

Students' and teachers' reactions to a novel school-based physical education SELF-FIT intervention

A qualitative study

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The Self-determined Exercise and Learning For FITness (SELF-FIT; Australia New Zealand Clinical Trial Registry: ACTRN12615000633583) intervention was designed based on self-determination theory to increase secondary school students' physical activity levels. The intervention included a novel gaming tool (fitness dice) and teachers were trained to teach in an autonomy supportive way. In this study, we reported the qualitative data collected from the trial. Seventy-five students and 11 teachers from 10 Hong Kong secondary schools were interviewed through focus groups and through interviews respectively. Thematic data analysis was conducted. Students and teachers felt that the intervention enhanced students' knowledge of physical fitness and how to perform exercises (competence), gave them control over which activities to do (autonomy), and increased students' connectedness with peers and teachers (relatedness). In turn, students' motivation for physical activity was enhanced. These findings provided evidence for effectiveness of SDT-based PA promotion intervention with autonomy-supportive teachers.

KEY WORDS: Autonomous motivation, Basic psychological needs, Health-related fitness; school-based interventions, Moderate-to-vigorous physical activity.

A growing pandemic of physical inactivity and the consequent risks of chronic diseases, especially in children and adolescents, has become a global public health concern (Dumith, Gigante, Domingues, & Kohl, 2011; Lee et al., 2012). Decreasing physical activity (PA) levels have been observed, with the greatest declines in early adolescence (Sallis, 2000). More than 80% of adolescents (aged 13-15 years) around the world failed to achieve the recommendation of 60 minutes of moderate-to-vigorous physical activity (MVPA) daily (Hallal et al., 2012). Behaviours established early in life are likely to per-

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sist into adulthood and contribute to health status later in life (Craigie, Lake, Kelly, Adamson, & Mathers, 2011; Loprinzi, Cardinal, Loprinzi, & Lee, 2012). Thus, the World Health Organization has called for effective PA promotions, and highlighted the need for quality physical education (PE) in schools (World Health Organization, 2008, 2013).

School-based PE serves as an ideal platform for PA promotion, as attendance is compulsory in most countries and thus can reach the majority of adolescents (Ha, Macdonald, & Pang, 2010; Norris, Shelton, Dunsmuir, Duke-Wi lliams, & Stamatakis, 2015). Regular school PE lessons are important, particularly in areas such as East Asian countries, where students commonly spend a considerable amount of after-school time on homework and academic tutoring rather than PA (Müller, Khoo, & Lambert, 2013). PE plays a pivotal role, not only in providing knowledge but also in enabling students to reach their recommended MVPA level. Through school PE, students could build interest in PA, thereby motivating their current and future participation in these behaviours. Secondary school students tend to exhibit low engagement in PE. Researchers have shown that students' participation in MVPA is less than 50% of PE lesson time across many countries (Chow, McKenzie, & Louie, 2009; Fairclough & Stratton, 2005; Hollis et al., 2017). Strategies to increase students' MPVA through school-based interventions have been developed. Interventions for primary school students are also important, but since fitness is not a core part of PE in primary school, fitness-based interventions might be more appropriate for implementation in secondary schools.

Researchers have suggested that short but intense bouts of fitness exercises (e.g., repeated 10- to 30-second exercise at an intensity of 90% heart rate maximum) might be a feasible and efficacious strategy to increase fitness and health in adolescents (Eddolls, McNarry, Stratton, Winn, & Mackintosh, 2017), and could be embedded into secondary school PE (Costigan, Eather, Plotnikoff, Taaffe, & Lubans, 2015). According to a systematic review and meta-analysis conducted by Lonsdale et al. (2013), supplementing school PE lessons with high-intensity activity (i.e. fitness infusion) is a more effective way to increase students' MVPA during PE lessons, compared to intervening teachers' lesson delivery alone. Within the fitness-infused studies included in this review, intervention activities usually took up a substantial amount of class time (i.e. >30 minutes to 100% of class time) (Ignico, Corson, & Vidoni, 2006; Scantling, Dugdale, Bishop, Lackey, & Strand, 1998). This would demand PE teachers' full commitment or require changes to the school curriculum. Some interventions required a large playing area and specific sports equipment (e.g., tennis rackets and floor hockey sticks) (Ignico et al., 2006). These interventions might not be transferable to schools with a less flexible

curriculum, or with limited space and resources. Low-cost fitness-infused interventions that do not require a large space would be more practical and more likely to be adopted in densely populated areas (Johns & Ha, 1999).

Therefore, a fitness-infused intervention named Self-determined Exercise and Learning For FITness (SELF-FIT) was designed to increase activity levels of secondary students during school PE lessons in Hong Kong. Details of this SELF-FIT trial protocol can be found elsewhere (Ha, Lonsdale, Lubans, & Ng, 2017). In short, this is a clustered randomised controlled trial involving 674 Secondary 2 (grade 8) students from 26 Hong Kong local schools which were all mid socioeconomic status (SES) schools; 13 schools were randomized into an experimental group, and the remaining 13 were wait-list controls. Teachers from experimental schools were instructed to use a set of four fitness dice with changeable “faces” in 8 consecutive PE lessons at schools. Specifically, the size of the dice was 150mm*150mm*1500 mm. Each face of the dice was a transparent pocket, and cards representing different types of exercises could be placed in the film used as faces of the dice. Each dice was fitted with suggested exercise cards representing one of four exercise categories, namely cardiovascular fitness (e.g., burpees), upper body muscles (e.g., planks), lower body muscles (e.g., squats), and flexibility (e.g., stretching). Demonstration videos (accessible through a DVD or from the internet) for all the suggested exercises were created and provided to teachers as a supportive educational tool.

Fitness exercises are generally regarded as less interesting and enjoyable as children transition to adolescents across cultures (Ha, Macdonald, & Pang, 2010; Hollis et al., 2017; Owen, Smith, Lubans, Ng, & Lonsdale, 2014). A trial was designed based on self-determination theory (SDT), aiming to induce intrinsic motivation in students (Ryan & Deci, 2002). As described in the SDT, humans will act effectively and become motivated when the three inherent basic psychological needs (i.e. competence, autonomy, and relatedness) were fulfilled (Ryan & Deci, 2002). Competence refers to the sense of having the opportunities and also the ability to perform a task effectively. Autonomy refers to a sense of volition and willingness, and perceived choice towards the behaviour. Relatedness refers to a sense of belongingness and support within a social group. Basic need satisfaction plays an important role in supporting individuals' adaptive motivation, as well as their physical and psychological well-being (Ng et al., 2012). Therefore, interventions based on SDT should include components that support recipients' basic psychological needs. Methods employed in the SELF-FIT intervention, which were also recommended in previous research (Cheon, Reeve, & Moon, 2012), include providing meaningful rationales for instructions and taking students' perspective into consideration.

In this trial, PE teachers from experimental schools attended pre-intervention and mid-intervention workshops delivered by authors and learnt how to teach using the SDT-based teaching strategies and SAAFE (Supportive, Active, Autonomous, Fair and Enjoyable; Lubans et al., 2017) principles to support students' need of competence, autonomy, and relatedness (Cheon et al., 2012). Typically, teachers decided which dice to use (i.e. choosing from one of four exercise categories, namely cardiovascular fitness, upper body muscles, lower body muscles, and flexibility). However, when using the fitness dice, the exercise to be done was decided by a roll of a dice. Students were allowed to roll a dice and self-select their exercise intensity so as to elicit their sense of autonomy and control (Ekkekakis, Parfitt, & Petruzzello, 2011), thereby potentially increasing their perceived enjoyment of high intensity exercise. To further strengthen the sense of autonomy, both students and teachers had the freedom to interchange the exercise cards between the four dice, and to insert new ones. Teachers were empowered to make minor adjustments to customise the intervention to individual school settings and class dynamics, and were encouraged to involve students in modification. Example modifications include changing the difficulty of the default exercises, suggesting new exercises, choosing music to accompany the exercises, and changing solo exercise into paired ones.

The effectiveness of the SELF-FIT intervention was examined quantitatively in the main trial in terms of MVPA. Positive intervention results were found (Ha, Lonsdale, Lubans, & Ng, in press). Results showed that gender but not age differences were found in the level of MVPA in PE lessons. There was no gender $\times$ intervention interaction effects. Process evaluation is crucial to explore participants' perception and interpretation for their experiences in SELF-FIT. This allows understanding of intervention effects in deeper extent, and aids future refinement on how SDT can be best applied in practise. Thus, we conducted face-to-face interviews with students and teachers from experimental group, and the objective of this paper was to present the qualitative results with regards to theoretical fidelity of SELF-FIT. Specifically, students and teachers evaluated the PA intervention from the perspectives of SDT (competence, autonomy and relatedness).

Method

PARTICIPANTS

Students and teachers who took part in this qualitative study were participants in the experimental group of the main SELF-FIT trial. Written informed consent was sought from

all participants prior to the interviews, and parental consent was also sought for all students. Since more single-sex girls' classes than boys' classes participated in this trial, nineteen focus-group interviews were conducted with 55 girls and 20 boys from 10 local schools by research assistants trained by authors who had no relationships with students. Inclusion of students differed in gender, schools, and level of PA engagement could enrich our exploration and enhance credibility of our findings (Graneheim & Lundman, 2004). All seventy-five students who took part in the main trial, including all participants of this study, were from Secondary 2 (equivalent of Grade 8; age = 14.4 ± 0.9 years) classes. All interviews were arranged by school PE teachers and conducted at schools using semi-structured open-ended questions.

DESIGN AND PROCEDURE

Focus-group questions aimed to elicit comments on how students compared the fitness dice activity to usual fitness activities teachers had been using, and to explore whether students perceived differences in sense of autonomy, competence in PE or PA in general, teachers' role or other forms of social support, or other motivational factors before and after the intervention. Example questions include "How would you compare your feelings before and after using the fitness dice, for example, in terms of engagement, activity level, and interaction with your peers?", "What do you like or dislike about using the dice?", and "If you owned a set of dice, what would you do with it?" Students were interviewed following the same interview guide which was based on SDT and SAAFE principles and was deductive. Average length of the focus group interviews and the interviews with teachers were 25-min and 32-min on average.

Individual interviews with 11 teachers who implemented the intervention were also conducted. Teachers were asked about their perception of the differences in students' competence, autonomy and relatedness during SELF-FIT sessions versus usual PE lessons. The usual PE lessons were similar across schools regarding the duration, frequency, structure, teacher to student ratios. Specifically, a typical class has a sequence of warm up (usually running), stretching, fitness activities, instruction of sport-related skills, and free play. The contents were rather diverse but generally covered "key sports" such as basketball, volleyball, badminton, gymnastics, etc. We also sought teachers' opinions on the sustainability of the intervention, and the usefulness of teacher workshops and demonstration videos that were provided. All procedures of the study were approved by an ethical review board of the authors' institution.

ANALYSIS

All interviews were conducted in Cantonese (i.e., the first language for all participants). Interviews were audio-recorded and transcribed verbatim by authors. Thematic data analysis (Braun & Clarke, 2006) was conducted using NVivo 10 (QRS international) to facilitate the organisation of codes and themes. Initial codes were identified and then sorted into different categories, which were subsequently refined and conceptualized as potential themes with reference to SDT. Emerging themes and sub-themes were reviewed regularly by two authors with backgrounds in physical activity pedagogy and health research. The themes and sub-themes were defined through agreement among authors, and representative quotations were reported,

in order to enhance trustworthiness of the findings (Graneheim & Lundman, 2004). We acknowledged the potential loss of data during the inevitable translation process from Chinese to English. To maximize the credibility and conformability of our findings, data were collected and translated by a bilingual researcher who has high-level of sociocultural competence and background knowledge on the place of this study (Squires, 2009). A COREQ checklist (Tong, Sainsbury, & Craig, 2007) for reporting qualitative studies can be requested from the authors.

Results

THEMES

Three main themes relating to SDT were identified for theoretical fidelity, including (1) perceived competence, (2) autonomy, and (3) relatedness. Representative quotes are discussed below.

Perceived competence. Almost all students and teachers highlighted the benefit of the fitness dice in boosting students' understanding and confidence of physical fitness.

After using the fitness dice, I have a deeper understanding of physical fitness... The dice and the teacher's explanation together expanded my understanding of physical fitness. (School 4, female, student C)

Compared to usual fitness classes that heavily relied on teachers' oral instructions, some students emphasized the importance of the illustrations on the activity cards inserted in the dice in serving as a superior visual aid that facilitated their learning and engagement.

Now, using fitness dice in PE lesson I can see illustrations [on the activity cards] for references, giving me a better understanding of what I needed to do. The instructions became clearer to me and my classmates. (School 2, male, student D)

Several female students expressed their satisfaction regarding perceived improvement in their fitness levels after using the dice in class.

Overall, I felt my fitness level improved after [the intervention], especially [my upper body] strength. (School 7, female, student D)

Autonomy. Differences between pre- and post-intervention, in terms of volition and perceived choice, were commonly reported. Some students noted the general lack of PA in Hong Kong and pointed out the importance of PE lessons. According to both students and teachers, fitness exercises in typical PE lessons in Hong Kong are generally limited to teachers' choices of running, push-ups or sit-ups, while the fitness dice provide a variety of fitness

activities that they did not usually do. Interestingly, we observed that some students who were actively involved in PA preferred military-style training to the open-selection style provided by the fitness dice, as revealed in the following quote by a school basketball team member.

[Instead of rolling a dice, I prefer] fixed instruction as fixed instruction give you a limit, associating with a lesson plan/curriculum in it. But when rolling the dice, you might get repeated exercise so you'd have to roll again. It's wasting time. If you have everything lined up there, it won't be time wasted. (School 10, male, student C)

However, for most students, including those who were initially less active, the dice's open-selection appeared to be most popular, and able to raise students' acceptance and motivation to do fitness exercises. Several students referred to the sense of enjoyment when rolling the dice for exercise selection. Most students preferred using the dice to "select" which fitness activities to do rather than following teachers' fixed instructions, and having opportunities to "choose" seems to trigger students' engagement and persistence.

Using the dice, you are more willing to exercise. Because there is a dice, you rolled an exercise, it means you picked that one. Then you have to do it because you are the one who selected what to do. (School 2, male, student A)

Rolling the dice is better than the teacher's instruction, which only ask you to do this and do that. Rolling the dice actually feels very autonomous, as we students decide ourselves what to do, which seems more satisfying. (School 2, male, student D)

Before the intervention was implemented, some students considered exercise as mandatory, but then discovered that it could be fun after using the dice.

Before using the dice, [fitness exercise] were like rules. But after using the dice, I think fitness exercise are quite fun. Rolling them is fun. (School 6, female, student C)

Similar transformation was also observed by teachers, as revealed in the following quote.

Before using the fitness dice, [students] didn't want to do [fitness activities] and they were stalling... They cried... "Why do I have to do this? I'd rather not have class and just stay in the classroom." They really hated having to exercise. [After I introduced the dice], they loved it from the beginning... [They said] it was appealing and fun as they had never come across it before. Because the dice presents many exercises, it was fun. (School 4, female teacher for female students)

Lack of space was considered a barrier for using the fitness dice in a household setting by a few students, while more students expressed interest

in “playing” the dice at home or somewhere else outside school. This implied that the fitness dice is versatile to be used in different settings, even with limited space.

For some exercises, you need to find a place to do them, and so they are troublesome. ... Some exercises like lower limb stretching can be done when you are waiting for your ride. (School 2, male, student B)

We can play fitness dice with a group of friends at a party, or it would also be fun playing trick or treat using the dice at Halloween. (School 7, female, student B)

Relatedness. The intervention appeared to boost interaction between students, and motivated self-directed learning from others or independently.

This classmate probably does better [in particular fitness exercise] and we would ask him/her how to do it. Our teacher would also make us ask him/her when someone is spotted doing quite well. We would ask around if we don't know how to do it or we would discuss how to do it well. (School 8, female, student E)

The intervention also provided more opportunities for teachers to interact with students and encourage them to improve.

After adopting what I have learned from the intervention, I actually feel more relaxed... several [students] in a group came around and chatted, they asked questions. There weren't many chances for students to ask questions during PE classes, but there are more during the intervention. (School 11, female teacher of female students)

Some students' viewpoints were not that positive and may provide insights for further studies. For example, some students preferred activities assigned by teachers rather than chosen by themselves. Some schools assigned students of different levels of athletic ability into one group, e.g. students of school team and common students, which led to peer pressure on some common students. Some students failed in some specific activities and the teacher did not change the cards in the dice so the students kept failing. Future studies may refer to these individual differences when designing interventions.

Teachers' views on acceptance, feasibility and sustainability

Time pressure during fitness dice's introduction in the first two lessons was reported. Some teachers suggested early introduction of fitness dice to junior students from Secondary 1, so as to maximize the effectiveness of fitness training and to expedite future incorporation of the dice in PE. Almost all teachers expressed their eagerness to incorporate the dice in future PE lessons.

Junior classes are more passive and they react more strongly against doing fitness exercise. So [the dice] make [fitness exercises] more interesting... I hope there will be more opportunities and freedom to use this fitness dice next year. (School 4, female teacher of female students)

Most teachers indicated the benefits of the fitness video in assisting their lesson preparation and teaching. Attending workshops was deemed one of the most valuable gains among teachers, who did not only learn the theory, but also had opportunities to learn from co-workers' sharing and to experience practical operation of the fitness dice. Almost all teachers expressed appreciation for their gains from the intervention, which was considered useful in helping them to become better teachers.

Discussion

In this study, we explored teachers' and students' participants' experiences of a school-based intervention applied in secondary schools, grounded in SDT. The findings suggested that the intervention was rated positively by most students and teachers. This acceptability could be explained in terms of fulfilments to students' need of competence, autonomy and relatedness. Researchers have previously found that the satisfaction of these basic needs may lead to more health-related behaviours, including PA (Ng et al., 2012). Compared to typical PE lessons, both participating students and teachers in this study indicated that the use of fitness dice could enrich students' knowledge of physical activity (competence), offer various choices and a sense of control to provoke student's engagement (autonomy), and build and strengthen social support that motivate active learning from their peers or independently (relatedness). The findings are in line with those in the existing literature (Lonsdale et al., 2013; Owen et al., 2014), providing support to the use of SDT as a guiding theory to understand adolescents' PA behaviours.

In previous studies, PA in adolescents has been shown to be positively associated with perceived competence (Timo, Sami, Anthony, & Jarmo, 2016) and autonomous motivation (Ha & Ng, 2015; Owen et al., 2014). A review of 12 qualitative studies summarized adolescent perceptions on PA, and reported that low perceived competence, lack of PA opportunities for autonomy, and negative influences from peers and PE teachers were identified as barriers to PA participation (Martins, Marques, Sarmento, & da Costa, 2015). Inactive adolescents are usually low in perceived competence in physical literacy, and would demonstrate negative attitude towards PA

(Martins et al., 2015). Most participants in our study, including those who reported being more inactive, showed interest and enjoyment towards the fitness-infused intervention, even though high-intensity activity was usually considered hard and not appealing to inactive population (Ekkekakis et al., 2011). This implicated that enhancing perceived competence, autonomy and relatedness may be imperative in PA promotion among inactive adolescents.

According to a systematic review on school environment and adolescent PA, failure of unsuccessful interventions was mostly attributed to the lack of attention to school environment (including lack of space) and school policies (Morton, Atkin, Corder, Suhrcke, & Sluijs, 2016). In contrast, interventions that integrated educational, curricular and environmental components were most effective (Kriemler et al., 2011). These evidences can help explain the positive feedbacks from our teachers regarding the feasibility and sustainability of the SELF-FIT trial, as school environment and educational curriculum were taken into consideration during intervention development. The fitness dices were created with respect to the general local school context, where the educational curriculum is less flexible and physical space for PE is generally more limited than that in European countries (Johns & Ha, 1999). Teachers in this study were trained to teach in an autonomy supportive way, and were empowered to modify the intervention's delivery method according to individual school settings and class dynamics. Also, demonstration videos were provided for teachers to use in a way that they preferred, for their class preparation or presentation in class. Such flexibility enabled teachers to incorporate the intervention easily into their lesson plan, and was considered one of the key elements for a feasible and sustainable intervention.

ectiveness (Creswell, Plano Clark, GutmRecent adolescent PA interventions mostly focused on girls (Camacho-Miñano, LaVoi, & Barr-Anderson, 2011; Jago et al., 2015; Okely et al., 2011; Staiano, Beyl, Hsia, Katzmarzyk, & Newton, 2016), who are generally less active than boys. Nonetheless, the declining PA level in not only girls but also in boys cannot be ignored (Hallal et al., 2012; Sallis, 2000). The SELF-FIT intervention was shown to be acceptable and satisfying among adolescents regardless of their gender. Notwithstanding, one style never fits all. Just as the level of motivation and ability to participate in PA varies between students, the effectiveness of one intervention may differ from student to student. This intervention appeared to be more appealing to students who were initially less motivated to exercise than school-team members. Perceived gains from this intervention were also more pronounced in less motivated students, who are the population most in need for PA promotion. Therefore, our findings could serve as a reference for future intervention design aimed at PA promotion, especially for less-motivated adolescents.

One strength of this study is that it elicited insights from both students and teachers concerning the intervention through in-depth qualitative interviews. The sample of participants (75 students and 11 teachers) with various gender, schools of origin, and background of PA level could deepen the credibility of our findings (Graneheim & Lundman, 2004). Due to the nature of qualitative research, generalizability is not a goal, and the findings of this study may not represent the opinions of populations outside junior secondary students, or schools with similar settings. Instead, these findings allow a deep exploration of participants' feelings to complement the quantitative findings, so as to enable a complete evaluation of the intervention's effectiveness (Graneheim, & Hanson, 2003).

PERSPECTIVE

To help offset the global pandemic of physical inactivity, particularly among adolescents, secondary school PE teachers may require finely tuned interventions to entice their students to exercise. This study highlights the advantages of using SDT in a school-based PE intervention, and underscores the importance of fulfilling the needs of competence, autonomy and relatedness in PA promotion for adolescents. Giving students the autonomy to choose fitness activities, providing greater social support through well-trained teachers who can advise and encourage students, and providing students with an activity to interact among themselves and learn from each other would contribute to students' willing participation in PE class. Findings from this study show that it is important to consider students' needs, school environment, teachers' involvement, and incorporate social-support training for teachers in intervention development, in order to increase acceptability, feasibility and sustainability of a PA intervention.

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