Do Levels of Physical Activity among Pupils in Primary and Secondary Schools Explain the Number of Hours of Computer Use?
中小學生的體育活動水平可提示其使用電腦的時間嗎？

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Abstract

The purpose of the study was to examine if the levels of physical activity predict the number of hours of computer use among pupils of healthy body weight from primary and secondary schools in Singapore. 120 primary school participants (mean age: 10. 6 yrs) and 120 secondary school participants (mean age: 18.8 yrs), with the appropriate consents were involved in the study. Information number of hours of computer use, computer accessibility, how it is used for work and leisure and self-reported levels of current physical activity was gleaned from questionnaire responses Results showed that the number of hours spent per week using the computer increased with age (6.0±5.0 vs. 8.6±7.7 hrs, $p<0.05$), computer accessibility was very high (above 90%). No meaningful associations were detected among weekly number of hours of computer use and self reported levels of current physical activity, except for a small but significant correlation between hours of computer use and self-reported physical activity levels ($r=0.23$, $p<0.05$) in normal weight primary school participants. The results of the present study showed that the levels of current physical activity among primary and secondary pupils of healthy weight were not negatively associated with the weekly number of hour of computer use.

摘 要

本文對240名正常體重的中小學生（120名小學生，平均年齡為10.6歲和120名中學生，平均年齡為18.8歲）每周電腦使用時數、電腦普及程度、在學習和業餘時間如何使用電腦以及體育活動的水平進行了問倦調查，其目的是探討新加坡中小學生的體育活動水平是否可預測其使用電腦時間的長短。研究結果顯示，每周電腦使用時數的增加與年齡有關，小學生與中學生分別為6.0±5.0小時和8.6±7.7小時（$p<0.05$），電腦普及率高達90%以上。每周電腦使用時數與體育活動水平之間無明顯的關系，雖然在小學生中二者之間有統計學意義（$r=0.23$, $p<0.05$）。本研究結果表明了在正常體重的中小學生中，體育活動的水平與電腦使用周時數之間無顯著性負相關。

Introduction

The use of computers in for schoolwork and for leisure in Singapore continues to increase at an unprecedented pace since the launch of the Singapore Information Technology (IT) Master Plan for Education in April 1997. The IT Master Plan for Education is part of the country's overall IT Master Plan, which is a $2-billion initiative to wire up the entire island to make it an intelligent learning nation.

Outside of school, pupils have access to computers and the Internet, either at home, at community clubs or at 'cyber-cafes'. Health educationists are concerned that the increased prevalence of ICT use among young people may result in increased

levels of physical inactivity, increased juvenile obesity and reduced levels of physical fitness-factors that may be health crippling if the situation is allowed to evolve without temperance into adulthood (Chia, Teo-Koh, Tan & Quek, 2000). However not all the evidence is consistent. For example Robinson, Hammer, Killen, Kraemer, Wilson, Hayward and Taylor (1993) reported that children who watch television for long hours were only slightly less physically fit than the children who watch less television. Yet, others argue that obese children have been shown to watch more television than lean children (Dietz & Gortmaker, 1985). A key question that arises is whether overweight children and adolescents are physically inactive because of their condition or overweight young people choose to be physically inactive. The same question can be extended to whether overweight young people choose to spend more time engaged on the computer compared to normal weight young people.

Critics of ICT use have blamed increased multimedia use (television, video games, and computer use) as one of the significant causes of increased patterns of physical inactivity among young people (DuRant, Thompson, Johnson, & Baranowski, 1996; Pate, Trost, Felton, Ward, Dowda, & Saunders, 1997). Others have argued that behaviours that are associated with television and video watching-like hours of physical inactivity and incessant snacking on high fat, high sugar and energy dense foods, are the main culprits of increased juvenile obesity (Walker, & Gerhardt, 1990). The relationship between television watching and obesity has been quantified in a group of 12- to 17-year-old participants. Dietz and Gortmaker (1985) reported that for every additional hour of television watched, obesity in the group studied rose by 2%. However, whether such physically inactive and behaviours that may be compromising to health are associated with the number of hours of computer use remain to be elucidated. Additionally, data garnered from many developed countries in the West (Welsman, & Armstrong, 2000) and the East (Gilbey, & Gilbey, 1995; Lim, 1995) have shown that regular habitual physical activity declines as pupils move from primary to secondary school, an observation that mirrors trends observed in adults as they get older between early adulthood to mid-adulthood (National Health Survey 1998; Sallis, & Owen, 1999).

Increasingly, it seems that more young people than before, spend more of their time in front of the computer engaged in some form of cyber-activity, either for information or for pleasure (Chia, Teo-Koh, Tan, & Quek, 2000). However, research on physical activity in young people (Armstrong, & Welsman, 1997) and promoters of physical activity and young people's health (Chia, Leong, & Quek, 2002) and advocators of heart health (Harris, & Elbourn, 1990) in young people have used ICT to further their cause. In their paper 'Using Information and Communications Technology in Physical Education', Chia *et al*, 2000 explained that computer technology could be a boon or bane to physical education, depending on whether the technology is harnessed to enhance or promote physical education.

The levels of physical activity among primary and secondary pupils in Singapore have been described as inadequate for the development and maintenance of physical fitness (Gilbey, & Gilbey, 1995; Lim, 1995). For instance, both sets of researchers reported that very few primary and secondary pupils achieved at least 10 to 20 minutes of sustained aerobic-type activity of a moderate intensity. The authors in the cited studies alluded to that the number of hours spent engaged in physically inactive behaviours such as computer use and television watching might help explain why young people are insufficiently active. However, the authors provide no relevant data to back up their assertions.

Therefore the purpose of the present study was to investigate if physical activity levels among pupils in primary and secondary school predict the number of hours of computer use.

Methods

Participants

Two hundred and forty pupils of both sexes (120 girls and 120 boys) were purposefully sampled (Sherill, & O' Conner, 1999) from two primary and two secondary schools for the study. Participants that were drawn from two primary schools were 60 boys and 60 girls and were aged between nine and 10 years old. Another 60 boys and 60 girls, aged between 14 and 15 years old, were recruited from two secondary schools. The primary and secondary schools represented typical government-funded schools in Singapore. All the participants were free from any medical ailments and were classified as within the healthy weight range (i.e. between 90 and 110% based upon norms for weight for height) in accordance to the criteria enunciated by the School Health Services of the Ministry of Health in Singapore. Participants who were underweight (i.e. less 90% of weight-for-height norms) or overweight (i.e. greater that 110% for weight-for-height norms) were excluded from the study so as not to compound the results of the study. All participants gave informed written consent to participate in the study, and the conduct of the study had the required institutional ethical clearance.

Questionnaire

The questionnaire consisted of three sections-personal particulars, computer use and physical activity patterns. Participants were assured of the confidentiality of their responses, were instructed that there are no right or wrong answers and were encouraged to ask questions if they were unclear about the questionnaire items. Participants took about 15 minutes to complete the questionnaire in a quiet classroom.

The number of hours spent per week using the computer was determined based on the sum of four questionnaire items. These four items specified the four possible locations where participants were most likely to have access to computers. These include the home, school, libraries and others (specified by the participants). The amount of time spent using the computer for school-based work (e.g. word processing, completing worksheets, fact and information searches using the internet) and for leisure (emailing, watching videos, playing computer games) was also examined.

Participants were asked to describe their current level of physical activity. Four choices were available; very light physical activity (e.g. walk or stand for 3-4 hours daily with no regular organised leisure time physical activity), light physical activity (e.g. occasionally involved in recreational activities such as tennis, jogging, swimming, cycling, etc), moderate physical activity (e.g. regular involvement in stair-climbing and recreation or fitness activities such as jogging, swimming, soccer or cycling for at least three times a week for 20-60 minutes per session) and vigorous physical activity (e.g. regular involvement in extensive physical activity for at least 60 minutes per session for at least 4 times a week).

Statistical Analyses

All data were stored in computer and analysed using the SPSS for Windows version 10.0. Descriptive statistics (mean ± standard deviation) for physical characteristics, the weekly amount of time spent engaged in computer use. A descriptor of central tendency-the median-was also generated for the number of hours spent per week using the computer. Percentages were used to describe the participant responses to the questionnaire items in terms of the self-reported physical activity. Differences in the weekly durations of computer use between the participants in the primary and secondary schools were analysed using a one-way analysis of variance (OW-ANOVA). The relationship between the levels of physical activity and the number of hours of computer use was explored using the Pearson Product Moment correlation co-efficient. Linear regression analysis was used to confirm if the levels of current physical activity predicted the number of hours of computer use for the primary and secondary school participants. The level of statistical significance was set at $p<0.05$.

Results

Physical Characteristics of the Participants

The characteristics of the participants, organised by sex and academic level are summarized in Table 1.

Table 1. Physical Characteristics of the Participants.

	Primary		Secondary	
Variables	Boys	Girls	Boys	Girls
	(N=55)	(N=65)	(N=62)	(N=58)
Age (y)	10.6±0.3	10.5±0.3	14.8±0.6*	14.7±0.6*
Body mass(kg)	34.4±6.8	33.6±6.9	57.9±10.9*	48.5±5.6*
Stature (m)	1.42±0.08	1.45±0.06	1.69±0.07*	1.58±0.05*

* Difference between primary and secondary participants is statistically significant at $p<0.05$. Values are mean ± standard deviation.

In essence, the participants from the secondary school are significantly older, heavier and taller than the participants from the primary school.

Questionnaire responses

The key responses to the questionnaire items are summarized in Table 2. Preliminary data exploration revealed no sex difference in the key questionnaire responses of the participants. Data for both sexes were pooled and organised according to academic level. In the case of the response concerning previous use of the computer and present accessibility to computer use (e.g. in school, at home, libraries, community clubs and 'cyber-cafes', etc), data are reported collectively for all participants.

Table 2. Self-Report Questionnaire Responses about Computer Use and Current Levels of Physical Activity of the Participants.

Questionnaire respone	Primary (N-120)	Secondary (N=120)
Previous use of computer (% of participants)	98%	100%
Access to computer use (% of participants)	98%	100%
Hours of computer use per week	6.0±5.0 (median 4.9)	8.6±7.7* (median 6.0)
Hours of computer use for school-based work	1.7±1.0 (median 1.0)	3.1±2.2* (median 2.0)
Hours of computer use for leisure	2.1±1.8 (median 1.0)	6.1±3.4* (median 2.5)
Current physical activity classification (% of participants)		
• Very light	22	26
• Light	37	36
• Moderate	31	30
• Vigorous	10	8

* Difference in the mean between the groups is significant at $p<0.05$.

In terms of previous use of computer and the accessibility to computer use, either in the school or outside of school, participants reported a very high percentage. Use of the computer in terms of hours per week and the time spent using the computer for school-related work and for entertainment on a weekly basis increased significantly between primary five and secondary three.

In relation to self-reported current levels of physical activity, the primary school participants were marginally more physically active than the secondary school participants.

Associations among Number of Hours of Computer Use and Self-Reported Current Levels of Physical Activity

The correlation matrix outlined in Table 3 shows the relationships between the number of computer use per week and self-reported current levels of physical activity of the primary and secondary school participants.

Table 3. Correlation Matrix for Weekly Hours of Computer Use, Levels of Physical Activity and Physical Fitness Test Awards.

	Weekly hours of computer use	Self reported levels of physical activity
Weekly hours of computer use	1.0	-1.4 (Sec)
Self reported levels of physical activity	0.23 * (Pri)	1.0

Pri = primary and Sec = secondary. * Denotes significant correlation coefficient.

There was a significant positive relationship between the number of hours of computer use and the physical activity levels for the participants from the primary school, albeit the common variance was less than 6%. Linear regression techniques applied to the same data set, with the number of hours of computer use entered as the dependent variable and levels of current physical activity entered as the independent variable revealed similar results- for primary school pupils (b=1.23±0.23, $P<0.05$) and for secondary school pupils (b=-0.91±0.78, $p>0.05$).

Discussion

The physical characteristics-age, body mass and stature-of the participants are typical of that of primary five and secondary school pupils in Singapore. All of the 240 participants were considered as of healthy body weight for their age and sex according to the weight for height norms used by the School Health Services of the Ministry of Health in Singapore (School Health Service, 1993). In the present study, underweight and overweight participants were purposefully excluded from the study in order to investigate the relationships between the number of hours of computer use, and the levels of current physical activity among pupils from the primary and secondary schools.

The present results showed that previous experience with computer use and the accessibility to computer use in the school and outside the school is pervasive among primary five and secondary school boys and girls. These results are much higher than those reported for some developing and developed countries (Chia, Teo-Koh, Tan & Quek, 2000).

In terms of the number of hours per week of computer use, there was a significant increase between primary and secondary school with boys and girls from both levels spending substantially more time on the computer for entertainment and leisure than school-related work. It appears that since 1993, the time that pupils spent per week engaged in multimedia use, including computer use (Schmidt, Walkuski, & Stensel, 1993) has increased. For example, Schmidt and his colleagues reported that young people in Singapore spent an average of two hours per day engaged in multimedia activities, which included computer use. The increase in the number of hours per week of computer use in the present study is not unexpected since in 1993, the use of computers for work and for play in Singapore was not as pervasive and commonplace compared to the present time. The present result (see Table 2) also showed that in terms of computer use for leisure, the older participants spent three times as much time for that purpose compared to the younger participants. It appears that as the number of hours spent per week engaged in computer use for leisure increases, the trade-off is actual physical activity, even though the evidence is equivocal (Chia *et al*, 2000). The number of hours of computer use in the present result is dwarfed by the number of hours of television viewing in the USA and Canada where it has been reported that the average adolescent watches more than 20 hours a week, and where younger children watch more (Pate, Long, & Heath, 1994). Comparatively, the rate of juvenile obesity in the USA and Canada is also higher than the 10% obesity rate for people aged between eight and 18 years old (Chia, Leong, & Quek, 2002).

With reference to the self-reported current levels of physical activity, younger participants reported having slightly more active current physical activity than the older participants.. The reasons for that need to be investigated but they mirror the results of others (e.g. Gilbey, & Gilbey, 1995; Lim, 1995; Welsman, & Armstrong, 2000).

Equivalent data that are based on self-reported questionnaire responses and heart rate monitoring from the UK, the USA and Europe showed similar trends of declining physical activity patterns with increasing age during the childhood and adolescent years (Sallis, & Owen, 1999; Welsman, & Armstrong, 2000). For instance, Van Mechelen and Kemper (1995) reported that in the Netherlands, physical activity habits of young people declined steeply between the ages of 13 and 16 years in boys and girls but less steeply between the ages of 16 and 27 years. However, it is not clear whether such a decline in physical activity with age in the growing years is due to biology or to social influences (Sallis, & Owen, 1999) or is indeed a combination of the nature and nurture factors. Further investigation on this matter is advised.

The present results showed that there was no sex difference in physical activity patterns, a finding that is contrary to the results of other studies, which in the main showed that girls are physically less active than boys between the ages of six and 18 years (Armstrong, & Welsman, 1997; Gilbey, & Gilbey, 1995; Sallis, & Owen, 1999). However, the discrepancy between studies could be due to cultural and regional differences (Sallis, & Owen, 1999) or might be attributed to the different methods that have been used to collect and classify the physical activity data.

Other related data in Singapore have shown that girls performed better than boys in physical fitness tests, especially in the primary schools (Chia, & Wang, in press). Juxtaposing the findings from two separate studies, it appears that at about nine to 12 years old, girls were physically fitter and had similar physical activity patterns as boys and young adolescent boys and girls do not yet exhibit adult patterns of physical activity where adult women are physically less active than adult men (National Health Survey, 1998).

With reference to Table 3, a weak correlation was established between the weekly hours of computer use and levels of current physical activity in primary school pupils but there was no meaningful associations were detected for the secondary school cohort. Still, it might be argued that the number of hours of computer use has not yet have a negative impact on physical activity levels of primary and secondary pupils in Singapore. However, a cogent

argument can be made that as the number of hours spent per week on computer use increases with age (see Table 2), there is a concomitant reduction in the physical activity levels, even in normal weight pupils. As many health educators caution that childhood patterns of behaviour carry over into adulthood (e. g. Biddle *et al*, 1998; Welsman, & Armstrong, 2000), it is important to address the issue of declining physical activity and physical fitness with age since appropriate levels of physical activity are associated with lowered risks of heart disease, stroke and certain forms of cancer, the latter being the three major causes of premature death in adults in Singapore (Chia, Leong, & Quek, 2002). More remains to be done to encourage young people to start being physically active on all days of the week in order to fend off the makings of serious health-compromising diseases of the future.

Conclusion

Nearly all of the participants surveyed reported having had previous experience and accessibility to computer use. Time spent using the computer per week increased from primary five to secondary three, with participants spending more computer time on leisure-related activities than on work that was related to schools as they got older. No meaningful associations were detected among the number of hours of computer use, and the levels of current physical activity except for a small but significant positive correlation between the number of hours of computer use and levels of physical activity in primary school participants The results of the present study showed that the levels of current physical activity among primary and secondary pupils of healthy weight were not negatively associated with the weekly number of hour of computer use. More can be done to encourage and excite young people to be physically active since the results of the present study show that increasingly as children grow older, they spend more time on the computer for leisure and entertainment and concomitantly less time engaged in appropriate physical activity compared to when they were younger. Appropriate interventions to encourage and motivate young people of all ages to be more physically active on a daily basis can help foster a healthier future for an entire generation of people.

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