

EDITORIAL

A new direction in psychology and health: Resistance exercise training for obese children and adolescents

Gill A. Ten Hoor^{a,b*}, Guy Plasqui^a, Robert A.C. Ruiter^b, Stef P.J. Kremers^c,
Geert M. Rutten^c, Annemie M.W.J. Schols^d and Gerjo Kok^b

^a*Department of Human Biology, NUTRIM, Maastricht University, Maastricht, The Netherlands;*

^b*Department of Work and Social Psychology, NUTRIM, Maastricht University, Maastricht, The Netherlands;* ^c*Department of Health Promotion, NUTRIM, Maastricht University, Maastricht, The Netherlands;* ^d*Department of Respiratory Medicine, NUTRIM School for Nutrition, Toxicology and Metabolism Maastricht University Medical Centre, Maastricht, The Netherlands*

(Received 12 March 2014; accepted 1 July 2015)

Obesity is a growing health problem globally (Swinburn et al., 2011). It is an established risk factor for chronic metabolic and cardiovascular diseases (Kelsey, Zaepfel, Bjornstad, & Nadeau, 2014; Washington, 2008). In overweight and obese children and adolescents (5–17-year olds; further referred to as youngsters), not only metabolic health, but also psychological well-being is at risk (Cooke, Butterly, Mackreth, Carroll, & Gately, 2000; Kelsey, Zaepfel, Bjornstad, & Nadeau, 2014; Van der Baan-Slootweg et al., 2010).

Besides overeating and genetic susceptibility, an insufficient level of physical activity is one of the main contributors to childhood overweight and obesity (Kremers, Visscher, Seidell, van Mechelen, & Brug, 2005), and the target of many obesity reduction programmes (Lee, Shiroma, & Lobelo, 2012). Recent meta-analyses, however, show no effects of present physical activity programmes on body weight or body mass index (BMI, Guerra, Nobre, Silveira, & Taddei, 2013; Guerra, Nobre, da Silveira, & Taddei, 2014; Harris, Kuramoto, Schulzer, & Retallack, 2009), blood pressure (Guerra et al., 2013) or physical activity level (Metcalf, Henley, & Wilkin, 2013). In this editorial, we highlight the putative physiological and psychological benefits of resistance exercise training for obese youngsters as a relatively new direction in psychology and health.

The focus of a new programme

In our view, a long-term effective physical activity programme for overweight youngsters can be accomplished by combining biological and psychological knowledge. We think that current exercise programmes for overweight and obese youngsters are based on incorrect assumptions as they tend to focus predominantly on aerobic exercises and weight loss (Faigenbaum, 2007). We hypothesise that a physical activity programme should initially aim for obtaining a healthier body composition rather than weight loss,

*Corresponding author. Email: Gill.tenHoor@MaastrichtUniversity.nl

i.e. a relatively higher fat-free mass and a relatively lower fat mass. Improving the fat-free mass/fat mass ratio may increase energy metabolism and decrease the risk of chronic diseases (Dixon, 2010).

Overweight youngsters can often not compete with normal weight youngsters when it comes to aerobic exercises (Faigenbaum et al., 2009). Instead, resistance exercises might be easier for overweight youngsters, and therefore easier to comply with (Colella, Morano, Robazza, & Bortoli, 2009; Riddiford-Harland, Steele, & Baur, 2006). Additionally, when they participate in those resistance exercises, it might have a positive effect on their muscle (fat-free) mass (Lau, Yu, Lee, & Sung, 2004; Schranz, Tomkinson, Parletta, Petkov, & Olds, 2013; Yu et al., 2008). We argue that the focus of physical activity should be less on what these youngsters *have* to do, and more on what they *like* to do. This mindset might lead to long-term compliance in physical activity behaviour (Fishbein & Ajzen, 2010; Vansteenkiste, Soenens, & Lens, 2007). In order to become healthier in the long term, we suggest obesity reduction programmes in overweight youngsters that focus more on resistance exercises.

Resistance training as innovation in practice

Resistance exercises, whereby an individual is working against a wide range of resistive loads to enhance health (Lloyd et al., 2013), are not a new idea. In the past, it has been suggested that resistance exercises are harmful for youngsters, particularly during growth (i.e. growth plate injuries or stunted growth). However, more recent data indicate that this is a persistent misperception devoid of any evidence (Barbieri & Zaccagni, 2013; Benjamin & Glow, 2003; Benson, Torode, & Fiatarone Singh, 2008; Faigenbaum, 2007; Faigenbaum & Myer, 2010; Lloyd et al., 2013). As long as resistance exercises are performed under qualified supervision, they can even prevent injuries and cause a rapid rehabilitation from injuries (Lloyd et al., 2013; Sothorn et al., 2000). In fact, since 2008, public health agencies included resistance training as part of their physical activity guidelines for youngsters (Department of Health, Physical Activity, Health Improvement & Protection, 2011; McCambridge & Stricker, 2008; United States Department of Health & Human Services, 2008; World Health Organization, 2010).

Earlier studies have already suggested the use of resistance exercises in (overweight) youth (see, e.g. Faigenbaum, 2007; McGuigan, Tatasciore, Newton, & Pettigrew, 2009; Sothorn et al., 2000). However, the link between the focus on the biological strengths and the positive psychological consequences that it may yield is still undervalued. From a biological perspective, there is a consensus that most youngsters and adults with overweight do not only have an absolute higher fat mass but also an absolute higher fat-free mass than their lean counterparts (Westerterp, Donkers, Fredrix, & Boekhoudt, 1995). Consequently, they have more muscle mass, making them stronger in absolute sense, and less limited in the performance of resistance exercises. Empirical evidence shows that overweight youngsters perform even better on resistance-based exercises than their normal weight peers (Colella, Morano, Robazza, & Bortoli, 2009; Riddiford-Harland, Steele, & Baur, 2006). Furthermore, by performing resistance exercises one's fat-free mass increases, resulting in long-term positive effects on metabolic and cardiovascular health (Alberga, Farnesi, Lafleche, Legault, & Komorowski, 2013; Lloyd et al., 2013).

From a psychological point of view, interventions focusing on behaviour change are most effective when perceived behavioural control for performing the new behaviour is

high, and the new behaviour has positive outcome expectations (e.g. more fun) and is more intrinsically rewarding (Ekkekakis, Lind, & Joens-Matre, 2006; Fishbein & Ajzen, 2010; Fortier, Williams, Sweet, & Patrick, 2009; Rhodes, Fiala, & Conner, 2009; Ryan & Deci, 2002). Compared to normal weight youngsters, overweight youngsters are less capable of performing at a desired or comparable level in aerobic exercises (D'Hond, Deforche, De Bourdeaudhuij, & Lenoir, 2008; Faigenbaum et al., 2009). These negative experiences may result in disinterest and a loss of motivation, causing a vicious cycle: the loss of motivation causes individuals to disengage from physical activity. This lack of physical activity causes an increase in weight, which in turn may result in even lower levels of physical activity. We expect that overweight youngsters will notice that resistance exercises are easier than aerobic exercises and that their performance will be better than the performance of their normal weight counterparts. As a consequence, their enhanced feelings of competence may induce an increase of autonomous motivation for physical activity, which is required for sustained behaviour change (Silva et al., 2011). We therefore expect that in the long term, these overweight youngsters will feel fitter, stronger, more confident, and they will perceive physical activity as more positive. The hypothesised psychological gains (e.g. enhanced feelings of competence and perceived behavioural control) are lacking in programmes focusing on aerobic exercises (Ryan & Deci, 2002).

Current evidence for psychological strengths

Empirical evidence exists for the biological benefits of resistance training (see, e.g. Lloyd et al., 2013), but we have limited knowledge about the psychological benefits of resistance training. In a review by Schranz, Tomkinson, and Olds (2013a) on the effects of resistance training for overweight youngsters, empirical support for large positive effects on muscle strength and small positive effects on body composition were reported. However, the effects of resistance training on psychosocial outcomes remained unclear because of the limited number of studies available. In a later Randomized Controlled Trial (RCT), Schranz and colleagues (2013) found large increases in strength, perceived behavioural control, confidence and self-esteem during and immediately after a six months resistance training programme compared to a no intervention control group. However, six months after the intervention had ceased, the adolescents' outcomes had returned to baseline levels. Velez, Golem, and Arent (2010) reported improved competences and self-worth in both normal and overweight adolescents after 12-weeks of resistance training, compared to a regular physical activity education training. Lubans, Aguiar, and Callister (2010) found a significant improvement in perceived body attractiveness in secondary school girls after resistance training and compared to a control group maintaining their normal physical activity and nutrition behaviour. Yu et al. (2008) found that in a strength exercise group of obese children (but not in a diet-only group), the physical self-concept in endurance improved. Lau et al. (2004) found non-significant improvement in obese adolescents' anxiety levels with no additional effect of strength training. In a qualitative study, Pescud, Pettigrew, McGuigan, and Newton (2010) reported pleasant social interactions, improved confidence and self-esteem, and ongoing parental support as factors for continuation in a resistance programme for the children.

Research Agenda

To develop a long-term effective resistance-based physical activity programme, there are still several issues that need to be answered. First, the right methods should be identified to convince parents of the benefits of resistance exercises. Youngsters often do not engage in resistance exercises, because parents lack knowledge about resistance training. This was shown in a recent cross-sectional study among 314 parents of 12- to 15-year olds, where 93 parents (29.6%) stated that they would not allow their child to perform resistance exercises (Ten Hoor et al., [submitted](#)). Almost half of them ($n = 42$) indicated the child being too young, or considered resistance exercises not healthy during growth. Interestingly, Pescud, Pettigrew, McGuigan, and Newton (2010) describe that parents can learn to accept positive changes in body composition as desirable outcomes of strength training instead of weight loss.

Second, to make programmes sustainable, youngsters need to be guided from supervised settings to non-controlled settings where they remain physically active. Adding motivational techniques such as motivational interviewing (Naar-King & Suarez, 2011; Ryan & Deci, 2002) might be helpful to strengthen the motivation for change and enhance behavioural maintenance by focusing on what youngsters like to do. Motivational interviewing is

a collaborative, goal-oriented style of communication with particular attention to the language of change. It is designed to strengthen personal motivation for and commitment to a specific goal by eliciting and exploring the person's own reasons for change within an atmosphere of acceptance and compassion (Miller & Rollnick, 2013).

Randomised controlled trials should evaluate the immediate and long-term effectiveness of a combined resistance and motivational intervention.

Third, further research is required on how possible programme characteristics (e.g. intensities, quantities, form of exercise, feedback mechanisms) can be tailored to the individual (e.g. for the same exercise, an overweight adolescent lifts a heavier weight than a lean adolescent) or group level (e.g. girls may prefer other resistance exercises than boys, Biddle, Braithwaite, & Pearson, 2014). For example, it will be a challenge to develop resistance exercises that are attractive to adolescent girls. Therefore, the development of an adequate programme of resistance exercises requires active participation of all stakeholders (including the target population, sports clubs, and physical education teachers).

A fourth research topic is the under-investigated relation between social comparison and self-determination. Given that overweight youngsters are better in resistance exercises than normal weight youngsters, applying social comparison theory (Lemaine, 1974; Suls, Martin, & Wheeler, 2002; van Knippenberg, Wilke, & de Vries, 1981) would suggest having overweight and normal weight youngsters exercising together. Overweight youngsters may find out that they perform better in the domain of resistance exercises (contrary to the domain of aerobic exercises) which, in time, is hypothesised to improve their self-worth. Some authors (e.g. Ames & Archer, 1988) have suggested that stimulating social comparison may have detrimental effects on autonomous motivation. However, O'Keefe, Ben-Eliyahu, and Linnenbrink-Garcia (2013) suggest that social comparison is part of typical classroom settings and therefore unavoidable. Note that we do not suggest promoting 'outperforming others', as this

might relate to more controlled types of motivation, but a positive comparison with others for youngsters who are used to only experiencing negative comparisons. Moreover, Senko, Hulleman, and Harackiewicz (2011) argued that normative-based performance goals often facilitate classroom achievement. Standage, Duda, and Ntoumanis (2003) found that perceptions of competence and relatedness are more predictive of self-determined motivation than autonomy, but also that normative feedback that is repeatedly negative will lead to a-motivation. We think that, next to promoting autonomy (e.g. by giving youngsters choices; Deci & Ryan, 2000), positive social experiences of overweight youngsters with resistance exercises may increase their perceptions of competence, their self-worth, and in time, their intrinsic motivation for exercise. Moreover, having youngsters compete as teams in multi-component exercises, might encourage interpersonal appreciation of various skills, e.g. speed Vs strength. This is a topic for further research. The relation between social comparison theory and self-determination theory has rarely been studied empirically (Neighbors & Knee, 2003).

Conclusion

We have argued that new physical activity directions for overweight and obese youngsters might benefit by a stronger emphasis on resistance exercises, whereas a motivational intervention might stimulate them to engage in these exercises. When it comes to overweight and obese youngsters, based on the currently available evidence, we suggest to stop emphasising their overweight, stop pushing them for weight loss, and to start focusing more on resistance exercises. In our view, it is time to start concentrating on their biological strengths and using psychological principles and techniques to make youngsters aware of these strengths. Only then long-term behaviour changes and long-term health benefits may be achieved. To make overweight and obese youngsters healthier, stronger, more confident (and feeling better in general), resistance exercise may be the fruitful way to go.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This project was sponsored by the Netherlands Organization for Health Research and Development (ZonMw [grant number 525001004]). The paper by Ten Hoor et al. (submitted) can be requested from the first author.

References

- Alberga, A. S., Farnesi, B. C., Lafleche, A., Legault, L., & Komorowski, J. (2013). The effects of resistance exercise training on body composition and strength in obese prepubertal children. *The Physician and Sports Medicine, 41*, 103–109.
- Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology, 80*, 260–267.

- Barbieri, D., & Zaccagni, L. (2013). Strength training for children and adolescents: Benefits and risks. *Collegium Antropologicum*, *37*, 219–225.
- Benjamin, H. J., & Glow, K. M. (2003). Strength training for children and adolescents. *Physician and Sports Medicine*, *31*, 19–26.
- Benson, A. C., Torode, M. E., & Singh, M. F. (2008). The effect of high-intensity progressive resistance training on adiposity in children: A randomized controlled trial. *International Journal of Obesity*, *32*, 1016–1027.
- Biddle, S. J., Braithwaite, R., & Pearson, N. (2014). The effectiveness of interventions to increase physical activity among young girls: A meta-analysis. *Preventive Medicine*, *62*, 119–131.
- Colella, D., Morano, M., Robazza, C., & Bortoli, L. (2009). Body image, perceived physical ability, and motor performance in nonoverweight and overweight Italian children 1. *Perceptual and Motor Skills*, *108*, 209–218.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*, 227–268.
- Department of Health, Physical Activity, Health Improvement and Protection., 2011 Start Active, Stay Active: a report on physical activity from the four home countries’ Chief Medical Officers. Retrieved July 20, 2014, from <https://www.gov.uk/government/publications>
- D’Hond, E., Deforche, B., De Bourdeaudhuij, I., & Lenoir, M. (2008). Childhood obesity affects fine motor skill performance under different postural constraints. *Neuroscience Letters*, *440*, 72–75.
- Dixon, J. B. (2010). The effect of obesity on health outcomes. *Molecular and Cellular Endocrinology*, *316*, 104–108.
- Ekkekakis, P., Lind, E., & Joens-Matre, R. R. (2006). Can self-reported preference for exercise intensity predict physiologically defined self-selected exercise intensity? *Research Quarterly for Exercise and Sport*, *77*, 81–90.
- Faigenbaum, A. D. (2007). State of the art reviews: Resistance training for children and adolescents: Are there health outcomes? *American Journal of Lifestyle Medicine*, *1*, 190–200.
- Faigenbaum, A. D., Kraemer, W. J., Blimkie, C. J., Jeffreys, I., Micheli, L. J., Nitka, M., & Rowland, T. W. (2009). Youth resistance training: Updated position statement paper from the national strength and conditioning association. *Journal of Strength & Conditioning Research*, *23*, S60–S79.
- Faigenbaum, A. D., & Myer, G. D. (2010). Pediatric resistance training: Benefits, concerns, and program design considerations. *Current Sports Medicine Reports*, *9*, 161–168.
- Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach*. New York, NY: Taylor & Francis.
- Fortier, M. S., Williams, G. C., Sweet, S. N., & Patrick, H. (2009). Self-determination theory: Process models for health behavior change. In R. J. DiClemente, R. A. Crosby, & M. C. Kegler (Eds.), *Emerging theories in health promotion practice and research* (pp. 157–183). San Francisco, CA: Jossey-Bass.
- Gately, P. J., Cooke, C. B., Butterly, R. J., Mackreth, P., & Carroll, S. (2000). The effects of a children’s summer camp programme on weight loss, with a 10 month follow-up. *International Journal of Obesity Related Metabolic Disorders*, *24*, 1445–1452.
- Guerra, P. H., Nobre, M. R., Silveira, J. A., & Taddei, J. A. (2013). The effect of school-based physical activity interventions on body mass index: A meta-analysis of randomized trials. *Clinics*, *68*, 1263–1273.
- Guerra, P. H., Nobre, M. R. C., da Silveira, J. A. C., & Taddei, J. A. A. C. (2014). School-based physical activity and nutritional education interventions on body mass index: A meta-analysis of randomized community trials – Project PANE. *Preventive Medicine*, *61*, 81–89.
- Harris, K. C., Kuramoto, L. K., Schulzer, M., & Retallack, J. E. (2009). Effect of school-based physical activity interventions on body mass index in children: A meta-analysis. *Canadian Medical Association Journal*, *180*, 719–726.

- Kelsey M. M., Zaepfel A., Bjornstad P., & Nadeau K. (2014). Age-related consequences of childhood obesity. *Gerontology*, *60*, 222–228.
- Kremers, S. P., Visscher, T. L., Seidell, J. C., van Mechelen, W., & Brug, J. (2005). Cognitive determinants of energy balance-related behaviours. *Sports Medicine*, *35*, 923–933.
- Lau, P. W., Yu, C. W., Lee, A., & Sung, R. Y. (2004). The physiological and psychological effects of resistance training on Chinese obese adolescents. *Journal of Exercise Science and Fitness*, *2*, 115–120.
- Lee, I.-M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., & Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major noncommunicable diseases worldwide: An analysis of burden of disease and life expectancy. *Lancet*, *380*, 219–229.
- Lemaine, G. (1974). Social differentiation and social originality. *European Journal of Social Psychology*, *4*, 17–52.
- Lloyd, R. S., Faigenbaum, A. D., Stone, M. H., Oliver, J. L., Jeffreys, I., Moody, J. A., ... Myer, G. D. (2013). Position statement on youth resistance training: The 2014 international consensus. *British Journal of Sports Medicine*, *48*, 498–505. doi:10.1136/bjsports-2013-092952.
- Lubans, D. R., Aguiar, E. J., & Callister, R. (2010). The effects of free weights and elastic tubing resistance training on physical self-perception in adolescents. *Psychology of Sport and Exercise*, *11*, 497–504.
- McCambridge, T. M., & Stricker, P. R. (2008). Strength training by children and adolescents. *Pediatrics*, *121*, 835–840.
- McGuigan, M. R., Tatasciore, M., Newton, R. U., & Pettigrew, S. (2009). Eight weeks of resistance training can significantly alter body composition in children who are overweight or obese. *The Journal of Strength & Conditioning Research*, *23*, 80–85.
- Metcalf, B., Henley, W., & Wilkin, T. (2013). Republished research: Effectiveness of intervention on physical activity of children: Systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird 54). *British Journal of Sports Medicine*, *47*, 226–226.
- Miller, W. R., & Rollnick, S. (2013). *Motivational interviewing: Helping people change* (p. 29). New York, NY: Guilford.
- Naar-King, S., & Suarez, M. (2011). *Motivational interviewing with adolescents and young adults*. New York, NY: Guilford Press.
- Neighbors, C., & Knee, C. R. (2003). Self-determination and the consequences of social comparison. *Journal of Research in Personality*, *37*, 529–546.
- O’Keefe, P. A., Ben-Eliyahu, A., & Linnenbrink-Garcia, L. (2013). Shaping achievement goal orientations in a mastery-structured environment and concomitant changes in related contingencies of self-worth. *Motivation and Emotion*, *37*, 50–64.
- Pescud, M., Pettigrew, S., McGuigan, M., & Newton, R. (2010). Factors influencing overweight children’s commencement of and continuation in a resistance training program. *BMC Public Health*, *10*, 709.
- Rhodes, R. E., Fiala, B., & Conner, M. (2009). A Review and meta-analysis of affective judgments and physical activity in adult populations. *Annals of Behavioral Medicine*, *38*, 180–204.
- Riddiford-Harland, D. L., Steele, J. R., & Baur, L. A. (2006). Upper and lower limb functionality: Are these compromised in obese children? *International Journal of Pediatric Obesity*, *1*, 42–49.
- Ryan, R. M., & Deci, E. L. (2002). An overview of self-determination theory: An organismic-dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). Rochester, NY: University of Rochester Press.
- Schranz, N., Tomkinson, G., & Olds, T. (2013). What is the effect of resistance training on the strength, body composition and psychosocial status of overweight and obese children and adolescents? A systematic review and meta-analysis. *Sports Medicine*, *43*, 893–907.

- Schranz, N., Tomkinson, G., Parletta, N., Petkov, J., & Olds, T. (2013). Can resistance training change the strength, body composition and self-concept of overweight and obese adolescent males? A randomised controlled trial. *British Journal of Sports Medicine*, *48*, 1482–1488. doi:10.1136/bjsports-2013-092209
- Senko, C., Hulleman, C. S., & Harackiewicz, J. M. (2011). Achievement goal theory at the crossroads: Old controversies, current challenges, and new directions. *Educational Psychologist*, *46*, 26–47.
- Silva, M. N., Markland, D., Carraça, E. V., Vieira, P. N., Coutinho, S. R., Minderico, C. S., Matos, M. G., Sardinha, L. B., Teixeira, P. J. (2011). Exercise autonomous motivation predicts 3-yr weight loss in women. *Medicine & Science in Sports & Exercise*, *43*, 728–737.
- Sothern, M. S., Loftin, J. M., Udall, J. N., Suskind, R. M., Ewing, T. L., Tang, S. C., & Blecker, U. (2000). Safety, feasibility, and efficacy of a resistance training program in preadolescent obese children. *The American Journal of the Medical Sciences*, *319*, 370–375.
- Standage, M., Duda, J. L., & Ntoumanis, N. (2003). A model of contextual motivation in physical education: Using constructs from self-determination and achievement goal theories to predict physical activity intentions. *Journal of Educational Psychology*, *95*, 97–110.
- Suls, J., Martin, R., & Wheeler, L. (2002). Social comparison: Why, with whom, and with what effect? *Current Directions in Psychological Science*, *11*, 159–163.
- Swinburn, B. A., Sacks, G., Hall, K. D., McPherson, K., Finegood, D. T., Moodie, M. L., & Gortmaker, S. L. (2011). The global obesity pandemic: Shaped by global drivers and local environments. *The Lancet*, *378*, 804–814.
- Ten Hoor, G. A., Sleddens, E. F. C., Kremers, S. P. J., Schols, A. M. W. J., & Kok, G., Plasqui, G. (submitted). Strength exercises for youngsters aged 12 to 15: What do parents think?
- United States Department of Health and Human Services. (2008). *Physical activity guidelines for Americans*. Retrieved July 20, 2014, from <http://www.health.gov/paguidelines>
- Van der Baan-Slootweg, O. H., van der, N., Nolle, M. N., Weller, F. R., Benninga, M. A., & van Aalderen, W. M. C. (2010). Ernstige obesitas bij kinderen: een zaak van gewicht [Severe obesity in children: A matter of importance]. *Tijdschrift Kindergeneeskunde*, *78*, 106–113.
- Van Knippenberg, A., Wilke, H., & De Vries, N. K. (1981). Social comparison on two dimensions. *European Journal of Social Psychology*, *11*, 267–283.
- Vansteenkiste, M., Soenens, B., & Lens, W. (2007). Intrinsic versus extrinsic goal promotion in exercise and sport: Understanding the differential impacts on performance and persistence. In M. S. Hagger & N. L. D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 167–180). Champaign, IL: Human Kinetics.
- Velez, A., Golem, D. L., & Arent, S. M. (2010). The impact of a 12-week resistance training program on strength, body composition, and self-concept of Hispanic adolescents. *The Journal of Strength & Conditioning Research*, *24*, 1065–1073.
- Washington, R. L. (2008). Metabolic syndrome – No longer an adult only disease. *The Journal of Pediatrics*, *152*(2), A1.
- Westerterp, K. R., Donkers, J. H. H. L. M., Fredrix, E. W. H. M., & Boekhoudt, P. (1995). Energy intake, physical activity and body weight: A simulation model. *British Journal of Nutrition*, *73*, 337–347.
- World Health Organization. (2010). *Global recommendations on physical activity for health*. Geneva: World Health Organization press.
- Yu, C. C., Sung, R. Y., Hau, K. T., Lam, P. K., Nelson, E. A., & So, R. C. (2008). The effect of diet and strength training on obese children's physical self-concept. *The Journal of Sports Medicine and Physical Fitness*, *48*, 76–82.