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Exergames and Youth - Exergames for Cancer Prevention in Youth: Challenges and Contemporary Research

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One of the most contemporary health challenges that Canada faces is the number of deaths attributed to cancer. Since 2005, cancer has been the leading cause of mortality and continues to severely impact the lives of many Canadians (Statistics Canada, 2012). Most recent epidemiological reports show that the prevalence of individual cancers continues to persist (Ellison & Wilkins, 2012), and it is anticipated that over 186,400 new diagnoses will surface in 2012 (excluding 75,7000 cases of non-melanoma skin cancer). In the same year, nearly 76,000 Canadians are projected to die from the disease. Accounting for 50% of the deaths are cancers associated with the prostate, lung, breast, and colorectum. In terms of morbidity, over 748,000 Canadians are currently living with a diagnosis of cancer made within the last 10 years (Canadian Cancer Society's Steering Committee, 2012). Ultimately, such austere statistics on cancer-associated mortality and morbidity significantly contribute to overall healthcare expenditures and loss in economic output. The most recent national report on the economic burden of cancer alone is estimated at \$26 billion: \$14.2 billion (e.g., health care and rehabilitation related to disease) in direct costs and \$11.8 billion in indirect costs (e.g., missed work due to illness, premature death)(Public Health Agency of Canada, 1998).

These statistics clearly show that it is critical for research initiatives to focus on primary prevention of cancer as well as treatment. Epidemiological studies have shown that over half of new cancer cases and deaths worldwide can be prevented (Adami, Day, & Tichopoulos, 2001; Stein & Colditz, 2004). Particularly in developed countries, modifiable risk factors with impact on cancer prevention have

included tobacco use and physical activity (Adami, et al., 2001). Of late, population-focused anti-smoking campaigns and government policies have exemplified an effective approach to curtailing smoking and lung cancer rates (Ellison & Wilkins, 2012; Health Canada, 2008). Hence, shifting the research focus to increasing physical activity among Canadians may show similar promise to the anti-smoking initiatives. Extensive reviews and meta-analyses have suggested a strong inverse relationship between physical activity and many of the most prevalent forms of cancer, including breast (Monninkhof, Elias, & Vlems, 2007), lung (Tardon, Lee, & Delgado-Rodriguez, 2005), and colon (Harriss, Atkinson, & Batterham, 2009) cancers. In spite of the overwhelming evidence of its importance, most Canadians do not meet the national physical activity recommendations (Colley, et al., 2011b). Perhaps more alarming is the extremely low physical activity prevalence of youth, given that physical activity across the life-span is likely necessary for primary prevention success. According to a recent nationwide survey that objectively measured children's activity levels, only 9% of boys and 4% of girls between the ages of 6 to 19 met the physical activity recommendations of 60 minutes of moderate to vigorous physical activity daily (Colley, et al., 2011a); and previous research has shown that this low activity level in childhood has a tendency to persist into adulthood (Malina, 2001). Physical activity interventions for youth are clearly warranted.

When considering where to target physical activity interventions, the public school system appears to be an excellent aperture. Children spend considerable amounts of their waking days within the school structure and it serves as a community centerpiece for child learning and development. These interventions, however, have seen modest to limited success despite relatively strong resourcing and sustained campaigning (Harris, Kuramoto, Schulzer, & Retallack, 2009; Van Sluijs, McMinn, & Griffin, 2007). While any small positive change in physical activity should be viewed with optimism, there is clearly a need to move to additional apertures in physical activity intervention among youth.

Family-based intervention, that is physical activity changes within the family leisure-time structure, is another logical avenue for intervention. Children spend considerable time within the care of their parents; indeed parents are the "gatekeepers" of young children and their experiences during family time (Gustafson & Rhodes, 2006). Unfortunately, physical activity interventions focused on the family home are limited and have resulted in negligible changes for both children and their parents. Previous interventions have typically included a heavy focus on education about the benefits/barriers of physical activity, followed by a self-monitoring and self-regulatory (e.g., goal-setting) component. While these approaches are generally grounded in the operational constructs common in our theoretical models of health behaviour (Fishbein, et al., 2001), some critical constructs linked to physical activity may have been under-represented.

An area often overlooked when trying to increase physical participation among youth is affective expectations or judgments (expected pleasure and enjoyment). Affective judgments are a central construct – in some form - in many of our popular health behaviour models (Nasuti & Rhodes, in press; Rhodes, Fiala, & Conner, 2009), yet few interventions have focused on the modification of affective expectations, despite its reliable and robust association with physical activity (Nasuti & Rhodes, in press).

Exergaming and Youth

One group of activities with the potential to target exercise behavior through increased pleasure/enjoyment is interactive exercise videogaming (exergaming). Exergaming systems such as the Gamebike system, the Nintendo Wii™ and the Microsoft Kinect are relatively inexpensive and offer the potential to provide a safe, enjoyable, and controlled opportunity for physical activity and exercise in a family environment. During these games, players interact physically (using leg, arm, or whole-body movement) in response to some on-screen virtual activity. Exergaming is a relatively unexplored topic but early results have generated several reviews due to its very different focus from traditional physical activities (Baranowski, Buday, Thompson, & Baranowski, 2008; Barnett, Cerin, & Baranowski, 2011; Biddiss & Irwin, 2010; Mark, Rhodes, Warburton, & Bredin, 2008; Peng, Crouse, & Lin, 2012; Primack, et al., 2012). Interested readers are encouraged to read these reviews for the full scope of research on this topic; however, the emerging evidence suggests that some exergames – most notably Dance Dance Revolution™, high intensity Wii games™, and Gamebike™ - can significantly increase energy expenditure similar to moderate intensity physical activities and that these can translate into health-related fitness improvements. Despite these positive effects, limited research is available to understand adherence to exergames. Further, of the available literature on exergames and exercise adherence, reviews find that the exergame conditions typically report higher adherence than various control conditions but long-term change is negligible/unreported or advantages diminish across time (Baranowski, et al., 2008; Barnett, et al., 2011; Biddiss & Irwin, 2010; Mark, et al., 2008; Peng, et al., 2012).

Our research on exergaming has shown similar results to the overall findings of these reviews, but the results have been among the most positive of the studies employed on the topic. These studies employ exergames within the context of traditional exercise bikes (i.e., exercise bikes that interact with video games) because they demonstrate physical activity in the moderate to vigorous intensity range that results in marked fitness changes (Warburton, et al., 2007; Warburton, et al., 2009). Importantly, studies have also shown that exergames do result in changes to the hypothesized target of increasing enjoyment/pleasure and this increase can be linked to participation rates (Rhodes, Warburton, & Bredin, 2009). For example, in a family-based home pilot study of Game-bike, significantly higher enjoyment and use for children in the exergame condition compared to a control bike (in front of the TV) was demonstrated across six weeks (Mark & Rhodes, in press). Parents had differences in the same direction, but only enjoyment was significantly different. A study of young adults showed similar findings where adherence and enjoyment significantly favored the exergame condition over a bike (playing music of choice) (Rhodes, Warburton, et al., 2009). Still, declines in enjoyment of the bikes and subsequent use were reported in these trials, similar to the other studies on exergames.

As well as studying the effectiveness of existing exergames, we have worked to invent novel styles of exergames. For example, haptics (force feedback) can improve the immersiveness of exergames, for example, allowing players of a racing game to feel the incline of a road through their pedals (Stach & Graham, 2011). It has also been demonstrated that the benefits of exergaming can extend beyond simply providing a fun vehicle for physical activity. A heart rate balancing technique allows people of radically different fitness levels to exercise together, by basing in-game performance on heart rate rather than raw power (Stach, Graham, Yim, & Rhodes, 2009). Thus, computer-mediation of exercise allows it

to be more broadly shared by friends than might be possible with traditional exercise. In keeping with this theme of exploring how exergaming can make group exercise possible where it otherwise might not be, the Liberi exergame and cycling apparatus have been developed to allow children with cerebral palsy to carry out moderately vigorous exercise (Hernandez, et al., 2012; Ye, et al., 2012).

Exergaming Challenges

While early exergaming studies show promise, the decline in enjoyment and subsequent use poses the primary challenge to their use in primary prevention. Exergaming research that attempts to foster maintenance is needed to demonstrate that the initial high participation rate can be sustained within the context of the family home. There may be several reasons for the diminishing effect of exergames in the early research trials. For example, the feedback from families in one study suggested that the bikes themselves were uncomfortable and the Gamebike interface was sometimes slow and choppy (Mark & Rhodes, in press). Improvement of these technical aspects (more comfortable bikes, better gaming system) may improve adherence. In addition, one of the faulty assumptions in exergame research may be that videogames sustain playing behaviour generally and therefore exergames should show continued adherence without decline. Videogames, similar to these initial exergame results, show decline in playing frequency as games become familiar and the novelty wears off (Koster, 2004). To sustain videogame play, manufacturers continually develop new games, and new editions of the same games. The videogame marketplace is well-timed so that new games are constantly made available to satiate the needs of gamers who have completed or become bored of their older games. It would stand to reason that exergames would require the same approach as ordinary video games for behavioural maintenance. Another faulty assumption of exergame research appears to be that all games are equivalently fun. The general videogaming industry has enormous variety in the success of its games, with estimates showing as low as 20% of games turning a profit (Irwin, 2008). It stands to reason that exergames are equally varied in their appeal to players, and that some exergames will likely create far better adherence than others.

Another source of variability in exergames is the tradeoff designers make when blending exercise and gaming. For example, EA's Sport Fitness for the Xbox 360 is at its root a coached exercise product, with little traditional gaming elements, whereas in Harmonix' Dance Central, exercise is an incidental side-effect of an enjoyable dancing game. Exergames which are "exercise first" may not appeal to the same players as those which are "games first". The final challenge in this area of research that we have observed is the over-emphasis of concern and criticism among the health research community (Baranowski, et al., 2008; Barnett, et al., 2011; Biddiss & Irwin, 2010; Mark, et al., 2008; Peng, et al., 2012). Some exercise researchers have challenged the basic philosophical stance of this work as "giving-up" on real physical activity. Related to this finding, exergames interventions that show small changes, or gradual declines across time have been treated with aggressive derision among some researchers and the media (New York Times, 2012), despite similar or inferior findings from traditional physical activity interventions (O'Connor, Jago, & Baranowski, 2009). Our stance is that exergames represent one possible activity among an activity pallet and could even serve as a gateway to other traditional physical activities (Mark & Rhodes, in press). Past research that has tried to make exergames the exclusive activity in physical activity promotion are likely flawed.

Conclusion

Clearly the prevention of cancer through the promotion of physical activity is an important research area. Family-based promotion initiatives are also very timely because parents and children represent low activity groups where inactivity transitions are prevalent and may continue across the life-span. Past interventions have focused on changing variables that may not be as powerful to change behaviour as the affective qualities of the physical activity experience. Exergame interventions are thus not only innovative and contemporary but based on solid theory that has demonstrated that health-related fitness changes through increased behavioural participation is a consequence of improved affective judgments about exergames compared to other physical activity interventions. Despite these early signs of success, exergames face several challenges for physical activity promotion. Some exergames do not provide the intensity of physical activity required for disease prevention, and most of the games show difficulties in long term adherence. These challenges serve as the focus for the next generation of exergame research.

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