

# Top 10 practical lessons learned from physical activity interventions in overweight and obese children and adolescents

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**Abstract:** Physical activity (PA) interventions targeting overweight and obese children and adolescents have shown only modest success, and dropout is an area of concern. Proper design and implementation of a PA intervention is critical for maximizing adherence and thus increasing the overall health benefits from PA participation. We propose practical advice based on our collective clinical trial experience with support from the literature on best practices related to PA interventions in overweight and obese children and adolescents. The top 10 lessons learned are (i) PA setting–context is important; (ii) choice of fitness trainer matters; (iii) physical activities should be varied and fun; (iv) the role of the parent–guardian should be considered; (v) individual physical and psychosocial characteristics should be accounted for; (vi) realistic goals should be set; (vii) regular reminders should be offered; (viii) a multidisciplinary approach should be taken; (ix) barriers should be identified early and a plan to overcome them developed; and (x) the right message should be communicated: specifically, what's in it for them? The recommendations in this paper can be used in other pediatric PA programs, physical education settings, and public health programs, with the hope of decreasing attrition and increasing the benefits of PA participation to promote health in children and adolescents.

**Key words:** physical activity, obesity, overweight, child, adolescent, intervention, resistance training, aerobic training, adherence, compliance.

**Résumé :** Les interventions par l'activité physique s'adressant aux enfants obèses et à ceux présentant un surpoids ont connu un succès mitigé et l'abandon de la pratique est un sujet préoccupant. La conception judicieuse et la mise en œuvre des interventions au moyen de l'activité physique sont d'une importance capitale pour maximiser le maintien de la pratique et améliorer de ce fait la santé globale de cette population. Nous donnons les conseils pratiques suivants à la lumière de notre expérience clinique de groupe et de la documentation au sujet des meilleures pratiques d'interventions par l'activité physique auprès d'enfants et d'adolescents obèses et présentant un surpoids. Les 10 conseils les plus importants sont : (i) le contexte–milieu de pratique de l'activité physique est important, (ii) le choix de l'entraîneur physique compte, (iii) les activités physiques sélectionnées doivent être diversifiées et amusantes, (iv) on doit envisager un rôle pour le parent–tuteur, (v) on doit prendre en compte les caractéristiques physiques et psychosociales individuelles, (vi) on doit fixer des objectifs réalistes, (vii) on doit faire régulièrement des rappels, (viii) on doit utiliser une approche multidisciplinaire, (ix) on doit identifier rapidement les obstacles et élaborer un plan pour les éliminer et (x) on doit communiquer le vrai message : dire spécifiquement pourquoi on le fait. Les recommandations dans cet article peuvent être utilisées pour d'autres programmes d'activité physique à l'intention des enfants et des adolescents, dans d'autres milieux d'éducation physique et de santé publique, et ce, dans l'espoir de diminuer l'abandon de la pratique de l'activité physique et d'en tirer des bénéfices sur le plan sanitaire pour cette population. [Traduit par la Rédaction]

**Mots-clés :** activité physique, obésité, surpoids, enfant, adolescent, intervention, entraînement contre résistance, entraînement aérobie, adhésion, compliance.

## Introduction

Physical activity (PA) and the physical fitness levels of children and adolescents have declined in the past few decades (Tomkinson and Olds 2007; Tremblay et al. 2010). Exercise interventions targeting overweight children and adolescents have been only modestly successful, and dropout is of great concern. Despite the well-known benefits of exercise, PA interventions tend to have highly variable adherence rates (Pavey et al. 2012), diminishing the potential health benefits for participants. The focus of exercise interventions in overweight youth should not be on weight loss alone, given that exercise has also resulted in improvements in body composition (Gutin et al. 2002), fitness (Gutin et al. 2002), blood profile, (Shaibi et al. 2006), and well-being (Yu et al. 2008). Proper design and implementation of strategies to maintain or increase PA adherence are critical to maxi-

mizing the overall health benefits associated with a physically active lifestyle. Although some predictors of dropout from PA interventions have been identified in obese youth (de Niet et al. 2011; Jelalian et al. 2008), practical advice on how to improve the design of these interventions and to encourage adherence is lacking.

This manuscript reviews 10 of the most pertinent lessons we have learned as physicians, psychologists, scientists, research staff, educators, exercise specialists, and personal trainers involved in PA research intervention trials targeting overweight and obese children and adolescents. We compiled retrospectively a list of the most recurrent issues we encountered while working with children and adolescents in various PA settings. Because of significant overlap among these issues, we selected recommendations that encompassed all our practical advice and compiled them into

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a concise list of 10 lessons. Once these 10 practical lessons were selected (they do not appear in order of importance), we sought and cited published intervention studies that targeted children and youth to support each of our recommendations. For this manuscript, use of the word “physical activity” (PA) refers mostly to planned, structured PA and exercise interventions rather than unstructured activity (any physical movement that may increase daily minutes of PA). When we refer to “children” we mean those aged  $\leq 12$  years and when we refer to “adolescents” we mean those between the ages of 13 and 18 years.

## 1. PA setting–context is important

Both the physical and the sociocultural environment are predictors of PA and should be considered when designing PA interventions for overweight and obese youth (Franzini et al. 2009; Sallis et al. 2000).

### 1.1. Physical environment

PA intervention settings for overweight youth should be accessible. In the preschool population, more portable equipment on the playground, less fixed playground equipment, and a larger playground size were associated with more minutes of moderate to vigorous PA and less time in sedentary activity (Dowda et al. 2009). It was found that the characteristics of the preschool attended had a greater influence on the PA level of preschoolers than did sociodemographic factors (age, sex, race–ethnicity, parent education, body mass index (BMI)) (Pate et al. 2004). Frequency of exposure to play spaces, time spent there, and convenience of play spaces were found to be positively correlated with (unstructured) PA in children 4 years of age (Sallis et al. 1993). Access to facilities is positively associated with PA level in children (Sallis et al. 2000) and is negatively associated with obesity in adolescents (Dunton et al. 2009). In the Girls' health Enrichment Multi-site Study (GEMS), an afterschool weight-loss intervention in 61 African-American girls aged 8 to 10 years, transportation was reported as the main barrier to participation (Robinson et al. 2003). This indicates that to promote facility-based PA adherence, the provision of or reimbursement for transportation may need to be considered for participants. Alternatively, a possible solution for individuals with barriers to transportation is a home-based PA intervention. However, participants training at fitness facilities may experience a different social environment (see section 1.2). Evidence also suggests that music may be incorporated into the PA program to increase motivation and reduce awareness of the body and (or) physical discomfort (De Bourdeaudhuij et al. 2002). Notably, music used as a distraction increased exercise tolerance and perseverance on a treadmill test in a sample of overweight and obese youth aged 9 to 17 years (De Bourdeaudhuij et al. 2002) and increased exercise duration in overweight or obese adolescents aged 12 to 17 years (Adamo et al. 2010).

### 1.2. Sociocultural environment

Increased PA participation in children has been associated with a favourable social environment as indicated by higher scores on collective socialization, collective efficacy, social ties, perceived safety, and neighbourhood exchange (how often neighbours exchange favours) (Franzini et al. 2009). This relationship was observed even when controlling for sociodemographic factors such as age, sex, race–ethnicity, and parent education. To promote PA adherence, Deforche et al. (2011) recommend capitalizing on what motivates participants to exercise. Motivators for adolescent girls were found to be both extrinsic (being thin) and intrinsic (overcoming challenges, developing a sense of accomplishment) (Gillison et al. 2011). Understanding and documenting all motivators will allow the PA program developers to modify the setting to emphasize or promote intrinsic motivators, thereby increasing the participant's autonomy with regard to PA. Deforche et al.

(2011) suggest that group exercise sessions may promote long-term PA behaviours. In obese boys (8–12 years), PA level and motivation to be physically active were shown to be greater in the presence of friends and peers (regardless of friends' weight status) than when PA was performed alone or with family members (Salvy et al. 2012).

Fostering positive social interactions and team-building activities are important in group PA settings. Interacting with others in an inclusive environment appears to be an important factor when promoting PA. From a sample of 122 adolescents aged 13 to 17 years (BMI unknown), those who were randomized to an exercise group that incorporated team-building activities demonstrated greater exercise adherence compared with the control group, who participated in exercise alone (Bruner and Spink 2011). Team-building activities and (or) frameworks have also been employed in PA interventions for overweight or obese children and adolescents. A weight-loss intervention called REACH for obese children (mean age, 14.6 years) that used group-mediated cognitive behaviour techniques found that minutes of PA per week, self-regulatory efficacy, and enjoyment of PA all significantly increased after the intervention (Wilson et al. 2012). It is suggested that team-building PA may be effective for overweight and obese children and adolescents in groups in which they feel equal to their peers, included, and emotionally secure. Group-based training appears to be effective for overweight and obese children and adolescents, provided the physical setting (see section 1.1) is taken into consideration. It has been shown that overweight adults were more embarrassed and intimidated about exercising in health clubs and exercising around fit and younger people than were nonoverweight adults, and overweight women were more embarrassed than were overweight men (Millar and Millar 2010). Although no such evidence about perceptions of exercise facilities has been shown in overweight and obese youth, health clubs (e.g., exercise clubs, fitness facilities, gyms, etc.) may not be the optimal setting in which to attempt to increase PA for overweight and obese adolescents if they feel uncomfortable and self-conscious in that environment.

Social interaction can also have a negative impact on PA, especially for overweight and obese children and adolescents. The PA level of normal-weight youth (aged 8–12 years) decreases with negative peer interactions such as ostracism (Salvy et al. 2012), a scenario that may be more likely in obese youth (Stankov et al. 2012). Data from 1520 boys and girls show that by 14 years of age, obese youth had lower self-esteem than did nonobese youth (Strauss 2000). This was associated with feelings of loneliness, nervousness, and sadness (Strauss 2000). As well, overweight adolescent girls have reported more stigmatizing experiences in the presence of boys than when with same-sex peers (Neumark-Sztainer et al. 1998). Obese youths' comparisons with their peers are generally negative and can result in perceptions of inferiority (Stankov et al. 2012). It is advised that the focus of interventions be on the participant's effort during PA to adhere to healthy behaviours rather than on the outcomes (Deforche et al. 2011).

The participants' social and cultural beliefs and customs should also be considered carefully. In children aged 4 years, unstructured PA at home was negatively correlated with number of indoor and outdoor play rules (Sallis et al. 1993). A systematic review of qualitative studies examining barriers to PA for adolescents determined that components of the environment and social norms may increase an adolescent's feelings of being on display and could limit his or her participation in PA (e.g., set activities in physical education class such as jumping or swimming, tight physical education uniforms, lack of privacy in change rooms, etc.) (Stankov et al. 2012). The authors suggest that physical education uniforms, as well as the range of activities offered, should accommodate all body types, and that students be allowed to change their clothing in private.

While the influence of the social environment may apply to all age groups it is thought to be particularly important for adolescents undergoing puberty because adolescence has been identified as a critical and sensitive period for physiological and psychological development (Alberga et al. 2012; Dietz 1997). A respectful and welcoming environment should be established early to ensure the participants are comfortable and feel secure in their interactions with others.

## 2. Choice of fitness trainer matters

Fitness trainers play a strong role in creating a positive environment for participants in a PA program or intervention. Creating such an environment can be accomplished by having all staff (and other participants if present) introduce themselves and by allowing time for familiarization with the fitness and sports equipment. Deforche et al. (2011) recommend that the trainer know the names of the participants and treat the participants as their equals by not making them feel like the trainer is their parent, teacher, or specialist but more of a friend and mentor (Pescud et al. 2010). Overweight children aged 6 to 13 years who participated in a resistance-training intervention reported enjoying the social interactions and development of friendships with other children and their trainers (Pescud et al. 2010). Friendship was identified as an important factor in continued participation during the program and was especially valued in girls (Pescud et al. 2010). Participant preference regarding the sex of their trainer should also be taken into consideration, especially for cultural and ethnic sensitivity reasons. Although this preference has not yet been established with overweight and obese children and adolescents, having a same-sex athletic trainer has been associated with a greater comfort level in collegiate athletes (Drummond et al. 2007).

The characteristics of a good trainer that we identified include a strong knowledge of youth PA and healthful growth and development, empathy, enthusiasm, patience, genuine care for the well-being of the participants, sensitivity to their insecurities, and good communication skills. Trainers should be chosen carefully because they have the potential to be role models and have a powerful influence on the child's or adolescent's attitude and future PA participation. Trainers should be selected based on their ability to communicate simply and effectively to children, as well as on their knowledge of the sciences of PA and exercise and their ability to design and teach safe and effective exercises to children and adolescents.

Along with a required background in kinesiology, fitness trainers working with obese children and adolescents should comprehend the multifactorial etiology and complexity of obesity. Trainers should have experience working with individuals with chronic disease and should have a good understanding of both the physiological and the psychosocial issues associated with obesity in childhood and adolescence, to combat the pervasiveness of weight bias and obesity stigma (Puhl and Heuer 2009). Peer training may be another potential strategy for promoting PA, when peer trainers receive adequate training from the intervention staff to help deliver the program. A randomized controlled trial based on a peer health education program found that sedentary activity decreased in a sample of grade 7 children being educated by their peers (Cui et al. 2012). This peer training paradigm was found to be feasible, effective, and valued by participants (Shah et al. 2011). Another health promotion program, called Healthy Buddies, engaged older students (grades 4–7) to be peer teachers for their younger “buddies” (students in kindergarten to grade 3) (Stock et al. 2007). This program showed a positive impact on the health (BMI), health knowledge, attitudes, and behaviours of both the younger students and the peer teachers (Stock et al. 2007). However, because neither of these trials compared peer teaching with adult teaching, it is unclear whether the results were due to

the instruction by peers or to the intervention itself. Furthermore, the HEALTHY intervention (a 3-year, school-based randomized controlled trial that included nutrition, physical education, behaviour, and health communication components) had a significant effect on obesity prevalence in adolescents who made a public commitment to the trial by actively participating in health-promotion activities as peer leaders (DeBar et al. 2011). Further research is needed to determine the effectiveness of peer training and to compare it with more traditional types of adult-led exercise training interventions.

## 3. Physical activities should be varied and fun

A structured exercise program is typically a component of health interventions targeting overweight and obese youth; however, exercise adherence may depend on the program design. A variety of exercises should be prescribed and should reflect the participants' preferences (Deforche et al. 2011). The activities should be mastered easily (providing participants with an early sense of success) and progressive (developing general motor skills at the beginning of the program) to motivate exercise adherence (Sothorn et al. 1999a).

Obese youth generally have poorer performance on aerobic and weight-bearing activities (e.g., jogging) compared with nonobese youth (Deforche et al. 2003). One session of aerobic exercise of long duration may be perceived as monotonous and challenging for obese children and adolescents. In these circumstances, it may be desirable to involve the fitness trainer in the exercise with the participant to decrease boredom and to motivate the participant, especially if he or she is exercising alone. Moreover, group exercise sessions and (or) peer teaching (see sections 1.2 and 2.0) may be more enjoyable for youth. Alternating the type of aerobic exercise in different sessions (i.e., elliptical machine, group exercise session, treadmill, bike, rowing, etc.) and asking the participant's exercise preference may help make PA more enjoyable. Non-weight-bearing aerobic exercises (e.g., biking, rowing, etc.) should be incorporated at the beginning of an exercise program for overweight and obese youth. More weight-bearing activities (e.g., jogging, running, etc.) could be added as physical fitness and confidence increase throughout the program.

Research has shown that supervised, progressive, and age-specific resistance training (strength training or weight training) can be employed safely and effectively (Faigenbaum et al. 2009) in a multidisciplinary weight-management intervention for obese children aged 7 to 12 years (Bernhardt et al. 2001; Sothorn et al. 1999b) and may improve exercise program adherence for obese youth because of greater perceived competence and less discomfort compared with aerobic-type activities (Deforche et al. 2003). At the start of a resistance exercise program, incorporating exercises in which most of the individual's body weight is supported (e.g., weight machines with pulleys) to safely reinforce proper technique is recommended. In support of this concept, obese youth (aged 6–13 years) reported increased enjoyment and confidence in PA after participation in a resistance training program (Pescud et al. 2010).

Currently available evidence recommends a combination of aerobic and resistance-type exercises (Davis et al. 2011; Maziakas et al. 2003). Aerobic training combined with resistance training had a greater effect on maintenance of a lower body fat percentage 1 year after intervention compared with aerobic training alone (Maziakas et al. 2003). Participation in the “New Moves” multidisciplinary intervention (the PA component of which included a combination of aerobic and resistance exercise 4 days per week for 16 weeks) resulted in increased enjoyment of PA for overweight girls in grades 9 to 12 (Neumark-Sztainer et al. 2003). For more vigorous exercise sessions, circuit training in short bouts of alternating aerobic and resistance exercise may be perceived as more enjoyable and sustainable when exercise tolerance

could be an issue. Circuit training has been associated with decreases in abdominal fat and increases in fitness and insulin sensitivity in a sample of overweight and obese Hispanic adolescents (Davis et al. 2011). In summary, PA interventions in obese youth should incorporate a variety of activities that are progressive and enjoyable.

#### 4. The role of the parent–guardian should be considered

Parents–guardians can have an important influence on their children's health behaviours. The importance of parental involvement in the promotion of PA and healthy eating is demonstrated by a study by Golan et al. (1998). This randomized longitudinal prospective study found that overweight children aged 6 to 11 years of parents who were targeted as the exclusive agents of change (i.e., only parents participated in the support and education group sessions) lost more weight and were 9 times less likely to drop out than when the child was targeted as the only agent of change. Notably, these effects were maintained at the 7-year follow-up (Golan and Crow 2004).

Some parent–guardian factors such as parental age and academic education level, which are known to influence PA behaviours in youth, are less likely to change than others. Nevertheless, these less modifiable factors should be identified because they may be potential barriers to PA participation for children. For example, having older parents was found to be negatively correlated with the PA level of preschoolers (Zecevic et al. 2010). There is a positive association between the PA levels of parents and their children (for boys aged 4–12 years) (Van Der Horst et al. 2007), and children were more likely to be active if their parents perceived PA as highly enjoyable (Zecevic et al. 2010). Higher parental BMI predicted attrition from a weight-control trial for obese adolescents aged 13 to 16 years (Jelalian et al. 2008). Additionally, parental academic education level was found to be positively associated with level of PA in adolescents (Van Der Horst et al. 2007).

Parental support has been associated with higher PA levels in preschoolers (Zecevic et al. 2010) and children (Van Der Horst et al. 2007). Preschool-aged children were 6.3 times more likely to be highly active if they received greater parental support (Zecevic et al. 2010). The PA level in adolescents is positively associated with “family influences” (Van Der Horst et al. 2007). Parents reinforce and model healthy behaviours (Rhee et al. 2011) and can change the setting in which their child lives (Golan et al. 1998). Parental encouragement or decision was identified as a main factor in the initiation of a resistance-training program for overweight youth (Pescud et al. 2010).

Parental support can be intangible or tangible (Beets et al. 2010; Deforche et al. 2011). For intangible support, parents serve to model PA, encourage their children, and reinforce positive PA behaviours (Huang et al. 2009; Rhee et al. 2011). Transportation and paying for programs and equipment are the most obvious forms of tangible support for PA. Lack of such tangible support could be a major barrier to PA for some families. For example, in the GEMS intervention, transportation was a barrier to participation in afterschool dance classes for 8- to 10-year-old girls (Robinson et al. 2003). Similarly, parents identified the cost of a resistance-training program for overweight and obese children aged 6 to 13 years as a barrier to continuing participation (Pescud et al. 2010). A systematic review found that parent payment of fees and (or) equipment was positively associated with the measured PA of children and adolescents (Beets et al. 2010), highlighting the importance of tangible support by parents in the promotion of PA in their children.

The age of the participant should be considered when determining the level of parent–guardian involvement in the PA program. Parent–guardian perceptions, opinions, and time constraints, as well as the accessibility and time demands of the intervention, should be taken into account when designing a PA intervention.

To optimize parent–guardian influence on the children's and adolescents' adherence to the PA intervention, parent–guardian barriers should be identified and appropriate solutions developed, and more modifiable factors could be targeted as part of the intervention.

#### 5. Individual physical and psychosocial characteristics should be accounted for

It is suggested that the success of a PA intervention may depend on how well it is tailored to the individual (Deusinger 2012) since both physical and psychosocial characteristics influence PA behaviours (Pimenta 2010; Sherwood and Jeffery 2000; Sothorn et al. 1999a).

##### 5.1. Physical characteristics

Correlates of PA are different for children and adolescents (Sallis et al. 2000; Van Der Horst et al. 2007). The participants' physical size, age, race–ethnicity, and sex can all influence PA behaviours. Controlling for age and weight, the dropout rate from a 1-year PA intervention in obese youth (7–17 years) was greater for boys than for girls, greater for black participants than for white participants, and greater for those classified as moderate and severely obese than for those classified as mildly obese (Sothorn et al. 1999a). It is important to consider the physical size and capabilities of participants; Seidler et al. (1993) state that exercise equipment and facilities should be designed to meet the needs of populations such as children and obese individuals to prevent injury and so that participants receive the full potential benefits of PA. Overall, PA levels are greater in males than in females during childhood and adolescence (Gortmaker et al. 2012; Molnar and Livingstone 2000; Sallis et al. 2000; Van Der Horst et al. 2007). However, PA levels decrease with age (Gortmaker et al. 2012; Molnar and Livingstone 2000; Sallis et al. 2000) in both sexes, with the largest declines seen in adolescent girls (Butt et al. 2011; Molnar and Livingstone 2000), making PA intervention and programming especially important for this population.

When comparing overweight boys and girls (aged 9–13 years), it was found that motivation among girls for starting a resistance-training program was related more to general health improvement, whereas motivation for boys to begin the program was related to performance and strength outcomes (Pescud et al. 2010). Pescud et al. (2010) reported that continued participation for girls was attributed to the social aspects of the program (making friends with other participants, bonding with their trainer). Butt et al. (2011) found that boys aged 13 to 16 years participated in PA for the physical results (getting sweaty, feeling tired), whereas girls were motivated by improved body image and by the popularity associated with PA participation. Moreover, “New Moves”, an afterschool PA intervention targeting overweight girls (grades 9–12) or those at risk of becoming overweight, was successful in increasing the participants' self-worth (Neumark-Sztainer et al. 2003).

Race–ethnicity may also influence PA levels and obesity. Prevalence of overweight among children aged 6 to 19 years was found to be greater in African-American and Mexican-American youth compared with Caucasian youth (Hedley et al. 2004). It has been suggested that different cultural views can influence individual perceptions of obesity (Wheeler et al. 2012). For example, African-American girls report less body dissatisfaction compared with white girls (French et al. 1997). Greater dropout from a PA intervention for weight loss was reported in black children than in white children (aged 7–17 years) (Sothorn et al. 1999a). Understanding the individual variables and motives related to initiation of, participation in, maintenance of, and dropout from PA programs is important when tailoring a program to increase adherence.

## 5.2. Psychosocial characteristics

Greater depression has been associated with lower levels of PA in children and adolescents (Sallis et al. 2000). Having a higher delinquency score (measured with the Child Behaviour Checklist) predicted dropout within 3 months of a lifestyle intervention for obese children (de Niet et al. 2011). Increased autonomy may positively affect PA behaviour and can be accomplished by offering opportunities to master new skills, supporting participants' choices, and giving children the knowledge and skills to be physically active (Deforche et al. 2011). Different predictors of dropout were identified at different stages of a lifestyle intervention for obese children (de Niet et al. 2011), demonstrating the importance of continually monitoring individual characteristics throughout the intervention to avoid dropout. Questionnaires assessing stage of change (which has been related to individuals' perceptions of PA (Marshall and Biddle 2001)) and including a run-in program could help identify participants who have a better chance of adhering to the PA program or who are at a higher risk of dropout. Assessing the participant's stage of change can help identify his or her risk of attrition and can help individualize the intervention to facilitate the participant's readiness for change. Personal factors that predispose the participant to dropout should be addressed prior to commencing any PA program (see section 9).

In physical education settings, increasing the opportunities for PA and offering a variety of options while being cautious of obesity bias (Rukavina and Li 2008) is paramount to increasing levels of PA in all children and adolescents. Because of the controlled nature of research interventions, however, recommendations made in this section may be more difficult to implement depending on the objective of the study. A study that compared different exercise modes (swimming, water games, cycle ergometry, strength training and (or) stability circuit training, small group games-relays, and team sports) in a sample of 20 obese adolescents found that energy expenditure was comparable among different activities (Thiel et al. 2011). Thus, the authors suggest individualizing programs according to the participant's preferences to maximize adherence.

To promote exercise program adherence, interventions should be tailored to the individual's physical (size, age, race-ethnicity, and sex) and psychosocial (personality traits, autonomy, perceptions of PA, and stage of change) characteristics, as well as to the individual's preferences.

## 6. Realistic goals should be set

Goal setting is an effective behavioural change technique employed in PA interventions for overweight youth (Faith et al. 2012; Williams and French 2011). Specific, short-term, and measureable goals should be established with the child or adolescent (Huang et al. 2009). By offering youth the opportunity to take ownership of their involvement, goals promote self-efficacy and (or) autonomy. Interventions focusing on increasing the autonomy of overweight youth may increase adherence to an exercise program and level of PA (Deforche et al. 2011). Showing visual representations of individual progress such as journal logs, medical charts, and diagrams could be useful in measuring progress, giving feedback, and establishing future goals. Providing incentives for continued participation is recommended; however, effort and participation should be emphasized more than skill mastery, to increase self-efficacy and associated PA level (Deforche et al. 2011; Williams and French 2011). Using incentives and positive reinforcement in the form of praise and encouragement is particularly effective in increasing PA and health behaviour change in preadolescent children (Goldfield et al. 2002).

## 7. Regular reminders should be offered

Commitment to PA programs is a time-sensitive issue. A major barrier to PA participation in adolescents (aged 13–16 years) was

time (Butt et al. 2011). Individuals responsible for implementation of exercise programs should recognize that participants may have other commitments that take priority over PA participation and should provide reminders to promote adherence. Those who develop PA programs should take advantage of the rapidly changing breadth of online social media options (e-mail, blogs, Facebook, Twitter, text messaging, instant messaging, cell phone applications, etc.) and should establish the participants' preferred methods of communication prior to commencing the intervention. Although research suggests that social support (Dowda et al. 2007; Salvy et al. 2009) increases overweight youth's motivation to be physically active, there is a lack of evidence to support the use of social media to increase compliance to PA in youth. A systematic review by Nguyen et al. (2011) suggests that most studies are of poor quality, and 87% of the studies that incorporated electronic interventions into the prevention and treatment of obesity in youth have not evaluated the effects of the electronic intervention separately from the other components of the intervention. More recently, Facebook was shown to be an effective tool for recruiting participants and decreasing loss to follow-up in a large sample of adolescent girls in the Trial for Activity in Adolescent Girls (TAAG) (Jones et al. 2012). A review by Vandewater and Denis (2011) suggests that with the ever-growing popularity of social media among youth, social networking as a means of increasing adherence to health behaviours should be explored further. To our knowledge, no studies have examined the influence of social networking sites (e.g., Facebook, MySpace, LinkedIn, Twitter, etc.) on adherence to PA interventions in obese youth and thus, further investigation is needed. Program developers should capitalize on the ever-growing popularity, cost effectiveness, feasibility, and potential of social networking as a means of increasing social support to promote PA adherence. Providing regular reminders through their pre-established preferred method of communication may help increase attendance at training and (or) testing sessions. Reminders should be given 1 or 2 days before the scheduled session, and follow-up contact can be useful 1 or 2 days after their last session to reinforce their positive behaviour and thank them for attending.

## 8. A multidisciplinary approach should be taken

Obesity is a complex condition with multifactorial causes linked to the obesogenic environment we live in (Chaput et al. 2012). Incorporating a multidisciplinary approach is a key strategy for the successful prevention, management, and treatment of pediatric obesity and, importantly, its comorbidities (Bryan et al. 2010).

From our experience, a team of well-qualified empathetic professionals consisting of exercise specialists, dietitians, endocrinologists, and psychologists may enhance the success of a pediatric PA program. It is clear that the psychological impact of obesity on children and adolescents is widespread, showing evidence of body dissatisfaction, low self-esteem, depression, disordered eating habits, social stigma, and decreased quality of life (Vander Wal and Mitchell 2011). Having a psychologist on the team is vital to the success of a PA program, as is keeping in regular contact with participants to establish a rapport and to help resolve PA adherence issues related to psychological health as soon as they arise (Epstein and Goldfield 1999; Epstein and Wing 1980). Motivational interviewing is one of many widely used and empirically supported psychological techniques designed to peak motivation and readiness for change (Erickson et al. 2005). A meta-analysis of randomized controlled trials found that motivational interviewing for increasing PA had a positive effect in 8 of the 10 relevant studies (Rubak et al. 2005). Use of a multidisciplinary health care team allows comprehensive, ongoing evaluation and adjustment

**Table 1.** Summary of the top 10 practical lessons learned from PA interventions with overweight and obese children and adolescents.

Lesson	Recommendations	Age group	Key references
<b>1. PA setting–context is important</b>			
1.1. Physical environment	Maximize accessibility Use portable and multiuse equipment Incorporate music	C and A C C and A	Sallis et al. 2000; Dunton et al. 2009 Dowda et al. 2009 De Bourdeauduij et al. 2002; Adamo et al. 2010
1.2. Sociocultural environment	Reinforce intrinsic more than extrinsic motivators Consider group-based PA (offer same-sex option for children and adolescents undergoing puberty) Offer a choice of activities	A C and A C and A	Deforche et al. 2011; Gillison et al. 2011 Salvy et al. 2012; Bruner and Spink 2011; Wilson et al. 2012; Strauss 2000; Neumark-Sztainer et al. 1998 Stankov et al. 2012
<b>2. Choice of fitness trainer matters</b>	Ensure trainer makes friendly introductions among all staff and participants Ensure trainer familiarizes participants with equipment Ensure trainer treats participants as equals and develops friendships Consider participant preference in the sex of trainer Ensure trainer has knowledge of PA and the multifactorial complexity of obesity and avoids stereotypes and stigma Ensure trainer communicates effectively with youth and has empathy, enthusiasm, patience Consider including peer training	C and A C and A C and A C and A Pubescent C and A C and A C and A C and A	Deforche et al. 2011 Deforche et al. 2011; Pescud et al. 2010 Drummond et al. 2007 Puhl and Heuer 2009 Cui et al. 2012; Shah et al. 2011; Stock et al. 2007; DeBar et al. 2011 Deforche et al. 2011
<b>3. Physical activities should be varied and fun</b>	Use a variety of exercises depending on participant's preferences Offer easily mastered and progressive activities Aerobic training: less weight-bearing at the beginning Resistance training: supervised, progressive, and age specific Circuit training: short bouts of exercise (include a combination of resistance and aerobic exercises)	C and A C and A C and A School-aged C and A School-aged C and A	Sothorn et al. 1999a Deforche et al. 2003 Faigenbaum et al. 2009; Bernhardt et al. 2001; Sothorn et al. 1999b Davis et al. 2011; Maziekas et al. 2003
<b>4. The role of the parent–guardian should be considered</b>	Consider intangible support: parental habits and perceptions of PA Consider tangible support: cost and fees, proximity and location, and transportation	C and A C and A	Rhee et al. 2011; Huang et al. 2009 Beets et al. 2010; Robinson et al. 2003; Pescud et al. 2010
<b>5. Individual physical and psychosocial characteristics should be accounted for</b>			
5.1. Physical characteristics	Address personal factors that can predispose to dropout Consider participant's size, age, race–ethnicity, and sex Understand participant motivators for initiation and participation in PA, and monitor continuously throughout the program	C and A C and A C and A	Sallis et al. 2000; Van Der Horst et al. 2007 Seidler et al. 1993 Pescud et al. 2010; Butt et al. 2011
5.2. Psychosocial characteristics	Consider participant personality traits, autonomy, perceptions, and preferences for PA	C and A	Sallis et al. 2000; de Niet et al. 2011; Deforche et al. 2011; Thiel et al. 2011
<b>6. Realistic goals should be set</b>	Set specific, short-term, measurable goals Use journal logs, charts, diagrams to offer feedback on progress Provide incentives for continued participation and emphasize effort and participation (not outcomes only) Offer praise and encouragement	C and A C and A C and A C and A	Huang et al. 2009 Deforche et al. 2011; Williams and French 2011 Goldfield et al. 2002

**Table 1** (concluded).

Lesson	Recommendations	Age group	Key references
<b>7. Regular reminders should be offered</b>	Recognize that participants have other priorities and commitments	C and A	Nguyen et al. 2011; Jones et al. 2012; Vandewater and Denis 2011
	Consider using social media	C and A	
	Use participant's preferred method of communication	C and A	
	Send reminders 1 or 2 days before scheduled session, make follow-up contact 1 or 2 days after session	C and A	
<b>8. A multidisciplinary approach should be taken</b>	Develop a comprehensive, ongoing program evaluation and adjustment	C and A	Bryan et al. 2010
	Use a team of exercise specialists, dieticians, endocrinologists, and psychologists	C and A	Epstein and Goldfield 1999; Epstein and Wing 1980
<b>9. Barriers should be identified early and a plan to overcome them developed</b>	Consider using motivational interviewing	C and A	Erickson et al. 2005; Rubak et al. 2005 Abraham and Michie 2008; Dumith et al. 2012; Brennan et al. 2012 Stankov et al. 2012
	Consider biological, familial, behavioral, social, and environmental barriers	C and A	
	Realize that overweight and obese youth perceive more barriers to PA than do their nonoverweight peers	C and A	
	Use interviews and questionnaires at start of program to identify barriers	C and A	Marshall and Biddle 2001
	Address barriers and find solutions in collaboration with participant	C and A	
	Continually evaluate barriers throughout the program	C and A	
<b>10. The right message should be communicated: what's in it for them?</b>	Outline realistic expectations	C and A	Deusinger 2012
	Communicate purpose and outcomes in a meaningful way	C and A	
	Realize that every participant is different and tailor the intervention to the individual	C and A	

Note: PA, physical activity; C, children, A, adolescents.

of the intervention to allow better tailoring to the participants' needs.

### 9. Barriers should be identified early and a plan to overcome them developed

Early barrier identification is an effective technique for monitoring adherence in PA interventions (Abraham and Michie 2008). Change in PA levels from childhood to adolescence is influenced by social, familial, biological, behavioural, and environmental factors (Dumith et al. 2012), all of which may function as barriers to PA and program adherence. Based on qualitative analyses of barriers, it was suggested that overweight youth perceive more barriers to PA participation than do other youth (Stankov et al. 2012). To engage overweight adolescents in PA, the barriers preventing their participation must first be addressed (Stankov et al. 2012). An attrition analysis of a family-based cognitive behavioural lifestyle randomized controlled trial of overweight and obese adolescents and their parents identified parent and adolescent barriers to program completion (Brennan et al. 2012). The authors recommended increasing adolescent motivation, decreasing intervention requirements, and establishing a convenient location and flexible schedule around holidays and family commitments to promote participation (Brennan et al. 2012). Questionnaires and (or) interviews with participants may be conducted prior to the intervention to identify individual barriers and to plan PA drop-out prevention strategies. Once these barriers are identified, the team needs to address them and help the child and (or) family overcome them with continual evaluation throughout the intervention. The 10 recommendations we outline in this manuscript provide practical strategies to minimize the greatest barriers to PA participation for overweight and obese youth.

### 10. The right message should be communicated: specifically, what's in it for them?

Family-centered care is of the utmost importance in the successful design of any PA program (Farnesi et al. 2011). Children and adolescents and their families are dedicating their limited free time to participate in a PA program in which expected weight loss, fitness, and (or) health benefits and outcomes may not be realistic. As soon as the participant shows interest in the study, he or she should be made aware of the potential physical and (or) psychological benefits they may acquire from participation in the program. However, realistic expectations (both short and long term) and conditions of participation for optimal results should also be outlined to deter from dropout. For example, higher rates of weight loss at the beginning of an exercise intervention were associated with lower dropout rates in obese youth (aged 7–17 years) participating in an exercise intervention (Sothorn et al. 1999a). Epstein et al. (1984) also showed the highest weight loss in participants with high adherence to the PA intervention.

Communicating the purpose and outcomes of the intervention should also be done in a way that is meaningful to the participant. For example, telling younger, elementary school-aged children that they will improve their fitness may not be as encouraging as saying they will be able to play outside on the playground with their friends for longer without feeling as tired. This will allow a sense of personal fulfillment so that the participants understand that these PA programs are conducted to enhance their health and well-being.

### Significance

One of the most paramount lessons we learned from our practical experience in implementing PA interventions in the pediat-

ric population is the importance of identifying individual barriers to participation early and of addressing them prior to commencing the program. Even if all the participants are considered inactive and overweight or obese at baseline, barriers could be different among individuals. It is important to address these deeper personal and societal issues; otherwise, the short-term PA intervention alone may not result in long-term benefit if these changes are not feasible or sustainable for the individual.

Although our recommendations to increase adherence stem from our research experience with PA interventions in overweight and obese youth, we believe that the lessons we learned are practical for educators, exercise specialists, parents, researchers, and policy makers. The recommendations in this paper can be applied to other pediatric PA programs, physical education settings, and public health programs with the hope of decreasing attrition and increasing the benefits of PA participation for promoting health in children and adolescents.

## Conclusion

Lack of adherence to and long-term maintenance of PA in overweight and obese children and adolescents is of great concern. This paper reviewed 10 practical recommendations for maximizing participation and health outcomes of PA programs for overweight and obese children and adolescents. The setting of the intervention should be at an accessible location with a respectful and welcoming environment and should offer the option of group exercise sessions. Trainers have a great influence on the participants' attitudes and PA beliefs, and as such, they should be chosen with care. They should be knowledgeable, skilled, and empathetic. Physical activities prescribed should be varied and in line with the participants' preferences to increase motivation. Based on adherence rates, low-intensity aerobic exercise and resistance training may be preferable exercise modalities for overweight and obese children and adolescents. When possible, interventions should be tailored to an individual's physical and psychosocial characteristics. The participants' physical size, age, and sex may determine the equipment usage, choice of activities within the program, trainer characteristics, and level of parent or guardian involvement. It is crucial to assess and involve parents and guardians in programs, especially for younger children. Monitoring progress and providing regular and individual feedback are important. To accomplish this, participants should be assisted to develop specific and measurable goals. Participants should also be assisted in identifying potential barriers and in developing a plan to overcome these barriers. A multidisciplinary team is recommended to provide comprehensive and continuous individual evaluation and program adjustment. A family-centered approach should be taken, and the purpose and realistic potential outcomes of the intervention should be explained simply and effectively to the participants.

This paper serves as a guide to exercise specialists, exercise facility managers, clinicians, future investigators, and policy makers, offering practical advice on designing programs to increase adherence and continuation of PA to optimize the physical, psychological, and social health benefits of adopting a more active lifestyle in overweight and obese children and adolescents. Our 10 practical recommendations are summarized in Table 1. Although some of our recommendations may be more feasible in some settings than in others (e.g., physical education program vs community-based or public health program vs a randomized controlled research trial), efforts should be made to tailor the PA intervention to the individual, to maximize adherence. We hope that the recommendations listed in this paper will help health professionals in various settings increase adherence to and sustainability of PA in children and adolescents.

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