Physical Activity Patterns and Psychological Correlates of Physical Activity among Singaporean Primary, Secondary, and Junior College Students

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Abstract

The purpose of this research was to examine physical activity patterns and psychological correlates of physical activity among primary, secondary, and junior college students in Singapore. A sample of 3,333 school students aged 10 to 18 years took part in the study. Results showed that the younger students had significantly higher physical activity levels compared to the older students. In contrast, the older students had significantly higher prevalence of sedentary activity compared to their younger counterparts. Multiple regression analyses showed that the predictors of physical activity intention were different for the three age groups but similar between the two genders. Overall, these findings confirmed the characteristics of physical activity participation in school students and showed that physical activity and sedentary behaviors among students in Singapore were not inversely related to each other. In addition, results also showed that the psychological correlates were different for different age groups.

Key words: physical activity intentions, determinants, sedentary behaviors, lifestyles

According to the World Health Organization (2008), there are more than one billion overweight adults on earth, with at least 300 million of them clinically obese. The prevalence of obesity has reached an epidemic level. Unhealthy diets and physical inactivity are identified as two major causes of obesity and lifestyle diseases, such as coronary heart disease, type 2 diabetes, certain types of cancer and cardiovascular diseases (Bouchard, Blair, & Haskell, 2007; Bouchard & Katzmarzyk, 2010; Pate et al., 1995). In Singapore, the top causes of death are cancer, heart disease, pneumonia, stroke, accidents and violence, chronic obstructive lung disease, and diabetes (Ministry of Health, 2005). Cross-sectional studies and controlled trials have shown that regular exercise can offer protective effects of varying strengths on colon cancer (Lee, Paffenbarger, & Hsieh, 1991), coronary heart disease (Powell, Thompson, Caspersen, & Kendrick, 1987), hypertension (Hagberg, 1990), and non-insulin-dependent diabetes mellitus (Hardman & Stensel, 2009). Therefore, encouraging regular physical activity in young people is seen as a priority aim of many governments (e.g., The Class Moves in Wale, Project ACES in USA, Healthy Lifestyle Campaign in Singapore).

Activity patterns during childhood and through to adulthood are known to be related to age and gender (Gorely, Marshall, Biddle, & Cameron, 2007). We know that physical activity participation declines during the period of schooling (Myers, Strikmiller, Webber, & Berensen, 1996) and that the decline is greater in girls than in boys (Sallis, 2000). There are significant differences in physical activity and sedentary behavior patterns in the youth from different countries as well (Wang, Chia, Quek, & Liu, 2006). Therefore, there is a need to understand more about the current lifestyle of the youth in specific countries for guiding intervention programs (Sallis et al., 1992).

Previous studies often singled out multimedia technology or screen-based media as the main type of sedentary behavior to assess (Vandewater, Shim, & Caplovitz, 2004). This approach is now regarded as inadequate for understanding overall sedentary behaviors. A more accepted approach is to examine multiple sedentary behaviors in a wider context, such as TV viewing, video game playing, talking on the phone, sitting and talking to friends, using the computer, and reading and doing homework (Gorely, Marshall, et al., 2007; Marshall, Biddle, Sallis, Mckenzie, & Conway, 2002; Wang et al., 2006). Studies have established that physical activity and sedentary behaviors are not inversely related and that boys and girls have different patterns of sedentary behaviors. In addition, children from different countries also differed significantly in terms of their physical activity and sedentary behavior. For example, only 5% of boys and 6% of girls spent more than four hours per day watching TV in Singapore, as opposed to about one-third of children watching TV for four hours per day in the USA and the UK (Marshall et al., 2002; Wang et al., 2006). This suggests that differences could be due to different educational systems and/or cultures.

In addition to a descriptive approach to understanding children's and adolescents' lifestyles, Wang et al.'s (2006) study also showed that psychological correlates of physical activity should be identified at the same time. Wang and his colleagues showed that sport ability beliefs, perceived competence, and relative autonomy were key contributors in influencing the youth to participate in physical activity. An entity sport belief is a belief that sport ability is fixed and determined by nature. An incremental belief is a belief that sport ability is changeable through training and practice (Biddle, Wang, Chatzisarantis, & Spray, 2003). Perceived competence and relative autonomy are constructs central to self-determination theory (Deci & Ryan, 1985). Feelings of competence and autonomy facilitate intrinsic motivation in physical activity (Wang et al., 2006). Wang and his colleagues confirmed that young people with a combination of high incremental beliefs, low entity beliefs, high perceived competence and high autonomy tended to be involved in high levels of physical activity ("Self-Determined" cluster). However, they also revealed that psychological correlates with physical activity participation could be age-related.

The purpose of the present research was to examine physical activity patterns and psychological correlates of physical activity among primary, secondary, and junior college students in Singapore. It was hypothesized that (a) sedentary activity and physical activity patterns would differ between genders, (b) the patterns of sedentary and physical activity participation would differ among the three age groups, (c) the predictors of physical activity intention would differ between genders, and (d) the predictors of physical activity

intention would differ among the three age groups.

Methods

Participants

A sample of 3,333 school students aged 10 to 18 years from 28 schools took part in the study. There were 1,479 primary school students, 1,451 secondary school students, and 403 junior college students (1,257 boys, 1,963 girls and 113 participants who did not indicate their gender). The students were attending primary grade four level to junior college year two in the Singapore school system.

Procedures

Ethical approval was granted from the host University Ethic Review Board. The Ministry of Education granted the permission to conduct the study. Subsequently, the school principals were approached with a formal letter requesting consent for the study. All participants were told that their participation in the study was voluntary and they were free to withdraw at any time. The participants took 15 minutes to complete the questionnaire that was administered by research assistants in a quiet classroom setting. Participants were told that there were no right or wrong answers and were assured of the confidentiality of their responses.

Measures

Modified self-administered physical activity checklist (SAPAC). We used the modified SAPAC with a 7-day physical activity recall from previous studies (Marshall et al., 2002; Wang et al., 2006). The SAPAC included 32 activities that were grouped as sports, dances, exercises, and general physical activities. The participants were told to recall what activities they had engaged in the previous seven days and how many minutes they participated in each of these activities. There were seven sedentary activities listed on the SAPAC as well, and they were computer/internet, playing video games, doing homework, leisure reading, sitting and talking/ listening to music, talking on the telephone, and watching television. Participants were also asked to recall and write down minutes they spent on each of these sedentary activities during the previous seven days. Studies have established the reliability and validity of the 7-day recall SAPAC (Marshall et al., 2002; Sallis, Strikmiller, Harsha, & Feldman, 1996).

The achievement goal in physical education questionnaire (AGPEQ). The 12-item AGPEQ (Wang, Biddle, & Elliot, 2007) was used in this study. It was designed to measure four achievement goals in the Physical Education (PE) context. Wang and his colleagues (Wang, Liu, Chatzisarantis, & Lim, 2010) confirmed the validity of the measurement model of the AGPEQ. The internal consistency coefficients (alpha) for mastery-approach, mastery-avoidance, performance-approach, and performance-avoidance in the present investigation were .79, .72, .81, and .64, respectively.

Perceived mastery and performance climates. The participants' perceived motivational climate in PE was assessed using a 13-item inventory (Marsh, Papaioannou, Martin, & Theodorakis, 2006). There are seven items measuring perception of mastery climate and six items measuring perceived performance climate. The results of the confirmatory factor analysis (CFA) by Wang et al. (2010) showed satisfactory fit for the climate measure. The reliability coefficients computed for the current study were .86 for mastery climate and .70 for performance climate.

Sport ability beliefs. The Conceptions of the Nature of Athletic Ability Questionnaire-2 (CNAAQ-2; Biddle et al., 2003) was employed to measure two sport ability beliefs: incremental sport belief and entity sport belief. The two beliefs distinguish between the sport ability that is thought to be relatively fixed (entity) and the sport ability that is changeable (incremental). There were six items for each subscale. The fit indices for the CFA of the CNAAQ-2 were acceptable and invariant across gender and age. The alpha coefficient for incremental was .85 and for entity was .76 for this study.

Enjoyment and effort. The enjoyment and effort subscales of the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989) were adapted to assess enjoyment (e.g., "I enjoy PE very much") and effort (e.g., "I usually put a lot of effort into PE"). Cronbach's alpha for enjoyment was .95 and for effort was .91 for the current study.

Intention to exercise during leisure time. Two items were used to measure intention to exercise during leisure time (Hagger et al., 2007; Wang et al., 2008). The students were asked whether they *planned* and *intended* to play sport or exercise three times a week for the next two weeks. All the responses of the above scales were given on 7-point scales ranging from 1 (strongly disagree or very unlikely) to 7 (strongly agree or very likely).

Data Analyses

We followed the steps outlined by previous studies (Marshall et al., 2002; Wang et al., 2006) in transforming each variable. All the seven sedentary behaviors and physical activity were polychotomised. This approach reduces the excessive skewness and leptokurtic distribution of the variables. The time spent on computer/internet, playing video games, doing homework, leisure reading (not for school), sitting and talking/listening to music, and talking on the telephone were put into four categories: None (0 hour/week), Low (0.1 to 2.9 hour/week), Moderate (3.0 to 6.9 hour/week), and High (≥ 7 hour/week). Television watching was also classified into four categories: None (0 hour/week), Low (0.1 to 6.9 hour/week), Moderate (7.0 to 13.9 hour/week), and High (≥ 14.0 hour/week). In addition, the levels of physical activity participation were recorded into four categories: No Activity or Inactive (0 min/week); Low Activity with 0-150 minutes of moderate activity (3 to 5.9 METs) and ≤ 60 minutes/week of vigorous activity (≥ 6 METs); Moderate Activity with either > 150 and ≤ 300 minutes/week of moderate activity or > 60 and ≤ 120 minutes/week of vigorous activity, and High Activity with either > 300 minutes/week of moderate activity or > 120 minutes/week of vigorous activity.

The polychoric correlations of all the sedentary and physical activities were computed. We conducted Chi square tests of independence to examine the differences by gender and age among sedentary and physical activities. Finally, separate simultaneous regression analyses were conducted to examine predictors of physical activity intention using sport ability beliefs, achievement goals, perceived motivational climate, and enjoyment in PE for the primary, secondary, and junior college students and the two genders.

Results

Table 1 shows the prevalence of sedentary and physical activity behaviors among the overall sample, males, and females and the three age levels for the seven types of sedentary activity. Table 2 shows the frequency distribution of physical activity participation.

Table 1. ***Percentage of Students with Different Prevalence of Sedentary Behaviors by Gender and School Level***

Category	None (0 hr/wk)	Low (0.1-2.9 hr/wk)	Medoerate (3-6.9 hr/wk)	High (≥ 7 hr/wk)
Computer/Internet				
Overall	23.2	22.8	20.9	33.1
Boys	22.1	19.4	21.5	37.1
Girls	23.6	24.9	20.6	30.9
Primary	23.9	32.3	21.0	22.8
Secondary	22.3	15.7	21.3	40.7
Junior College	23.8	13.9	19.4	42.9
Video Games				
Overall	73.3	12.0	6.5	8.3
Boys	56.7	15.9	11.0	16.5
Girls	84.6	9.1	3.2	3.0
Primary	64.9	18.1	8.2	8.8
Secondary	78.7	7.2	5.4	8.6
Junior College	83.9	6.9	4.2	5.0
Homework				
Overall	21.2	11.0	16.8	51.0
Boys	27.9	11.8	17.6	42.8
Girls	16.6	10.3	16.0	57.1
Primary	19.6	14.9	18.4	47.1
Secondary	23.2	8.9	17.2	50.7
Junior College	19.9	4.7	9.7	65.8
Leisure Reading				
Overall	55.2	22.3	12.1	10.4
Boys	66.5	18.0	9.0	6.5
Girls	47.7	25.2	14.2	12.9
Primary	48.7	25.5	13.7	12.0
Secondary	59.1	20.5	10.7	9.7
Junior College	64.5	17.1	11.2	7.2
Sit & Talk				
Overall	41.7	22.0	13.4	22.8
Boys	56.0	16.9	9.7	17.4
Girls	32.7	25.0	15.8	26.6
Primary	47.6	27.6	10.6	14.2
Secondary	35.2	18.0	15.4	30.4
Junior College	40.7	16.4	16.4	26.6
Telephone				
Overall	47.7	34.1	9.9	8.3
Boys	60.6	26.7	6.9	5.8
Girls	39.3	38.6	11.9	10.2
Primary	44.6	41.0	8.5	5.9
Secondary	47.3	29.6	11.5	11.6
Junior College	60.5	25.1	9.2	5.2
TV Watching				
Overall	25.2	12.7	15.3	46.8
Boys	31.0	12.1	13.5	43.5
Girls	21.3	12.8	16.6	49.3
Primary	22.6	15.5	16.4	45.4
Secondary	25.3	9.7	14.1	50.9
Junior College	33.7	13.4	15.9	37.0

Note. For TV Watching, None means 0 hour/week, Low means 0.1-6.9 hours/week, Moderate means 7-13.9 hours/week, and High means ≥ 14 hours/week.

Table 2. ***Percentage of Students with Different Physical Activity Levels by Gender and School Level***

Group	Inactive[a]	Low[b]	Moderate[c]	High[d]
Overall	4.6	17.1	18.7	59.6
Boys	4.9	11.8	15.0	68.3
Girls	4.3	20.7	21.5	53.5
Primary	2.9	12.0	16.8	68.2
Secondary	5.2	19.3	19.9	55.6
Junior College	8.4	27.5	21.3	42.7

[a]0 minutes/week. [b]≤ 150 minutes/week of moderate activity and ≤ 60 minutes/week of vigorous activity. [c]> 150 and ≤ 300 minutes/week of moderate activity or > 60 and ≤ 120 minutes/week of vigorous activity. [d]> 300 minutes/week of moderate activity or > 120 minutes/week of vigorous activity.

Sedentary Behaviors

Computer/Internet. In general, the majority of Singaporean students spent more than three hours per week on a computer / internet. The results of the Chi-square tests showed that there were significant gender differences in the use of computer ($\chi^2_{(3)} = 19.95$, $p < .001$). Specifically, male students tended to spend more time on a computer and/or internet compared to female students. As age increased, the time spent using a computer and internet also increased ($\chi^2_{(6)} = 188.41$, $p < .001$).

Video games. In terms of video gaming, 73.3% of the students reported 0 hour/week on video gaming. Regarding students who did participate, male students tended to spend significantly more time in playing video games compared to their female counterparts ($\chi^2_{(3)} = 348.57$, $p < .001$). Primary school students reported higher playing time compared to secondary and junior college students ($\chi^2_{(6)} = 125.88$, $p < .001$).

Homework. Doing homework appeared to be the highest sedentary activity that the students participated in. More than half of the students spent seven hours or more per week doing their homework. Girls spent significantly more time on homework than boys ($\chi^2_{(3)} = 79.21$, $p < .001$). The junior college students spent more time doing homework compared to the secondary and primary school students ($\chi^2_{(6)} = 81.41$, $p < .001$).

Leisure reading. The majority of Singaporean students in this study did not read a great deal outside of their textbooks. More than half of the students reported zero hour/week reading books, magazines, and newspapers. Female students tended to spend significantly more time reading compared to their male counterparts ($\chi^2_{(3)} = 113.69$, $p < .001$). Primary school students reported higher reading time compared to secondary and college students ($\chi^2_{(6)} = 49.42$, $p < .001$).

Sitting and talking to friends. In terms of sitting down and talking to friends, the majority of Singaporean students spent less than three hours per week. However, the results of the Chi-square tests showed that there were significant gender differences ($\chi^2_{(3)} = 171.10$, $p < .001$), with female students spending more time sitting and talking to friends than males. In addition, secondary school students spent more time sitting and talking to friends than primary and junior college students did ($\chi^2_{(6)} = 161.46$, $p < .001$).

Use of the telephone. Most Singaporean students did not spend too much time on the telephone (less than three hours per week). Female students tended to spend more time talking on the phone than their male counterparts ($\chi^2_{(3)} = 140.79$, $p < .001$). In

addition, junior college students appeared to spend less time on the telephone, compared to secondary and primary school students ($\chi^2_{(6)} = 93.33$, $p < .001$).

TV watching. Nearly half of the students (46.8%) spent 14 hours or more per week watching TV. Female students tended to watch more TV than male students ($\chi^2_{(3)} = 39.32$, $p < .001$). In addition, secondary and primary school students appeared to spend more time than junior college students in TV watching ($\chi^2_{(6)} = 51.83$, $p < .001$).

Physical Activity

Overall, about 60% of the students reported a high amount of physical activity (> 300 minutes/week of moderate activity or > 120 minutes/week of vigorous activity). About 22% of the students reported low or no physical activity. Boys were more active than girls ($\chi^2_{(3)} = 80.44$, $p < .001$). The decreasing trend of physical activity participation from primary, secondary, to junior college was obvious ($\chi^2_{(6)} = 121.87$, $p < .001$). That is, as the students grew older, their amount of physical activity participation dropped.

Polychoric Correlations

Table 3 presents the results of the polychoric correlations. The results show that the use of a computer/internet had positive but weak significant relationships with all other items. Video gaming was positively associated with television watching, use of the telephone, and physical activity. Weak and positive associations were also found between homework and leisure reading, sit and talk, use of telephone, and television watching. Leisure reading was related to sit and talk, and telephone use. Use of the telephone was also related to television watching. Physical activity participation had positive but weak relationships with computer/internet, video gaming, sit and talk, and use of the telephone.

Table 3. ***Polychoric Correlation Matrix for the Sedentary Behaviors and Physical Activity***

Variables	1	2	3	4	5	6	7	8
1. Computer/internet	1.00							
2. Video Games	.26**	1.00						
3. Homework	.16**	-.04	1.00					
4. Leisure Reading	.12**	-.01	.23**	1.00				
5. Sit & Talk	.21**	.04	.21**	.26**	1.00			
6. Telephone	.27**	.10**	.15**	.15**	.31**	1.00		
7. TV Watching	.23**	.22**	.18**	.08*	.20**	.17**	1.00	
8. Physical Activity	.11**	.12**	.06	.06	.10**	.12**	.03	1.00

* $p < .05$. ** $p < .01$.

Predictors of Physical Activity Intention

Separate and simultaneous regression analyses were conducted to examine predictors of physical activity intention using sport ability beliefs, achievement goals, perceived motivational climate, and enjoyment in PE for the primary, secondary, and junior college students and the two genders. The predictors were entered in steps with enjoyment in PE first, followed by perceptions of climate, sport ability beliefs, and achievement goals. The results of these analyses are shown in Table 4.

Table 4. ***Predictors of Physical Activity Intention by School Level***

	Primary					Secondary					Junior College				
	B	SE B	β	t	R^2	B	SE B	β	t	R^2	B	SE B	β	t	R^2
Step 1															
Enjoyment	.30	.02	.31	12.58**	.10	.31	.02	.34	13.71**	.11	.28	.05	.29	5.97**	.08
Step 2															
Enjoyment	.27	.03	.29	10.08**		.26	.03	.28	9.66**		.30	.05	.30	5.53**	
Mastery Climate	.06	.03	.05	1.97		.14	.04	.10	3.56**		-.05	.09	-.03	-.50	
Perfa Climate	.10	.03	.08	3.42**	.11	.09	.04	.06	2.37*	.13	.08	.08	.05	.97	.08
Step 3															
Enjoyment	.18	.03	.19	6.49**		.19	.03	.21	7.00**		.20	.05	.20	3.58**	
Mastery Climate	-.05	.03	-.04	-1.32		.03	.04	.03	.85		- .12	.09	-.07	-1.29	
Perf Climate	.11	.03	.10	3.85**		.11	.04	.08	3.05**		.12	.08	.07	1.44	
Incremental	.31	.04	.26	8.44**		.26	.04	.20	6.68**		.36	.08	.23	4.25**	
Entity	-.11	.03	-.10	-3.78**	.16	-.16	.03	-.13	- 5.06**	.17	-.12	.07	-.09	-1.80	.14
Step 4															
Enjoyment	.13	.03	.14	4.47**		.12	.03	.13	3.81**		.09	.06	.09	1.45	
Mastery Climate	-.07	.03	-.06	-1.94		.02	.04	.02	.59		-.15	.09	-.09	-1.58	
Perf Climate	.08	.03	.07	2.73**		.07	.04	.05	1.79		.07	.08	.04	.89	
Incremental	.24	.04	.20	6.18**		.20	.04	.15	4.83**		.28	.09	.18	3.21**	
Entity	-.12	.03	-.11	-4.19**		-.16	.03	-.13	- 5.07**		-.12	.07	-.09	-1.72	
Perf- Approach	.09	.02	.11	3.70**		.10	.03	.09	2.87**		.08	.08	.07	1.08	
Mastery-Approach	.14	.04	.13	3.42**		.17	.04	.15	3.89**		.17	.10	.13	1.59	
Perf-Avoidance	-.06	.03	-.06	-2.13*		-.04	.03	-.03	-1.13		-.02	.07	-.02	-.32	
Mastery-Avoidance	.02	.03	.02	.74	.18	-.02	.04	-.02	-.59	.19	.06	.09	.05	.70	.16

[a]Performance.
* $p < .05$. ** $p < .01$.

For the primary school students, intention to participate in physical activity during leisure time was positively predicted by enjoyment, perceived performance climate, incremental beliefs, and approach achievement goals (mastery and performance), and negatively predicted by entity beliefs and performance-avoidance goals. The model explained 18% of the variance in intention.

Among the secondary school students, similar predictors were found; that is, enjoyment in PE, incremental beliefs, and approach achievement goals positively predicted physical activity intention, and entity beliefs negatively predicted the intention. The overall model predicted 19% of the variance in intention to participate in physical activity in the next two weeks. For the junior college students, incremental belief was the only positive and significant predictor of the intention in the final step, although enjoyment in PE was a positive predictor in the previous three steps. Sixteen percent of the variance in the intention was predicted in this model.

In terms of the two genders, enjoyment, mastery and performance approach goals, and incremental beliefs positively predicted physical activity intention, and entity beliefs negatively predicted the intention. Performance climate was a positive predictor for male students only. The total variance accounted for in the intention for boys and girls were 16% and 24%, respectively (Table 5).

Taken together, it seems that enjoyment in PE and sport ability beliefs were consistent and appeared to be strong predictors of physical activity intention among all the three age groups of students. The approach achievement goals were important predictors of the intention only for the secondary and primary students. The performance climate positively predicted the intention to be physically active only among primary school students and male students.

Discussion

Physical activity and sedentary activity are closely related to health and risk factors (Ekelund et al., 2006; Stensel, Gorely, & Biddle, 2008). From a psychological viewpoint, it is important to understand psychological correlates of physical activity so that possible intervention strategies can be designed to suit different target groups with specific motivational and physical activity profiles. The main purpose of the present study was to examine the sedentary behavior and physical activity patterns and correlates of physical activity for Singaporean school students in primary school, secondary school, and junior college.

The present study echoed the findings of previous research in that young people across all age groups participate in a variety of physical activities as well as sedentary activities. Physical activity participation is an important part of leisure time in this sample with almost 60% of the students participating in physical activity for more than 300 minutes of moderate to vigorous activity or more than 120 minutes of vigorous activity per week. This result is aligned to an earlier study by Wang et al. (2006) with Singapore children aged between 10 to 14 years old. In addition, Singaporean students also spent a significant amount of time doing homework (more than 50% spent more than seven hours/week). It is important to note on this issue that the sedentary behavior of homework may be highly valued, yet it is equally problematic for health if it contributes to excessive sitting time.

The third sedentary activity in which Singaporean youth spent

Table 5. ***Predicators of Physical Activity Intention by Gender***

	Male					Female				
	B	SE B	β	t	R^2	B	SE B	β	t	R^2
Step 1										
Enjoyment	.30	.02	.32	11.82**	.10	.35	.02	.40	19.43**	.16
Step 2										
Enjoyment	.26	.03	.28	8.65**		.32	.02	.36	14.78**	
Mastery Climate	.10	.04	.08	2.48*		.10	.03	.08	3.09**	
Perfa Climate	.08	.04	.06	2.27*	.11	.06	.03	.04	1.98*	.17
Step 3										
Enjoyment	.19	.03	.20	6.10**		.23	.02	.26	10.37**	
Mastery Climate	.00	.04	.00	.05		-.02	.03	-.01	- .48	
Perf Climate	.11	.04	.08	3.03**		.08	.03	.06	2.76**	
Incremental	.26	.04	.20	6.04**		.33	.03	.25	10.13**	
Entity	.14	.03	-.12	-4.48**	.15	-.12	.03	-.10	- 4.53**	.22
Step 4										
Enjoyment	.14	.03	.15	4.35**		.15	.03	.17	5.87**	
Mastery Climate	- .02	.04	- .01	- .34		.04	.03	- .03	- 1.34	
Perf Climate	.08	.04	.06	2.04*		.05	.03	.04	1.67	
Incremental	.20	.05	.15	4.37**		.25	.03	.19	7.18**	
Entity	-.15	.03	- .13	- 4.43**		.13	.03	- .11	- 5.00**	
Perf- Approach	.08	.03	.09	2.58**		.07	.02	.07	2.94**	
Mastery-Approach	.13	.05	.11	2.73**		.19	.04	.17	5.12**	
Perf-Avoidance	-.03	.03	- .03	-1.00		.02	.03	- .02	- .86	
Mastery-Avoidance	-.02	.03	- .02	- .53	.16	.02	.03	.02	.90	.24

[a]Performance.
* $p < .05$. ** $p < .01$.

most of their time was the use of a computer and/or internet, after television watching and homework. This is unsurprising and often a major cause for concern, particularly if the time spent in such behaviors is for recreational gaming. This kind of sedentary behavior has increased greatly in recent years and is likely to increase continuously.

We hypothesized that boys and girls across all age groups would have different patterns of sedentary and physical activity. The results of the present study support this hypothesis. In terms of physical activity patterns, boys are more active than girls across all ages, supporting the extant literature (Caspersen, Pereira, & Curran, 2000). In terms of sedentary activity, there are significant gender differences across all types of activities. Boys tend to engage more in using a computer/internet and video games, and girls spend more time doing homework, reading, sitting and talking, using the telephone, and watching television. The findings are similar to Wang et al.'s (2006) earlier study as well as UK data (Gorely, Biddle, Marshall, & Cameron, 2009). However, with the younger age group, Wang et al. found that 20% of boys and 24% of the girls watched more than two hours of TV per day, whereas the present study found that 43.5% of boys and 49.3% of girls spent more than two hours per day watching TV. There is an upward trend in watching TV and this could be due to the fact that there has been an increase in cable and digital TV providers and services in Singapore. Cable television has gained great acceptance in the last few years and the proportion of subscriptions to cable television has surged from 14% in 1998 to about 58% in 2008 in Singapore households (Department of Statistics, 2009). In addition, the use of a computer/internet has also increased among the younger age group compared to findings of previous studies. This is not surprising as Singapore is at the forefront in the use of IT in schools (Ministry of Education, 2009) and availability of computer-based entertainment has increased.

Our second hypothesis was that the patterns of sedentary and physical activity participation would differ among the three age groups. Literature indicates that participation in all types of physical activity declines strikingly as age or grade increases (Sallis, 2000; Sallis et al., 1992). Our findings are consistent with the literature. Although the junior college students demonstrated the lowest physical activity level in this study, the majority of them still engaged in moderate to vigorous intensity activity outside of PE classes. Previous studies (e.g., Myers et al., 1996; Nelson, Gordon-Larsen, Adair, & Popkin, 2005) suggest that during the transition from adolescence to young adulthood, the magnitude of decline in physical activity may depend on several factors. One of these factors could be the type of sport involved. For example, skaters have the greatest decline in skating participation once they reach adulthood. Also physical activity and sedentary behaviors are not inversely related in this study. This finding replicates a previous study done in Singapore (Wang et al., 2006) as well as data from the UK and the USA (Marshall et al., 2002).

Researchers have recognised the importance of psychological factors in influencing physical activity participation, but very few studies have used a theoretical framework in understanding motives in physical activity participation. Sallis, Prochaska and Taylor (2000) suggest that psychological variables such as perceived ability, beliefs system, and perceived support are consistently associated with physical activity participation. Wang et al. (2006) used three theoretical frameworks of achievement goal theory, self-determination theory, and sport ability beliefs and found that there were homogenous groups of children with distinct characteristics in psychological variables that differentiated the amount of physical activity. The present study has yielded the findings that the predictors of physical activity intention are different for the three age groups but are similar among two genders.

There are implications of the current findings. First, any formal or informal physical activity interventions should focus on reduction of multiple sedentary behaviors and not just focusing on one or two of them. Second, a program focusing on reduction of sedentary behaviors may not necessarily increase physical activity levels, because there is not an inverse relationship between physical activity and sedentary behavior. They are largely independent constructs, each requiring intervention. Third, the intervention programs need to be gender and age-specific.

Taken together, the findings of the present study highlight the need for practitioners such as physical educators, coaches, public health staff, and policy makers to consider gender and age-specific physical activity intervention programs aimed at reducing multiple sedentary behaviors and increasing physical activity. While there are multiple psychological predictors that may increase physical activity intention, the findings in this point to the importance of enjoyment of physical activity, cultivating an incremental belief, and promotion of mastery climate and approach achievement goals.

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