improvement of future primary studies, and guide the different sectors to develop action plans or policy.

2.2 Methods

The complete literature search consisted of two steps. Firstly, the search was conducted in the following databases: PubMed, Web of Science, PsycINFO, and SportDiscus through a well-structured search protocol referring to previous reviews (Ferreira et al., 2006; Ridgers et al., 2012; Stanley et al., 2012). In each database, three command groups were employed to search the original quantitative articles from 2005 to July. 2012. According to the review by Ferreira et al (2006), there is only 2 studies before 2005 examining non-curricular physical activity at school among adolescents (McKenzie et al., 2000; Sallis et al., 2001). Sallis et al. (2001) and McKenzie et al. (2000) did examine non-curricular physical activity at school, but they considered lunch recess, before school and after school physical activity together. Thus the search of this review began from 2005.

The tailored search terms in each command group were employed as follows, (1) study population terms: adolescent$ OR adolescence OR teen OR teenage OR youth OR child; (2) PA behavioral terms: “physical activity” OR exercise OR sports OR “active behavior” OR walking; (3) Correlates terms: for instance, correlates OR determinants OR “physical environment” OR school OR motivation OR enjoyment OR barriers OR “self efficacy” OR parent. These search terms were selected by referring to previous relevant systematic reviews and expanded through the synonymous and through the discussion of co-authors. Papers were limited to human studies in English language through the filters of each database. Secondly, manual researches through

reference list of published reviews and original researches matched the inclusion criteria were used to supplement the literature.

The inclusion criteria applied to select papers for the current review were: (1) published original research; (2) peer-reviewed journals; (3) target age groups: junior high school students (adolescents within age range: 12-15y); (4) cross-sectional and prospective or longitudinal studies; (5) dependent variable: studies needed to measure context-specific physical activity, which was defined as physical activity occurring at certain non-curricular time segments inside of school, for example, physical activity during recess or before/after-school hours. Studies focusing solely on sedentary behavior or physical inactivity were also excluded because physical activity and sedentary behavior are distinct behaviors with unique correlates (Stanley et al., 2012); and (6) questionnaire validation studies focusing on testing psychometric properties of measurement tools were only included if they explored the association between a correlate of context-specific physical activity.

Studies were excluded if: (1) the target populations were only children (<12y) or high school students or adults and elderly, and children or adolescent with disease or illness or disability were excluded (e.g. cancer, cardiovascular disease, clinically obese etc.) because these populations groups often have unique physical activity patterns, contraindications and related correlates which cannot be generalized to the general population; (2) articles were excluded that had a primary focus on physical activity or sports performance/ physical fitness but not on including physical activity, and on habitual physical activity; (3) case reports, editorials, qualitative study, comments, letters, abstracts, expert opinion, unpublished studies, conference proceedings, dissertations and review papers; and (4) experimental studies, qualitative studies, interventional research.

The data extracted from each paper included: study (author and date), gender, gender, race/ ethnicity, sample size, measures of independent variable and physical activity outcomes (subjective or objective and the reliability/validity if had); theoretical framework, data analysis, associations between examined factors with physical activity (positive, negative, none.), country, confounders and study design. **TableA-1** summarizes the study characteristics.

Table A-1
Characteristics of studies included in the review N=10

Study (auth/ date)	Gender	Independent Variables	PA Outcome	Sample size	Data analysis	Country or Region	Theoretical framework	Confounders
Bocarro et al. 2012	Boys & Girls	Observed School physical environment, and policy	Observed after-school PA level (2:30-4:30 pm)	>1000	Ordinal logistic regression	n.s	EM	time of the year (spring vs. fall); day of the week (Monday to Thursday); and activity area size
Gracia Marco et al. 2010	mixed	Self-reported socio-demographic factors; Objective measure of anthropometry	Self-reported extracurricular sports participation (after-school PA)	>1000	Logistic regression	Span	n.s.	none
Haerens et al. 2009	Boys & Girls	Self-reported socio-demographic, psychosocial, and school environment	Self-reported extracurricular physical activities (after-school PA)	500-1000	Multiple linear hierarchical regression	Belgium	EM	age, and SES
Haug et al. 2008	mixed	Self-reported individual, school environmental factors	Self-reported daily recess PA	>1000	Logistic regression	Norwegian	EM	
Haug et al. 2009	mixed	Self-reported individual, school environmental and policy	Self-reported daily recess PA	>1000	Multilevel Logistic regression	Norwegian	n.s.	interests in school PA, SES, and sex
Haug et al. 2010	mixed	Self-reported school physical environment	Self-reported daily recess PA	>1000	Multilevel logistic regression	Norwegian	EM	none
Hohepa et al. 2007	mixed	Self-reported encouragement	Self-reported lunchtime PA and after-school PA	>1000	Binary Logistic regression	Australia, New Zealand, Fiji, and Tonga	n.s.	sex and ethnicity
Khunti et al. 2007	mixed	Self-reported age, ethnicity, gender, and school	Self-reported break period and lunchtime PA	>1000	Logistic regression	UK	n.s.	none
La Torre et al. 2006	mixed	Self-reported parents' educational level, job, PA; age, sex, students' opinions about sport	Self-reported after-school PA	>1000	Multilevel logistic regression	Italy	n.s.	none
Nichol et al. 2009	mixed	Self-reported school recreational environment and policies	Self-reported daily recess PA	>1000	Multilevel logistic regression	Canada	n.s.	grade, sex, SES, school safety, school size, and urban or rural location

Notes of the table A-1: Gender: boys, girls, mixed (if analysis do not examine boys and girls separately; PA: physical activity; Sample size: <100; 100-500; 500-1000; >1000; Theoretical framework: SEM: social ecological model; SCT: social cognitive theory; TPB: Theory of planned behavior; n.s.: Not specified; Confounders: refers to the confounders controlled in the analysis of associations between independent variables and PA

2.3 Results

3.1 Characteristics of the studies reviewed

Overall, of the 29,548 studies identified from the electronic database and manual searches, ten of articles met the inclusion criteria for this review (Bocarro et al., 2012; Gracia-Marco et al., 2010; Haerens et al., 2009; Haug et al., 2008; Haug et al., 2009; Haug et al., 2010; Hohepa et al., 2007; Khunti et al., 2007; La Torre et al., 2006; Nichol et al., 2009). All of the ten studies are cross-sectional studies. Among the studies included in the review, four studies focused on after-school physical activity, and six studies examined recess physical activity (Hohepa et al., 2007; Haug et al., 2008; Hauget al., 2009; Haug et al., 2010;Khunti et al., 2007; Nichol et al., 2009). Among the six studies focusing on recess time at school, two examined lunchtime physical activity (Hohepa et al., 2007; Khunti et al., 2007), and one of which examined class break physical activity (Khunti et al., 2007), while others grouped lunch recess into whole daily recess time at school. School-based physical activity was assessed using observation in one study (Bocarro et al. 2012). Other studies adopted self-report measures of physical activity. More information about the study characteristics were displayed in the **Table A-1.**

3.2 Correlates of non-curricular physical activity in school

In order to be consistent with the approaches of previous reviews (Ridgers et al., 2012; Stanley et al., 2012), potential correlates of physical activity were extracted in reviewed articles and have been categorized into demographic/biological, psychological, social/cultural, and physical environmental correlates in the **Table A-2**(recess physical activity) and **Table A-3**(after-school physical activity).

Table A-2

Summary of the associations of potential correlates with recess physical activity among adolescents Studies N=6

	Summary (N of studies)		
Correlate	Positive association	Negative association	Non-significant association
Demographic			
Age		Khunti et al., 2007	
Gender (female)		Khunti et al., 2007	
Psychological			
Interest in school PA	Haug et al., 2008; Haug et al., 2009		
Social			
Parental support	Hohepa et al., 2007		
Cousins support			Hohepa et al., 2007
Friends support	Hohepa et al., 2007		
School support			Hohepa et al., 2007
Physical environment			
Availability of facilities	Haug et al., 2008; Haug et al., 2009; Haug et al., 2010		
Availability of playing field			Nichol et al., 2009
Availability of gym			Nichol et al., 2009
Playing field condition			Nichol et al., 2009
Gym condition			Nichol et al., 2009
Number of recreational features			Nichol et al., 2009
Policy			
Number of varsity sports			Nichol et al., 2009
Number of intramural sports			Nichol et al., 2009
Provision of PE class			Haug et al., 2009
Organized PA in non-curricular school time	Haug et al., 2009		
Written PA policy	Haug et al., 2009		Nichol et al., 2009
Involvement in a PA project			Haug et al., 2009

TableA-3

Summary of the associations of potential correlates with after-school PAamong adolescents

Studies N=4

Correlate	Association with after-school PA		
	Positive association	Negative association	Non-significant association
Demographic			
Age		Haerens et al., 2009 (girls); Gracia-Marco et al., 2010	Haerens et al., 2009 (boys)
Gender (female)	La Torre et al., 2006	Gracia-Marco et al., 2010	
Body fat			Gracia-Marco et al., 2010
Familiar SES	La Torre et al., 2006		Haerens et al., 2009
Psychological			
Attitudes towards PA	La Torre et al., 2006		Haerens et al., 2009
Self-efficacy	Haerens et al., 2009		
Perceived benefits			Haerens et al., 2009
Perceived barriers		Haerens et al., 2009 (girls)	Haerens et al., 2009 (boys)
Social			
Father's education level	La Torre et al., 2006; Gracia-Marco et al., 2010		
Mother's education level			Gracia-Marco et al., 2010
Parent's PA	La Torre et al., 2006		
Father's job	La Torre et al., 2006		Gracia-Marco et al., 2010
Supervision	Haerens et al., 2009 (girls)		Haerens et al., 2009 (boys); Bocarro et al., 2012
Social support			Haerens et al., 2009
Number of active boys	Bocarro et al., 2012 (boys)		
Number of active girls	Bocarro et al., 2012 (girls)		
Physical environment			

Access to accommodation at school			Haerens et al., 2009
Availability of facilities*	Bocarro et al., 2012 (basketball, inside studio, track, multi-purpose, soccer, open area and tennis vs. baseball; boys)	Bocarro et al., 2012 (gym vs. baseball; girls)	
Policy			
Availability of extracurricular PA	Haerens et al., 2009 (boys)		Haerens et al., 2009 (girls)
Varsity sports programs (vs. intramural sports)		Bocarro et al., 2012 (boys)	

Demographic variables. Four studies examined demographic correlates of physical activity among junior high school students. Age was the most frequently studied demographic variables. A negative association between physical activity and age was found in two studies (Gracia-Marco et al., 2010; Khunti et al., 2007). In addition, Haerens et al.(2009) reported that older girls were less likely to be active in after-school context, while this negative association was not significant for boys. Boys were found to be more active than girls in class break, lunch recess and after-school hours in the studies by Khunti et al. (2007) and Gracia-Marco et al. (2010), but in the study conducted by La Torre et al. (2006). The association between family socio economic status (SES) and after-school physical activity was inconsistent (La Torre et al., 2006; Haerens et al., 2009).

Psychological variables. Interest in physical activity was the only psychological variables investigated in the school recess context, which was found to be important in increasing recess physical activity at school (Haug et al., 2008; Haug et al., 2009). Self-efficacy, assessed in one study (Haerens et al., 2009), was found to be positively associated with after-school physical activity. Attitudes towards physical activity were explored in two studies (La Torre et al., 2006; Haerens et al., 2009). However, the results in relation to the attitudes reported were inconsistent between two studies. Perceived barriers, examined by Haerens et al. (2009), were found to be

important in female adolescents, but had no association with males' after-school physical activity. No significant association was found for perceived benefits.

Social variables. Social support was the most frequently examined variable. Perceived friend support and parent support were significantly related to lunchtime physical activity levels for junior high school students, while support from cousin and school were not for them (Hohepa et al., 2007).Although overall social support had no significant relationship with after-school physical activity (Haerens et al., 2009), parents' physical activity behavior (Torre et al., 2006) and the number of same-gender active adolescents (Bocarro et al., 2012) were found to be positively related with after-school physical activity among adolescents. No significant effects of mother's education level on the likelihood of engaging in one or more extracurricular sports were observed (Gracia-Marco et al., 2010). However, father's education level was important for the participation in extracurricular physical activities (Gracia-Marco et al., 2010; La Torre et al., 2006). Inconclusive evidence was found for supervision and father's job categories.

Physical environmental correlates. Overall facility provision at school has emerged as an important correlate of physical activity in both recess and after-school context (Haug et al., 2008; Haug et al., 2009; Haug et al., 2010). However, availability of playing field and gym, condition of playing field condition, and number of recreational features were not significantly with physical activity in recess context. Additionally, Bocarro et al. (2012) reported that boys tended

to be more active in an inside studio, track, soccer field, open area, and basketball court compared with the baseball field, and girls tended to be less active in a gym than on a baseball field.

School policy variables. Availability of organized physical activity during non-curricular time at school was identified to be important for adolescents' recess physical activity (Haug et al., 2009). However, availability of extracurricular physical activity was only significantly related with boys' after-school physical activity but not for girls(Haerens et al., 2009).The importance of varsity and intramural sports programs for school-based physical activity was inconsistent and complicated (Bocarro et al., 2012; Nichol et al., 2009).Similarly, inconsistent findings between adoption of physical activity promotion policy and recess physical activity was found in the study by Haug et al. (2009) and Nichol et al. (2009). Involvement in a physical activity project and provision of physical education class has found to have no association with school recess physical activity (Haug et al., 2009).

2.4 Discussion

The present review has provided an overview of the current evidence for influences on junior high school students' school-based physical activity during non-curricular times since Jan. 2005. In the ten studies identified in this review, the consistently reported correlates of physical

activity in this review included demographic, psychological, social and physical environmental, and policy factors. The factors associated with recess physical activity were from multilevel and included age (Khunti et al., 2007), gender (Khunti et al., 2007), interest in school physical activity (Haug et al., 2008; Haug et al., 2009), support from parent and friend (Hohepa et al., 2007), availability of facilities(Haug et al., 2008; Haug et al., 2009; Haug et al., 2010), and organized physical activity in non-curricular school time(Haug et al., 2009). The factors related with after-school physical activity included age (Gracia-Marco et al., 2010; Haerens et al., 2009), gender (Gracia-Marco et al., 2010; La Torre et al., 2006), self-efficacy (Haerens et al., 2009), father's education level (Gracia-Marco et al., 2010; Torre et al., 2006),parents' physical activity behavior (Torre et al., 2006), number of same-gender active adolescents (Bocarro et al., 2012), and availability of facilities (Bocarro et al., 2012). These findings are important for policy makers and intervention designer for developing effective physical activity promotion strategies and are meaningful for the development of future primary studies.

For example, in the current review, self-efficacy was associated with physical activity in both boys and girls during after-school hours. However, whether it would be important for recess physical activity is not sure. Although the association between overall social support and physical activity is inconclusive, the perceived encouragement from parent and friend, the physical activity of parents, and the number of same-gender active peers were associated with self-

reported physical activity levels during recess periods (Hohepa et al., 2009) and after-school hours (Bocarro et al., 2012; La Torre et al., 2006). Similarly, availability of facilities at school was significantly associated with physical activity during recess and after-school hours in western countries. Testing whether the social support and the availability of facilities would be related with non-curricular physical activity at school in the context of Japan would be interesting to compare with previous studies from other countries.

Only two studies compared the difference of correlates between boys and girls (Bocarro et al., 2012; Haerens et al., 2009), with interest in the after-school physical activity, others focused on whole population in the current review. The gender differences were observed in the two studies above across demographic (age), psychological (perceived barriers), social (supervision), physical (availability of facilities) and policy (availability of extracurricular sports programs, intramural and varsity sports programs) levels. These differences may be explained by the types of activities preferred in this specific time-period and may also be attributable to the underlying biological mechanisms. Boys may view school as a chance to engage in competitive games that tend to dominate play spaces in the school environment, while girls may view school recess time as an opportunity for socializing over being physically active (Blatchford et al., 2003).Moreover, girls may more likely to participate in activities, such as dance, aerobics, yoga, or walking at school, while boys may be prefer standardized games (e.g., ball games like football, basketball),

occupying more space than girls (Bocarro et al., 2012; Pate et al., 2010). Therefore, availability of facilities and organized sports program may be more important for boys but not for girls. Importantly, these gender differences suggest that future studies examining physical activity for junior high school students should examine the correlates of boys' and girls' physical activity separately.

Based on the current findings, relatively few studies met the inclusion criteria for this review, without high quality design. Most of the studies were conducted in western countries. Considering that no studies conducted in Japan and the differences of school education systems, the policy and the social culture between Japan and the western countries, there is a need to examine the factors in relation with physical activity specific for Japanese population. Moreover, each factor in this review was only assessed in one or two studies. The findings in this review may not be used to draw definite conclusions about the correlates of context-specific physical activity at school and should be interpreted with some caution. Additionally, among the studies included in the review, most of which only focused on one context (either recess or after-school). In the future, more studies are required to compare the differences of correlates in relation to physical activity behaviors in different contexts. Furthermore, from the findings, only four studies identified multiple levels of correlates (Bocarro et al., 2012; Haug et al., 2009; Haerens et al., 2009; La Torre et al., 2006). From the social ecological perspective, physical activity

behavior is a complex behavior determined by an interaction of multilevel influences across personal, social and environmental factors. No one factor explains physical activity levels or predicts the decline in physical activity across ages. As a result, it is reasonable to explore multilevel correlates of non-curricular physical activity in school (Hearst et al., 2012).

From the results of the present review, logistical regression analysis was found to be prevalently adopted in the studies of the present review. Dichotomizing the responses of physical activity may have increased the numbers of students correctly categorized. Additionally, the different criteria used to categorize the responses may explain the inconsistence of findings between studies. To develop effective interventions, it is necessary to identify modifiable correlates of physical activity that can be targeted as potential mediators (Baron & Kenny, 1986). However, there is a lack of studies understanding mediation effects of multilevel factors on non-curricular physical activity at school. Measurement of the mediators would allow researchers to determine which components of an intervention contribute to behavior change. Additionally, mediation analyses allow researchers to develop more parsimonious models by eliminating unrelated mediators from future intervention (Lubans et al., 2008). Therefore examining both the direct and indirect effects of multilevel factors on non-curricular physical activity in school is necessary for the development of effective interventions and health policies in the future.

2.5 Conclusion

In summary, school is well believed to be as a key setting to promote physical activity. At school, while there is strong evidence that recess and after-school periods are critical contexts for physical activity promotion among children and adolescents, there is relatively small number of studies provided preliminary evidence of correlates of such context-specific physical activity. This review which exposed a lack of clarity in this area further underscores the importance of examining such physical activity among junior high school students. In the future, more studies examining the direct and indirect effects of multilevel correlates of non-curricular school-based physical activity by gender are required, especially in non-western countries.

APPENDIX 2

「幼児・児童・生徒の健康や生活習慣に関する実態調査」

【質　問　票】

1. 運動について

Q1　普段の 1 週間で、あなたは以下のようなスポーツや運動など体を動かす活動を何日くらいしますか？実際に体を動かしている時間をお答えください。外遊びや室内遊びも含みます。

行っていない場合や、あてはまらない場合は、「0」分とご記入ください。

1）学校以外で、体を動かす活動(友達と遊ぶ、習い事も含みます)

週 □ 日　→　1 日あたり平均 □ 時間 □□ 分

2）授業が終わった後、学校の体育館やグラウンドで体を動かす活動(友達と遊ぶ、習い事、スポーツ少年団も含みます)

週 □ 日　→　1 日あたり平均 □ 時間 □□ 分

3）授業が終わった後、学校の体育館やグラウンド以外で体を動かす活動(友達と遊ぶ、習い事、スポーツ少年団も含みます)

週 □ 日　→　1 日あたり平均 □ 時間 □□ 分

4）学校の昼休みに体を動かす活動

週 □ 日　→　1 日あたり平均 □ 時間 □□ 分

5）家で体を動かす活動(たとえば、家の庭で遊ぶこと、トレーニングなど)

週 □ 日　→　1 日あたり平均 □ 時間 □□ 分

2. **学校の環境について**

Q1　あなたの学校の環境についてお聞きします。以下のすべての質問に対し、「1：全くそう思わない」「2：そう思わない」「3：そう思う」「4：とてもそう思う」の中から、あてはまる数字を□の中に記入してください。

1：全くそう思わない　2：そう思わない　3：そう思う　4：とてもそう思う

1.学校のグラウンドは、使いやすい	
2.学校の体育館は、使いやすい	
3.学校のグラウンドは、活動的に過ごすのに十分な広さである	
4.学校の体育館は、活動的に過ごすのに十分な広さである	
5.学校のスポーツ道具や運動用具(鉄棒やボールなど)は使いやすい	
6.学校には活動的に過ごすのに十分な用具がある	
7.学校には休み時間に使うのに十分な用具がある	
8.体育の授業は十分な時間がある	
9.学校の体育の授業でいろいろな活動をする	
10.学校ではいろいろな部活やクラブに参加することができる	
11.学校ではしばしば、運動会やスポーツ大会を行う	

12.部活・クラブ、授業以外で体を動かすために学校の施設を使う	
13.学校のグラウンドや体育館は安全に使える	
14.学校の運動用具は安全に使える	
15.学校のグラウンドや体育館は整備されている	

3. スポーツや運動などの応援について

Q7　以下のような人は、スポーツや運動などの体を動かすことについて、ほめてくれたり、応援したりしてくれますか？あてはまるものの番号を、それぞれ記入してください。

1：かなりそう思う　2：少しそう思う　　3：あまりそう思わない　　4：全くそう思わない

1)　家族 [ ]

2)　学校 [ ] の先生

3)　学校 [ ] の友だち

4)　近所の人

4.あなたはまわりの友達よりもスポーツや運動ができると感じていますか？

1：かなりそう思う　2：少しそう思う　3：あまりそう思わない　4：全くそう思わない [ ]