Chapter 23
Childhood Obesity and Exergames: Assessments and Experiences from Singapore

May O. Lwin, Benjamin J. Li, and Jerome D. Williams

Like many globalized countries, Singapore faces increasing rates of obesity. Asia as a whole too is seeing a phenomenal rise in weight gain. For instance, it has been estimated that six to ten million people become obese each year in China (MacLeod, 2008). The prevalence of obesity among adolescent children aged 14–17 years old in India had risen to 29% and 11.3% in private and government-funded schools, respectively (Bhardwaj, Misra, Khurana, Gulati, Shah, Vikram, 2008). In Singapore itself, the 2010 National Health Survey revealed that over a span of 6 years, the obesity prevalence among the general population increased from 6.9% to 10.8%, signifying a 0.7% annual increase (Health Promotion Board, 2010). Coming on the back of climbing obesity rates since 1992, the increase is the largest seen so far (see Fig. 23.1). Together with an overweight prevalence of 25.6% (Ministry of Health, 2005), over 36% of the population are ascertained as either overweight or obese. About 9.5% of those aged 7–16 are classified as obese (Soon, Yang, Wong, & Lam, 2008). Sensing the increasing severity of the problem, health institutions have in

M.O. Lwin (✉)
Division of Public and Promotional Communication,
WKW School of Communication and Information,
Nanyang Technological University, #04-42, 31 Nanyang Link,
637718, Singapore
e-mail: tmaylwin@ntu.edu.sg

B.J. Li
Division of Communication Research, WKW School of Communication and Information,
Nanyang Technological University, #05-18, 31 Nanyang Link, 637718, Singapore
e-mail: jbli1@ntu.edu.sg

J.D. Williams
Management and Global Business, Rutgers Business School, Rutgers University,
1 Washington Park Building WP 1040, Newark, NJ 07102, USA
e-mail: jeromew@business.rutgers.edu

J.D. Williams et al. (eds.), *Advances in Communication Research to Reduce Childhood Obesity*, DOI 10.1007/978-1-4614-5511-0_23,

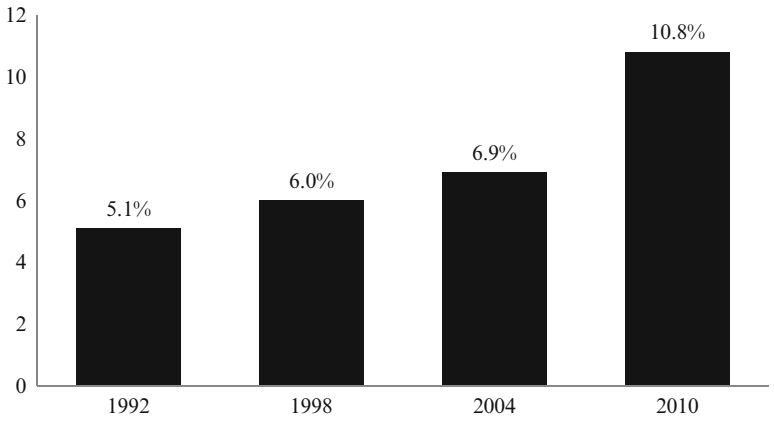

Fig. 23.1 Prevalence of obesity in Singapore from 1992 to 2010 measured in percentage of population

recent years set up weight management programs to help overweight and obese Singapore children manage the problem (Singapore Heart Foundation, 2008).

To combat the prevalence of obesity among children, the Singapore government has introduced several school-based interventions over the past two decades through the education and health ministries. Among the interventions is the noteworthy Trim and Fit (TAF) program. Introduced in 1992 by the Ministry of Education to all primary and secondary schools, the TAF program aimed to reduce the prevalence of overweight students through a two-prong approach of healthy nutrition and regular physical activity (Soon et al., 2008). Schools were equipped with fitness stations, sports facilities, and health-and-fitness rooms. Overweight students were required to engage in additional physical exercise every day, and healthier food options were made available through the installation of fruit and juice machines in school canteens.

While these intervention programs resulted in a system for overweight students to be more physically active in school, the increasing concern among educators and health practitioners is that these activities do not translate into a healthy lifestyle outside of the schooling environment. As a testament to the lack of an active lifestyle, more than 50% of Singaporeans do not participate in any form of sports and exercise (Health Promotion Board, 2010). In particular, children are spending long hours on screen-based activities, such as watching television, using computers, and playing video games. A recent survey revealed that Singapore youth spend on average 9 h a day on the Internet and watching television, compared to the regional average of 6.8 h (Synovate, 2009). There is substantial evidence associating longer time spent on sedentary screen-based activities with lower exercise and higher obesity levels among children (Kautiainen, Koivusilta, Lintonen, Virtanen, & Rimpelä, 2005; Scragg, Quigley, & Taylor, 2006).

One way to bridge the gap between the lack of healthy behaviors and the popularity of screen-based activities is through the use of health-themed video games.

These interventions can be classified into two broad categories. First, games with health messages educate players with health knowledge. The ultimate goal here is to equip players with the resource to make informed choices in diet and exercise. Research on these games revealed that these interventions have been effective in increasing knowledge regarding healthier food choices and behaviors. For instance, games that draw players emotionally into the story create an immersive environment that can contribute to intrinsic motivation (Baranowski et al., 2008). In a meta-analysis by Vogel et al. (2006), the use of interactive simulations or games were reported to produce higher cognitive gains and better attitudes toward learning compared to those using traditional teaching methods. In affirmation of the meta-analysis by Vogel et al. (2006), a computer game designed in a study by (Peng, 2009) to include key interactive features such as tailoring and role-playing was found to be an effective channel in teaching nutrition, increasing self-efficacy, and perceived benefits of healthy eating.

Second, there has been a rising interest in video games that use a *physically* immersive experience aim to encourage physical activity and exercise. These games are known popularly as *exergames*. As children are spending more time with sedentary screen-based activities, exergames offer the possibility of making physical exercise a lifestyle habit among overweight children by allowing players to engage with the game through body movements and activity. Research in this area has been gaining momentum, and various research studies have been undertaken in Singapore to gain a deeper understanding into the following questions: What are the changing media usage habits of Singaporean children? Are video games, in particular, exergames, an integral part of daily lives? Can exergames serve as an effective platform for exercise promotion among Singapore children? If so, are there elements within exergames that can enhance the gaming experience to promote better attitudes and motivations toward physical activity?

Exergame Research

Research in exergames has examined two key areas: technology and game intervention effectiveness. These are reviewed in the following sections.

Technology of Exergames

The technology of exergames can be split into three categories—controllers, software, and systems.

Controllers. Traditional game controllers allow players to only use their fingers to control the game through the use of a gamepad. The first exergames make use of dance pads to track lower limb movements. Games such as *Dance Dance*

Revolution require players to step on the correct symbols, while staying in beat with the music. Transferring game operation from fingers to feet opened up the possibility of using digital games to exercise and this has garnered interest from health researchers.

Later innovations such as the Sony EyeToy and the Microsoft Kinect picked up player movements using a camera mounted on top of the television set. Players are able to control their characters in-game using both upper body and lower body gestures, and usually see themselves on screen the form of their mirror image or silhouette.

The Sony Playstation Move and Nintendo Wii, on the other hand, use accelerometers and infrared sensors in the controllers to sense player movement. Players wield these baton-shaped controllers in their hands and control the game by moving the controllers in various directions. Games that require the use of lower limb movements (such as running or jumping) usually come with fabric straps that players can wear on their thighs. The game controllers can then be inserted into the straps to sense the movement of the lower limbs.

Software. Dance games constitute the most popular form of exergames at the moment (Thin & Poole, 2010), with titles such as *Dance Dance Revolution* and *Dance Central* requiring players to move their bodies to control their characters. Players score points based on how accurately they replicate the dance moves shown on screen. Other than having an intense body workout to some high-tempo songs, advanced players are known to memorize dance sequences that they can replicate or challenge others outside of the gaming environment (Hoysniemi, 2006).

Sports games such as the *Mario & Sonic at the Olympic Games* and *Kinect Sports* offer an array of sporting activities, such as tennis, soccer, boxing, track and field, and beach volleyball. Players move their bodies during game activity, and the movements are picked up by various game controllers. Virtual sports games form an interesting avenue for research with regard to individual characteristics such as competition (player versus player) and collaboration (players versus computer opponents) (Song, Kim, Tenzek, & Lee, 2010).

Workout and fitness games on video game consoles were almost unheard of a decade ago, but due to technology advancement in recent years has resulted in this new genre gaining popularity. Titles such as *Wii Fit* and *Gold's Gym Cardio Workout* allow players to engage in various workouts such as kickboxing, aerobics, and muscle toning with the aid of a virtual trainer. The presence of positive encouragement through the trainer and other health messages opens up research possibilities in the area of health communication and motivation.

Systems. Among video game consoles, the most popular exergames are those that are based on the platforms designed by Microsoft *(Xbox 360)*, Nintendo *(Wii)*, and Sony *(Playstation 3)*. Recent exergame research has centered on the *Nintendo Wii*, in part due to its early popularity among audiences, family-friendly game titles, simple control system, and gentle learning curve. However, the hands-free control

system of the Microsoft *Kinect* shows promise in incorporating a full-body workout for players.

An area which shows signs of promise is mobile phone gaming. Mobile phones are beginning to have faster processing speed and better graphics, while the popularity of smartphones like the *Apple iPhone* and phones running on the *Google Android* platform has seen developers introducing exergames on mobile phones. For instance, *SpecTrek*, which makes use of the Global Positioning System and camera functions on smartphones, requires players to track down "ghosts" on their mobile phones. The augmented reality (AR) ghost hunting game tasks the player to locate ghosts using the local map and then the phone camera to scan and catch ghosts. Other applications in development include *Zombies, Run!*, where players are required to run around in the real world to collect supplies in a zombie apocalypse. These AR exergames appear to provide a real-world extension of the exergames that are typically based in the living room, as players are not bound by space constraints and can be engaged with the real-life environment.

Effectiveness of Exergames

Physiological benefits. Studies that examined the effects of exergames often looked at their contribution to the energy output of players. Energy expenditure is measured through heart rate monitoring, via the use of a chest strap and an accompanying monitoring device, and oxygen consumption through the use of a facemask and analyzer unit. Studies on the effectiveness of *Dance Dance Revolution* found players' heart rates averaging between 137 and 147 beats per minute, as compared to the resting heart rate of 60–80 beats per minute (Tan, Aziz, Chua, & Teh, 2002; Yang & Graham, 2005). Work by Lanningham-Foster et al. (2006) and Smith (2005) also found supporting evidence that heart rates of exergame players are comparable to those engaged in traditional aerobic exercises. Individuals playing Nintendo Wii games burned significantly more energy than those playing normal screen-based sedentary games (Graves, Stratton, Ridgers, & Cable, 2007), while overweight children were found to burn more calories than their normal weight counterparts (Unnithan, Houser, & Fernhall, 2006).

Other Benefits. Aside from increasing energy expenditure, exergames have been found to reap benefits in other areas. When introduced in third- and fourth-grade classrooms, students found themselves attending school more often, had better social skills and reported being more enthusiastic about physical activity and sports (Chamberlin & Gallagher, 2008). Overweight and obese children who played exergames over time had increased self-esteem and self-efficacy scores (Brubaker, 2006; Staiano et al., 2011). Children who were allowed to play exergames were more likely to spend less total time playing computer and video games, and spent a greater proportion of that time on games that encourage the use of physical activity (Ni Mhurchu et al., 2008).

Exergame Research in Singapore

We embarked on a research program on exergames in Singapore in 2005. Supported by the Singapore Ministry of Health, in particular, the Health Promotion Board, and the Singapore Heart Foundation, our agenda includes the following:

(a) An assessment of the health profiles, changing lifestyles, and exercise patterns of young Singaporeans.
(b) The potential use of digital games for health promotion and health education.
(c) The potential use of digital games for educating overweight and obese children (alongside clinical weight management programs).

Prior to our recent studies, there had been few documented explorations into the field of exergaming in Singapore. Tan et al. (2002) conducted a study with 40 teenagers to assess the intensity and aerobic demands of a dance-themed exergame. Results showed that energy output during the game met the minimum requirements from the American College of Sports Medicine (ACSM) for cardiorespiratory daily requirements, and the authors recommended that exergames be placed in homes so as to provide more regular workout sessions. The dearth of research on exergames prompted us to take an in-depth look into its effectiveness in promoting physical exercise among overweight children in Singapore.

Research has shown that an improvement in attitudes toward a health behavior can encourage individuals to engage in it (Armitage & Conner, 2001; Godin & Kok, 1996). In particular, people who have more positive attitudes to exercise were found to exercise more (Blue, 1995). Here, we are interested to examine the extent to which exergames can provide an improvement in the exercise motivations among Singapore children. Among our studies we examined research in these key areas: the health profile, media, and exercise habits of Singapore children and youth, the effectiveness of exergames in improving attitudes and motivations toward exercise, and in-game and external factors that influence the effectiveness of exergames. These are summarized next:

Health Profile, Media, and Exercise Habits of Singapore Children and Youth

We undertook a paper and pen survey with high school and elementary students in 2010. The respondents' height and weight were measured by the Physical Education teachers in each school. Body mass index (BMI) was then computed using the formula BMI = kg/m^2. Subsequently, respondents were classified into underweight (BMI < 5%), normal weight (5% < BMI < 85%), overweight (85% < BMI <95%), and obese (BMI > 95%) based on the BMI-for-age percentile chart developed by the Centers for Disease Control and Prevention (CDC) in the USA. However, we also present the breakdown based on local BMI criteria.

Table 23.1 Weight Profile of School Students in Singapore

(*N* = 1,273)	Count	Percent
Based on CDC chart		
Underweight (UW) (<5%)	113	8.8
Normal weight (NW) (5%–85%)	710	55.6
Overweight (OW) (85%–95%)	216	16.9
Obese (OB) (≥95%)	234	18.3
Based on HPB chart		
Severely Underweight (<3%)	53	4.2
Underweight (3%–5%)	39	3.1
Normal (5%–90%)	906	70.9
Overweight (90%–97%)	195	15.3
Severely overweight (>97%)	80	6.3

Elementary and high school students (41.5% and 58.5%, respectively), aged between 10 and 15 years old (mean age of 11.4 years old) from nine Singaporean schools participated in this study (male = 55.1%; female = 44.9%). The proportion of the ethnic group—61.7% Chinese, 25.5% Malay, 7.7% Indian, and 5% of other races—is roughly representative of the resident population in Singapore.

Based on CDC's BMI-for-age percentile, out of the 1,278 respondents, 55.8% were found to have a normal weight, 8.9% are underweight, 17% are overweight, and 18.4% are obese. A classification based on the BMI-for-age percentile chart from Health Promotion Board (HPB) resulted in 4.2% respondents who are severely underweight, 3.1% are underweight, 70.9% have a normal weight, 15.3% are overweight, and 6.3% are severely overweight. The BMI-for-age percentile breakdowns from both CDC and HPB charts can be found in Table 23.1.

In terms of exercise profile, we found that elementary school children undertake strenuous exercises more than their older counterparts in high school (see Table 23.2). This trend is likely to be linked to children's increased use of online media as they grow. This is explored in our follow-up study discussed next.

In another current project, which is supported by the Singapore Ministry of Health, a large-scale survey is being undertaken in elementary and high schools in Singapore to assess how prevalent exergames are within the new media context (Lwin, 2011). The emergence of new media, however, has changed the media consumption pattern of children and youth. Similar to children in other countries our findings are in agreement that Internet use has displaced television consumption (Lee & Kuo, 2002). Our preliminary findings suggest not just a generation of children who are highly exposed to the online and mobile phone environments but a growing penetration of exergames within Singapore households. Our initial results show that over 5% of children (and families) whether overweight or of normal weight play such games during leisure time and often as a family activity that involves more than one generation. Some families own more than one type of exergame, and exergames are played both with friends and family members of varying ages.

Table 23.2 Exercise habit and type of exercise (by educational level)

Exercise Habit (Times per week)	Elementary		High School	
	(n=530)		(n=748)	
	Mean	SD	Mean	SD
Strenuous Exercise (Heart Beats Rapidly) (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long-distance bicycling)	2.84	2.03	2.20	1.87
Moderate Exercise (Not Exhausting) (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, popular and folk dancing)	2.36	1.91	2.03	1.77
Mild Exercise (Minimal Effort) (e.g., yoga, archery, fishing, bowling, golf, easy walking)	2.38	2.50	1.91	2.21
	Elementary		High school	
	(n=530)		(n=748)	
Type of exercise	Count	%	Count	%
Skipping	132	24.9	146	19.5
Running	275	51.9	264	35.3
Swimming	337	63.6	303	40.5
Tennis/badminton	284	53.6	370	49.5
Cycling	322	60.8	408	54.5
Combatives	87	16.4	65	8.7
Push up/sit up	79	14.9	85	11.4
Basketball	194	36.6	261	34.9
Volleyball	93	17.5	122	16.3
Soccer	157	29.6	206	27.5
Active games	199	37.5	162	21.7
Others	1	0.2	0	0.0

Improving Exercise Attitudes with Exergames (Obese and Overweight Children)

We conducted a study with overweight children to assess the effectiveness of exergames to improve their attitudes toward exercise (Li, Lwin, & Jung, 2011). We worked with the Singapore authorities to determine the qualified (overweight) children and identified suitable participants out of an entire cohort of 800 students who were currently enrolled in the school's obesity management program and identified

by the school as those needing help in reducing their weight. Participants of the obesity management program are required to engage in additional exercise sessions every week, and are given advice on how to maintain a healthier diet. In addition, the shortlisted students were further screened by a check on their BMI, which is one of the most widely accepted ways to distinguish individuals of different weight categories (Cole, Bellizzi, Flegal, & Dietz, 2000; Dietz & Robinson, 1998). Children are generally described as being overweight if their BMI is at the 95th percentile or higher (Kuczmarski et al., 2002; Mei et al., 2002; Ogden et al., 2006). For Asian populations, individuals with a BMI of 23 and above are considered overweight (Choo, 2002). The average BMI of participants in this study was 25.9 (SD = 3.63). After the two-step selection process was complete, a total of 140 students made the final cut and participated in the experiment.

The program included each participant using *the Nintendo Wii* to participate in an exergame titled *Active: Personal Trainer*. Students were asked to fill out a pre-test questionnaire that asked about their attitude and motivation to exercise, and to engage with a pre-selected workout game. After the workout, participants were asked to fill up a post-test questionnaire with the aforementioned measures. We found that participants reported higher levels of exercise attitude, exercise motivation, and motivation to use digital gaming interventions for exercise. These results suggest that the exergames show promise in promoting exercise attitudes among overweight children.

Improving Exercise Attitudes with Exergames (Normal Weight Children)

We conducted another study, this time with normal weight children to assess the effectiveness of exergames to improve their attitudes toward exercise when coupled with health education messages (Lwin & Malik, 2012). We deployed an intervention program utilizing Wii games play during physical education classes coupled with health messaging among elementary school children in Singapore. The results indicate that when children who were exposed to threat-framed messages, which communicated risks of not exercising such as growing obese, played Wii active exergames during PE lessons, they reported more positive physical activity attitude, self-efficacy, perceived behavioral control, and group norm than those who underwent regular PE lessons and exposed to the same messages.

Influence of In-Game Cues and Other Factors

While the previous studies add support to a growing interest of research into the effectiveness of exergames on improving exercise attitudes and behavior among overweight and obese children, less is known about how various aspects of the game

can influence its effectiveness. We conducted a study to answer whether graphical representations in exergames, in the form of the player's in-game avatar, can influence overweight children's attitudes and behaviors in the game. We sought to examine how overweight children respond to visual cues within an exergame in the form of avatars (Li, Lwin, Wong, & Chong, 2011). A between-subjects factorial design study was conducted where we created avatars of various body sizes were created within the *Active: Personal Trainer* game. They were further remodeled to include both male and female versions of the normal and overweight avatars.

Our findings showed that participants who were assigned to avatars of overweight body size have poorer exercise attitude, exercise motivation, motivation to use the exergames to exercise and game performance than those assigned to avatars of normal body size.

With the increasing popularity of the Nintendo Wii and other upcoming video game consoles that allow for consumers to work out in the comfort of their homes, more exercise-themed games are being released that set the appearance of user avatars based on their weight. The Wii Fit, for example, allows for the creation of avatars of varying body sizes based on the height and weight values that users input into the system (Loguidice & Loguidice, 2010). Our findings suggest that designing avatars that are slim and toned may provide more motivation and yield more positive attitudinal and behavioral changes in children who play the game.

Other Research Areas

Another area that is currently being explored is the use of exergames by overweight and obese children who are seeking medical attention. More than just having a higher than normal BMI, these children are already suffering from health problems as a result of obesity, or have been diagnosed by doctors as being more susceptible to health problems than other overweight children. Studies are being carried out now with the partnership of hospitals and health institutions in Singapore. At the weight management centers where these children are attending weekly workout sessions to reduce their body weight, exergames are incorporated into the program in an effort to improve their exercise attitudes and habits as they have fun. This study aims to examine how exergames can improve overweight Singapore children's exercise attitudes over a 12-week period.

With regard to game elements, game genre is an area that is being actively explored in exergame research. Exergames come in various attractive themes, such as dance, sports, fitness/workout, and adventure. While the appeal of these genres to different age groups and genders have been well documented in conventional computer and video games (Quaiser-Pohl, Geiser, & Lehmann, 2006; Sherry & Lucas, 2003), their attractiveness and subsequent motivational pull to exercise within an exergame has been relatively unexplored. How does the genre of exergames influence their effectiveness? Do overweight children's exercise attitudes differ between being assigned a particular genre or if they are allowed to choose a

genre of exergame? These questions are being explored in an ongoing study with overweight and obese Singapore children.

With the rising rate of obesity among Singapore children, it is encouraging to see that exergames are reasonably effective in improving exercise attitudes and motivations among overweight children. A more focused exploration into the use of exergames by target groups and the effects of various in-game elements will allow health practitioners and educators to better utilize these digital gaming interventions in the near future.

Conclusion

Research has found that children and youth today are faced with many digital devices and new media offerings that can impede physical activity. However, the exergame offers potential to reduce the amount of sedentary activities undertaken by this generation while still allowing the use of digital devices and media typically considered as increasing sedentary time. With the right type of games and gaming concepts, exergames can influence not just the level of physical activity but also influence attitudes and perceptions toward exercise. In addition, exergames can offer a platform for imparting health messages. Taken as a whole, our research findings present a number of key considerations for policymakers and educators. Educators can consider using exergames not as a replacement to physical activities in school but as a supplement to motivate and encourage this digital generation to be more active. Adding on to the repertoire of aerobic workouts and sports introductory lessons currently available in Singapore schools, exergames will be a refreshing and appealing health intervention for schoolchildren.

Efforts should also be focused on raising the profile of exergames among game developers and publishers, as popularity of game genres is often the driving force behind game quality and innovation. As the Singapore government is increasingly promoting itself as a hub for video game design (Nutt, 2010), authorities can consider incentivising the development of exergames by local game developers. Such incentives can come in the form of grants for developers working on exergames that appeal to the local audience or infrastructural support for budding game designers and entrepreneurs. The end product of an appealing and quality exergame may increase the motivational factor of the exergame as a health intervention tool.

Looking forward, we plan to execute a number of exciting research projects to further knowledge in this field which will include hospital and clinical-based intervention programs as well as expanding our study to include adults. Much work remains to be done as technology evolves and video games become increasingly sophisticated.

Acknowledgement The authors gratefully acknowledge the Ministry of Health Centre for Health Service Research, the Health Promotion Board, the Ministry of Education, and the Singapore Heart Foundation for their support in the research described in this chapter.

References

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *The British Journal of Social Psychology, 40*(4), 471–499.

Baranowski, T., Buday, R., Thompson, D. I., & Baranowski, J. (2008). Playing for Real: Video Games and Stories for Health-Related Behavior Change. *American Journal of Preventive Medicine, 34*(1), 74–82.e10.

Bhardwaj, S., Misra, A., Khurana, L., Gulati, S., Shah, P., & Vikram, N. K. (2008). Childhood obesity in Asian Indians: a burgeoning cause of insulin resistance, diabetes, and sub-clinical inflammation. *Asia Pacific Journal of Clinical Nutrition, 17*(S1), 172–175.

Blue, C. L. (1995). The predictive capacity of the theory of reasoned action and the theory of planned behavior in exercise research: an integrated literature review. *Research in Nursing and Health, 18*(2), 105–121.

Brubaker, B. (2006). Teachers join the Dance Dance Revolution: Educators begin training to use the exercise video game. *The Dominion Post*. Retrieved from http://www.redorbit.com/news/scifi-gaming/424434/teachers_join_the__dance_dance_revolution/index.html.

Chamberlin, B., & Gallagher, R. (2008). *Exergames using video games to promote physical activity*. Paper presented at the Children, Youth and Families At Risk Conference, San Antonio, TX.

Choo, V. (2002). WHO reassesses appropriate body-mass index for Asian populations. *The Lancet, 360*(9328), 235.

Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: International survey. *British Medical Journal, 320*(7244), 1240–1243.

Dietz, W. H., & Robinson, T. N. (1998). Use of the body mass index (BMI) as a measure of overweight in children and adolescents. *The Journal of Pediatrics, 132*(2), 191–193.

Godin, G., & Kok, G. (1996). The theory of planned behavior: A review of its applications to health-related behaviors. *American Journal of Health Promotion, 11*(2), 87–98.

Graves, L., Stratton, G., Ridgers, N. D., & Cable, N. T. (2007). Comparison of energy expenditure in adolescents when playing new generation and sedentary computer games: Cross sectional study. *British Medical Journal, 335*(1), 1282–1284.

Health Promotion Board. (2010). Life's better and brighter when we get healthy together! Retrieved September 2, 2011, from http://www.hpb.gov.sg/news/article.aspx?id=9008.

Hoysniemi, J. (2006). International survey on the Dance Dance Revolution game. *Computers in Entertainment, 4*(2), 8.

Kautiainen, S., Koivusilta, L., Lintonen, T., Virtanen, S. M., & Rimpelä, A. (2005). Use of information and communication technology and prevalence of overweight and obesity among adolescents. *International Journal of Obesity, 29*(1), 925–933.

Kuczmarski, R. J., Ogden, C. L., Guo, S. S., Grummer-Strawn, L. M., Flegal, K. M., & Mei, Z. (2002). 2000 CDC growth charts for the United States: Methods and development. *Vital & Health Statistics – Series 11 L Data From the National Health Survey, 246*, 1–190.

Lanningham-Foster, L., Jensen, T. B., Foster, R. C., Redmond, A. B., Walker, B. A., Heinz, D., et al. (2006). Energy expenditure of sedentary screen time compared with active screen time for children. *Pediatrics, 118*(6), e1831–e1835.

Lee, W. & Kuo, E.C.Y. (2002). Internet and displacement effect: Children's media use and activities in Singapore. *Journal of Computer-Mediated Communication*, *9*(2). Retrieved March 4, 2010, from http://jcmc.indiana.edu/vol7/issue2/singapore.html.

Li, B., Lwin, M., & Jung, Y. (2011). *Impact of visual and social cues on exercise attitudes and behavior of overweight children playing an exergame*. Paper presented at the 61st Annual International Communication Association Conference, Boston, MA.

Li, B., Lwin, M., Wong, M. L., & Chong, S. M. (2011). *Gender differences and the influence of in-game factors on the effectiveness of exergames on overweight children*. Paper presented at the 2011 American Marketing Association Marketing & Public Policy Conference, Washington, DC.

Loguidice, C. T., & Loguidice, B. (2010). *Wii fitness for dummies*. Hoboken, NJ: Wiley.
Lwin, M. O. (2011). *Children and adolescents' media and digital exposure in Singapore*. Working Paper.
Lwin, M. O., & Malik, S. (2012). The efficacy of exergames incorporated physical education lessons in influencing drivers of physical activity: A comparison of children and pre-adolescents. *Psychology of Sport and Exercise, 13*(6), 756–760.
MacLeod, C. (2008). China wrestles with growing obesity. *USA Today*. . http://www.usatoday.com/news/world/2008-12-18-chinaweight_N.htm. Accessed 22 Jan 2009.
Mei, Z., Grummer-Strawn, L. M., Pietrobelli, A., Goulding, A., Goran, M. I., & Dietz, W. H. (2002). Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. *The American Journal of Clinical Nutrition, 75*, 978–985.
Ministry of Health. (2005). National Health Survey 2004. Retrieved September 2, 2011, from http://www.moh.gov.sg/mohcorp/publicationsreports.aspx?id=2984.
Ni Mhurchu, C., Maddison, R., Jiang, Y., Jull, A., Prapavessis, H., & Rodgers, A. (2008). Couch potatoes to jumping beans: A pilot study of the effect of active video games on physical activity in children. *International Journal of Behavioral Nutrition and Physical Activity, 5*(1), 8.
Nutt, C. (2010). Q&A: Singapore's Government On encouraging game industry growth. Retrieved October 22, 2011, from http://www.gamasutra.com/view/news/28815/QA_Singapores_Government_On_Encouraging_Game_Industry_Growth.php.
Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flegal, K. M. (2006). Prevalence of overweight and obesity in the United States, 1999–2004. *Journal of the American Medical Association, 295*, 1549–1555.
Peng, W. (2009). Design and Evaluation of a Computer Game to Promote a Healthy Diet for Young Adults. *Health Communication, 24*(2), 115–127.
Quaiser-Pohl, C., Geiser, C., & Lehmann, W. (2006). The relationship between computer-game preference, gender, and mental-rotation ability. *Personality and Individual Differences, 40*, 609–619.
Scragg, R., Quigley, R., & Taylor, R. (2006). Does watching TV contribute to increased body weight and obesity in children? Scientific Committee of the Agencies for Nutrition Action.
Sherry, J., & Lucas, K. (2003). *Video game uses and gratifications as predictors of use and game preference*. Paper presented at the International Communication Association Annual Convention, San Diego, CA.
Singapore Heart Foundation. (2008). Weight management. Retrieved September 3, 2011, from http://www.myheart.org.sg/a-heart-healthy-lifestyle/weight-management/.
Smith, B. K. (2005). Physical fitness in virtual worlds. *IEEE Computer, 38*(10), 101–103.
Song, H., Kim, J., Tenzek, K., & Lee, K. (2010). *Intrinsic motivation in exergames: Competition, competitiveness, and the conditional indirect effect of presence*. Paper presented at the annual meeting of the International Communication Association, Suntec Singapore International Convention & Exhibition Centre, Suntec City, Singapore.
Soon, G., Yang, H. K., Wong, M. L., & Lam, P. W. (2008). *Obesity prevention and control efforts in Singapore*. Seattle, WA: The National Bureau of Asian Research.
Staiano, A. E., Terry, A., Watson, K., Scanlon, P., Abraham, A., & Calvert, S. L. (2011). *Physical activity intervention for weight loss in overweight and obese adolescents.* Paper presented at the biennial meeting of the Society for Research in Child Development, Montreal, Canada.
Synovate. (2009). Synovate survey shows that young Asians are driven by media and music Retrieved September 2, 2011, from http://www.synovate.com/news/article/2009/03/synovate-survey-shows-that-young-asians-are-driven-by-media-and-music.html.
Tan, B., Aziz, A. R., Chua, K., & Teh, K. C. (2002). Aerobic demands of the dance simulation game. *International Journal of Sports Medicine, 23*(2), 125–129.
Thin, A., & Poole, N. (2010). Dance-based ExerGaming: User experience design implications for maximizing health benefits based on exercise intensity and perceived enjoyment. In Z. Pan, A. Cheok, W. Müller, X. Zhang, & K. Wong (Eds.), *Transactions on edutainment IV* (Vol. 6250, pp. 189–199).

Unnithan, V. B., Houser, W., & Fernhall, B. (2006). Evaluation of the energy cost of playing a dance simulation video game in overweight and non-overweight children and adolescents. *International Journal of Sports Medicine, 27*(10), 804–809.

Vogel, J. J., Vogel, D. S., Cannon-Bowers, J., Bowers, C. A., Muse, K., & Wright, M. (2006). Computer gaming and interactive simulations for learning: A meta-analysis. *Journal of Educational Computing Research, 34*(3), 229–243.

Yang, S. P., & Graham, G. M. (2005). Project GAME (Gaming activities for more exercise). *Research Quarterly for Exercise and Sport, 76*(1 (Supplement)), A-96.