Implementation and evaluation of the Youth Physical Activity Towards Health (Y-PATH) intervention: the role of fundamental movement skills

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A thesis submitted for the award of Doctor of Philosophy (PhD)

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Authors Declaration

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Doctor of Philosophy is entirely my own work, and that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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Abstract

Title: Implementation and evaluation of the Youth Physical Activity Towards Health (Y-PATH) intervention: the role of fundamental movement skills

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Introduction: Fundamental movement skills (FMS) are goal directed movement patterns. They are seen as a pre-requisite for the development of sport specific skills, and are a contributor towards future participation in sport and physical activity (PA). A lack of confidence and ability in performing these skills may lead to withdrawal from participating in PA, creating a vicious circle that can result in the reduction of the necessary practice of these FMS. The Youth-Physical Activity Towards Health (Y-PATH) intervention was developed and implemented with the aim of improving adolescents FMS proficiency levels and attitudes towards PA participation, with an overall goal of increasing PA levels.

Methods: Participants (n = 564, 12-14 years of age) from 20 mixed gender post-primary schools were recruited as part of the Y-PATH cluster randomised controlled trial. A total of 15 FMS were assessed using a combination of process oriented measures including the TGMD-2. Participants' PA levels, BMI, fitness levels and physical self-confidence levels were also assessed pre-intervention at the start of the school year. Post-intervention testing was completed at the end of the school year, and again three months later to assess any retention of changes which occurred. The reliability and validity of the physical self-confidence scale and TMGD-2 used in this study were also assessed.

Results: Results indicate that Irish adolescent youth are performing below the expected FMS proficiency levels for their age group. Males are significantly more proficient than females in both overall FMS ($p=0.02$) and object control scores ($p=0.001$). Results of a between groups ANOVA indicate that the intervention group improved by significantly more than the control group over the period of the intervention ($p<0.001$). Males exhibited significantly higher physical self-confidence scores than females ($p<0.001$). A significant correlation was found between females FMS score and their physical self-confidence ($r=0.305$, $p<0.001$), while there was no correlation between these two variables among males ($r=0.101$, $p=0.209$). Results indicate that the physical self-confidence scale is a valid ($r=0.72$) and reliable

(r=0.92) tool for use with adolescents. A 2 factor model with a reduction in the number of skills in the TGMD-2 to just seven (run, gallop, hop, horizontal jump, bounce, kick and roll) revealed an overall good fit for use with adolescents.

Conclusion: The results of this study highlight that Y-PATH is an effective intervention to improve adolescents FMS proficiency. To further improve FMS and PA levels interventions should be implemented and assessed longitudinally and physical self-confidence should be monitored and improved accordingly as it is said to provoke behavioural change.

Chapter 1

Introduction to thesis

1.1 Publications:

In Press:

- Physical self-confidence levels of adolescents: Scale reliability and validity (McGrane et al. 2015).

Revise and Resubmit:

- Where does the time go? Patterns of physical activity in adolescent youth. Belton, S., Issartel, J., **McGrane, B.,** Powell, D., and O'Brien, W. *Medicine & Science in Sports & Exercise*.

Under Review:

- An alternative consideration for the TGMD-2: the case of an adolescent population. Issartel, J., **McGrane, B.,** Fletcher, R., Powell, D., O'Brien, W., and Belton, S. *Research Quarterly for Exercise and Sport*.
- The relationship between fundamental movement skill proficiency and physical self-confidence; Are adolescents as good as they think? **McGrane, B.,** Powell, D., Belton, S., and Issartel, J. *Journal of Adolescent Health*.

Poster Presentations:

- Fundamental movement skill age equivalence of Irish adolescent youth. **McGrane, B.,** Belton, S., O' Brien, W., and Issartel, J. (2013) *PEPAYS Research Forum,* Dublin (Ireland).
- A disturbing childhood trend towards high daily screen time can be interrupted through the effective implementation of the Youth Physical Activity Towards Health (Y-PATH) intervention. O'Brien, W.R., Belton, S., **McGrane, B.,** and Issartel, J. (2013) *European Child Health Conference,* Dublin (Ireland).

- Patterns of physical activity in adolescent youth as measured by accelerometer. Powell, D., Issartel, J., **McGrane, B.,** O'Brien, W., and Belton., S. (2014) *Irish Postgraduate Conference*, Limerick (Ireland).
- An analysis of adolescent sedentary behaviour using accelerometry and self-report. Powell, D., Issartel, J., **McGrane, B.,** O'Brien, W., and Belton., S. (2014) *PEPAYS Research Forum,* Waterford (Ireland).
- Lack of fundamental movement skills proficiency: can we override it? **McGrane, B.,** Issartel, J., Fletcher, R., Powell, D., O'Brien, W., and Belton, S. (2015) *PEPAYS Research Forum,* Limerick (Ireland).
- The reliability and validity of a perceived motor competence scale among adolescents. **McGrane, B.,** Powell, D., Belton, S., Woods, C., and Issartel, J. (2015) *ISBNPA conference,* Edinburgh (Scotland).
- Are Irish adolescents overestimating their actual motor skill abilities? **McGrane, B.,** Belton, S., Powell, D., and Issartel, J. (2015) *ISBNPA conference,* Edinburgh (Scotland).
- Are low levels of physical activity confidence and high levels of perceived barriers to physical activity encouraging sedentary behaviour? Powell, D., Issartel, J., **McGrane, B.,** and Belton., S. (2015) *ISBNPA conference,* Edinburgh (Scotland).

Oral Presentations:

- The evaluation of the Youth-Physical Activity Towards Health (Y-PATH) intervention. O'Brien, W.R., Belton, S., Woods, C., Meegan, S., **McGrane, B.,** and Issartel, J. (2013) *PEPAYS Research Forum,* Dublin (Ireland).
- Fundamental movement skill proficiency levels of Irish adolescent youth. **McGrane, B.,** Belton, S., O' Brien, W., and Issartel, J. (2014) *Irish Postgraduate Conference,* Limerick (Ireland).
- Are adolescents as good as they think? **McGrane, B.,** Belton, S., Powell, D., and Issartel, J. (2014) *PEPAYS Research Forum,* Waterford (Ireland).
- The "durability" of physical activity promotion amongst Irish adolescent youth: A structured pathway for ensuring sustainability. O'Brien, W.R.

Belton, S., Woods, C., Meegan, S., **McGrane, B.,** Powell, D., and Issartel, J. (2014) *PEPAYS Research Forum,* Waterford (Ireland).

- Discrepancy between perceived motor competence and fundamental movement skills proficiency. **McGrane, B.,** Belton, S., Powell, D., and Issartel, J. (2014) *ECSS conference,* Amsterdam (Netherlands).
- Understanding adolescent sedentary behaviour using accelerometry and self-report. Powell, D., Issartel, J., **McGrane, B.,** O'Brien, W., and Belton., S. (2014) *ECSS conference,* Amsterdam (Netherlands).
- Age is just a number, maturity in movement is a choice. O'Brien, W.R., Belton, S., **McGrane, B.,** Powell, D., and Issartel, J. (2014). *ECSS conference,* Amsterdam (Netherlands).
- Where does the time go? PA patterns of adolescent youth. Belton S., O'Brien, W., **McGrane, B.,** Issartel, J., & Powell, D. (2014). *ECSS conference,* Amsterdam (Netherlands).
- Y-PATH, A new curriculum model for adolescent youth? Belton S., O'Brien, W., **McGrane, B.,** Powell, D., Woods, C. & Issartel, J. (2014). *Global Summit on the Physical Activity of Children, Toronto, Canada*.
- Evaluation of the Y-PATH intervention: results of a cluster randomised controlled trial. Belton, S., **McGrane, B.,** Powell, D., Woods, C., and Issartel, J. (2015) *ISBNPA conference,* Edinburgh (Scotland).
- The association between objectively measured physical activity and physical activity barriers and confidence in adolescent youth. Powell, D., Issartel, J., **McGrane, B.,** and Belton, S. (2015) *PEPAYS Research Forum*, Limerick (Ireland).

1.2 Introduction

Clark (1994) defined motor development as "change in motor behaviour over the lifespan and the processes that underlie the change" (p.245). This development includes the development of fundamental movement skills (FMS). FMS are goal-directed movement patterns, and consist of locomotor, object control and stability skills performed in the bipedal position (Burton & Miller 1998). FMS allow children to move from location to location and to react in an appropriate way to a range of stimuli (Krebs 2000).

Children are expected to develop these FMS in the fundamental movement phase of development which occurs from age 3 to 7 (Gallahue & Ozmun 2006). During this phase, children practice their gross- and fine-motor skills. They are involved in advancing and enhancing FMS such as running, skipping, kicking, jumping, throwing, and catching. Children in this phase first learn the skills individually and then merge them with other skills to form more advanced skills (Gallahue et al. 2012). FMS are used in every-day life, and mastery of these skills among children and adolescents is an important contributor of future participation in sports and physical activities (Booth et al., 1999; O'Neill & Williams, 2008). Gallahue and Ozmun (2006) highlight that children should have these FMS mastered by the age of 10 in order to progress to sport specific skill development. It is important to note that this advancement does not occur naturally and children do not just acquire these skills as a result of maturation but they also must be taught (Clark, 2007; Haywood & Getchell, 2002).

As children are expected to develop these skills by the age of 10 there is a lot of research assessing the FMS levels of children under this age (Cliff, Okely, & Magarey, 2011; Cliff, Okely, Smith, & McKeen, 2009; Van Beurden, Zask, Barnett, & Dietrich, 2002). Results of these studies consistently report low levels of FMS proficiency (Hardy et al. 2010; Hardy et al. 2013). Despite the expectation of FMS to be mastered in childhood, this result of low FMS proficiency levels into adolescence. Research also suggests that adolescents should be developing sport specific skills but are not yet at the mastery level required for FMS to enable progression (Booth et al. 1999; Hardy et al. 2010; Hardy et al. 2013; Mitchell et al. 2013; O' Brien et al. 2015). When O' Brien et al. (2015) assessed Irish adolescents FMS, they found that merely 11% achieved mastery or near mastery. Although the studies across countries differ, proficiency levels remain consistently low across all age groups. Evidence would suggest a need to improve FMS development, among children and adolescents, to optimise proficiency in these basic skills prior to expanding to the sport specific stage. If these FMS levels are not mastered a knock on effect on physical activity (PA) levels may be observed as research has shown that the mastery of FMS is associated with higher levels of PA in both children and adolescents (Cliff, Okely, Smith, & McKeen, 2009; Lloyd, Saunders, Bremer, & Tremblay, 2014). It is important to intervene and target FMS levels as research suggests that as FMS proficiency levels increase, adolescents are more inclined to participate in PA and sport (Lubans, Morgan, Cliff, Barnett, & Okely, 2010).

This issue of children not reaching the required level of FMS proficiency by the age of 10 has not only resulted in them not meeting the required skill level to progress to sport specific skills, but it has also presented a new methodological issue associated with the actual measurement of FMS. As FMS are deemed achievable by the age of 10, FMS assessment tools have traditionally been validated for use up to this age group only. As discussed above, recent findings suggest that children are not at the expected FMS proficiency levels (Lubans, Morgan, Cliff, Barnett, & Okely, 2010), and are now entering adolescence displaying poor FMS levels (O' Brien et al. 2015; Hardy et al. 2013). This poses new methodological issues. So far no FMS assessment tool has been validated for use with adolescents. Such an assessment tool, which could be used with both children and adolescents, may allow researchers and educators to track this FMS development across a larger age range. It is essential that FMS development is not just ignored after the age of 10 but that it is assessed and monitored into adolescence to ensure the transition to more advanced skills is achieved or appropriate intervention put in place to address the lack of FMS proficiency.

When assessing adolescents FMS, it is also important to assess their self-efficacy as research suggests that someone's confidence level is in his/her ability to perform a motor task affects their performance and interest in participating in an activity (Stodden et al. 2008). Bandura (2001) states that self-efficacy is the cognitive mechanism which arbitrates information on personal abilities to proficiently execute required routes of action in a specific domain. Self-confidence is the confidence someone has in their own ability. Harter (1981) proposed a model explaining the relationship between perceived motor competence and FMS. The model proposed that actual competence leads to perceived competence, with perceived competence leading more to motivation for participation in PA in comparison with actual competence (i.e. FMS proficiency level). According to McAuley and Gill (1983), self-confidence is essential for accomplishing success in a sporting performance, and this confidence may be skill specific. Bandura, Adams and Beyer (1977) refer to this specific confidence as self-efficacy, and propose that it provokes behavioural change. Self-efficacy expectations influence perseverance, thoughts, stimulation, and behaviour. It is well known that children who lack confidence in their abilities may avoid participation in sport or activities (Piek et al. 2006). Harter (1987) suggests that people evade circumstances in which they may display their low ability, and that this lack of confidence limits people's behaviours. Schoemaker and Kalverboer (1994) propose that this withdrawal may lead to a vicious cycle of events as a lack of confidence and fear of failure leads to withdrawal, and then to less practice of the skills/activity.

Research suggests that there is a relationship between FMS and self-confidence (Barnett, Morgan, Van Beurden, & Beard, 2008; Robinson, 2011). However, Lubans et al. (2010) state that there are only a limited number of studies assessing this relationship, and therefore the association between the two variables remains uncertain. Studies to date which have assessed participants confidence or perceived ability have used universal measures which assess overall self-efficacy or overall sports competence (Robinson 2011; Barnett et al. 2008). These types of assessment tools provide little information when compared with actual FMS ability as they are not skill specific.

It is essential that an intervention is designed to improve FMS proficiency and to help prevent the expected decline in PA during adolescence. For this reason in their policy guidelines, the World Health Organisation (WHO) identifies interventions targeting an increase in PA among youth as a necessity (Currie, Zanotti, De Looze, Roberts, & Barnekow, 2012). PA, skill and exercise interventions have been identified as designed attempts to influence individuals or populations to alter and improve their PA, FMS or exercise levels to achieve and maintain a healthy lifestyle (Dunn et al. 1998). Following a report on children's PA participation (CSPPA) levels in Ireland, it was also recommended by Woods et al. (2010) that FMS programmes aimed to develop the skills and aptitudes of youth common to all sports and activities be developed and implemented. As a result of these recommendations and the low PA levels among adolescents the Youth–Physical Activity Towards Health (Y-PATH) intervention was designed and trialled (Belton et al. 2014). It was developed based on previous interventions and essential components such as those highlighted by Timperio, Salmon, and Ball (2004). This Y-PATH intervention is a multi-component school based intervention with four components (the parent/guardian, the student, the teacher, and the media). It has been suggested in the literature that there is strong rationale for school-based programmes aimed at increasing PA levels (Kriemler et al., 2011; Sutherland et al., 2013; Timperio, Salmon, & Ball, 2004), FMS levels (Van Beurden et al., 2003; McKenzie, Sallis, & Rosengard, 2009) and reducing inactivity (Ward et al. 2006). The purpose of Y-PATH is to increase PA levels of adolescent youth, through "enabling youth to positively re-evaluate their predisposing factors 'Am I able' (e.g. self-efficacy) and reinforcing factors 'Is it worth it' (e.g. enjoyment, attitudes), while also addressing the enabling factors (e.g. skill level) that influence participation" (Belton et al., 2014, p.8). Recent evidence has suggested that the Y-PATH intervention is successful at significantly improving adolescents FMS proficiency and PA levels (O' Brien et al. 2013). It is important to note however that these positive results from the Y-PATH intervention are merely from an exploratory trial involving 2 schools. While this results are encouraging, it is essential that the Y-PATH intervention undergoes further investigation (O' Brien et al. 2013; Campbell et al. 2000). It is logical that the efficacy of the Y-PATH intervention be assessed on a larger scale in a randomised controlled trial as the medical research council (MRC) framework suggests (Campbell et al. 2000).

Summary and significance of this thesis

Since children nowadays are not reaching the expected mastery level of FMS by the age of 10 and are entering adolescents lacking in FMS proficiency there is now also a requirement for the validation of a FMS assessment tool which can be used into adolescence. This thesis aims to address this issue by assessing the validity of the TGMD-2 with age 12-14 year olds so that researchers can monitor FMS from childhood through to adolescence. This assessment will help facilitate the development of interventions aimed at targeting FMS development in this age group.

This thesis also highlights the importance of assessing physical self-confidence. It is important that physical self-confidence can be assessed at a skill specific level to provide transferable results with the FMS proficiency assessment tool used. This thesis will report the development of a physical self-confidence scale to track adolescents' self-confidence in their ability in performing FMS. Additionally, this scale will then be used in this thesis to assess this relationship between FMS and physical self-confidence among adolescents.

Research suggests that this lack of FMS proficiency in adolescents is an international issue (Hardy et al., 2013; Lubans et al., 2010; O' Brien et al., 2015). Therefore to address this issue in Ireland, an exploratory trial called the Y-PATH intervention has proven to be successful at increasing adolescent's PA and FMS proficiency levels. It is essential that this intervention undergoes a randomised controlled trial to ensure that these positive results are definite with a larger sample. This thesis assesses the efficacy of the Y-PATH intervention at increasing FMS levels of Irish adolescents in a randomised controlled trial prior to national implementation.

1.3 Aim and objectives of the study

Aim of research:

To implement and evaluate the efficacy of the Y-PATH intervention at improving adolescents FMS proficiency through a clustered randomised controlled trial.

Primary Objective:

1. To assess the changes in FMS proficiency (pre, post and retention) of the experimental group receiving the intervention in comparison with the control group (Chapter 6).

Secondary Objectives:

1. To develop and validate a scale to assess the physical self-confidence of adolescents at skill level (Chapter 3).
2. To assess gender differences in physical self-confidence (Chapter 3).
3. To assess the relationship between FMS and physical self-confidence in adolescents (Chapter 4).
4. To evaluate the validity of the TGMD-2 for assessing adolescents FMS proficiency levels (Chapter 5).
5. To determine whether gender was a moderator of the intervention effects on FMS (Chapter 6).

1.4 Research Questions and Hypotheses

1. What are the FMS proficiency levels of Irish adolescent youth?

   Hypothesis: Irish adolescents are below the expected proficency level of FMS.

2. Does the Y-PATH intervention improve FMS when assessed using a clustered randomised controlled trial?

   Hypothesis: The Y-PATH intervention significantly improves adolescents FMS proficiency through participation in a randomised controlled trial.

3. What are the physical self-confidence levels of adolescents, and do these levels differ by gender?

   Hypothesis: Adolescents physical self-confidence varies between males and females with males being more confident than females.

4. Is there a relationship between physical self-confidence and FMS proficiency in adolescents?

   Hypothesis: There is a significant relationship between adolescents' physical self-confidence and FMS proficiency.

5. Is the TGMD-2 an appropriate and valid tool for assessing adolescents FMS proficiency?

   Hypothesis: The TGMD-2 is an appropriate and valid tool for assessing adolescents' FMS proficiency.

1.5 Thesis Structure

Following this introduction to the thesis, Chapter 2 critically reviews and evaluates previous literature in the area of FMS, self-confidence and school-based interventions. Chapters 3 to 6 consist of 4 studies which address the primary and secondary objectives of this thesis. Chapters 3 and 5 are methodological studies looking at the development and validity of the physical self-confidence scale, and assessing the validity of the TGMD-2 with an adolescent population. Chapter 4 assesses the relationship between FMS and physical self-confidence, whereas chapter 6 assesses the efficacy of the Y-PATH intervention at improving FMS proficiency in adolescents.

Chapter 2- *Review of Literature:* Following from this introduction in Chapter 1, the review of literature summarises, synthesises and discusses literature on FMS (empirical and methodological), self-confidence and school-based interventions giving a comprehensive overview of the main findings to date in this area.

Chapter 3- *Physical self-confidence levels of adolescents: Scale reliability and validity*. This chapter assesses the validity and reliability of a physical self-confidence scale for use with adolescents. It also examines the physical self-confidence of participants at a skill-specific level.

Chapter 4- *The relationship between fundamental movement skill proficiency and physical self-confidence; Are adolescents as good as they think?* This chapter assesses adolescents FMS and physical self-confidence levels. It then uses the scale developed in Chapter 3 to assess the relationship between adolescents' physical self-confidence and FMS proficiency levels across 15 skills with a specific focus on the potential gender differences between these two variables.

Chapter 5- *An alternative consideration for the TGMD-2: the case of an adolescent population*. This chapter assesses the validity of the TGMD-2 for use with adolescents using confirmatory factor analysis. It also highlights the importance of assessing FMS into adolescence and the requirement for an appropriate scale to track this development from childhood.

Chapter 6- *An evaluation of the randomised controlled trial of the Y-PATH intervention; does it improve FMS proficiency?* This chapter assesses the efficacy of the Y-PATH intervention at improving adolescents FMS proficiency over a one-year period. Data for this chapter was collected at 3 time points: pre-intervention (Sept. 2013), post-intervention (May 2014) and 3 months later at retention (Sept. 2014). This assessment also allows us to determine the current level of FMS proficiency in an adolescent population in Ireland.

Chapter 7- *Conclusions and future directions for Y-PATH*. This chapter provides an overview of the thesis. It presents various strengths and limitations of the thesis. It also provides direction for future research in the area of FMS proficiency.

1.6 Definition of Terms

*Adolescence:*A transitional stage of physical and psychological human development and growth tthat generally occurs during the period from puberty to legal adulthood. It is often associated with teenage years (Gallahue & Ozmun 2006).

Balance: In the context of FMS, the balance is the essential prerequisite of almost all movement skills. A balance is defined as being able to maintain a stationary position throughout the movement. The static balance on one foot is an important non-locomotor skill that is used in gymnastics, dance, diving and many team sports (NSW Department of Education and Training, 2000).

Body Mass Index: A measure of body composition using a height-weight formula - Weight (kg) /Height (m2). High BMI values have been related to increased disease risk (Corbin et al., 2006).

Children and Young People: Used to describe those aged 5-18 years. The term children is used when specifically referring to those aged 5–12 years and the term young people when referring to those aged 13-18 years (BHF National Centre Physical Activity and Health, 2013).

Conception of ability: One's understanding of their ability (Bandura, 2001).

Fine motor skills: The coordination of small muscle movements—usually involving the synchronization of hands and fingers—with the eyes (Gallahue & Ozmun 2006).

Fundamental Movement Skills (FMS): Fundamental movement skills are the basic observable patterns of behaviour present from childhood to adulthood; often examples exhibited during PE and PA include running, hopping, skipping (locomotor), balancing, twisting (stability), throwing, catching and kicking (object control) (Department of Education Victoria, 1996; Gallahue and Ozmun, 2006; Stodden et al., 2008).

Gross motor skills: The abilities usually acquired during infancy and early childhood as part of a child's motor development involving large muscle groups and whole body movement (Gallahue & Ozmun 2006).

Implementation fidelity: The degree to which an intervention or programme is delivered as intended.

Locomotor Subtest: In the context of FMS, the locomotor subtest measures the gross motor skills that require fluid coordinated movements of the body as the child moves in one direction or the other (Ulrich, 2000).

Mastery/Near Mastery: In the context of FMS, 'mastery' is defined as correct performance of all components of a skill (Van Beurden et al., 2002). 'Near mastery' is defined as correct performance of all components but one (Van Beurden et al., 2002).

Obesity: Excessive fat accumulation that may impair health (Corbin et al., 2006).

Object Control Subtest: In the context of FMS, the object control subtest measures gross motor skills that demonstrate efficient throwing, striking, and catching movements (Ulrich, 2000).

Parsimonious: Very unwilling to spend money or use resources.

Perceived motor-competence: How someone perceives his/her ability to competently perform a motor task (Harter & Pike, 1984).

Physical Activity Intervention: Programmes which are defined as planned efforts to influence individuals, groups, or populations to alter, modify, and increase their physical activity or exercise levels, with the ultimate goal of producing positive health outcomes (Bouchard et al., 2007).

Physical Activity: Physical activity is described as any body movement produced by the skeletal muscles that result in a substantial increase over resting energy expenditure (Bouchard et al., 2007). Examples of physical activity include play, lifestyle activities such as walking and cycling (active transport), sport and recreational activities, household chores and gardening (BHF National Centre Physical Activity and Health, 2013).

Physical Education: A school-based subject providing children with learning opportunities through the medium of movement and contributing to their overall development by helping them to lead full, active and healthy lives (Department of Education and Skills, 1999).

Physical Inactivity: Physical inactivity is described as doing no or very little physical activity at work, home, for transport or during discretionary time - not reaching physical activity guidelines deemed necessary to benefit public health (Bouchard et al., 2007).

Physical self-confidence: A measure of how confident someone is that they can perform a skill correctly.

Post-Primary Education: Students are required to complete between five to six years of education after primary school in Ireland (pending the students decision to undertake transition year upon completion of the junior cycle). Most often, students complete the junior cycle (lower secondary education) between the ages of 12 and 15 and then the senior cycle between the ages of 15 and 18 years old (higher secondary education) (Department of Education and Skills, 2004).

Reliability: Reliability is a determination of whether two administrations of an instrument produce a similar result (Thomas et al., 2011).

Screen Time: Mean daily hours of television, videos and computers/computer games. High screen time is considered greater than 2 hours per day (Anderson et al., 2008).

Sedentary Behaviour: Sedentary behaviour refers to activities that do not increase energy expenditure substantially above the resting level and includes activities such as sleeping, sitting, lying down, and watching television, and other forms of screen-based entertainment. (Pate et al., 2008). The low energy requirements distinguish sedentary behaviours from other behaviours that also occur whilst seated but require greater effort and energy expenditure, e.g. using a rowing machine (BHF National Centre Physical Activity and Health, 2013).

Self-efficacy: The cognitive mechanism which arbitrates information on personal abilities to proficiently execute required routes of action in a specific domain (Bandura, 2001).

Test of Gross Motor Development 2: Criterion- and norm-referenced instrument designed to measure the process of how children coordinate their trunk and limbs during FMS (a movement task) rather than assessing the end product result (Ulrich, 2000).

Validity: Validity is a determination of the extent to which an instrument measures what we think it's supposed to be measuring (Thomas et al., 2011).

1.7 List of Abbreviations

BMI = body mass index

BOT-2 = Bruininks-Oseretsky Test of Motor Proficiency-2

CFA =Confirmatory Factor Analysis

CFI= Comparative Fit Index

CI = confidence interval

CSPPA = Children's Sport Participation and Physical Activity Study

DCU = Dublin City University

DCUREC = Dublin City University Research Ethics Committee

FMS = fundamental movement skills

HRA = health related activity

JCPE = Junior certificate physical education (years 1-3 in Irish post-primary schools)

KTK = Körperkoordinationstest für Kinder

LEAP = Lifestyle Education for Activity Program

M = mean

MNM = mastery and near mastery

MRC = Medical Research Council

MRC = Medical Research Council

MVPA = moderate-to-vigorous physical activity

PA = physical activity

PE = physical education

PSC = physical self-confidence

PSPP = Physical Self Perception Profile

PSW = Physical Self-Worth

RMSEA= Root Mean Square Error of Approximation

SD = standard deviation

TGMD = Test of gross motor development

TGMD-2 = Test of gross motor development 2nd edition

TGMD-2 = test of gross motor development-2

TLI= Tucker-Lewis Index

VPA = vigorous physical activity

Y-PATH = Youth-Physical Activity Towards Health

1.8 Delimitations

1. This study was delimited to first year post-primary youth aged 12-14 years old.

2. The Y-PATH intervention was implemented in mixed gender schools.

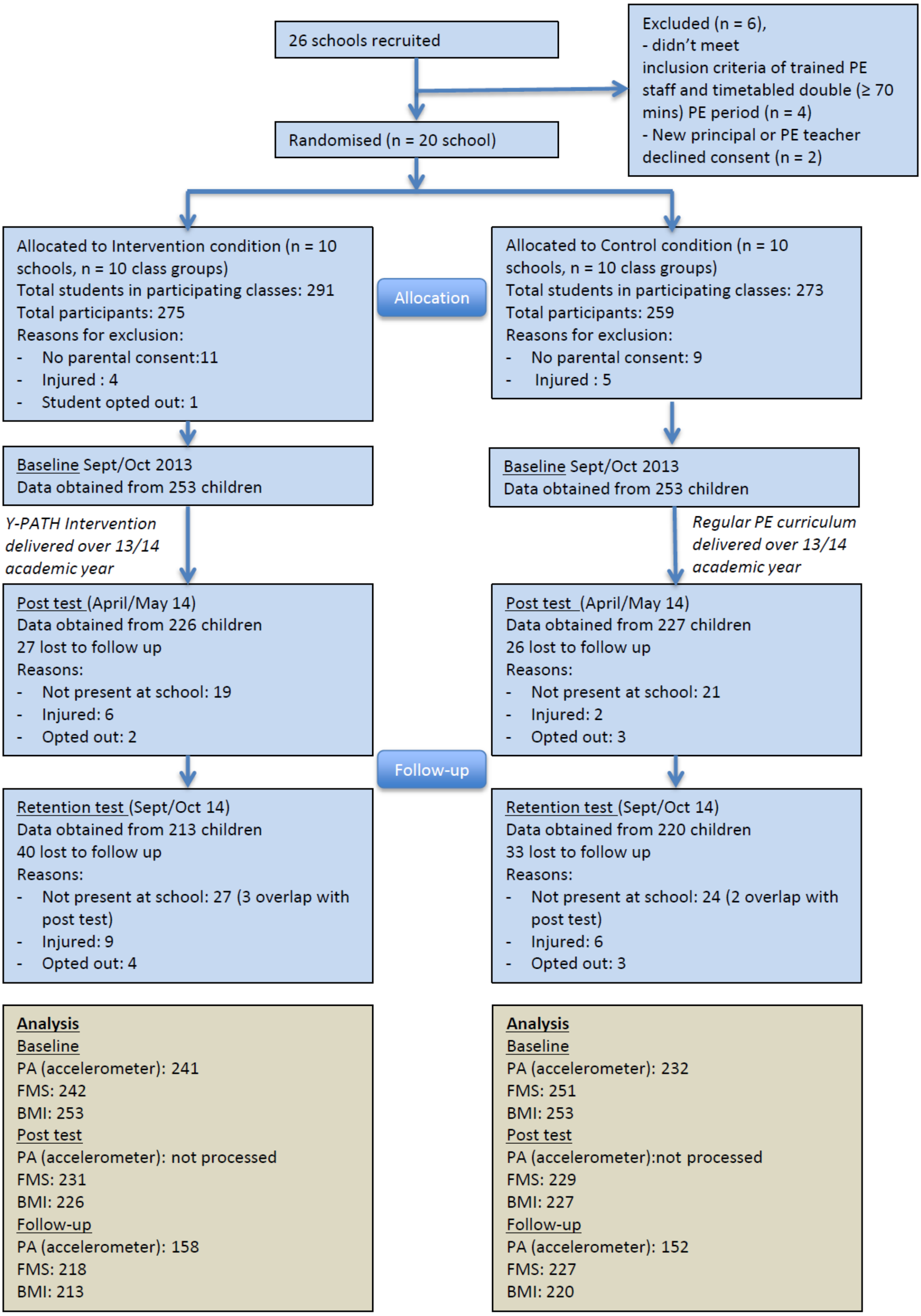
3. The Y-PATH intervention lasted for one year.

4. This study was delimited to the examination of participant’s gross motor skills.

5. This study assessed the validity and reliability of the TGMD-2 for Irish adolescents.

Note. * = Data were collected as part of the Y-PATH programme on physical activity, body mass index, fitness levels, fundamental movement skills and numerous psychological variables, however they were not all a primary responsibility for this PhD.

1.9 Figure 1.1 Schematic overview of study design



1.10 Figure 1.2 Participant overview

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Chapter 2

Literature Review

2.1 Fundamental movement skills

2.1.1 Description of fundamental movement skills

Fundamental movement skills (FMS) have been defined as basic observable patterns of movement (Gallahue & Ozmun 2006; Gallahue et al. 2012). FMS are goal-directed movement patterns, and consist of locomotor, object control and stability skills performed in the bipedal position (Burton & Miller 1998). Children's overall motor development includes the development of FMS. Gallahue and Ozmun (2006) developed an hourglass model (see Figure 2.1) to assist in outlining the key stages of motor development. This model describes the sequence of movement skill acquisition from birth to adulthood across the lifetime. Clark (1994) defined motor development as "change in motor behaviour over the lifespan and the processes that underlie the change" (p.245). FMS allow children to move from one location to another and to respond in an appropriate way to a variety of stimuli (Krebs, 2000). They are used in every-day life, and as such the mastery of these skills among children and adolescents is an important contributor to future participation in sports and physical activities (O'Neill et al. 2008).

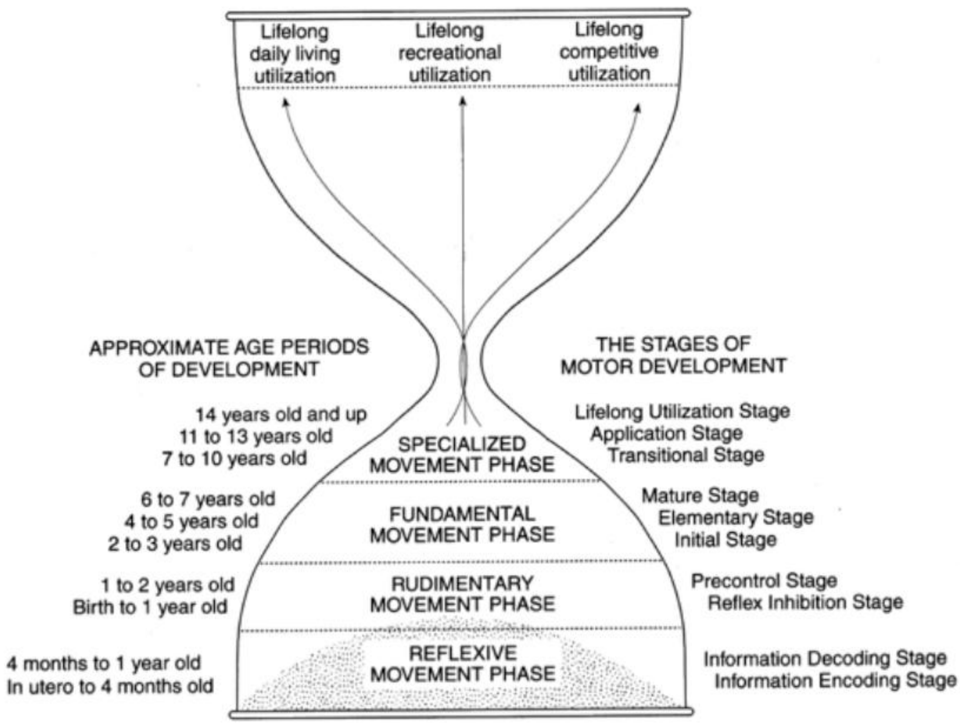

Figure 2.1. Hourglass model of the stages of development (Gallahue & Ozmun 2006)

Infants begin development with the reflexive and rudimentary phases. The reflexive movement phase ranges from birth to about 1 year of age. In this phase the infant engages in reflexive movements. The rudimentary movement phase includes the basic motor skills acquired in infancy such as reaching, grasping and releasing objects, sitting, rolling, crawling, standing, and walking. The skills of the rudimentary movement phase acquired during the first 2 years form the foundation for the fundamental movement phase (Gallahue et al. 2012). By the age of 3, children are building on previously developed movements as they move into the fundamental movement phase. The fundamental movement phase occurs from age 3 to 7. During this phase, children gain increased control over their gross and fine-motor skills. They are involved in developing and enhancing FMS such as running, skipping, kicking, jumping, throwing, and catching. Control of each FMS progresses through initial stages before reaching a mature mastery stage. Children in this phase first learn the skills individually and then merge them with other skills to form a coordinated movement (Gallahue et al. 2012). The development of FMS is a prerequisite for the specialized movement phase where these basic skills prepare children for the progression to more advanced sport specific skills. Gallahue and Ozmun (2006) highlight that children have the developmental potential to master FMS by the age of 6 years, and all children should have them mastered by the age of 10 in order to advance to sport specific skill development. It is important to note that this development does not occur naturally and children do not only acquire these skills as a result of maturation but on the contrary, they must be taught (Haywood & Getchell 2002; Clark 2007). Some literature may overlook this fact with the common misconception that they develop naturally through free-play (Cools, Martelaer, Samaey, & Andries, 2009; Stodden et al., 2008). However there are various studies supporting the fact that these FMS must be taught and practiced in both an educational and free play setting (Booth et al., 1999; Mitchell et al., 2013; Okely & Booth, 2004; Strong et al., 2005). In an educational setting children will be taught the components of the skills in a controlled environment, however it may not be very enjoyable and children may not be able to apply them afterwards in a game setting. Where as in a free-play setting, although it may be enjoyable for children, they will not be provided with specific feedback on what components of each skills they need to improve which is available in an education setting (Booth et al., 1999; Mitchell et al., 2013; Okely & Booth, 2004). It is evident that there are pros and cons to skill development in an educational and free-play setting. It is important that children are taught these skills correctly but are then given the time to develop these in a fun way during free-play (Booth et al., 1999; Mitchell et al., 2013; Okely & Booth, 2004).

Booth et al. (1999) proposes that it takes approximately 10 hours of teaching for the average child in the fundamental movement phase to become proficient at one FMS. This is why according to Okely and Booth, (2004), FMS should be a key feature of 95% of primary school physical education programs. By the time children reach age 10 they should be at mastery level in FMS. However, differences in teachers, learning environments or a combination of the two may affect FMS levels resulting in children not being at the required mastery level of FMS in order to advance to sport specific skills (see Figure 2.1) (Martin et al. 2009). Sport specific skill development occurs during the specialised movement phase which can begin as early as 7 years old and continue throughout adolescence. This phase consists of the refinement of skills and the progression to more advanced forms of FMS required for participation in sports (Gallahue et al. 2012). As Robinson and Goodway (2009) state FMS skills must be learned, practiced and reinforced. Given that children can possess the sufficient competencies in the FMS by the age of 7 and should possess these competencies by the age of 10 to progress to sport specific skills, it seems logical that the early school years are identified as key in a child's motor development. The National Association for Sport and Physical Education (NASPE) (2004) which is headquartered in the United States, state that the focus of the curriculum at "elementary level should emphasize the development of mature forms of various locomotor, non-locomotor, and manipulative skills" (Martin et al., 2009, p.227).

Many of the skills performed in various sports are advanced versions of FMS (Haywood & Getchell 2009; Gallahue & Ozmun 2006). O'Keeffe, Harrison, and Smyth (2007) investigated this relationship by assessing the similarities between the over arm throw and advanced sport specific throwing/striking in an Irish adolescent population. The results highlighted that the over arm throw is positively associated with sport specific skills such as the javelin throw. This verifies that FMS are the building blocks for sport specific skills. For this reason, it is preferable that children learn a broad spectrum of FMS to ensure the successful transfer of skills and progression into diverse sports and activities (McKenzie & Lounsbery, 2009).

2.1.2 The school setting

As stated previously FMS do not just develop naturally and must be taught correctly (Strong et al. 2005), therefore the school setting provides an appropriate environment for this teaching to occur. As stated by Okely and Booth (2004) primary school programs should contain FMS as a key feature. This is the case in Ireland, at least at the curriculum level, with the Irish Primary school PE curriculum incorporating "Childs holistic development, stressing personal and social development, physical growth and motor development" (Department of Education and Skills, 1999, p.9). However, there is a lack of curricular coherence as children progress from primary school to secondary school, with no recommendation or guideline regarding motor skill development included in the secondary school PE curriculum. It is possible that the National Council for Curriculum and Assessment, the body responsible for curriculum development in Ireland, share the view of Stodden et al. (2008) and expect that children will naturally develop proficiency in FMS during primary school. The fact the PE is only a recommendation and not compulsory either in primary or secondary school in Ireland also highlights the lack of importance placed on FMS development by policy makers. Strong et al. (2005) acknowledges that there is less emphasis placed on the development of FMS during adolescence, but argues that mastery of FMS and the development of more advanced skills is important during this time as it can contribute to an active lifestyle. Despite there being a curriculum for PE in primary and secondary schools there is also a lack of assessment of curriculum implementation so therefore it is possible that FMS are not getting the emphasis required for successful development. It is evident from the Children's Sport Participation and Physical Activity (CSPPA) report (Woods et al., 2010), that more emphasis must be put on FMS development in Ireland. This is supported by a recent study which found that Irish adolescent youth are entering secondary school lacking in FMS proficiency (O' Brien et al. 2015). Given that FMS need to be taught (Strong et al. 2005), it is logical to suggest that they must form part of both primary and secondary school PE curricula, as not only is there a need to continue refining the FMS (Gallahue et al. 2012), but the new generation of adolescents appear to lack FMS proficiency (O' Brien et al. 2015).

In other countries such as the United States the development of motor skills feature more prominently in PE in both primary (elementary) and secondary (high) school (McKenzie & Lounsbery, 2009; Sallis et al., 2012). NASPE state that to be a physically educated person you must be competent in many movements, for the development of motor skills (National Association for Sport and Physical Education 1995). The American Heart Association (AHA) also state that if children are taught FMS, they are more likely to engage in physical activity (PA) throughout their lives (Pate et al., 2006). They recommend that health related PE programmes should provide moderate to vigorous PA (MVPA), and the teaching of motor skills to students at all school levels. There are now various PE programs around the world which are focusing on developing FMS through PE such as the Sports, Play, and Active Recreation for Kids (SPARK) programme. The SPARK programme addresses motor skills during PE units though the appropriate prescription of skills used in various sports (McKenzie, Sallis, & Rosengard, 2009). The 'Get Skilled; Get Active' programme is a teaching aid used in Australia. This resource assists the teacher in the breakdown of the skill and allows them to teach and develop several FMS (NSW Department of Education and Training, 2000). More recently in Ireland the Youth Physical Activity Towards Health (Y-PATH) programme is another example of a programme focusing dually on developing PA and FMS through PE. It's efficacy at improving FMS and maintaining PA levels has been highlighted in a small scale efficacy trial (O' Brien et al. 2013), with the need for a larger scale evaluation acknowledged by the authors. Since Y-PATH has previously proven its efficacy it seems logical to assess Y-PATH further on a larger sample in a randomised controlled trial of the intervention with the long term aim of national implementation of this intervention to assist in the teaching of FMS and prevention of low PA participation.

2.1.3 Measurement of FMS

In order to assess current levels of FMS and implement effective FMS programmes it is imperative to gather information regarding the FMS proficiency of children and adolescents (Hands 2002; O' Brien et al. 2015). There are a wide variety of assessment tools which measure FMS proficiency. A large number of these focus primarily on the performance outcome. Product-oriented assessment is based on "time, distance or number of successful attempts resulting from the performance of a skill" (Burton & Miller, 1998, p.215). In some cases the outcome can be easily assessed for example throwing a ball could be measured by the distance thrown or whether it was on target, running could be measured using time. In a PE setting, teachers can do this through observation; however, it gives little constructive feedback in order to improve proficiency. Ulrich (2000) states that, too often, FMS assessment focuses on the product rather than the process of the movement, which does not provide any information on specific components of the skill which may require improvement. Process-oriented assessment relates to an assessment of "how the skill is performed or the process responsible for the performance outcome" (Burton & Miller, 1998, p.215). Process-oriented assessment is more accurate in identifying specific components of movement that may require improvement (Hands 2002). It is viewed as the most informative method of assessment as it identifies these components and allows for appropriate and specific feedback to be given (Ulrich 2000). It also assists in identifying those with motor development delays or specific areas of weakness in motor skill performance (Ulrich 2000). There are numerous assessment tools which measure motor skill development, with varying levels of validity and reliability.

2.1.3.1 Assessment tools

The Movement Assessment Battery for Children test, the original form Movement-ABC (M-ABC) (Henderson & Sugden 1992) revised to Movement-ABC-2 (M-ABC-2) (Henderson et al. 2007) is a commonly used FMS test. The initial test assesses the developmental status of FMS with a focus on detection of delay or deficiency in a child's movement skill development. It is suitable for children between 4-12 years of age and consists of 32 items, subdivided into 4 age bands. The revised version of the test focuses on how a child manages everyday tasks encountered in school and at home, and has a motor and a non-motor component that provides information on direct and indirect factors that might affect movement. The revised version is suitable for children between 3-16 years old. The test itself takes 20-30mins to complete and measures movement skills in three categories: manual dexterity skills, ball skills and balance skills (Cools et al. 2009). Burton and Miller (1998) consider the test suitable for assessment of motor abilities, early milestones, FMS and specialized movement skills. However, the test is product oriented so while some children may produce high scores, their technique and FMS proficiency might be less developed. Cools et al. (2009) report that it is not specifically designed for young children and Henderson et al. (2007) commented on the lack of reliability and low efficiency of this test.

A second FMS assessment test is the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) and the Bruininks-Oseretsky Test 2nd Edition (BOT-2). These are tools specifically designed to assess fine and gross motor skill development and used to identify individuals with mild to moderate motor coordination deficits. The test is suitable for individuals aged 4-21 years, and the complete BOT-2 features 53 items divided into 8 sub-domains. The time required to assess one individual varies between 45 to 60 minutes for the complete test, and between 15 and 20 minutes for the short form (Cools et al. 2009). Despite this being a very detailed assessment instrument, Peerlings (2007) notes some disadvantages such as the complicated score sheet and the length of time taken to complete the full test, making it unsuitable for young children and a larger population study. It also assesses other skills such as agility and flexibility and does not assess as many FMS as other tools so therefore does not provide the assessor with a full profile of FMS for the participant, but rather a select few.

A third skill assessment tool that analyses a type of gross body control and coordination through dynamic balance skill is the Körperkoordinationtest für Kinder (KTK). The KTK is a shortened version of the Hamm-Manburger Körperkoordination Test für Kinder consisting of 4 items (Kiphard & Schilling 1974) . Cools et al. (2009) report that it covers an age range of 5-14 years with an assessment time of 20 minutes for one child. It is relatively simple to set up and takes little time to administer. The KTK has been described as being thoroughly standardized and considered highly reliable. Despite these positives, the KTK is limited to one aspect of gross movement skill assessment (body control and coordination) and does not cater for locomotion functioning and object control. It also is a product oriented form of assessment which as mentioned previously does not give the full picture of technique and motor control.

The 'Get Skilled: Get Active' assessment tool was developed to coincide with the 'Get Skilled: Get Active' FMS teaching resource in Australia. It is a process-oriented assessment tool which consists of 12 skills (run, balance, vertical jump, catch, hop, side gallop, skip, over arm throw, leap, kick, two-handed strike and dodge). The 12 skills were included as they are considered to collectively form the foundation for the development of sport specific skills (NSW Department of Education and Training, 2000). Each skill is broken down into observable and behavioural components that allow for the estimation of the proficiency level for each skill (Okely & Booth, 2004). Teachers receive a checklist which they can use to help assess the performance (NSW Department of Education and Training, 2000). It is seen as a popular, appropriate and reliable assessment tool to assess gross motor skill proficiency in children and adolescents (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2010; Okely & Booth, 2004). However, there is a strong limitation around validity, with Barnett et al. (2010, p.168) stating it's "validity was not assessed in terms of whether the specialised skill features reflected proficient performance compared to that specified in the current literature".

A recent meta analysis of the effectiveness of FMS interventions (Logan et al. 2011) only included studies which used The Test of Gross Motor Development -2 (TGMD-2) (Ulrich 2000). Logan et al. (20110) state that "there are many assessments that are designed to measure some aspect of motor competence; however, the TGMD-2 qualitatively measures skill competence" (p.3). The TGMD-2 is a gross motor skill proficiency process oriented method of assessment which refers to a criterion and a norm (Cools et al. 2009). It assesses 12 skills which are divided into 2 sub-domains: locomotor (run, leap, hop, gallop, slide, horizontal jump) and object control (catch, kick, throw, roll, strike, dribble). Each of these skills is broken down into various components which are assessed to determine proficiency levels in performing the given skill. It was conducted on a sample of 1208 participants in the United States, with gender normative comparison tables created for the object control sub-domain (Ulrich 2000). It has been designed to assess the FMS of children aged 3-10 years and is widely used due to its high validity and reliability (Cliff, Okely, & Magarey, 2011; Hardy, King, Farrell, Macniven, & Howlett, 2010; O' Brien et al., 2015). Considering the TGMD-2 has been recommended for use following a recent meta analysis (Logan et al. 2011) and has been validated for various populations across countries, ethnic groups and groups with specific disabilities (Houwen, Hartman, Jonker, & Visscher, 2010; Wong & Yin Cheung, 2010), it is logical to choose it above the other assessment tools. A limitation however of the TGMD-2 is that it does not assess stability (Gallahue & Ozmun 2006) and despite it being used with adolescents it has not yet been validated for use with this age group (O' Brien et al. 2015). Given that these FMS not only require assessment and development during primary school (age 4-11) but also into secondary school (age 12-18), it is essential that the validity of a tool such as the TGMD-2 is assessed for adolescents so that their FMS proficiency levels may be measured and tracked from childhood.

Table 2.1 Comparison of FMS assessment tools

Assessment Tool	Age group	Properties assessed	Validity	Reliability	Type
BOT-2	4-21 year olds	53 items assessing FMS	Valid	Reliable	Process
Get Skilled, Get Active	3-18 year olds	12 FMS	Limited validity	Reliable	Process
KTK	5-14 year olds	1 aspect of gross motor skills	Valid	Reliable	Product
TGMD-2	3-10 year olds	12 FMS	Valid	Reliable	Process

2.1.3.2 Importance of assessing the validity of the TGMD-2

Tools such as the TGMD-2 must be assessed in terms of validity and reliability prior to recommending them as appropriate measures for use with specific populations. Reliability refers to the consistency of scores of a particular instrument and validity is the degree to which evidence and theory support the interpretations of test scores (Morgan et al. 2001). The TGMD-2 was originally validated for use in the United

States (Ulrich 2000). Since then it has been validated for use in many different countries and also with various populations (Houwen et al. 2010; Simons et al. 2008; Valentini 2012). Discrepancies in skills may emerge during this validation due to differences in development levels and sporting cultures. For example, in China children are not as familiar with the strike skill as children in the United States.

As stated, various studies assess the validity of the use of the TGMD-2 on specific populations, for example; Flemish children with intellectual disabilities (Simons et al. 2008), children with visual impairments (Houwen et al. 2010) and Brazilian children (Valentini 2012). It is important when assessing validity and reliability that standardised procedures are followed. All three studies used confirmatory factor analysis (CFA) to assess the two factor structure of the TGMD-2 for use with their population. The CFA entails a 5 step procedure (model specification, identification, estimation, testing fit, and re-specification). The process may be stopped at step 4 if the model fits well (Hoyle & Panter 1995). Each study varied in which fit indices they chose to use as a measure of good fit. The Chi-square (χ^2) and its associated degrees of freedom may be used, however, given the known problems with the χ^2 being overly sensitive when used with large samples more emphasis is placed on the other fit indices (Marsh et al. 1988). The comparative fit index (CFI) and the Tucker-Lewis index (TLI) were used by both Valentini (2012) and Simons et al. (2008) and are recommended by Byrne (2001). Values for both the TLI and CFI are considered as marginal fit for values > 0.85, acceptable fit for values > 0.90 and superior fit for values > 0.95 (Byrne 2001). The root mean square error of approximation (RMSEA) was used by Valentini (2012), Simons et al. (2008) and Houwen et al. (2010) to assess the degree of fit for the model. Values for RMSEA of <.05 are considered good fit, values >.05 and <.08 are considered acceptable fit, and values >.08 and <.10 are considered marginal fit (Hu & Bentler 1999). All 3 studies achieved good fit for the TGMD-2 for use with their population As can be seen from the fit indices: Simons et al. 's study (2008) achieved χ^2=83.77, GFI=.88 and AGFI=.82., Houwen et al.'s study (2010) achieved $\chi^2 = 79.55$, p = 0.01, RMSEA = 0.07 and GFI = 0.85 and Valentini's study (2012) achieved RMSEA= 0.06, CFI=.88, TLI=.83, GFI=.98, and AGFI=.95. These results also highlight the discrepancies in what indices studies report.

The reliability of the locomotor and object control sub-domains in these 3 studies was established by calculating Cronbach's alpha, corrected item-total correlations, and inter-item correlations. Inter-rater, intra-rater, and test-retest reliability were assessed using the intra-class correlation coefficient (ICC) (Rankin & Stokes 1998). The ICC gives a relative index of the ratio of variance among participants to the variance among participants plus error variance. All three studies reported the TGMD-2 to be reliable for use with their populations. (Simons et al. (2008) reports the following: test-retest reliability=.98, intra-rater reliability=.90 and inter-rater reliability=1.00. Houwen et al. (2010) reports test-retest reliability=.92, intra-rater reliability=.95 and inter-rater reliability=.89. Valentini (2012) reports test-retest reliability=.90, intra-rater reliability=.92-.99 and inter-rater reliability=.86-.94).

When the validity for the TGMD-2 was assessed for various populations multiple indexes of fit were used because each parameter had different strengths and weaknesses. Although all 3 studies found the TGMD-2 to be valid for use with all three populations Simons et al. (2008) and Houwen et al. (2010) did not achieve as strong a validity index as Ulrich (2000). This is to be expected as the TGMD-2 was designed and validated by Ulrich (2000) for use with children in the United States with typical development. This may mean that some skills or components may not be as relevant as others for a new population as they were for the original United States population. Furthermore, the small sample sizes may have also contributed to discrepancies in the strength of their results as the study by Houwen et al. (2010) had 75 participants and the study by Simons et al. (2008) had 99 participants.

It is evident that an assessment tool such as the TGMD-2 must be evaluated in terms of validity and reliability for use with a specific population. Since the TGMD-2 was originally validated for use with children aged 3-10 years old, its validity and reliability has not yet been assessed for use with adolescents. The reason for this is that from age 3-10 children should be developing FMS, and therefore in theory should be proficient at these skills by the time they reach adolescence. Unfortunately this is not the case, as adolescence have been shown to lack these basic skills at age 12 – 14 years (O' Brien et al. 2015). As such there is a need for a tool to be validated for the adolescent age group, and given the TGMD-2 has been highlighted as the most appropriate FMS assessment tool available (Logan et al. 2011), then it is logical that such validation be carried out on this tool.

2.1.4. Population levels of FMS and differences between boys and girls

It is important to assess children and adolescents FMS proficiency to identify their developmental levels and identify any developmental delays or skills which may need further teaching or practice.

Hardy et al., (2010) assessed the FMS levels of 2-6 year olds (n=425). They found as expected for this age group 0% mastery. Despite this there were significant gender differences observed, with females scoring significantly higher at locomotor skills than males and males scoring significantly higher both in object control skills and in total FMS. Cliff et al., (2012) and Wong and Cheung (2010) also assessed FMS among 3-5 year olds. Cliff et al., (2012) found similar results on their sample of 46 children, with females scoring significantly higher at locomotor and males scoring significantly higher at object control. Wong and Cheung (2010) (n=630) found similar results for males as they scored significantly higher than females at object control skills, however there were no significant differences in locomotor proficiency.

These trends of low mastery levels in FMS continue into later childhood as various studies highlight children are below the expected FMS proficiency levels (Okely & Booth, 2004; Siahkouhian, Mahmoodi, & Salehi, 2011; Van Beurden, Zask, Barnett, & Dietrich, 2002). Okely and Booth's (2004) study on Australian children in years 1-3 (age 6-9 years old, n=1288) highlight the low levels of mastery of FMS during childhood. The results highlight that the proportion of students who displayed mastery of a skill did not exceed 35% for any of the 6 FMS assessed. The results also highlight that males performed significantly better than females in all object control skills (catch, kick, throw, and strike). With regard to the locomotor skills, the level of mastery between genders was similar. It was also found that girls were more proficient in skipping than boys. This perhaps reflects cultural expectations with girls more likely to participate in games and activities that use skipping (i.e. dance, gymnastics) (Okely & Booth, 2004). Van Beurden et al. (2002) assessed the FMS proficiency of children (n=1045) aged 8-11 years old. 21.3% of children achieved mastery in less than half of the FMS. They also found similar gender differences as observed in early childhood with females scoring significantly higher at locomotor skills than males and males scoring significantly higher both in object control skills. Van Beurden et al. (2002) suggest that participation in different sporting activities may be the reason for differences between genders, with boys favouring team games where object control is prominent. Barnett et al. (2010) conducted a study which assessed FMS at age 10 and then re-assessed the participants at age 16. They found that males also scored significantly higher than females at object control skills but there were no gender differences in locomotor skills. This is exemplified with the overhand throw at 16 years of age where 88% of boys were at mastery/near mastery level in comparison to only 49% in girls. They found low levels of FMS mastery at age 10 but did observe improvements with 80% of males achieving mastery in 5 skills and 80% of females achieving mastery in 3 skills by age 16.

Research suggests that adolescents should be developing sport specific skills, yet they are not at the mastery level required of FMS to enable progression (Booth et al. 1999; Hardy et al. 2010; Hardy et al. 2013; Mitchell et al. 2013; O' Brien et al. 2015). Booth et al. (1999) and Mitchell et al. (2013) who found that for 9 to 15 year olds and 5-13 year olds mastery levels did not exceed 40 % for the FMS which were assessed This was similar for O' Brien et al. (2015) as they assessed 12-13 year olds (n=242) FMS proficiency across 9 skills. Their findings state that 11% achieved mastery or near mastery across all skills. They also observed gender differences as males performed object control skills significantly better than females but no significant difference between the genders in terms of locomotor performance.

Although the mastery levels for each skill may vary from country to country the proficiency levels remain consistently low from childhood through to adolescence. There are also variations in FMS proficiency observed between genders. Various studies provide suggestions as to the reasons gender differences may exist for example participation in different activities. Charlesworth (2010) highlights that factors such as body size and physical growth, and strength relative to body weight can affect the timing of the emergence of FMS, however, Thomas and French (1985) postulate that these differences could be reduced if females are provided with the same opportunities for instruction, practice, feedback and encouragement as males. This evidence would suggest a need to improve FMS development among children and adolescents. While an intervention targeting overall FMS proficiency is required, it is essential that extra attention is given to the areas which are particularly poor such as object control skills among females. Since females achieve a lower level of mastery at FMS than males that this may contribute to females lower levels of PA (Hardy et al. 2013). PA is only an example as, according to the literature, there are several correlates that seeem to affect FMS proficiency levels which will be discussed in further detail in the coming section.

2.1.5 Correlates of FMS proficiency level

2.1.5.1 Role of physical activity

Research has shown that the mastery of FMS is associated with higher levels of PA participation (Cliff, Okely, Smith, & McKeen, 2009; Lloyd, Saunders, Bremer, & Tremblay, 2014). The World Health Organisation defines PA as any bodily movement produced by skeletal muscles that requires energy expenditure. It can be divided into organised PA such as sport or non-organised PA such as free-play (Hager 2006). It is reported that adolescents who are currently physically active are more likely to continue this type of behaviour into adult life, which may contribute to a healthy lifestyle and can also help reduce the incidence of chronic diseases such as heart disease and lung cancer (Hallal et al. 2006). A previous review highlights a strong positive relationship between FMS and PA in both children and adolescents (Lubans et al. 2010a). As FMS proficiency levels increase among adolescents it makes them more inclined to participate in PA and sport (Okely, Booth, & Patterson, 2001). There is also evidence among children that FMS, in particular locomotor skills, are positively correlated with PA (Hardy et al. 2010). Researchers agree that "cross-sectional evidence has demonstrated the importance of motor skill proficiency to PA participation" however, it is difficult to determine the direction of this relationship (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009, p.253).

A study was carried out investigating the association between FMS and PA levels among Australian adolescents. Students aged 13-15 years old students were assessed on six FMS (Okely, Booth, & Patterson, 2001). Multiple regression analysis indicated that FMS significantly predicted time in organised PA, although the percentage of variance it could explain was small. This prediction was stronger for girls than for boys. Multiple regression analysis also showed no relationship between time in non-organised PA and fundamental movement skills (Okely, Booth, & Patterson, 2001). This suggests the importance of participation in organised PA to improve FMS levels as opposed to free-play.

Fisher et al. (2005) showed similar results when they assessed 4 year olds (n=394) PA and FMS in Scotland. Their results highlight that total PA ($r=0.10$, $p<0.05$) and percent time spent in moderate to vigorous PA (MVPA) ($r=0.18$, $p<0.001$) were significantly correlated with total FMS score. They also found that children with limited engagement in PA had the poorest skill level and had a higher level of sedentary activities. Pang and Fong (2009) conducted a similar study on 167 students aged 6-9 years in Hong Kong. They found a significant association ($r=0.20$, $p<0.05$) between FMS and PA also. They state that FMS must be taught and continually refined and combined with other movement skills in a variety of PA.

Results were similar in an American study which examined the relationship between PA and motor proficiency in 65 children aged 8-10 years old (Wrotniak et al. 2006). They found that motor proficiency explained 8.7% of the variance in PA stating that there is an association between the variables. They suggested that targeting FMS proficiency development in children and adolescents may be significant in counteracting physical inactivity.

2.1.5.2 Role of Body Mass Index

Body mass index (BMI) may also be considered a correlate of both FMS proficiency and PA (Siahkouhian et al. 2011; Dwyer-Lindgren et al. 2013). BMI is an indicator of a person's body composition determined by their height and body mass and is utilised to categorise whether a person is underweight, normal weight, overweight or obese. Ogden, Carroll, and Curtin (2006) highlight that the prevalence of overweight and obesity among children is dramatically increasing worldwide which is having a negative effect on PA levels, and a knock on effect on poor FMS levels among children.

Siahkouhian, Mahmoodi, and Salehi (2011) carried out a study of the relationship between FMS and BMI in 7-8 year old children in Iran. The study was conducted on 200 children detailing 8 FMS and using the TGMD-2. Significant negative correlations were found between the raw scores of the locomotor skills sub-domain and BMI: the run ($r=-0.46$, $p<0.01$), gallop ($r=-0.14$, $p<0.05$), hop ($r=-0.38$, $p<0.01$), horizontal jump ($r=-0.28$, $p<0.01$) and overhand throw ($r=-0.17$, $p<0.05$), whereas correlations were not found between strike, catch, kick and BMI. In more detail, the results indicate that BMI was inversely related to locomotor skills and one object control skill; the overhand throw. This may be in part explained by the fact that locomotor skills require a greater overall movement of body mass than object control skills, which may increase the task difficulties for overweight children. A similar study was conducted in the United States on 153 subjects aged between 6-10 years with the objective to compare FMS of overweight/obese children and healthy weight peers (Cliff et al., 2012). Twelve FMS were assessed using the TGMD-2. They found the prevalence of mastery was lower among overweight/obese children compared to their normal weight peers. Differences were the largest among locomotor skills such as the run, slide and hop and object control skills such as the dribble and kick.

Cliff et al. (2011) assessed the relationship between FMS and BMI in a sample of 132 participants aged 6-10 years old using the TGMD-2. The prevalence of FMS mastery was significantly lower among children categorized as overweight/obese for all 12 FMS skills across all age groups. Excluding the leap for 6-7-year olds, differences between the two samples remained when the prevalence of advance skill proficiency was examined for children categorized as overweight/obese. A study by Poulsen et al. (2011) of 118 children from ages 6-12 years, using the BOT-2 test, showed similar results and found an inverse relationship between locomotor skill deficiency and obesity. Their findings suggested that children with a higher BMI had low self-competence and decreased FMS proficiency. The findings from the above studies highlight and support the relationship between FMS and BMI i.e. the higher the BMI, the lower the FMS proficiency.

A Belgian study investigating the relationship between motor skill and BMI in 117 children aged between 5-10 years looked at gross and fine motor skill in overweight and obese children and compared them with normal-weight peers (D'Hondt et al. 2009). Fine motor skills are described as smaller movements such as picking up a spoon (Gallahue et al. 2012). The children were assessed under the M-ABC test and found a negative correlation between obesity and M-ABC score, with scores for balance and ball skills being significantly better in normal weight children compared to their obese counterparts. A similar result was found for manual dexterity with the study demonstrating that general motor skill level is lower in obese children than in normal-weight and slightly overweight peers. Researchers suggest the reason for low motor skill level in children with a high BMI is mechanical; as obesity influences body geometry and increases the mass of different body segments it makes it more difficult for the child to control movements efficiently (D'Hondt et al. 2009).

The vicious circle associated with FMS, BMI and PA can be summarised by postulating that because children may have movement difficulties, they are less likely to be physically active and show preferences for sedentary activities which may lead to an increase in BMI (Cairney et al. 2006). In brief, all above discussed research findings consistently highlight that as BMI increases, overall FMS proficiency decreases.

2.1.5.3 Role of fitness levels

A review by Lubans et al. (2010) examining the potential psychological, physiological and behavioural public health benefits associated with FMS proficiency in children and adolescents not only found a positive relationship between FMS competency and PA, and an inverse relationship between FMS competency and weight status, but also found strong evidence to support a positive relationship between FMS competency and cardio-respiratory fitness. Stodden, Langendorfer, and Roberton (2009) completed a study assessing 3 different FMS (throw, kick and jump) and physical fitness in young adults aged 18-25 years old in

Australia. Multiple regression results indicated the physical fitness measures substantially contributed to the amount of variance explained in kicking ($R = 0.48$, $p<0.001$), throwing ($R = 0.41$, $p<0.001$), and jumping ($R = 0.48$, $p<0.001$). They suggest that FMS proficiency may be fundamental in both developing and maintaining fitness into adulthood. They discuss the relationship between FMS, PA and fitness and state that during adolescence FMS proficiency and high fitness levels allow individuals to persist and achieve success in activities therefore creating more opportunities to further develop these FMS.

Barnett, Morgan, Van Beurden, and Beard (2008) completed a longitudinal study over 7 years to investigate the relationship between perceived sports competence, childhood FMS, adolescent PA, and fitness. Participants were Australian and ranged from 14 to 18 years old. They found that locomotor proficiency did not predict any relationship between the variables however object control proficiency in childhood may be influential in developing a good perception of sports competence which in turn increases both PA participation and fitness levels. Barnett et al. (2008) state that their findings "demonstrate that a positive perception of sports competence is a key predictor of PA and fitness outcomes and is influenced by motor skill proficiency as a child" (p.8). This is also the case in childhood as a 20 year follow up cross-sectional study showed that children aged 6 years old with low FMS proficiency, had lower performance-related fitness and higher BMI than children with high FMS proficiency (Lloyd et al. 2014) at the age of 26 years.

2.1.5.4 Role of socio-economic status

Many researchers measure socio-economic status (SES) when researching correlates of FMS proficiency. There are several aspects of SES such as educational attainment and individual and neighbourhood level household income. All of these aspects contribute to PA (Cerin et al. 2009). A lack of opportunity, equipment and resources result in fewer opportunities for children with low SES to engage in PA and FMS. The main reason the relationship between these two variables is assessed is so that resources can be allocated to the areas which have poor FMS (Booth et al. 1999). Booth et al. (1999) found that FMS was positively and consistently associated with

SES among girls in Australia, with low SES is likely to result in low FMS proficiency (assessed using the MAB-C). Hardy et al. (2010) also state that socio demographic differences in FMS (assessed using the TGMD-2) have been observed; finding that speaking a language other than English was inversely associated with FMS in an Australian sample of 425 2-6 year olds. Chowdhurya, Ghosha, and Wrotniakb (2010) carried out a study on 841 participant's aged 5-12 years old from a tribe in India. One of their aims was to gain information on SES and motor development. They measured SES based on monthly family income, parental education, parental occupation and FMS using the BOT-2. Structured questionnaires were used to gather the information and the results showed that SES had a significant effect on motor development.

There may be inconsistencies in the strength of the association and the methods used for assessing SES and FMS however, it is evident that there is a relationship between FMS and SES among specific groups. This highlights the need to assess this relationship when aiming to improve FMS as it will highlight the specific areas/groups that may need extra financial support or resources.

2.1.5.5 Role of self-confidence

As presented so far, current research (Armstrong & Welsman, 2006) has identified several influencing factors on FMS proficiency: BMI, gender, PA and fitness. One factor that has not yet been discussed in this literature review however is the effect self-confidence has on FMS performance. Self-confidence is the confidence someone has in their own ability. Harter (1981) proposed a model explaining the relationship between perceived motor competence and FMS. The model proposed that actual competence leads to perceived competence, with perceived competence leading more to motivation for participation in PA in comparison with actual competence (i.e. FMS proficiency level). Griffin and Keogh (1982) have also suggested that actual competence influences perceived competence which in turn affects PA participation choices. When assessing adolescents FMS, it is also important to assess their self-efficacy as it is evident that how confident someone is in their ability will affect their performance and interest in participating in an activity. Thus, the following section of the literature review will comprise of an in-depth review of self-efficacy literature to date.

2.2 Self-efficacy

2.2.1 Definition and distinction between terms

Bandura (2001) states that self-efficacy is the cognitive mechanism which arbitrates information on personal abilities to proficiently execute required routes of action in a specific domain. Perceived self-efficacy is associated with people's beliefs in their abilities to produce given accomplishments (Bandura, 1997). People differ in the areas in which they expand their efficacy and to what extent they advance it. "Thus, the efficacy belief system is not a global trait but a differentiated set of self-beliefs linked to distinct realms of functioning" (Bandura, 2006, p.307). Fox (1990) suggests however that there is a confusion of terms or at least a misuse of word in the self-esteem literature. Various terms such as self-esteem, self-concept, self-efficacy, confidence and perceived competence are used interchangeably to describe similar and sometimes the same constructs (Fox 1990). For example, Fox (1990) developed the Physical Self Perception Profile (PSPP) to measure self-perception, however, in a more recent study it is used to determine perceived sports competence (Barnett et al. 2008) which is only a sub-section of the PSPP.

2.2.2 Conception of ability affects confidence

Bandura (1993) states that conception of ability (one's understanding of their ability) affects confidence and belief levels. Some people adopt a functioning-learning goal i.e. they view ability as an acquirable skill that can be improved by gaining knowledge and practicing (Biddle et al. 2003). They enjoy challenges that may expand their knowledge and improve their competency levels. They view errors as part of the learning process and learn from mistakes and difficulties they face. They assess themselves in terms of personal improvements rather than comparison with peers. Others view ability as an inherent capacity. For these people, competency is indicative of their intrinsic intellectual capacities. Poor proficiency carries a highly valued threat that they lack intelligence of a sort. For this reason, they prefer tasks that they can achieve success at and display their proficiency at the cost of reaching their full potential (Biddle et al. 2003). The success of others also belittles their own perceived ability. Hence, it is important to consider people's conception of ability when interested in assisting them to reach their potential (Viholainen et al. 2014).

2.2.3 Self-confidence and performance

According to McAuley and Gill (1983), self-confidence is a necessity for achieving success in a sporting performance. They also state that this confidence may be skill and situation specific. For example, during a basketball game a player may feel highly confident passing the ball but may exhibit low-confidence dribbling the ball up the court. Bandura, Adams and Beyer (1977) refer to this type of specific confidence as self-efficacy and propose that it provokes behavioural change. Self-efficacy expectations influence persistence, thoughts, stimulation, and behaviour. It is important to mention that positive self perceptions lead to positive experiences (Bandura et al., 1977). It is also suggested that general physical self-efficacy is associated with the performance of basic tasks such as FMS (Ryckman et al. 1982). However, according to McAuley and Gill (1983), the influence of physical self-efficacy on the performance of complex physical activities remains uncertain. They state that it would be plausible to suggest that physical self-efficacy affects a more task-specific self-efficacy which consequently, influences how well one expects to perform (i.e. perceived motor competence), which ultimately may affect performance (McAuley & Gill, 1983). For this reason they suggest that task-specific self-efficacy is an important determinant of performance. They state that "the individual's knowledge, experience, and past accomplishments (all sources of efficacy information) apparently combine to form a more accurate representation of event-specific efficacy expectations than do measures constructed by researchers, judges, and coaches" (McAuley & Gill, 1983, p.417). This also highlights that when assessing self-efficacy it is important to assess it at a task specific level as opposed to a general self-efficacy. Bandura (2006) states that feelings and beliefs of efficacy can vary in strength and this may affect their perseverance at performing a given task. The author also states that "weak efficacy beliefs are easily negated by disconfirming experiences, whereas people who have a tenacious belief in their capabilities will persevere in their efforts despite innumerable difficulties and obstacles" (Bandura, 2006, p.313). The greater one believes in their ability the more they will persevere which increases the possibility of the activity being performed successfully (Bandura, 2006). Assessing and knowing someone's perception of their own capabilities is an important addition and complement to the understanding of the actual competence as discussed previously (i.e. FMS proficiency level).

2.2.4 Self-assessment of self-efficacy

How people assess their abilities also affects their confidence and the perception of their ability. The people with whom individuals compare their own ability against has an effect on how they rate their own ability and their confidence at performing. Seeing peers surpass your ability can cause a decrease in self-esteem and confidence in your ability. In contrast seeing yourself gain proficiency and surpass your peers may strengthen self-esteem and confidence in ability, thereby resulting in enhanced performance attainments (Bandura, 1993).

2.2.4.1 Assessment scales

There are various psychological assessment tools which assess the varied constructs such as self-efficacy, self-confidence and perceived motor competence, however there is no universal measure. A generic approach usually has limited explanatory and predictive value as most items in a universal all-purpose scale may have little or no relevance, and will not be task specific (Bandura, 2006). In an aim to serve a wide variety of purposes, items in a universal measure usually consist of general terms which leave much vagueness about what exactly is being measured (Bandura, 2006). Universal measure also do not provide information on the level of task specific demands (Bandura, 2006). According to Bandura (2006) in his guide for Constructing Self-efficacy Scales, "Scales of perceived self-efficacy must be tailored to the particular domain of functioning that is the object of interest" (p.308).

The PSPP was constructed in order to validate a physical self-perception profile that reflected self-perception content and allowed for the hierarchical structure of self esteem (Fox 1990). According to Fox (1990) there are different levels of physical self-perception varying from very specific to more general perceptions. Figure 2.2 shows an example of this range of perception within two aspects of the physical domain: sports competence and physical condition. The PSPP is divided into five '6-item sub-scales': sports competence, physical condition, body attractiveness, physical strength and physical self-worth. The sub-domains consist of various statements which are sub-divided into two statements. On completion people must first decide which of the two statements best describes them and then whether the statement is 'sort of true' or 'really true' for them. Each item can be scored from 1 (low self-perception) to 4 (high self-perception). The PSPP was first used among college students but then was later validated for use among children (Welk & Eklund 2005; Fox 1990). Barnett et al. (2008) used the sports competence domain from this scale to assess adolescents aged 14-18 years old. In this study they used the PSPP to assess whether perceived sports competence mediated the relationship between childhood motor skill proficiency and subsequent adolescent PA and fitness. They found that developing a high perceived sports competence through object control skill proficiency in childhood is important for both boys and girls in determining adolescent PA participation and fitness. This is one of the few perceived competence scales which is validated for use with adolescents, however a limitation of this scale is that it is not task or sport specific as it only gives an overall view of perceived sports competence. For example, people may feel confident at performing specific sports or certain skills within a sport however, they may not feel confident about all sports/ skills (McAuley & Gill 1983).

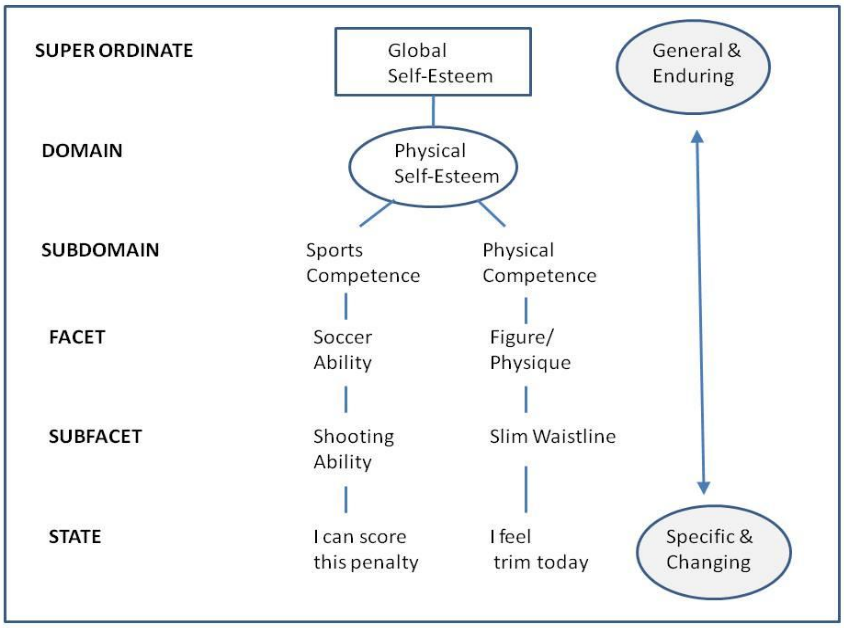

Figure 2.2. Different levels of physical self-perception (Fox 1990)

Harter and Pike (2014) developed a pictorial scale of perceived competence and social acceptance for young children. There are two versions of this instrument, one for preschoolers and kindergartners and a second one for first and second graders. Harter (1984) used a pictorial format for the scale to ensure it was developmentally appropriate, the idea being that a visual presentation of the action would facilitate participants understanding of the task. Unlike adolescents, the young children's self-judgments involve the behavioural description of their specific abilities, such as playing games, running fast or working with friends. When they get older, terms such as smart and good-looking become used for self-description. The scale contains four separate subscales: cognitive competence, physical competence, peer acceptance, and maternal acceptance. Each subscale contains six items. There are gender specific pictures for each activity of a child performing the activity correctly and incorrectly. The child's first task is to indicate which of the two they are most like. Using this picture, they then are asked to indicate whether they are a lot like that person (the big circle) or just a little bit like that person (the smaller circle) to highlight their perception of their performance level.

Based on Harter and Pike's scale (1984), a pictorial scale assessing FMS perceived competence in young children, on a skill level, was subsequently developed (Barnett et al. 2015). This scale was developed as there was a lack of an instrument which assessed perceived competence on a skill specific level. Such instrument further enhance researchers' understanding about how accurately children estimate their FMS ability (Barnett et al. 2015). They developed a 12 item pictorial scale which matched the skills of the TGMD-2. The scale consisted of drawings of children performing the skill correctly and incorrectly. Children were required to choose which drawing best matched their own ability. For each drawing they chose, they then had to further indicate their perceived competence by picking an appropriate option (for the good picture they stated whether they were really good or pretty good at the specific skill, and for the poor picture they state whether they were sort of good at or not that good at the specific skill). They demonstrated good reliability (ICC=0.83) and content validity for use with 5-8 year olds. Though effective for younger children, this scale wouldn't be appropriate for use with adolescents as a pictorial scale may lead to other constructs such as good-looking and athletic as opposed to the skill traits in question (Harter & Pike, 1984).

Since a pictorial scale is not age appropriate for adolescents, a likert scale similar to that of Ryckman et al. (1982) may be more suitable for assessing self-efficacy among this age group. Prior to the construction of this self-efficacy scale, Ryckman et al. (1982) felt that existing measures were based on assessment of attitudes regarding body appearance and did not measure individual differences in perceived competence or individual's confidence levels in performing motor skills. The scale consisted of 90 6-point likert items, each with response options ranging from strongly agree (1) to strongly disagree (6). The items assessed (a) individuals' generalized expectancies concerning their perceived competence in performing tasks involving the use of physical skills, and (b) their level of confidence in performing these skills and having them evaluated by others. This scale was constructed and validated using college students, the authors state however that it has relevance for use in physical education and athletic programs.

McAuley and Gill (1983) state that self-efficacy is a situation-specific construct, and therefore measures which assess self-efficacy for different behavioural domains are required. As a result of McAuley and Gill (1983) validated the Ryckman et al. (1982) scale on female college gymnasts, for use in a gymnastics The scale consisted of the original Physical Self-Efficacy Scale, plus four task-specific efficacy inventories which they added. These task-specific measures comprised seven gymnastic skill elements. The gymnasts were asked to indicate how many of the items on each scale that they thought they could successfully complete at that point in time and also how confident they were that they could complete each item. The gymnasts also predicted their actual score on each event that they were competing in that day. The scale was found to be reliable (ICC=0.72) and valid when correlated with other measures of self efficacy. A task-specific scale such as this one may be appropriate for use when assessing various FMS as it is important to assess these on a skill specific level to highlight specific weaknesses, as opposed to an overall self-efficacy scale.

As shown in the literature above, there are a large variety of scales which all measure various constructs of self-efficacy. Various tools have been developed and then later re-developed or re-validated for use with different populations or for different uses. When developing a scale, it is important to ensure that it is age appropriate to increase the likelihood of it being used as efficiently as possible. It is also important that the scale is providing the researcher with the information intended, for example if you are assessing confidence in skill performance that the scale actually refers to the specific skill as oppose to sport in general. For this reason, a task-specific scale would be most appropriate for use when assessing confidence in performing FMS. It would specifically highlight the areas of weaknesses which may need more emphasis when practicing the skill, and would also help researchers to better understand the relationship between actual FMS and confidence at performing those FMS.

2.2.5 Influencing factors of self-efficacy

2.2.5.1 Relationship between self-concept and physical activity

Physical self-perception (i.e. how one perceives their own physical abilities) has been recognised as a central correlate of PA among youth and has been associated with the PA participation levels in various studies such as Roberts, Kleiber and Duda (1981). Perceived competence which is one of the components of physical self-perception also correlates with PA behaviour (Crocker et al. 2000). During adolescence it has been found (Sallis, Prochaska and Taylor, 2000) that perceived competence is positively associated with PA. According to Barnett et al. (2008) perceived competence may be imperative to self-esteem, as Harter and Pike (1984) refer to self-esteem as a multidimensional construct of various domains that all tie under the construct of global self-esteem (Harter & Pike, 1984). Harters model (1978) also proposes that actual competence comes before perceived competence, which in turn affects motivation. Conversely Griffin and Keogh (1982) suggest that actual competence manipulates perceived competence which in turn influences the choices in PA participation (Griffin & Keogh 1982). According to Barnett, Morgan, Van Beurden and Beard (2008) "children who are skill proficient may develop a high perception of sport competence leading to greater participation in PA and higher fitness levels. Conversely, children with poor skill proficiency may develop low perceived competence resulting in less engagement in PA in adolescence" (p.2).

It is well known that children who are not confident in their abilities may shy away from participation in an activity which displays their ability (Piek et al. 2006). Harter

(1987) suggests that people avoid situations in which they may demonstrate low ability, and that this lack of confidence limits people's actions. Schoemaker and Kalverboer (1994) propose that this withdrawal may lead to a vicious cycle of events, as a lack of confidence and fear of failure leads to withdrawal and then to less practice of the skills/activity. This feeling of lack of confidence and withdrawal may be present in youth from 6 years of age (Schoemaker & Kalverboer, 1994).

Stodden et al. (2008) proposed a model that describes this developmental dynamic and reciprocal relationship, as a *"positive spiral of engagement"*. Highlighting that youth with higher levels of actual and perceived motor competence, are more likely to be physically active, subsequently providing them with more opportunities to further develop confidence and proficiency in the performance of motor skills (Stodden et al., 2008). It is also suggested that general physical self-efficacy is associated with the performance of basic tasks such as FMS (Ryckman et al. 1982). Stodden's theoretical model (2008) has also identified a positive relationship between perceived motor competence, FMS proficiency and PA participation, however, this relationship has limited evidence among adolescents.

Self-confidence and self-perception have often been associated with PA levels and FMS ability. It is important to assess children's and adolescent's self-confidence to see how they feel about performing motor skills in order to highlight any lack of confidence. This lack of confidence may potentially result in a lack of FMS proficiency, and subsequently a drop out from PA, and as such it is crucially important to monitor these correlates.

2.2.5.2 Age and maturation

As discussed above, there has been limited research on self-confidence among adolescents, particularly at a skill specific level. For this reason, there is limited literature questioning potential differences in physical self-confidence changes from childhood through to adolescence which is not helped by the fact that terms such as confidence and efficacy are used interchangeably in literature (Fox 1990). The subsequent paragraph highlights changes which may result in a decline in confidence levels from childhood to adolescence. It is well known that self-efficacy and confidence is high during childhood (Bandura, 1993). However, a decline seems to occur as children enter adolescence (Dweck 1991). Adolescents go through a variety of changes as they transition from childhood; one such change is puberty. During this period, they experience various physical and hormonal alterations which can result in poor co-ordination and consequently low self-esteem (Davies & Rose 2000; Dorn et al., 2006). They also enter a new school environment as they progress form primary to secondary school. Completing skills in front of new peers may also result in a change in self-esteem and confidence (O' Keefe & Smyth 1999). A study by Barnett et al. (2008) looked at object control skill proficiency in childhood, and how it affects perception of competence later in life. They suggest that "for both adolescent males and females, object control skill proficiency as a child appears important in developing a positive perception of competence in sports and seems to combine to increase PA and fitness outcomes as an adolescent" (p.8). However, it is important to note they do not assess locomotor or overall motor skill proficiency, and therefore do not offer a representation of whole motor skill proficiency. Nevertheless, they do highlight the importance of developing adolescent's perception of competence in order to ensure that they lead active lifestyles.

2.2.5.3 Gender

There is also limited literature highlighting the gender differences in physical self-confidence among adolescents. Raudsepp and Liblik (2002) assessed perceived motor competency in 10-13 year olds, and Barnett et al. (2008) assessed sports competency among adolescents. In both studies males scored higher than females. Vedul-Kjelsås, Sigmundsson, Stensdotter and Haga (2012) also found among a group of children aged 11 years old, that FMS and self-perception was most strongly correlated among girls in comparison with boys. A similar finding is presented in Viholainen, Aro, Purtsi, Tolvanen and Cantell's study (2014) on self-concept, motor skills and psychosocial well-being, with results also highlighting that motor skill proficiency is associated with psychosocial correlates among adolescent girls. Assessing gender differences in self-confidence in this age group may provide an insight into the changes of confidence level experienced by adolescents as they move to a new school environment and progress physically and developmentally during maturation.

2.3 Physical activity based interventions

2.3.1 The need to intervene

As discussed previously, there is a lack of FMS proficiency among adolescents (Barnett et al., 2010; Lubans et al., 2010; O' Brien et al., 2015). This can have major effects on various correlates such as PA participation, self-efficacy, fitness and BMI (Lubans et al., 2010). It is clear that there is not only a need to monitor FMS development but also a need to intervene by targeting PA participation and FMS development (Van Beurden et al., 2003; Lubans et al., 2010; O' Brien et al., 2015). The long-term effects of low PA and low FMS proficiency can result in obesity and a lack of perceived and actual competence to partake in sport and exercise (Barnett et al., 2009; Gallahue & Ozmun, 2006; Haywood & Getchell, 2002). By improving PA levels, an individual is more likely to develop FMS and self-efficacy due to the increased opportunity to practice these skills (Van Beurden et al., 2003). FMS form the building blocks for future participation in sport and PA (Gallahue & Ozmun 2006). Unfortunately however, as children enter adolescence they may be below expected FMS levels (O' Brien et al. 2015), which can result in a decrease in PA participation levels which can in turn lead to an inactive and unhealthy lifestyle with an overall risk of premature mortality (Dwyer-Lindgren et al. 2013).

The importance of an effective intervention targeting adolescents PA and FMS is palpable as it is crucial for youth health. It is of no surprise that many intervention programmes have been developed, implemented and evaluated with the purpose of increasing PA and/or FMS (Van Beurden et al., 2003; McKenzie et al., 2001; Sutherland et al., 2013). These interventions are target a wide variety of age groups, however given that i) PA decline is most prevalent among adolescents (Dumith et al. 2011) and ii) FMS proficiency levels are below expected norms in adolescence (O' Brien et al. 2015), there is a clear requirement to target the adolescent population specifically. It is vital to create and maintain interest in PA during this crucial period to ensure adolescents have the opportunity and the drive to lead an active and healthy life.

Young people are not meeting the recommended guideline of 60 minutes of moderate to vigorous PA per day (Belton, O' Brien, Meegan, Woods, & Issartel, 2014; Currie, Zanotti, De Looze, Roberts, & Barnekow, 2012; Woods et al., 2010). For this reason in their policy guidelines, the WHO identifies interventions targeting an increase in PA among youth as a necessity (Currie et al. 2012). PA, skill and exercise interventions have been identified as designed attempts to influence individuals or populations to alter and improve their PA, FMS or exercise levels to achieve and maintain a healthy lifestyle (Dunn et al. 1998). School has been identified as the most logical and key opportunity to target children and adolescents as it is where the population spend most of their waking hours (Haerens, De Bourdeaudhuij, Maes, Cardon, & Deforche, 2007; Khambalia, Dickinson, Hardy, Gill, & Baur, 2012; O' Brien et al., 2013; Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007). In addition, particularly at second level, there are trained PE professionals there who can assist in implementing an intervention (Breslin et al. 2012). Although a recent systematic review provides strong evidence that physical activity interventions have had only a small effect (approximately 4 minutes more walking or running per day) on children's overall activity levels (Metcalf et al. 2012), there are also various studies which now provide evidence supporting school-based multi-component interventions to increase PA and FMS levels of children and adolescents (Dobbins, Husson, DeCorby, & LaRocca, 2013; Salmon et al., 2007; Van Sluijs, McMinn, & Griffin, 2007). Woods et al. (2010) highlight in Ireland only 35% of primary schools and 10 % of secondary schools deliver the recommended minimum of PE per week (60 minutes at primary school and 120 minutes at secondary school). A variety of studies highlight that interventions which are well-constructed and monitored targeting the PE lesson itself can improve PA levels among youth (McKenzie & Lounsbery, 2009; Sallis et al., 2012; Strong et al., 2005). School-based PE programmes represent just one aspect of interventions; multi-component whole-school approaches targeting a variety of areas including the PE curriculum, policy and environmental change appear most effective (Timperio, Salmon, & Ball, 2004). Additionally to targeting the school environment for improving PA and FMS, it is also important to target ecological domains beyond the individual (Perry 2012). Perry (2012) states that this can be done by developing behavioural skills and by providing additional opportunities for PA. It is evident that school provides an excellent setting for intervention development and implementation to target children and adolescents PA behaviour, however these interventions should have a multi-component approach to obtain long-term positive changes (Timperio et al., 2004).

2.3.2 Important components of interventions

Reviews of school based interventions such as that of Timperio, Salmon and Ball (2004) and Murillo Pardo et al. (2013) highlight various components and strategies which were observed during the evaluation of the effectiveness of school-based interventions. Both reviews state that school-based interventions should be multi-component and not limited solely to PE programmes. Timperio, Salmon and Ball (2004) state that "those that incorporated whole-of-school approaches including curriculum, policy and environmental strategies appeared to be more effective than those that incorporated curriculum-only approaches" (p.20). Salmon et al. (2007) carried out a review on 76 interventions worldwide which targeted the promotion of PA participation among children and adolescents. They found that for children aged 4-12 years old school-based interventions with a PE component and also a school break time component were most effective. Various studies such as Haerens et al., (2006), (2007), Kriemler et al. (2010) and Sutherland et al. (2013) have developed strategies to increase PA during break time at school. For adolescents aged 13-17 years old Salmon et al. (2007) found that motivationally tailored advice sessions showed potential at increasing PA. This component was implemented in a variety of studies, and also through a variety of methods such as group sessions and personal advice delivered through the medium of computers (Jamner et al. 2004; Haerens et al. 2007; Haerens et al. 2006; De Bourdeaudhuij et al. 2010). Murillo Pardo et al.'s review (2013) on school-based interventions to increase PA among adolescents also supports the initiative of computer-tailored interventions, and acknowledges the importance of implementing specific strategies for girls. Murillo Pardo et al. (2013) also highlight that implementing non-curricular programmes and activities assists in promoting PA.

Research suggests that multi-component school-based interventions not only see a rise in PA levels during school hours but can also increase PA levels outside of school time which is crucial to ensuring the desired long-term behavioural change (Kriemler et al., 2011; Salmon et al., 2007). There is also significant evidence highlighting the importance of implementing a whole-school approach, with family and wider community components in adolescent interventions (de Meij et al. 2011; Belton et al. 2014; Murillo Pardo et al. 2013). A behavioural and community focus in PE and school-based interventions provides strong evidence as an effective strategy to improve PA and fitness among youth (McKenzie & Lounsbery, 2009; McKenzie, Sallis, & Rosengard, 2009; Pate et al., 2005). As stated previously despite discrepancies in PE time, PE provides children and adolescents with the opportunity to develop and practice skills required to lead a healthy and active lifestyle (Sallis et al., 2012). Considering that FMS are the building blocks for future participation in sport and PA (Gallahue & Ozmun 2006), it is important that there is a strong emphasis on skill development in PE (Stodden et al., 2008) in order to equip children and adolescents with the confidence and essential movement skills required for lifelong activity. There are various PE interventions which not only focus on skill development but balance skill acquisition with health related PA such as the Move it Groove it (Van Beurden et al., 2003) and the Y-PATH programme (Belton et al. 2014; O' Brien et al. 2013).

A systematic review on the effectiveness of interventions to promote PA in children and adolescents also found that school-based interventions which included a family or community component were effective at increasing PA among adolescents (Van Sluijs et al., 2007). Various intervention studies included a component which targeted family or community settings whether this be educating or facilitating changes and activities (Van Beurden et al., 2003; De Meij et al., 2011; Haerens et al., 2007; O' Brien et al., 2013; Pate et al., 2005; Salmon et al., 2011). It is evident from these review articles that a multi-component school based intervention is the most recommended method of improving PA among youth. As highlighted in the reviews, when targeting the adolescent population, the intervention should be multi-component, target PE, include the whole school, family and community setting and also provide specific feedback. Although these are the most recommended components, it is unfeasible for all interventions to implement all of the aforementioned components therefore the population of interest must be well researched in order to create an effective multi-component intervention for them. For this reason it is appropriate to review and summarise key findings from various published PA and FMS interventions among children and adolescents.

2.3.3 Examples of interventions targeting FMS proficiency

There are many interventions targeting children and adolescent PA participation, fitness levels and FMS proficiency levels. It is important to look at previous research to ensure the most effective and appropriate method is used when targeting a specific population. Each intervention may have different primary and secondary outcome measures such as BMI, PA, FMS etc.

The Switch-Play intervention was evaluated in a randomised controlled trial involving 311 participants with a mean age of 10.8 years (Salmon, Ball, Hume, Booth, & Crawford, 2008). The primary outcome measure was BMI, however it also assessed sedentary behaviour, PA and FMS. The aim of the intervention was to test three approaches towards maintaining a healthy body mass. These were 1) Reducing time in sedentary behaviour, (behaviour modification group) 2) Increasing skills and enjoyment of PA (FMS group), and 3) A combination of the two strategies (combined group). The control group received usual care. Children in the behaviour modification group participated in 19 lessons which encouraged them to swap screen-based behaviours with PA alternatives. The FMS group participated in 19 lessons that focused on the mastery of 6 skills and enjoyment of PA. The combined group participated in all the behaviour modification and FMS lessons. Results indicated that the combined group were significantly less likely than controls to become overweight/obese between baseline and post intervention, this was also maintained at 12-month follow-up. The FMS group children recorded significantly higher levels of PA and greater enjoyment than the control group. The behaviour modification children recorded significantly higher levels of PA and TV viewing across all four time points than the control group (Salmon et al, 2008). It is evident from these results that the Switch-Play programme has the potential to prevent excess weight gain and to improve PA, FMS and enjoyment of PA among this age group.

Another intervention which targeted a similar age group was the SPARK programme (Sallis et al., 1999). This specific evaluation of the SPARK programme had 745 participants with a mean age of 9.25 years. The SPARK programme has 3 different conditions 1) Certified PE specialist implemented the programme, 2) Classroom teachers were trained to deliver the programme, and 3) A control group. The intervention programme which was delivered in conditions 1 and 2 consisted of both a PE curriculum, and a self-management curriculum. The PE curriculum included conditioning exercises, health related activities (HRA) and sports skills. The self-management programme involved self-monitoring, self-evaluation and self-reinforcement with the overall aim that children could apply these to their PA habits. The main outcome measure was BMI. The results supported that those in the teacher-led group (group 2) had significantly the lowest increase in BMI across the 2 years (Sallis et al., 1999). Despite Swtich-Play and SPARK obtaining positive results there are some limitations; as they do not have a whole-school approach, and do not contain a family/community element which has been identified as important in ensuring long term results (Timperio et al. 2004)

Similarly to the SPARK intervention, the Lifestyle Education for Activity Program (Leap) was a 2 year intervention involving 1604 girls with a mean age of 13.6 years (Pate et al., 2005). The main outcome measure was PA, with BMI as a secondary outcome measure. The Leap intervention had 6 components 1) PE, 2) Health education, 3) School environment, 4) School health services, 5) Faculty/staff health promotion and 6) Family/community involvement. Positive results were obtained showing a significant increase in MVPA with the intervention schools achieving a higher percentage of regular MVPA than control schools (Pate et al., 2005). The results highlight that the Leap programme may be an effective method of increasing PA however the results are limited to girls.

In evaluation of The Move it Groove it intervention PA, FMS and PE lesson content were assessed (Van Beurden et al., 2003). This evaluation of the intervention had 1045 participants aged 7-10 years old. It was a whole school multi-component intervention with school project teams (including principals, teachers and parents), a buddy system (buddies provided updated strategies, resources, and knowledge and experience for the pre-service teachers i.e. the buddy), website (which contained resources for the intervention schools only), 4 teacher training workshops and grants for equipment. There were also positive results obtained for the intervention group with substantial improvements in FMS (7.2% to 25.7%) and a 3% increase in vigorous PA (VPA) (Van Beurden et al., 2003). These results provide evidence for the effectiveness of the Move it Groove it intervention for increasing FMS and PA levels in children aged 7-10 years old.

The Y-PATH intervention is also a multi-component school-based intervention which consists of 4 components 1) The student component: specific focus on HRA and FMS in PE, 2) Parent/guardian component: parents and guardians are educated about the health benefit of PA, 3) Teacher component: all school staff participate in 2 workshops with the main objective to promote PA participation among staffs and students during school time, and 4) The website component: resources are made available online (Belton et al. 2014). The study which evaluated the efficacy of the intervention assessed a slightly older age group than the previous interventions (O' Brien et al. 2013). Data was collected on 174 adolescents (boys and girls) of 12-14 year olds. The primary outcome measure was PA participation and the secondary outcome measures were BMI and FMS proficiency. Out of the previous 3 interventions (Switch-Play, SPARK and Leap) all had skill development as part of their intervention programme however only Switch-play assessed it as a secondary outcome measure. Similar to the Leap intervention the Y-PATH intervention is also a multi-component school-based intervention which contains a family element. The results of the Y-PATH intervention provide evidence to suggest that it is an effective intervention to improve PA and FMS among adolescents as the intervention group made a significantly greater increase in PA and FMS than the control group. There were no significant differences observed for BMI. Despite the positive results obtained supporting the efficacy of Y-PATH it is important to note that this study was an exploratory trial with only 2 schools involved. It would be important to consider the implementation of the Y-PATH intervention on a larger sample size as part of a randomised controlled trial (O' Brien et al. 2013).

Having looked at 5 different school-based interventions it is evident that each contains both similarities and unique elements. It is important to consider when developing an intervention the specific age group and population which is targeted. As discussed previously, to improve PA and FMS levels of children and adolescents, the most effective interventions are school-based multi-component interventions which include a family/community element (Timperio et al., 2004; Van Sluijs et al., 2007).

2.3.4 Evaluation of interventions

It is important when developing and evaluating interventions that a framework such as that suggested by the Medical Research Council (MRC) be adhered to (Campbell et al. 2000). There are many study designs to choose from depending on the different questions and circumstances (Craig et al. 2008). It is recommended in the Y-PATH study (O' Brien et al. 2013) that a definitive randomised controlled trial should be carried out to specifically evaluate the overall intervention effectiveness. When completing a randomised controlled trial of an intervention various issues are posed such as sample size, inclusion and exclusion criteria, methods of randomisation and the challenges of complex interventions (Campbell et al. 2000). It is important that all of these issues are addressed for the main trial of the intervention to ensure it remains randomised. It is also important to avoid contamination with the control group (Campbell et al. 2000).

The MRC developed a framework in 2000 (see Figure 2.3) which may assist in the development and evaluation of a randomised controlled trial, with the aim of long-term implementation (Campbell et al. 2000).

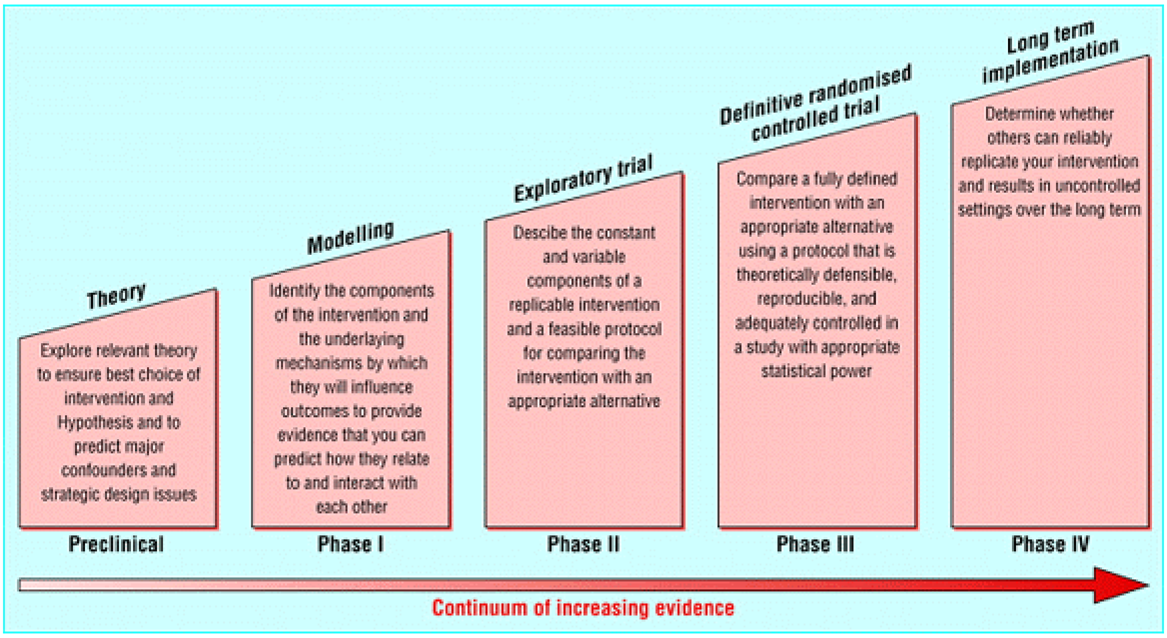

Figure 2.3. MRC Framework for complex interventions (Campbell et al. 2000)

When evaluating the effectiveness and results of the intervention, it is also important to evaluate implementation fidelity. As stated by Carroll et al. (2007): "only by understanding and measuring whether an intervention has been implemented with fidelity can researchers and practitioners gain a better understanding of how and why an intervention works, and the extent to which outcomes can be improved" (p.1).

2.4 Conclusion

It is evident from the CSPPA report (Woods, Tannehill, Quinlan, Moyna, & Walsh, 2010) that more emphasis must be put on FMS development in Ireland. This is supported by a recent study which found that Irish adolescent youth are entering secondary school lacking FMS proficiency (O' Brien, Belton, & Issartel, 2015). Since FMS are the building blocks for sport specific skills it is preferable that children learn a wide variety of universal FMS to ensure the successful transfer of skills and progression into diverse sports and activities (McKenzie & Lounsbery, 2009). Given that FMS need to be taught and will not just happen naturally over time (Strong et al., 2005), it is logical to suggest that they must form part of both primary and secondary school PE curriculum.

In order to implement effective FMS programmes, it is imperative to gather information regarding the FMS proficiency of children and adolescents (Hands, 2002), to identify their developmental levels and any motor developmental delays which may need further teaching and practice. There are a wide variety of assessment tools which measure motor skill proficiency. The choice of the assessment tool is highly dependent of the level of its validity and reliability for the intended population. Most FMS assessment tools have been validated for use with children. Based on a recent meta analysis (Logan et al., 2011), the TGMD-2 has been named as the most recommended assessment tool as it qualitatively assesses FMS. However, this test has not been validated for children over 10 years of age. As a next step, it is logical to assess the validity and reliability of the TGMD-2 with an adolescent population.

Although the mastery levels for each skill may vary from country to country the proficiency levels remain consistently low (Cliff et al., 2009; Hardy et al., 2013; O' Brien et al., 2015). This evidence would suggest a need to intervene to improve FMS development among children and adolescents with the idea to ensure mastery of these basic skills prior to allow for the advancement to the sport specific stage. Also, it is well known that there is a difference in the performance of FMS across genders in childhood (Lubans et al., 2010; O' Brien et al., 2015; Van Beurden et al., 2002). For this reason, it is important to assess this further among adolescents where both genders experience a variety of developmental changes (Hardy et al., 2013; Sallis et al., 2000).

To gain a better understanding of FMS proficiency levels, and also to target an improvement in FMS, it is important to take into account various correlates such as PA participation, fitness levels, socio economic status and self-efficacy. For example, it is well known that self-efficacy affects performance. According to McAuley and Gill (1983), physical self-efficacy affects a task-specific self-efficacy which consequently, influences how well one expects to perform (i.e. perceived motor competence), which ultimately may affect performance (McAuley & Gill, 1983). For this reason, they suggest that task-specific self-efficacy is an important determinant of performance. The greater one believes in his/her ability the more he/she will persevere. This will in turn increase the possibility of the activity being performed successfully (Bandura, 2006). Assessing self-efficacy ensures that weaknesses can be identified and taken into consideration in the development of an intervention for example.

There are numerous psychological assessment tools which assess the a variety of constructs such as self-efficacy, self-confidence and perceived motor competence however there is no specific measure assessing perceived confidence in performing FMS (physical self-confidence). It would be beneficial to develop a scale specifically based on the development of a task-specific scale would be most appropriate for assessing physical self-confidence. It would highlight areas of weaknesses informing future practice or the development of an intervention. It would also provide information on the relationship between actual FMS proficiency and FMS self-confidence. Assessing gender differences in self-confidence in this age group may also provide an insight into the confidence changes that adolescents experience as they change school environments and experience physical and developmental progressions during puberty.

It is evident from the literature that there is a lack of FMS proficiency among adolescents (Hardy et al., 2013; Lubans et al., 2010; O' Brien et al., 2015). It is clear that there is not only a need to monitor FMS development and physical self-confidence, but also a need to intervene (Belton et al., 2014; Van Beurden et al., 2003; Lubans et al., 2010; O' Brien et al., 2015). The school provides an excellent setting for intervention development and implementation to target children and adolescents PA behaviour and FMS development, however these interventions must be well-planned and multi-component to obtain long-term positive results (Timperio et al., 2004). From this literature review there is strong rationale presented to support a multi-component whole-school approach when targeting children and youth's PA and FMS levels. Providing effective PE which not only teaches students FMS but also educates them on self-management and PA benefits, including the whole school and a family element seems to produce positive results (O' Brien et al., 2013; Saunders, Ward, Felton, Dowda, & Pate, 2006).

It is important when developing and evaluating interventions that a framework such as that suggested by the MRC be adhered to (Campbell et al., 2000). The Y-PATH study (Belton et al. 2014) is one such intervention which has been developed following these exact guidelines. This intervention focuses on developing PA and FMS through PE (Belton et al. 2014), and has achieved positive results among the adolescent population (O' Brien et al. 2013), however, it must undergo further investigation (O' Brien et al. 2013). Given the lack of development of FMS among adolescents it is essential that a school based FMS programme such as Y-PATH be robustly evaluated prior to the final phase on the MRC framework i.e. long-term implementation.

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Chapter 3

Physical self-confidence levels of adolescents: Scale reliability and validity.

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3.1 Abstract

Objectives: To establish reliability, content validity and concurrent validity of the physical self-confidence scale among adolescents. Demonstrate the use of this scale to assess the physical self-confidence of adolescents across genders at performing specific fundamental movement skills (FMS).

Design: Three hundred and seventy six adolescents were involved in this study. A 15 item scale was developed to assess physical self-confidence.

Methods: The scale was developed based on 15 specific FMS. Experts in the field reviewed the scale to ensure content validity. The reliability of the scale was assessed on a sub-sample of 67 participants who answered the scale 7-days apart. Concurrent validity was assessed on the sub-sample using the Physical Self-Perception Profile (PSPP) as a comparative tool. 376 adolescents completed the physical self-confidence scale (mean age=13.78, SD=±1.21, males n=193) to assess gender differences, and also their levels of physical self-confidence across all skills.

Results: An Intra Class Correlation indicated excellent test retest reliability for the scale with an overall r=0.92. Content validity and concurrent validity were also good, with the scale achieving a correlation coefficient of 0.72 with the PSPP. Males possess significantly higher physical self-confidence than females across all items.

Conclusions: This scale is the first reliable and valid tool which specifically measures physical self-confidence in performing FMS among male and female adolescents. The results highlight gender differences in physical self-confidence and emphasise the importance of measuring this at skill level as differences were task specific. This scale will facilitate future research examining the relationship between self-confidence, FMS proficiency and physical activity participation.

Key words: youth; movement skill; locomotor; object control; perceived competence; self-efficacy.

3.2 Introduction

Fundamental movement skills (FMS) are goal-directed movement patterns which consist of the performance of locomotor, object control and balance skills (Gallahue et al. 2012). FMS allow children, in daily activities, to move from one location to another and/or to respond appropriately to a variety of conditions. They are seen as the building blocks for more advanced physical activity (PA) and sport specific skills (Gallahue et al. 2012). Due to their use in every-day life, a high level of FMS proficiency among children and adolescents is considered as a key contributor of future participation in sports and physical activities (Booth et al., 1999). Children between the ages of 6 to 12 years with advanced FMS spend more time engaged in PA behaviours in comparison with children with low levels of FMS proficiency (Hardy et al. 2013). To better understand the acquisition of FMS alongside children and adolescents' levels of PA; it is crucial to consider mediators, such as confidence, that may account for the motor development of adolescents (Lubans et al. 2008).

Children do not solely acquire FMS as a result of maturation and free play; these skills must also be taught (Dollman et al. 2008). However, differences in learning environments and duration of practice can affect FMS levels, resulting in children not being at the required proficiency level of FMS in order to advance to sport specific skills (Hastie et al. 2009). FMS are a key feature of primary school physical education (PE) programs (Booth et al., 1997) yet, high numbers of children are leaving primary school lacking in these basic physical skills (O' Brien et al. 2015). Children and early adolescents then enter a new PE environment with new peers where this lack of proficiency may translate into a lack of confidence in performing specific skills (O' Keefe & Smyth 1999). Additionally, at this age the emphasis in sports clubs and extra-curricular activities is progressing onto sport skill development and competition. Therefore, it is of no surprise if youth shy away from participating in sport and PA due to the fear of demonstrating a lack of FMS proficiency (Harter & Pike 1984). This lack of confidence may lead to withdrawal from participating in PA (sports or free play) creating a vicious circle that will consequently result in the reduction of the necessary practice of these FMS (Stodden et al. 2008). This lack of confidence is likely to increase as children progress and enter a new school environment at 11-12 years of age.

According to McAuley and Gill (1983), self-confidence is a necessity for achieving success in a sporting performance. They also state that this confidence may be skill and situation specific. For example, during a basketball game a player may feel highly confident passing the ball but may exhibit low-confidence dribbling the ball up the court. Bandura (1986) refers to this type of specific confidence as self-efficacy and proposes that it provokes behavioural change. Self-efficacy expectations influence persistence, thoughts, stimulation, and behaviour as positive self perceptions lead to positive experiences (Bandura 1986). It is also suggested that general physical self-efficacy is associated with the performance of basic tasks such as FMS (Ryckman et al. 1982). However, according to McAuley and Gill (1983), the influence physical self-efficacy has on the performance of complex physical activities is uncertain. They state that it would be plausible to suggest that physical self-efficacy affects a more task-specific self-efficacy which consequently, influences how well one expects to perform (i.e. perceived motor competence), which ultimately may affect performance (McAuley & Gill 1983).

It is important to assess both FMS proficiency and psychological variables such as physical self-confidence to ensure an optimal learning environment and to promote success for all levels (Duda 1992). There are various instruments which assess self-efficacy and perceived motor competency on a broader scale for example the Physical Self Perception Profile (PSPP) (Fox 1990). The PSPP is divided into four sub-domains of self-perception: sports competence, attractive body, physical strength and physical condition which all include questions about confidence (Fox 1990; Barnett et al. 2009). The PSPP was used by Barnett et al. (2008) in a study to assess adolescents perceived sports competence, however i) the PSPP is not skill specific and ii) does not measure confidence as a specific and stand-alone construct (Barnett et al. 2008). As Barnett et al. (2015) suggest, a limitation of current research is the lack of an instrument to assess perceived motor competence specific to FMS among youth. This led to the development of a skill specific pictorial scale (Barnett et al. 2015) used to assess the perceived motor competence of children based on the skills of the Test of Gross Motor Development-2nd Edition (TGMD-2) (Ulrich 2000). Barnett et al. (2015) developed their scale for use with children and therefore a pictorial scale was appropriate, however for adolescents a scale such as a likert scale may be more suitable (Harter & Pike 1984). A gap still remains as there is no instrument for adolescents measuring physical self-confidence in relation to specific skills. Such a scale would provide information on an important correlate of PA at a stage where behavioural change occurs and participation begins to decline rapidly (van Sluijs et al. 2007). It is important that the physical self-confidence levels of this age group are assessed across males and females as there may be gender differences which perhaps account for the decline in PA levels during adolescence particularly among females (Barnett et al. 2009; Barnett et al. 2008; Barnett et al. 2015). Building and encouraging confidence plays an important role in maintaining participation levels (O'Donovan et al. 2010). By assessing this age group's physical self-confidence it will therefore highlight those who require support and specific attention. This study aims to assess the content validity, concurrent validity and reliability of a physical self-confidence scale among adolescents. It will also investigate physical self-confidence levels and explore any differences in scores between genders.

3.3 Methods

Three hundred and seventy six adolescents (males n=193, females n=183) with a mean age of 13.78 years old (SD=±1.21) completed the physical self-confidence scale. Participants were recruited from second year classes throughout 21 schools in the Leinster region in Ireland. Ethical approval was granted by Dublin City University Research Ethics Committee. Parental consent and participant assent were obtained prior to administration. Scales were completed in school, with each school given the option of using an online version (through survey monkey) or pen and paper to answer the questions. The ratio of participant:researcher was 10:1. Prior to completion of the scale the researcher introduced the purpose of the study and encouraged participants to answer the questions honestly.

The physical self-confidence scale, developed by a team of experts in the area of FMS assessment, uses 15 questions in which participants rate their perceived confidence at performing 15 specific skills. Twelve of these questions were derived from the skills assessed in the TGMD-2 (run, leap, gallop, slide, horizontal jump, hop, catch, throw, roll, kick, strike and stationary dribble) (Ulrich 2000). The remaining 3 questions were based on 3 additional skills (skip, balance and vertical jump) from the TGMD (Ulrich 1985) and Victorian skills tests (Dept of Ed. Victoria, 1996) as these were deemed central to the Irish sporting culture (O' Brien et al. 2015; Woods et al. 2010). The participants were asked to rate their confidence at performing each skill on a likert scale of 1-10, "1" being not confident at all and "10" being very confident. The scale development was based on a PA self-efficacy scale that had then been adapted by Nigg and Courneya (1998) to assess adolescent perceived confidence in general PA. These instruments gave the stem and grading structure to the physical self-confidence scale, however neither of these instruments were skill specific, which is a novel aspect that the physical self-confidence scale accounts for. Barnett et al. (2015) have previously created a skill specific pictorial scale for children (age=5-8 years) based on the description of each skill in the TGMD-2 (Ulrich 2000). It was decided to use questions instead of pictures when developing the physical self-confidence scale as it was more age appropriate and efficient for adolescents (Harter & Pike 1984). Prior to administration, both scale and protocol had been reviewed by 8 experts in the field to ensure clarity and aptness for each question. When ensuring content validity, it was decided to alter the question on the "slide" skill to calling it the "slide (side shuffle)" as experts felt that it could be misinterpreted. All other questions contained the original wording in order to match the TGMD-2. For example: "How confident on a scale of 1-10 are you at the following skill: Catch a tennis ball with two hands? Run in a straight line? Kick a stationary ball that is placed in front of you? Hop 3 times on each foot? Jump as far as you can?"

Test-retest reliability was assessed using an intraclass correlation on a (convenience) sub-sample of 67 participants (males n=36, and females n=31). This sub-sample completed the scale on two occasions 7 days apart under the same setting and using the same protocol. The intraclass correlation was conducted for each individual skill item in the scale. The skills were then categorised into locomotor, object control, balance and the overall physical self-confidence total score. An intraclass correlation was completed using each of these categories.

To assess concurrent validity a Pearson product-moment correlation coefficient was calculated between the physical self-confidence scale and the PSPP as this is deemed an appropriate tool for use with this age group and included various questions on participants' confidence (Fox 1990; Barnett et al. 2008).

A Mann Whitney U test was conducted using data from 376 participants to assess any differences in physical self-confidence levels across genders in overall physical self-confidence scores and then in self-confidence scores for each of the skills. All statistical analyses were completed using SPSS version 21.

3.4 Results

The individual ICCs for all 15 skills are presented in Table 3.1 below. The Cronbach alpha coefficient for all 15 skills combined was 0.92, for the locomotor category the Cronbach alpha coefficient was 0.88 and for the object control category the Cronbach alpha coefficient was 0.92 highlighting that is a reliable scale. All skills individually achieved an ICC of ≥ 0.60.

Preliminary analysis was performed to assess the potential violation of the assumptions of normality, linearity and homoscedasticity. There was a strong positive correlation found between the overall physical self-confidence scale and physical self-worth domain of the PSPP ($r=0.72$, $p<0.001$). When assessed in further detail there was a significant positive correlation found between the physical self-confidence scale and all four sub-domains of the PSPP (see Table 3.2). The relationship between the physical self-confidence scale and the sub-domain 'perceived sports competence' resulted in the highest correlation coefficient ($r=0.78$, $p<0.001$).

Results from the Mann Whitney U test highlighted a significant gender difference in overall physical self-confidence with males ($M=207.6$) scoring significantly higher than females ($M=166.51$, $p<0.001$). This was also the case for both overall locomotor physical self-confidence score (male $M=207.04$, female $M=167.11$, $p<0.001$) and overall object control physical self-confidence score (male $M=207.65$, female $M=168.30$, $p<0.001$). There were also significant gender differences observed among each individual skill (see Table 3.3).

Table 3.1. Reliability of each skill item in the Physical Self-Confidence Scale

PSC on each skill	n	Mean at Time 1	Mean at Time 2	ICC
Run	n=67	6.72	7.27	0.80
Skip	n=67	6.82	6.89	0.87
Leap	n=67	7.28	7.29	0.88
Gallop	n=67	7.00	6.79	0.84
Slide	n=67	7.09	6.79	0.81
Hop	n=67	7.04	6.91	0.85
Vertical jump	n=67	7.06	6.86	0.82
Horizontal Jump	n=67	6.94	7.04	0.85
Catch	n=67	7.04	6.86	0.85
Kick	n=67	6.85	6.77	0.92
Strike	n=67	6.57	6.26	0.88
Dribble	n=67	7.34	7.10	0.90
Throw	n=67	7.01	6.7	0.83
Roll	n=67	7.15	6.98	0.94
Balance	n=67	6.76	5.88	0.63

ICC=Intraclass correlation coefficient, PSC=Physical self-confidence

Table 3.2. Concurrent Validity of each skill item in the Physical Self-Confidence Scale PSC=Physical self-confidence, PSPP=Physical self perception profile PSW=Physical self worth (Fox 1990)

		Sport PSPP	Condition PSPP	Body PSPP	Strength PSPP	PSW PSPP
PSC Run	r=	0.70	0.45	0.49	0.32	0.65
	p=	0.00	0.00	0.00	0.01	0.00
PSC skip	r=	0.73	0.45	0.53	0.30	0.65
	p=	0.00	0.00	0.00	0.01	0.00
PSC Leap	r=	0.73	0.49	0.58	0.36	0.71
	p=	0.00	0.00	0.00	0.00	0.00
PSC Gallop	r=	0.75	0.46	0.58	0.32	0.69
	p=	0.00	0.00	0.00	0.01	0.00
PSC Slide	r=	0.73	0.42	0.59	0.28	0.65
	p=	0.00	0.00	0.00	0.02	0.00
PSC Vertical jump	r=	0.79	0.51	0.60	0.31	0.73
	p=	0.00	0.00	0.00	0.01	0.00
PSC Horizontal jump	r=	0.79	0.54	0.64	0.31	0.72
	p=	0.00	0.00	0.00	0.01	0.00
PSC Throw	r=	0.73	0.48	0.62	0.28	0.67
	p=	0.00	0.00	0.00	0.02	0.00
PSC Catch	r=	0.77	0.48	0.56	0.27	0.69
	p=	0.00	0.00	0.00	0.03	0.00
PSC Kick	r=	0.69	0.47	0.53	0.36	0.65
	p=	0.00	0.00	0.00	0.00	0.00
PSC Strike	r=	0.68	0.46	0.52	0.30	0.65
	p=	0.00	0.00	0.00	0.01	0.00
PSC Dribble	r=	0.76	0.51	0.58	0.34	0.69
	p=	0.00	0.00	0.00	0.00	0.00
PSC Balance	r=	0.76	0.54	0.55	0.33	0.72
	p=	0.00	0.00	0.00	0.01	0.00
PSC Hop	r=	0.76	0.54	0.58	0.30	0.69
	p=	0.00	0.00	0.00	0.01	0.00
PSC Roll	r=	0.78	0.54	0.56	0.33	0.70
	p=	0.00	0.00	0.00	0.01	0.00

Table 3.3. Gender differences in physical self-confidence

		Male (n=193)			Female (n=183)		
PSC on each skill	**p=**	**Mean**	**SD**	**Median**	**Mean**	**SD**	**Median**
Run	0.00	7.93	3.25	10.00	7.17	3.11	8.00
Skip	0.01	7.87	3.18	10.00	7.18	3.05	8.00
Leap	0.00	8.21	3.10	10.00	7.81	2.8	9.00
Gallop	0.00	8.09	3.04	10.00	7.46	2.86	9.00
Slide	0.00	8.18	2.95	10.00	7.36	2.89	8.00
Hop	0.00	8.17	2.99	10.00	7.39	2.83	8.00
Vertical Jump	0.00	8.09	3.06	10.00	7.13	3.00	8.00
Horizontal Jump	0.00	7.83	3.11	10.00	6.77	3.11	7.00
Catch	0.01	8.19	3.00	10.00	7.77	2.66	9.00
Kick	0.00	8.14	2.96	10.00	7.40	2.83	8.00
Strike	0.00	7.91	3.05	10.00	7.03	2.90	7.00
Dribble	0.01	8.26	2.93	10.00	7.93	2.58	9.00
Throw	0.01	8.13	2.96	10.00	7.51	2.86	9.00
Roll	0.00	8.25	2.98	10.00	7.83	2.70	9.00
Balance	0.01	7.79	3.08	10.00	7.31	2.84	8.00

PSC=Physical self-confidence

3.5 Discussion

This study investigated the reliability, content validity and concurrent validity of the physical self-confidence scale which is designed to assess adolescents' confidence in their FMS proficiency. Barnett et al. (2015) previously developed a pictorial scale which measures skill specific perceived motor competency for children using the TGMD-2. This paper is an extension of their work in validating a physical self-confidence scale with an adolescent population. The methods followed to assess the reliability and content validity were similar to that of the pictorial scale as the scale was reviewed by experts prior to administration and then completed again 7 days apart (Barnett et al. 2015). The ICC results achieved were also similar to that of Barnett et al. (2015) as the highest ICC they achieved was 0.81 for all skills, where as the ICC achieved for all skills in the physical self-confidence scale was 0.92. Barnett et al. (2015) do not assess the concurrent validity of their scale whereas this study also shows the concurrent validity of the physical self-confidence scale. It is important that physical self-confidence is assessed using a reliable and valid scale among this age group as children who leave school with confidence in their FMS are more likely to adhere to an active lifestyle as they age (Woods et al. 2010). Furthermore, Bandura (1986) states that task specific confidence is a mediator for behavioural change. Therefore this scale can be used to prevent the frequently observed drop out in PA during adolescence by highlighting those who lack physical self-confidence.

There are various assessment tools which have been used to measure self-efficacy and perceived motor competence, however none of these tools measure skill specific physical self-confidence. The PSPP was chosen as a comparative scale as it was the most comparable scale valid for use with this age group. It contains overall physical self-worth which included various questions on confidence (Fox 1990). Barnett et al. (2008) stated the PSPP is the most specific assessment tool for use in relation to sports rather than general PA. The physical self-confidence scale achieved significant positive correlations with all four sub-domains and the overall physical self worth domain of the PSPP. The highest significant correlation coefficient was achieved between the physical self-confidence scale and the sports competence scale ($r=0.78$, $p<0.001$). This finding was expected considering the close relationship between physical self-confidence and sports competence (Barnett et al. 2008). It also highlights the close relationship between perceived competence and physical self-confidence. These high correlations support the concurrent validity of the physical self-confidence scale for use with adolescents.

In this study, females had significantly lower physical self-confidence than males, consistent with Barnett et al. (2008). The study by Barnett et al. (2008) highlights that females (age=14-18years) have lower perceived sports competence, are less fit and less active than males. It is suggested that females may feel less confident than males at performing FMS, due to them being less proficient at FMS (O' Brien et al. 2015). When taking into account that high levels of FMS proficiency should be achieved by the age of 10 (Ulrich 2000), it may in part explain why there is a higher dropout rate of females participating in PA and sport in comparison with males (Biddle et al. 2003). Females also scored significantly lower than males in physical self-confidence in each specific skill (see Table 3.3). Males and females both felt most confident at competently performing the dribble skill, however males felt least confident at performing the balance skill whereas females felt least confident at performing the strike skill. These differences may be due to behavioural consequences as a result of males and females participating in different types of sport and/or physical activities (Dollman et al. 2008). There may also be skill differences as a result of environmental factors which could be reduced if girls are provided with the same opportunities for instruction, practice, feedback and encouragement as boys (Thomas 2000). It is important that self-confidence is measured on a skill by skill basis as those who are confident at performing one skill may not feel confident at performing others (McAuley & Gill 1983). The fact that self-confidence is skill specific reiterates the usefulness of this scale as it will highlight specific skills that may require feedback or specific support, which may then assist researchers and practitioners in the development of an appropriate intervention.

It is essential to assess and monitor the correlates of PA participation such as physical self-confidence and FMS to highlight those at risk of dropping out of PA and sport (Barnett et al. 2009). According to the results of this study and research (Mandigo et al. 2008), females would be at most risk of low FMS proficiency levels and dropping out of PA due to their low physical self-confidence scores at FMS they should be proficient at. Stodden et al. (2007) proposed a model which highlights that youth with higher levels of FMS proficiency and perceived motor competence are more likely to be physically active, subsequently providing them with more opportunities to further develop their FMS and confidence. Considering this model and the results of this study, the physical self-confidence scale can be used to highlight those with low self-confidence as being at risk of ceasing participation in PA and sport, as well as not achieving high levels of FMS proficiency.

3.6 Conclusion

The results of this study demonstrate that the physical self-confidence scale is a reliable and valid instrument for use with adolescents. It builds on the strengths of previous psychological scales and is a short concise scale for ease of use in research, clinical or education settings. It is the first valid and reliable instrument that has been developed to assess physical self-confidence in adolescents, and at a skill specific level. Results suggest that gender differences and self-confidence differences exist between FMS for each of the genders. This scale highlights possible candidates, in particular females, and the specific skills which may require specific attention from researchers and practitioners. It is important to note that this study occurred on an Irish population and therefore caution should be taken if considering generalising these results beyond Irish adolescents, therefore future research may want to expand to other countries. Future research should also use this assessment tool to examine the relationship between adolescent's self-confidence at performing a range of skills, and their actual FMS proficiency level. This could in turn be used to facilitate intervention development for those participants at risk of ceasing participation in PA.

3.7 Practical Implications

-This instrument may be used to assess physical self-confidence among adolescents.

-This instrument may be used to assess the relationship between FMS proficiency and self-confidence.

-This instrument may be used to help shape an intervention aimed at adolescents who may drop out or have dropped out of PA and sport by identifying specific FMS they are not confident at performing.

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Link Section Chapter 3 to Chapter 4

Purpose of Chapter 3:

Chapter 3 addressed a noticeable gap in literature as to date there has been no instrument, validated for adolescents, measuring physical self-confidence in relation to specific skills. This physical self-confidence scale provides information on an important correlate of PA at a stage where behavioural change occurs, and participation begins to decline rapidly. It is important that the physical self-confidence levels of this age group can be assessed and those for both males and females to take into consideration potential gender differences. Gender seems to be a key element to consider for this age group as it could account for the decline in PA levels during adolescence. The assessment of adolescents' physical self-confidence highlights those who require support and specific attention. Hence, this chapter provided the first reliable and valid tool which specifically measures physical self-confidence in performing FMS among adolescents. The results highlighted gender differences in physical self-confidence levels, and emphasised the importance of measuring physical self-confidence at skill level. The validation of this new scale was a key factor prior to being used in Chapter 4.

Purpose of Chapter 4:

Chapter 4 uses the physical self-confidence scale to assess the relationship between physical self-confidence and FMS proficiency. Lubans et al. (2010) highlight that there is limited research assessing this relationship, and therefore any association which has been made to date between the two variables remains uncertain. Unlike previous research, where a generalised confidence scale has been used, this chapter uses the skill specific scale to assess physical self-confidence with all questions corresponding to the specific assessment tool used to examine FMS proficiency. This chapter will also assess any gender differences which may exist in FMS proficiency levels or physical self-confidence levels of participants. It is important that gender is taken into account when assessing these variables and the relationship between them, as previous research highlights discrepancies across gender. Furthermore, assessing these variables and their relationship will not only highlight those in need of interventions, but will also facilitate in the development of interventions. The nature and type of relationship between FMS proficiency and self-confidence would vary amongst adolescents. This would mean some adolescents may require particular attention and a different intervention focus specifically targeting their requirements.

Chapter 4

The relationship between fundamental movement skill proficiency and physical self-confidence; Are adolescents as good as they think?

Manuscript submitted as: The relationship between fundamental movement skill proficiency and physical self-confidence; Are adolescents as good as they think? McGrane, B., Belton, S., Powell, D., and Issartel, J. (Journal of Adolescent Health June 2015).

4.1 Abstract:

Objectives: To assess adolescent fundamental movement skill proficiency (FMS), physical self-confidence levels, and the relationship between these variables, and to investigate any gender differences.

Design: Five hundred and six adolescents aged 13.78 years (SD=±1.2) from 20 schools were involved in this study.

Methods: Using the TGMD-2, the TGMD and the Victorian Skills Manual, 15 FMS were assessed. Participants' physical self-confidence was also assessed using a skill-specific scale which was developed and validated for use alongside assessment of specific FMS. Separate correlations were used to assess the relationship between participants FMS proficiency and their physical self-confidence for male and female. A chi-square was conducted to assess the association between gender and physical-self confidence group. Between groups ANOVAs were conducted to explore the impact of gender and physical self-confidence group on FMS total score, locomotor score and object control score.

Results: A significant correlation was observed between FMS proficiency and physical self-confidence for females only ($r=0.305$, $p<0.001$). Males rated themselves as having significantly higher physical self-confidence levels than females ($p=0.001$). There was a significant main effect for both gender and physical self-confidence groups on FMS proficiency; post hoc comparisons indicated that males scored significantly higher than females in FMS proficiency, and the lowest physical self-confidence group were significantly less proficient at FMS than the medium and high physical self-confidence groups.

Conclusion: The results highlight a relationship exists between female's physical self-confidence and FMS proficiency. It also highlights that those with low physical self-confidence have lower FMS proficiency than those with higher physical self-confidence. This information not only highlights those in need of an intervention but will also facilitate in the development of the intervention.

Key words: youth; motor skill; locomotor; object control; perceived competence; self-efficacy.

4.2 Introduction

Fundamental movement skills (FMS) are regarded as the prerequisite for more complex motor skills and movement patterns (Gallahue & Ozmun 2006). They are categorised into three different domains: locomotor, object control and stability skills, whereby they represent the performance competency required for participation in physical activity (PA) during life (Isaacs & Payne 2002). From childhood to adolescence continual movement changes, are observed in a sequential manner with the development of FMS followed by the development of sport specific skills (Gallahue & Ozmun 2006). It is important to note that children do not only acquire these skills as a result of maturation but they also must be taught (Isaacs & Payne 2002). By the time children are age 10 they should reach mastery level in FMS performance (Gallahue & Ozmun 2006). However, differences in various factors such as teachers, learning environments and exposure to free-play may affect FMS development levels, resulting in children not being at the required mastery level of FMS in order to advance to sport specific skills (Logan et al. 2011; Breslin et al. 2012).

Research has identified several factors influencing the development of FMS proficiency: age, gender, PA and self-confidence, (Armstrong & Welsman 2006). Adolescence is a transitional period of life marked by many biological, environmental, social, and psychological transformations, and these changes in turn may affect the level of FMS proficiency (Garcia 1994). Davies and Rose (2000) highlight that "Investigators have suggested that these physiological and anatomical changes during puberty…[such as growth spurts]…may contribute to motor performance differences between males and females" (p.39). This would suggest that depending on age, there may be gender differences within FMS as a result of puberty. Dorn et al. (2006) stated that gender differences after puberty may be due to biological factors with males becoming stronger and taller so therefore would be more proficient than girls in FMS requiring strength such as throwing and running. Before puberty however, there are little differences between males and females physically, therefore environmental factors are the main reason for gender differences in the majority of motor tasks (Thomas, Nelson, & Church, 1991). This view is supported by Pääsuke and Raudsepp (1995) who stated that if only biological variables were used to predict motor performance, they would only explain 30% of the performance variance on average. During adolescence as well as undergoing puberty, they also experience a transition in educational settings as they move from primary to second level education. According to Bandura (2005), this transition may result in a change in self-efficacy and confidence levels as they must re-establish social status and self-confidence in a new environment with new peers; for example a new PE environment may affect their self-confidence which may magnify any lack of FMS proficiency. Additionally, at this age the emphasis in sports clubs and extra-curricular activities is on progressing to sport skill development and competition. This may result in a change of skill practice due to the fear of demonstrating a lack of motor skill proficiency (Piek et al. 2006), which may be even greater for those with low self-confidence, as the concept of self-confidence and FMS proficiency seem to be related in some way (Lubans et al. 2010).

Harter (1981) proposed a model explaining the relationship between perceived motor competence and FMS. The model proposed that actual competence leads to perceived competence, with perceived competence leading more to motivation for participation than actual competence. Griffin and Keogh (1982) have also suggested that actual competence influences perceived competence which in turn affects PA participation choices. Stodden et al. (2008) proposed a model (see Figure 4.1) that describes this developmental dynamic and reciprocal relationship, as a *"positive spiral of engagement"*. This model highlights that youth with higher levels of actual and perceived motor competence, are more likely to be physically active, subsequently providing them with more opportunities to further develop confidence and proficiency in the performance of motor skills (Stodden et al., 2008). Bandura (2005) refers to this type of specific confidence as self-efficacy and proposes that it provokes behavioural change. Self-efficacy expectations influence persistence, thoughts, stimulation, and behaviour as positive self-perceptions leading to positive experiences (Bandura 2005). It is also suggested that general physical self-efficacy is associated with the performance of basic tasks such as FMS (Ryckman et al. 1982). Stodden's theoretical model (2008) also suggests a positive relationship between the two correlates, however limited research has been carried out exploring this relationship among adolescents.

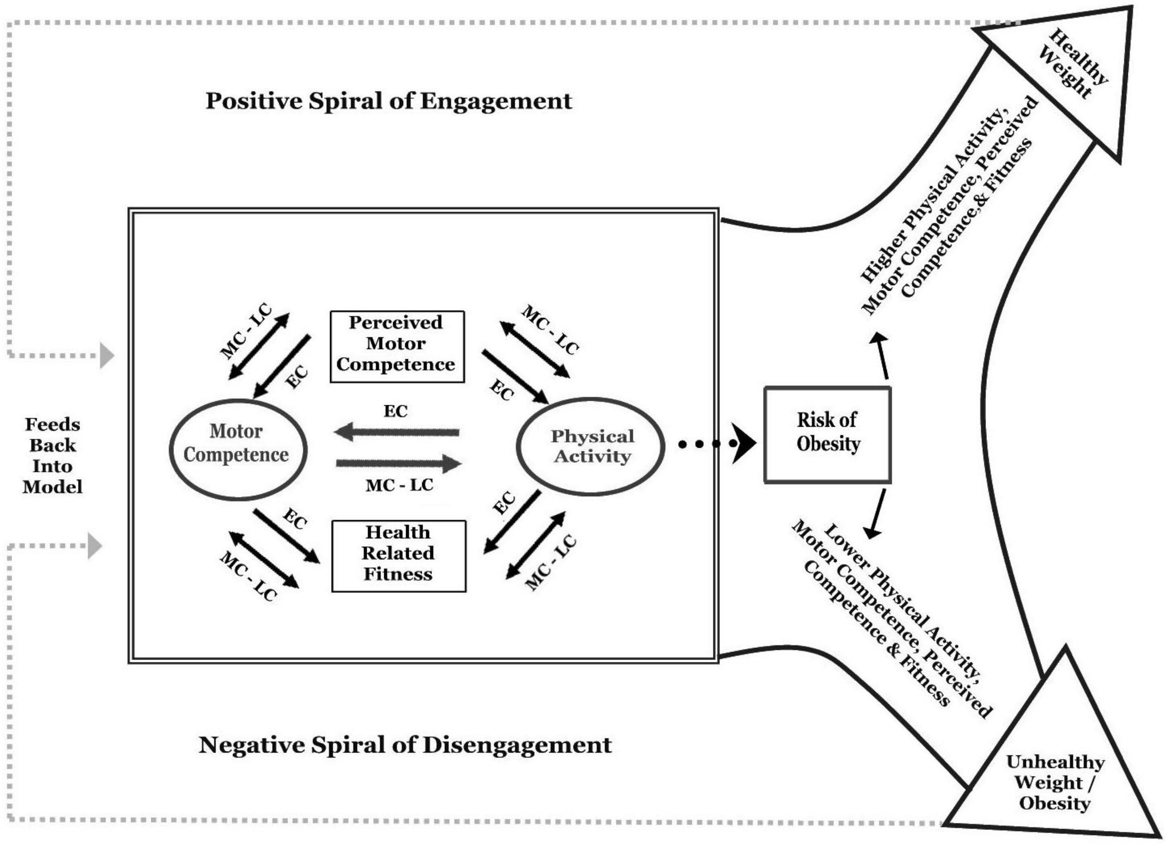


Figure 4.1. Developmental mechanisms influencing physical activity trajectories of children (Stodden et al., 2008)

Assessing adolescent's self-confidence and FMS will provide information on confidence and FMS ability levels which may assist in creating an optimal motivational climate for all. Dweck (1991) states that those with high performance ability and high self-confidence will continue to choose challenging tasks providing they have a chance of achieving success. Those with high performance ability and low confidence in their ability will choose less challenging tasks that require less effort and will ensure success, which may result in deterioration in performance over time (Dweck 1991). Those who possess low performance ability and high confidence in their ability will have unrealistic expectations which will lead to a sense of failure and loss of motivation (Dweck 1991). There are few studies highlighting the relationship between perceived motor competence, confidence levels and FMS levels (Barnett et al. 2008; Robinson 2011; Colella et al. 2008), In a review of the benefits of FMS competency Lubans et al. (2010) states that the association between perceived competence and FMS proficiency is uncertain due to the limited amount of studies conducted assessing this relationship. There are also no studies published to date that look at FMS and physical self-confidence levels among adolescents at a skill specific level as none have previously used a physical self-confidence scale which is skill specific. This is a crucial age group to look at these elements, as outlined previously, it is a period in their life where many developmental, social and psychological changes occur. It is known that some children are entering adolescence lacking the proficiency required to progress onto sport specific skills (O' Brien et al. 2015), therefore it is essential for more researchers to assess FMS at this critical period to determine exact development levels and highlight specific areas to target for improvement.

It is evident that there is a lack of research assessing the relationship between physical self-confidence and FMS proficiency specifically among adolescents. This study aims to assist in the examination of this relationship between adolescents FMS and physical self-confidence levels, to investigate the relationship between the two variables, and also to explore difference by gender.

4.3 Methods

Participants

In total 506 participants (52% males, 48% females) were recruited to this study from second year classes throughout 20 schools in the Dublin Region, Ireland. Ethical Approval was granted by the University Research Ethics Committee. Three hundred and ninety five adolescents (males n=199, females n=196) with a mean age of 13.78 years old (SD=±1.2) had full data available from the FMS assessment, and 309 of these fully completed the physical self-confidence scale (males n=157, females n=152).

Procedures

Fifteen FMS were assessed during a regular 80 minute PE class at the participants' school. The Test of Gross Motor Development-2nd Edition (TGMD-2) (Ulrich 2000) was used to assess 12 of these skills which were made up of 6 locomotor (run, hop, gallop, slide, leap and horizontal jump) and 6 object control skills (catch, kick, throw, dribble, strike and roll). The remaining three skills comprised of the skip, vertical jump and the balance, which were assessed using the Victorian Fundamental Movement Skills Manual (Department of Education,Victoria, 1996) and the Test of Gross Motor Development (TGMD) (Ulrich 1985). These skills were included as they were deemed relevant to the Irish sporting culture (Woods et al. 2010).

As per protocol of the relevant assessment tools, participants received a brief description of each skill and observed the FMS trained researchers demonstrating each of the skills once. They then completed one practice go and two trials of each skill with no feedback given at any stage. All trials were video recorded. Prior to data analysis a minimum of 95% inter-rater and intra-rater reliability was achieved by researchers. Skills were then analysed as per assessment tool guidelines scoring a "1" if the component of the skills is present and a "0" if it is absent (Ulrich 2000). For each FMS, the two test trials were added together to get the total score for each skill. Scores were then totalled to give and overall locomotor, overall object control and overall FMS score.

Participants' physical self-confidence was assessed using the physical self-confidence scale. This scale is a valid and reliable assessment tool for measurement of adolescent's physical self-confidence (See Chapter 3). It consists of 15 questions in which participants rate their confidence at performing each of the 15 FMS. Participants rated their confidence at performing each skill on a likert scale of 1-10, "1" being not confident at all and "10" being very confident. The maximum physical self-confidence score which could be achieved was 150 if participants scored their confidence at 10/10 for performing all 15 skills.

Data analysis

Pearson product correlation coefficients were conducted to explore the relationship between FMS and physical self-confidence overall and for each gender. Participants were divided into 3 tertiles based on physical self-confidence using visual binning in SPSS (≤119 was the low physical self-confidence group, 120-148 was the medium physical self-confidence group and 149+ was the high physical self-confidence group). A chi-square was conducted to assess the association between genders and physical self-confidence groups. Separate between groups ANOVAs (with Tukey HSD post hoc analysis) were used to investigate the effect of gender and physical self-confidence category on overall FMS score, locomotor score and object control score. Data were analysed using SPSS version 21.

4.4 Results

A small significant correlation was found between physical self-confidence and FMS across all participants (r=0.219, p=0.000), however when this analysis was conducted separately by each gender, a medium significant correlation was found for females (r=0.305, p<0.001) with no significant correlation for males (r=0.101, p=0.209).

The overall mean FMS score of participants was 98.75 (SD=±15.45). Mean skill by skill and total scores by gender, for FMS, locomotor, object control and physical self-confidence, are given in Table 4.1 below. Mean physical self-confidence scores for the three physical self-confidence groups were as follows; low = 97.24 (SD=±6.45), medium = 100.5 (SD=±4.89) and high = 100.06 (SD=±6.43). Results of the chi-square indicated a significant association of medium effect size between gender and physical self-confidence group (χ^2 (2, n=309) =26.31, p=0.00, Cramer's V=0.292). It is evident from the chi-square results in Table 4.2 that males score higher than females in physical self-confidence.

Results of the between groups ANOVA on total FMS score demonstrated a significant main effect for gender (F (2, 304) =5.210, p=0.023, partial eta squared=0.02), with males (mean=99.92, SD= ± 6.21) scoring significantly higher than females (mean=97.57, SD=±6.02). There was also a significant main effect for physical self-confidence groups (F (2,304) =6.179, p=0.002, partial eta squared=0.039). Post Hoc comparisons indicated a significant difference in FMS score between the low and medium (p = 0.000), and the low and high (p = 0.002) physical self-confidence groups. There was no significant interaction between gender and physical self-confidence group (F (2,304) =.818, p=0.66).

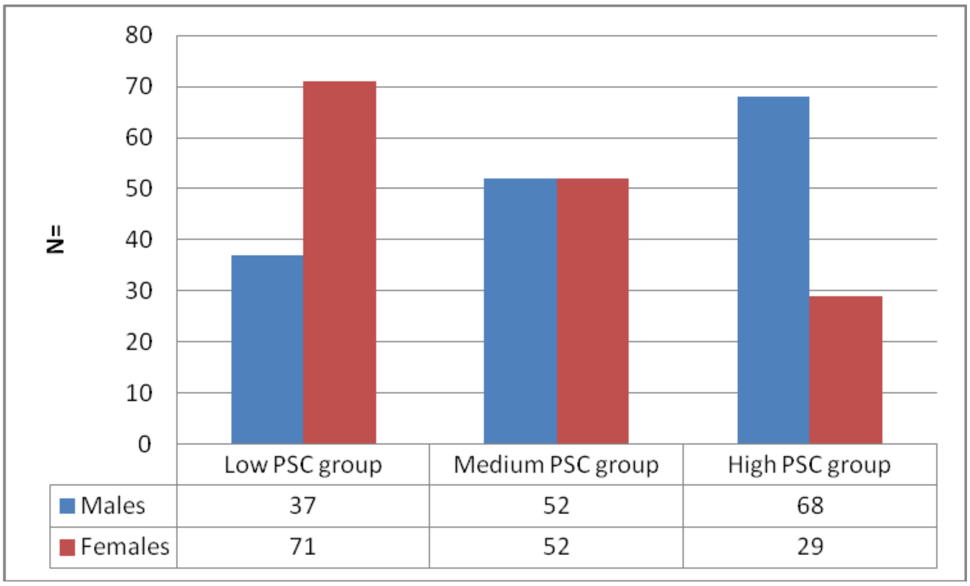
Results of the between groups ANOVA on locomotor score and object control score demonstrated a significant main effect for gender (F (2, 302) =5.479, p=.005, partial eta squared=0.035). There were significant differences between males and females in object control skill proficiency with males scoring higher than females (male mean=42.67 SD=±3.66, female mean=40.92, SD=±3.78, $p<0.001$) out of a maximum possible score of 48. However, there was no significant difference between genders in locomotor proficiency but again both genders scored below the maximum possible score of 66 level (male mean=57.25, SD=±4.27, female mean=56.65, SD=±4.25, $p=0.751$). Post hoc comparisons indicated a significant difference in object control scores between the low and medium ($p<0.01$), and the low and high ($p <0.05$) physical self-confidence groups. This was also the case for locomotor scores. There was no significant interaction between gender and physical self-confidence group ($F (4,604) =.543$, $p=0.74$).

Table 4.1. Mean scores for FMS and physical self-confidence by gender

Skill	FMS			PSC		
	Male	Female	Total	Male	Female	Total
Run	7.83 ±0.55	7.75 ±0.73	7.79 ±0.64	8.17* ±3.17	7.32 ±2.97	7.74 ±3.07
Gallop	6.92 ±1.62	6.81 ±1.39	6.86 ±1.51	8.31* ±2.99	7.59 ±2.73	7.95 ±2.86
Hop	7.74 ±1.48	7.62 ±1.37	7.68 ±1.43	8.37** ±2.91	7.54 ±2.72	7.95 ±2.81
Leap	5.44 ±0.90	5.73** ±0.62	5.58 ±0.76	8.44 ±3.01	7.91 ±2.69	8.18 ±2.85
Horizontal Jump	7.09** ±1.29	6.53 ±1.69	6.81 ±1.49	8.01** ±3.11	6.77 ±3.08	7.39 ±3.10
Slide	6.78** ±1.05	6.51 ±0.98	6.64 ±1.02	8.43** ±2.88	7.43 ±2.78	7.93 ±2.83
Vertical Jump	10.03 ±1.99	10.08 ±1.91	10.06 ±1.95	8.31** ±2.99	7.18 ±2.98	7.74 ±2.99
Skip	5.42 ±1.10	5.63* ±0.77	5.52 ±0.94	8.09* ±3.07	7.28 ±2.98	7.69 ±3.03
Strike	8.92* ±1.25	8.65 ±1.31	8.78 ±1.28	8.21** ±2.94	7.14 ±2.80	7.67 ±2.87
Bounce	7.52* 0.95	7.27 1.05	7.40 1.00	8.47 2.92	8.07 2.42	8.27 2.67
Catch	5.46 ±0.97	5.66* ±0.78	5.56 ±0.87	8.43 ±2.95	7.95 ±2.49	8.19 ±2.72
Kick	7.67** ±0.83	7.23 ±0.94	7.45 ±0.88	8.46** ±2.82	7.51 ±2.75	7.98 ±2.78
Throw	6.89* ±1.55	6.51 ±1.71	6.70 ±1.63	8.35* ±2.91	7.66 ±2.75	8.01 ±2.83
Roll	6.20** ±1.83	5.61 ±1.92	5.90 ±1.88	8.49 ±2.89	7.99 ±2.55	8.24 ±2.72
Balance	7.42 ±2.10	7.39 ±1.99	7.40 ±2.05	8.02 ±3.05	7.44 ±2.74	7.73 ±2.89

*p≤0.05 **p≤0.01
PSC=Physical self-confidence

Table 4.2. Number of participants in each physical self-confidence group



4.5 Discussion

According to Gallahue and Ozmun (2006) children are developmentally able to master most FMS by the age of six and should have mastered all by age 11. This would imply an expected score of 124 (the maximum score) across these fifteen skills for this group of 12 – 14 year olds, however as can be seen from the descriptive results the mean score of participants was 98.75. This low FMS proficiency level indicates that they underperform the basic locomotor, object control and stability skills proficiently. Despite these poor results this age group should be making the transition to the sport specific stage. According to previous research (Cliff, Okely, Smith, & McKeen, 2009; Fisher et al., 2005; Okely & Booth, 2004), FMS levels during childhood are proven as a predictor for increased PA during adolescence. Considering this evidence and the relationship between PA participation and FMS, one can suspect that the likelihood to dropout of PA increases for those with low FMS proficiency levels (Cliff et al. 2009; Hardy et al. 2013).

In this study while both males and females are performing below expected levels of FMS, consistent with the literature (Barnett et al. 2010; Hardy et al. 2010) males scored significantly higher than females both overall and for object control skills. One plausible explanation for the observed trend may be due to a variety of maturation factors occurring during early adolescence (Garcia 1994). Furthermore, research has proposed that a reason for higher male proficiency in object control skills is linked with the fact that such skills are evident within sports more commonly partaken by males (Hardy et al. 2013). Thomas (1999) also suggested that gender variations may be accredited to the individual gender differences in habitual PA and sports participation. No significant gender variation was observed in the locomotor domain, with female and male participants achieving similar scores. This is in contrast to a study by Hardy et al (2010), where females significantly outperformed males in the locomotor domain. One difference between the current study and the Hardy study is the age of participants (4.4 years compared to 13.78. years) which may in part explain the inconsistency in results. In addition a study by O' Brien et al. (2015), males scored significantly higher than females in the locomotor domain, pointing to the need for further research to investigate this particular domain.

Dollman et al. (2008) found that the games children choose to play during free-play time affect their proficiency at FMS. Boys for example chose games that relied heavily on gross motor skills for success such as the kick and tend to be more competitive. Whereas girls may have played games which relied more on balance or flexibility and were less competitive in comparison to those chosen by males. Another factor which may result in differences between genders is the social acceptance of their peers to be involved in sport and organised PA. In the case of girls, participation in certain sports and team games can be seen as outside the social norm , where for boys, participation in sport and team games are seen as a part of their social and personal development (Okely, Booth, & Patterson, 2001). Indeed, social acceptance of boys among their peers may be more at risk if they do not participate (Okely, Booth, & Patterson, 2001).

In this study physical self-confidence and FMS proficiency levels were moderately correlated among females (r=0.305). Suggesting that if a female has low FMS ability they will tend to have low physical self-confidence levels, or vice versa. Among males there was no significant correlation between FMS and physical self-confidence. Similar to the results of this study, Vedul-Kjelsås et al. (2012) also found that that FMS and self-perception was most strongly correlated among girls (r=0.312, mean age 11.46 years). Viholainen et al.'s study (2014) on self-concept, FMS and psychosocial well-being also found that FMS proficiency is connected to psychosocial correlates among adolescent girls. This contradicts the findings of Barnett et al. (2009) as they found that for males and females skill proficiency as a child appears important in developing a positive self-perception of physical competence as an adolescent. When each individual mean was considered males consistently scored a mean of 8 or above (out of 10) in confidence for each skill. Dwecks theory (1991) highlights that if you perceive yourself at being proficient at a skill you are more likely to participate in the activity and have a good experience, which may be the case with males. It is important to note that males may still be below expected FMS proficiency levels for their age group, however, if they have high physical self-confidence they are more likely to participate and keep practicing (Dweck 1991) which over time should result in improved FMS levels.

When physical self-confidence was categorised into low, medium and high, the results highlight that those with low physical self-confidence have significantly lower FMS proficiency than those with medium and high physical self-confidence. This was similar to a study comparing FMS and perceived competence in overweight children which found that those with low perceived competence also had low FMS proficiency (Southall et al. 2004). Research suggests that those who are not confident about their ability (in this case those in the low physical self-confidence group) will not want to put themselves in a situation where they may display low ability levels, which in turn may affect their performance (Harter & Pike, 1984). This leads to a vicious cycle of events as those not confident in FMS may not participate as often in FMS, which according to Schoemaker and Kalverboer (1994) will lead to deterioration in performance and has the potential to reduce or even cease participation in PA.

4.6 Conclusion

This study highlights low levels of adolescent FMS proficiency, at an age where they should be ready to progress onto sport specific skills. In additions physical self-confidence levels of adolescents, particularly females, across these skills are low. According to Barnett et al. (2008) and Dweck (1991), there is an emergent relationship between the FMS proficiency and physical self-confidence that may affect adolescent's PA participation levels. For this reason it is important in the future to assess PA, FMS proficiency and physical self-confidence to gain a better understanding of this emergent relationship, and the potential interaction FMS and physical self-confidence in influencing PA level. Due to the discrepancies in the physical self-confidence levels of males and females in the results of this study it is important to analyse this relationship separately for each gender. Assessing both FMS and physical self-confidence will not only highlight those in most need of an intervention, but will also facilitate in the development of the intervention. Due to differences in FMS proficiency and self-confidence, some adolescents may require different attention and a different intervention focus specifically targeting their requirements.

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Link Section Chapter 4 to Chapter 5:

Purpose of Chapter 4:

In Chapter 4, the relationship between physical self-confidence and FMS proficiency was explored. In addition, the FMS levels of participants and any gender differences which may exist were investigated. In this chapter, 15 FMS were assessed using the TGMD-2, the TGMD and the Victorian skills manual. A significant correlation was observed between FMS proficiency and physical self-confidence for females ($r=0.305$, $p<0.001$). Results highlight that those with low physical self-confidence have significantly lower FMS proficiency than those with medium and physical self-confidence ($p<0.01$). It is also evident from the results that adolescents are below the expected levels of FMS proficiency. Children are capable of mastering these skills by the age of 6, and are expected to have them mastered by the age of 10. Findings also suggest however that despite being expected to have progressed to more advanced sport specific skills by the age of 12 – 14 years, the reality is that the vast majority of adolescents are not yet proficient at these basic FMS skills.

Purpose of Chapter 5:

As children are expected to achieve mastery in FMS by age 10 so that there has not previously been a need for an assessment tool examining adolescents FMS. Findings of Chapter 4 present a new methodological issue therefore; the need for such an assessment tool to allow for FMS measurement in older cohorts. Chapter 5 aims to address this issue and assess the validity of the TGMD-2 with an adolescent population. It is important that a scale is validated for adolescents so that any developmental delays are highlighted. An assessment tool for use with both children and adolescents would also allow researchers and educators to track FMS development from childhood through to adolescence, to ensure that improvements are being made and the development of these skills are not neglected

Chapter 5

An alternative consideration for the ‘Test of Gross Motor Development-2’; the case of an adolescent population

Manuscript submitted as: An alternative consideration for the TGMD-2: the case of an adolescent population. Issartel, J., McGrane, B., Fletcher, R., Powell, D., O’Brien, W., and Belton, S. (Research Quarterly for Exercise in Sport-Submitted May 2015).

5.1 Contribution to this paper

Title: An alternative consideration for the 'Test of Gross Motor Development-2'; the case of an adolescent population

My Role:

- I conducted an extensive literature review on the area of validation which was used to inform this study; specifically on research which had validated the TGMD-2 for use with specific populations
- I was responsible for the organization and collection of all data used in this study.
- I analysed all FMS videos which were recorded as part of the data collection, and inputted the data into SPSS.
- In terms of data analysis, I contributed strongly to this section of the paper alongside Dr. Richard Fletcher.
- I co-wrote and co-completed the methods section alongside Dr. Richard Fletcher.
- I co-wrote and co-completed the results section alongside Dr. Richard Fletcher.
- I provided feedback and participated in the writing of the re-drafts of this paper alongside Dr. Johann Issartel prior to submission.

5.2 Abstract

Objectives: This study proposes an extension of a widely used test evaluating fundamental movement skills (FMS) proficiency (Test for Gross Motor Development–2 - Ulrich et al., 2000) to an adolescent population, with a specific emphasis on validity and reliability for this older age group.

Method: A total of 851 participants (n = 464 male, 12.76 ± 0.47 years) participated in this study. The twelve FMS of the TGMD-2 were assessed. Inter-rater reliability was examined to ensure a minimum of 95% consistency between coders. Confirmatory factor analysis (CFA) was undertaken with a one-factor model (all 12 skills) and two-factor model (6 locomotor skills and 6 object-control skills) as proposed by Ulrich et al. (2000). The model fit was examined using χ^2, TLI, CFI and RMSEA. Test-retest reliability was carried out with a subsample of 35 participants.

Results: The test-retest reliability reached ICC of 0.78 (locomotor), 0.76 (object related) and 0.91 (gross motor skill proficiency). The CFA did not display a good fit for either the one-factor or two-factor model due to a really low contribution of several skills. A reduction in the number of skills to just seven (run, gallop, hop, horizontal jump, bounce, kick and roll) revealed an overall good fit by TLI, CFI and RMSEA measures.

Conclusion: The proposed new model offers the possibility of longitudinal studies to track the maturation of FMS across the child and adolescent spectrum, while also giving researchers a valid assessment to tool to evaluate adolescent FMS proficiency level.

Key words: Fundamental Movement Skills, Validity, Motor Skills Proficiency

5.3 Introduction

Fundamental movement skills (FMS) are the building blocks for movement that children learn during childhood. FMS are often classified into three main domains: object-related, locomotor and stability sub-domains (Gallahue, Ozmun, & Goodway, 2012). FMS constitute the foundation stones for more complex and specialized motor skills used in everyday activities (e.g. in sport settings or the work place). Maturation of these FMS are an essential component of motor development for the ramification on children's physical, cognitive and social domains (Cools, Martelaer, Samaey, & Andries, 2009).

The level of physical activity (PA) participation also plays a key role in a typical child's motor development. It is now well established that, children and adolescents lack of PA participation is a major factor in increasing the risk of chronic disease in later years (Centers for Disease Control and Prevention, 2011). With a decrease in PA participation (Kohl et al., 2012), further evidence suggests that there is an increase in the prevalence of overweight and obesity in children and adolescents (Department of Health & Children, 2005).

National and international PA guidelines are now proposing that youth should accumulate at least 60 minutes of moderate-to-vigorous physical activity (MVPA) every day (World Health Organization, 2010). Currently, scientists, teachers, health professionals and policy-makers are all trying to target this situation with contemporary intervention strategies for increasing children and adolescents PA participation. The main focus being the promotion of lifelong health and well being, alongside an emphasis on fitness and the development of motor skill proficiencies (Logan, Robinson, Wilson, & Lucas, 2011).

There is evidence of a positive association between FMS proficiency and PA participation (Cohen, Morgan, Plotnikoff, Callister, & Lubans, 2014), with longitudinal data suggesting that FMS ability can have long-term consequences on PA participation (Hardy, Barnett, Espinel, & Okely, 2013). Furthermore, it is known that a lack of motor skill proficiency affects daily activities and has even been shown to impact subsequent academic achievement (Piek & Dyck, 2004).

Booth et al. (1999) were among the first to highlight the low level of youth FMS proficiency. In more recent years, findings consistently reveal low levels of FMS proficiency during childhood (Hardy, Barnett, Espinel, Cosgrove, & Bauman, 2010) and adolescence (Belton et al., 2014; O'Brien, Belton, & Issartel, 2015). This lack of maturity of FMS development precludes the outgrowth of the FMS phase towards the specialized movement phase (Gallahue et al., 2012). During the specialized movement phase, sport specific scenarios and other complex movement skills (Gallahue et al., 2012) are introduced to the learners. Children below mastery level are attempting to make the transition to sport specific skills in a school context, during leisure time or more structured activities (i.e. sport clubs), before reaching maturity in most FMS (Belton et al., 2014; O' Brien, Issartel, & Belton, 2013). All of this evidence points to the rise of a new situation, with the new generation of adolescents not possessing the FMS proficiency level they should have acquired during childhood (Hardy et al., 2013). Therefore, it is crucial for healthcare practitioners and teachers to have the appropriate tools to assess the level of maturity of these FMS (Barnett, Ridgers, & Salmon, 2014).

To measure the maturation level of these FMS, a wide range of movement skill assessments (fine and gross motor skills) have been developed over the years, with many focusing on children (Bruininks & Bruininks, 2010; Henderson & Sugden, 1992; Ulrich, 2000). The outcome measures of these tests are to provide a representative assessment of motor skill proficiency level (Piek, Hands, & Licari, 2012). A key rationale in more recent years for having a good understanding of motor coordination is to potentially diagnose children with developmental coordination disorder (DCD), motor impairments (MI), or "clumsiness" as it is traditionally described (American Psychiatric Association, 2013). More specifically, performance-based tests assessing FMS have been developed to objectively and formally measure children's motor skill proficiency (Bruininks & Bruininks, 2010; Henderson & Sugden, 1992; Ulrich, 2000). These process-oriented measurements focus on the quality of the movement rather than assessing the product such as time, speed or success rate for example (Cools et al., 2009). These process assessment tests enable the identification of movement components (i.e. performance criteria) requiring specific attention (Ulrich, 2000). Each FMS is often composed of several performance criteria. A standardized scaling procedure, taking into account factors such as age and gender, translates the scales into a normative scoring system representing the children's performance (Ulrich, 2000).

The Test for Gross Motor Development-2 (TGMD-2) has been extensively used as a process assessment tool of children's motor skill performance (3 to 10 years old) (Cohen et al., 2014; Logan et al., 2011). It consists of six locomotor skill sub-domains (run, gallop, jump, slide, hop, and leap) and six object control sub-domains (striking a stationary ball, stationary dribble, catch, kick, overhand throw, and underhand roll). For each of the skills, there are between three and five performance criteria. During testing, each of the skills are performed twice and each criteria is deemed present or absent to determine mastery of the skill (Ulrich, 2000).

The TGMD-2 was validated on 1208 American children (4-10 years old) using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) (Ulrich, 2000). The test showed support for its concurrent validity with fair to good correlation coefficients for overall total scores and both sub-domains (total scores r = 0.63, locomotion r = 0.63 and object control r = 0.41). The content validity as well as the construct validity levels were also acceptable (Ulrich, 2000; Wong & Yin Cheung, 2010). The TGMD-2 has also reported excellent internal consistency and inter-rater reliability correlations. The correlation coefficient for the test-retest reliability ranged from good to excellent ($0.84 < r < 0.96$). Overall, the TGMD-2 demonstrated an adequate level of sensitivity for children with typical development aged from 3 to 10 years old. Since 2000, numerous studies have further validated the TGMD-2 for special populations, and in several countries with socio-cultural differences (Kim, Han, & Park, 2014; Valentini, 2012; Wong & Yin Cheung, 2010).

While the TGMD-2 is widely considered as a robust process-oriented tool to assess FMS in children up to the age of 10 years of age, it has previously not been validated for an adolescent population. With research suggesting that this current generation of children and adolescents underperform previously recognized norms in terms of FMS proficiency and PA participation, there is a need for scientists, teachers, health professionals and policy-makers to consider this situation in their respective domain of competences. Unfortunately, this cannot be done efficiently unless one develops a way to assess adolescent FMS proficiency levels with scientifically robust instruments; more specifically, the extension of existing tests to an adolescent population. Having valid and reliable FMS tests for children and adolescents will link up these two populations, while helping us to better understand maturation development. The purpose of the current study addresses this research gap by assessing the reliability and validity of the TGMD-2 for an adolescent population.

5.4 Methods

Data were collected as part of the Youth-Physical Activity Towards Health (Y-PATH) study in mixed gender schools in Ireland (Belton et al., 2014; O' Brien et al., 2013). Informed consent were granted by the principal and physical education (PE) teachers in each second-level school for a year one class group to participate in the study. Twenty four schools consented to participate with a total of 851 participants (males = 464, females = 387) aged 12.76 years (SD=± 0.47). Informed assent for participation was given by each participant on the day of data collection, and consent was granted by their parent/guardian; all participants were free to withdraw from the study at any stage. Full ethical approval for this study was granted by the university research ethics committee.

Instrument and Procedure

Twelve FMS were assessed: 6 locomotor skills (run, leap, gallop, slide, horizontal jump, hop) and 6 object control skills (dribble, catch, throw, roll, strike and kick) during a standard 80 minute PE class using the TGMD-2 (Ulrich, 2000). To ensure accurate assessment of the FMS, trained researchers gave a brief verbal description and demonstrated each of the skills once as per the TGMD-2 protocol. Participants then completed one familiarization trial, followed by two trials of each skill with no feedback given at any stage. All trials were video recorded with complete body movement in view. These recordings were then labeled, stored and saved for later assessment. Researchers were trained to assess these videos accurately and completed inter-rater reliability assessments. They then completed assessment of the skills as directed by the protocol (Ulrich, 2000), scoring a "1" if the component of the skills was present and a "0" if it was absent. As per TGMD-2 protocol, for each FMS, the two test trials were added together to get the total raw skill score.

Data Analysis

Inter-rater reliability: First of all, experts in the field of motor behavior undertook rigorous training in the coding of the skills. The aim of this process was to achieve a minimum consistency between the three expert raters of at least 99%. Once this was achieved, the expert raters trained a team of coders. Each expert was subsequently responsible for training four coders. These coders were then responsible for scoring a minimum of four skills (i.e. run, hop, kick, strike). The overall aim was to achieve at least 95% consistency between experts and coders. For additional rigor, each child's performance of each skill was coded separately by two coders with again a 95% consistency target.

Test-retest reliability: In the present study, to ensure that adolescent performance was constant over time across the twelve selected FMS, the research team conducted a 48 hour time sampling test-retest reliability measurement amongst a sample of 35 participants aged 12-13 years. This procedure is consistent with reported research on the TGMD-2 (Ulrich, 2000). A test-retest correlation was calculated using the Pearson Product moment correlation. (Chinapaw, Mokkink, Van Poppel, Van Mechelen, & Terwee, 2010) outlined that to measure reliability. Intraclass Correlation Coefficient (ICC) values should reach >0.70 to be considered acceptable and >0.80 as positive (Landis & Koch, 1977).

Confirmatory Factor Analysis: Consistent with previous published research Confirmatory Factor Analysis using AMOS21 (Arbucke, 2012) was undertaken using maximum likelihood estimation methods. Two models were specified separately. The first model was a one factor model specified by the twelve skills of the TGMD-2 (Ulrich, 2000). The second model tested was a correlated two factor model based on the 2 sub-domains of the TGMD-2 (Ulrich, 2000), the locomotor sub-domain (run, gallop, hop, horizontal jump, slide, leap) and the object control sub-domain (bounce, kick, roll, catch, throw, strike).

Model fit: Model fit was examined using the following fit measures. The χ^2 and its associated degrees of freedom is reported, however, given the known problems with the χ^2 being overly sensitive when used with large samples (Marsh, Balla, &

McDonald, 1988) more emphasis is placed on the other fit indices. The TLI was used along with the CFI (Byrne, 2001). Values for both the TLI and CFI are considered as marginal fit for values > 0.85, acceptable fit for values > 0.90 and superior fit for values > 0.95 (Byrne, 2001). The RMSEA, which is considered to be among the most robust of the fit indices, was also used. Values of <.05 are considered good fit, values >.05 and <.08 are considered acceptable fit, and values >.08 and <.10 are considered marginal fit (Hu & Bentler, 1999). In order to consider a model as satisfactory, acceptable fit values for all three indices (TLI, CFI, and RMSEA) are required.

5.5 Results

Reliability

The inter-rater reliability for each of the skills was above the 95% consistency target. The ICC values reached 0.78 (locomotor), 0.76 (object related) and 0.91 (gross motor skill proficiency) indicating that the scores across twelve skills were stable over time.

Confirmatory Factor Analysis

Table 5.1 displays the goodness of fit measures (TLI, CFI and RMSEA) for each of the models tested. The first Model tested (see Model 1) corresponds to the original two-factor model from the TGMD-2. As indicated in Table 5.1, the values for the Model 1 present poor TLI and CFI and a good fit for RMSEA. As this model was not satisfactory, a second analysis was performed on the one-factor model. The one-factor model (Model 2) presented slightly better, but still low values for TLI and CFI. These values were due to a low contribution of several skills (see Table 5.1). At this stage, several individual skills presented low standardized regression weights. These skills were not contributing to the overall model bringing down each of the goodness of fit measures. They were removed from the original models (Model 1 and 2) and a new model was consequently tested (Model 3). The reduction of the number of skills contributed to higher TLI and CFI values for a new one-factor model (Model 3) but the RMSEA revealed a poor fit. The original two-factor model (Model 1) was then tested with a reduction of the number of skills (Model 4). Overall, each of the goodness of fit measures (i.e. TLI, CFI and RMSEA) are higher for the two-factor model. For this specific model, while the TLI and CFI are slightly lower than the values suggested by Byrne (2001), the RMSEA suggests good fit. As the RMSEA penalizes overly complex models, this result suggests that even with just seven skills, these work together in the two-factor model. The latent correlation between the two factors (locomotor sub-domain and object control sub-domain) was r = 0.71 suggesting that just over 50% of the variance between the two factors was shared.

Table 5.1. Descriptive values for each of the 4 Models

Model	Description	χ^2	Df	Prob	CFI	TLI	RMSEA
Model 1	Full model two correlated factors	171.350	53	0.00	0.56	0.36	0.058
Model 2	Full model one factor	187.943	54	0.00	0.70	0.56	0.045
Model 3*	Reduced model one factor	114.745	27	0.00	0.80	0.62	0.61
Model 4**	Reduced model with two correlated factors	30.254	13	0.004	0.88	0.74	0.045

Note. ** = For this model, the following skills were removed: slide, hop and throw*
*** = For this model, the following skills were removed: leap, slide, strike, catch and throw*

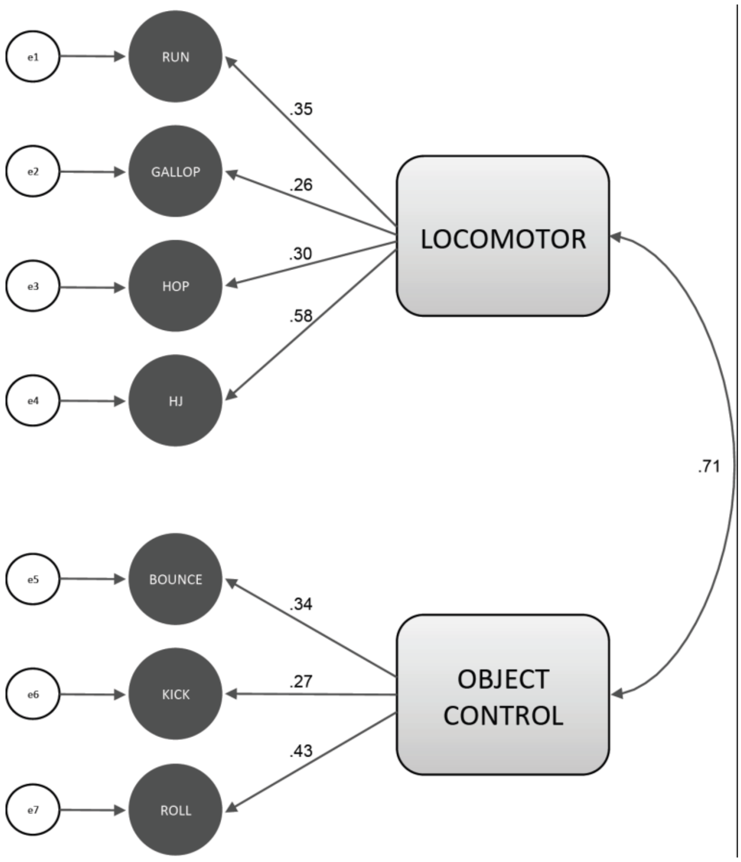

Figure 5.1. Two-factor model of the TGMD-2 for an adolescent population

5.6 Discussion

This study assessed i) the reliability and ii) validity of the TGMD-2 for an adolescent population. Regarding the first step, the reliability coefficients obtained are in line with those presented in the TGMD-2 manual with values ranging between 0.85-0.91, and are deemed acceptable. The second step and primary purpose of this study was to establish if the TGMD-2 two-factor model (locomotor and object control), validated for children aged 4-11 years, was appropriate for an adolescent population. The validation of the TGMD-2 for an adolescent population has never been previously considered. Hence, expanding the validation of such a model was deemed important, considering the lack of data pertaining to FMS proficiency amongst adolescent youth (Belton et al., 2014; O' Brien et al., 2015).

The results of the current study are similar to that of the original model (Ulrich, 2000) when we consider the two factors model. The highest goodness of fit measures were found with a two-factor model: locomotor and object control showing that the model postulated is supported by the data. Thus, the theoretical construct, with the two-factor model was the best model for explaining the underlying factor structure within this adolescent population. This result highlights that the two subtest categories (locomotor and object-related) (Gallahue et al., 2012) remain present throughout the maturation process from childhood to adolescence. This may provide further support for the usability of the TGMD-2 in the secondary school context for adolescents where evidence suggests that there is now a need to assess FMS proficiency level for this specific age group (Belton et al., 2014; Hardy et al., 2013; O' Brien et al., 2015).

What is very interesting about the findings, however, is that while the original two factor model holds with an adolescent population, the model with best fit does not encompass such a broad range of skills as the original research carried out on younger children. As some variables did not sufficiently load the model they were consequently excluded from it. This was due to a low level of multi-collinearity between these excluded variables (leap, slide, strike, catch and throw) and those kept in Model 4. In line with Larwin and Harvey (2012), reducing the number of variables in the model makes it more parsimonious. The goodness-of-fit indices for the model with this reduced number of skills were good (see Table 5.1 – Model 4).

It is important to consider the literature around FMS in order to understand the reason why the excluded skills (leap, slide, strike, catch, and throw) may not make sense in an FMS model for adolescents. According to Hardy et al. (2013), the catch was one of the FMS with the highest level of improvement from childhood to adolescent. This characteristic could potentially be associated with a ceiling effect (Okely, Booth, & Chey, 2004). It would consequently become harder to discriminate amongst the adolescent proficiency level suggesting why this variable does not load the object control factor anymore.

Regarding the absence of the throw and the catch from Model 4, the role and value of the particular skills' components can be discussed (Barnett, Minto, Lander, & Hardy , 2013). These authors demonstrated a low inter-rater reliability for these two skills. They discussed the possibility that participants could be considered competent in striking without performing the skills proficiently. This could be due to the fact that participants could simply 'stab' or 'bunt' at the ball without a specific "follow through" (i.e. key factors traditionally associated with a powerful bat-swing - Katsumata, 2007). Partial rotation and weight transfer could also occur during a 'stab' making the assessment confusing. As the powerful bat-swing is not being assessed, one can reach mastery level without demonstrating movement skill proficiency for this factor. The presence of this key factor is more likely to happen when the participants are getting older. A Similar discussion point was made concerning the throw where the component "windup is initiated with downward movement of hand/arm" could create discrepancy amongst the performers (Barnett et al., 2013). It all comes down to the initial position of the hands. If the ball is handed to the participants at chest level, then success of this criteria is more likely to occur while giving the ball to the participants at hip level would reduce the chance to observe a downward movement even if the participants perform a "good overall looking throw" (Barnett et al., 2013, p.668). At this age, these movement characteristics are likely to occur specifically considering the high level of FMS proficiency for both strike and throw (O' Brien et al., 2015). Consequently, it is not surprising to see these skills being removed from the object control subtest (Model 4).

There are two potential reasons why the slide skill was removed from the locomotor factor. The first one relates to the resemblance between slide and side shuffle. A side shuffle implies a time where both feet are in the air, while one of the components for the slide consists of a "slide of the trailing foot to a point next to the lead foot"; while these two skills are very similar there are small differences in their performance relating to the foot action. In an Irish context there is a discrepancy between the demonstration of a 'slide' and what would be traditionally performed by adolescents in PE classes or sporting contexts. In this adolescent population it is reasonable to postulate that this discrepancy led to performance inconsistency. The second potential reason relates to the fact that all of the locomotor skills except the slide are performed with the trunk facing the direction of travel. One of the slide components specifies that the trunk is "turned sideways so shoulders are aligned with the line on the floor". The dissociation between leg and trunk action becomes more efficient with age; with maturation, it becomes easier to independently control legs and trunk (Gallahue et al., 2012). Thus adolescents may in fact perform the slide 'too well', and as a result fail on one or more components. These potential discrepancies in the performers i) understanding of the instructions and ii) way to engage with the task may explain why this skill does not contribute to the locomotor subtest.

The tasks themselves with regards to the age of the participants are also important factors to consider. Asking an adolescent to strike a ball on a tee is a simple and artificial task considering the theoretically expected maturation level of FMS proficiency of this age cohort, potentially reducing the participants' willingness to fully engage in the task. A similar argument can also be formulated for the leap. Leaping over a beanbag does not match the theoretically expected maturation level of an adolescent, though one can argue that the current generation of adolescent is falling behind the expected level of FMS proficiency. We are facing a situation where, physically, adolescents have not reached the appropriate FMS proficiency level of certain skills (Hardy et al., 2013; O' Brien et al., 2015), but have moved both biologically and psychologically beyond the skills' objective as currently described in the TGMD-2. This in turn may well have influenced the small factor loading of these skills for their respective sub-domains such that they had to be removed from the final model. When the developmental continuum is considered, it is important to note that the movement criteria proposed in the TGMD-2 is the same for a four and a ten years old child. It might be interesting to consider modifying the objective of some skills. For example, adolescents may engage differently in the skill "leap" if they would have been asked to leap for a distance instead of leaping over a beanbag. Further research should also explore if the criteria used for this adolescent population should be reviewed and adapted as the movement characteristics change with age (Stodden et al., 2008).

5.7 Conclusion

The extension of the TGMD-2 to an adolescent population opens the door for longitudinal studies targeting the observation and development of FMS for an adolescent population. For the last twenty years, most researchers in the area of motor control and motor development have been focusing on children for the assessment of FMS. Today, the reduction of childhood and adolescents PA levels (Kohl et al., 2012) has changed the landscape for coaches and teachers, as they are now faced with a wider range of insufficient movement capabilities amongst youth; FMS may be age-related (Gallahue et al., 2012) but are not age-determined (O' Brien et al., 2015). For this reason, the shift from FMS to sport specific skills (Gallahue et al., 2012) may now happen at a later stage. Given this progressively shifting landscape, it is evident that the global evaluation of FMS during adolescence is warranted. The extension of the TGMD-2 to the adolescent population, as demonstrated in the paper, offers an effective movement skill assessment tool to carry out such an evaluation.

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Link Section Chapter 5 to Chapter 6:

Purpose of Chapter 5:

Chapter 5 proposed a new model which offers researchers for the first time a valid tool for assessing adolescents FMS proficiency level. The results of Chapter 5 shown that it is only necessary to measure 7 of the 12 skills in the TGMD-2 when assessing adolescents overall FMS proficiency. This validated new model will allow longitudinal studies to track the maturation of FMS across the child and adolescent spectrum, while also giving researchers a valid assessment tool to evaluate adolescent FMS proficiency levels. It is important that children and adolescents FMS proficiency can be assessed to facilitate intervention development and evaluation.

Purpose of Chapter 6:

Chapter 6 assesses the efficacy of the Y-PATH intervention at improving adolescents FMS using a cluster randomised controlled trial. FMS data in Chapter 6 was assessed using the new adolescent model of 7 skills validated in Chapter 5. Data was collected at 3-time points pre-intervention, post-intervention and retention. It is important that interventions such as the Y-PATH intervention undergo thorough evaluation prior to national dissemination to ensure all results obtained are definite.

Chapter 6

An evaluation of the randomised controlled trial of the Y-PATH intervention; does it improve FMS proficiency?

6.1 Abstract

Objectives: to evaluate the efficacy of the Y-PATH intervention in improving adolescent FMS.

Design: Clustered randomised controlled trial of the Y-PATH intervention (a school based intervention which aims to improve adolescent PA participation and FMS proficiency).

Methods: A total of 532 participants from 20 schools (10 control and 10 intervention) participated in this study. Data was collected at 3 time points: pre-intervention (September 2013), post-intervention (May 2014) and retention (September 2014) for intervention and control schools. Four hundred and sixty four participants (male=235, female=229, mean age=12.7, SD=±0.91) had full data from two of more time points. While the control group continued with regular PE and school activities, the intervention schools implemented the Y-PATH intervention for the full duration of the academic year. The TGMD-2 (Ulrich, 2000) was used to assess participants' ability in 7 FMS: run, gallop, horizontal jump, hop, dribble, roll, and kick. Only participants with all skills measured at at least two time points were retained (n=464). Separate repeated measures ANOVAs were conducted to assess the difference between genders and intervention conditions in overall FMS scores across the 3 time points. The analyses also focused on the difference between genders and intervention conditions on locomotor skill proficiency, object control skill proficiency and skill by skill across the 3 time points.

Results: The interaction effect between time*intervention highlighted that the FMS proficiency of the intervention and control groups changed over time. The post hoc test revealed no significant difference between intervention and control groups at time one ($p=0.09$), however there was a significant difference between them at time 2 ($p<0.001$), and time 3 ($p<0.001$) with the intervention group scoring higher at time 2 and time 3 than the control group. There was a significant interaction effect for time*gender ($p<0.001$) highlighting that males and females FMS proficiency changed over time. The post hoc test revealed that both genders improved significantly over time but females improved by a greater amount than males ($p<0.01$). Despite this, males were significantly more proficient at FMS than females at all 3 time points ($p<0.001$). There was also a difference in the control and intervention groups across each individual skill with the intervention group making a greater increase compared to the control group.

Conclusion: The results highlight the efficacy of the Y-PATH intervention at improving adolescents FMS proficiency. In the future, the longer term maintenance effects of the Y-PATH intervention should be examined.

Key words: motor skill; locomotor; object control; randomised controlled trial.

6.2 Introduction

Fundamental movement skills (FMS) have been defined as basic observable patterns of movement (Gallahue & Ozmun, 2006). Gallahue and Ozmun (2006) highlight that children have the developmental potential to master FMS by the age of 6 years, and all should have mastered them by the age of 10 in order to develop sport specific skill. This development does not occur as a result of maturation but likewise, they must be taught (Clark, 2007; Haywood & Getchell, 2002). Some literature may overlook this fact with the common misconception that they develop naturally through free-play (Cools, Martelaer, Samaey, & Andries, 2009; Stodden et al., 2008). However, various studies support the fact that these FMS must be taught and practiced both in an education and free play setting (Booth et al., 1999; Mitchell et al., 2013; Okely & Booth, 2004). Booth et al. (1999) propose that it takes approximately 10 hours of teaching for an average child in the fundamental movement phase to become proficient at one FMS. As Robinson and Goodway (2009) state, FMS skills must be learned, practiced and reinforced.

FMS development during childhood can help lifelong physical activity (PA) participation (Gallahue & Ozmun, 2006). The result of children being below the expected levels of FMS proficiency for their age (Lubans, Morgan, Cliff, Barnett, & Okely, 2010a; Woods, Tannehill, Quinlan, Moyna, & Walsh, 2010) may result in an increase in difficulties in the development of more advanced sports skills during adolescence (Gallahue & Ozmun, 2006), and as a result a drop in participation in PA or sport (O' Brien, Belton, & Issartel, 2015). There is evidence among children that FMS, in particular locomotor skills, are positively correlated with PA (Hardy, King, Farrell, Macniven, & Howlett, 2010). Researchers agree that "cross-sectional evidence has demonstrated the importance of motor skill proficiency to PA participation" (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009, p.253). However, it is difficult to determine the direction of this relationship. Results from various studies which examined the relationship between PA and FMS found that FMS proficiency is positively correlated with time spent participating in PA, and that targeting FMS proficiency development in children and adolescents may be significant in counteracting physical inactivity (Fisher et al., 2005; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). It is also well known that adolescence is a period with a rapid decline in PA (Sutherland et al., 2013). Therefore, it is important to focus on the development of factors correlated with PA such as FMS during this key period (Belton, O' Brien, Meegan, Woods, & Issartel, 2014).

It is also important when focusing on FMS that moderators such as gender is considered. While research suggests adolescents both male and female are below expected FMS proficiency levels for their age, it also highlights that gender differences exist (Hardy, Barnett, Espinel, & Okely, 2013; Lubans, Morgan, Cliff, Barnett, & Okely, 2010; O' Brien et al., 2015). Results of studies assessing gender differences in FMS appear inconsistent with regard to locomotor and object control skills , however in the majority of these studies males are reported to be significantly more proficient at FMS than females (Barnett et al., 2009; Lubans et al., 2010; O' Brien et al., 2015). Previous interventions such as Switch-Play performed analysis to determine if gender was a moderator of their intervention (Salmon, Ball, Hume, Booth, & Crawford, 2008). They found that the Switch-Play intervention had a greater effect on girls' FMS than boys' FMS. These inconsistencies between genders much be considered when aiming to assess and improve FMS proficiency.

Okely and Booth (2004) advocate that primary school programmes should contain FMS as a key feature. This is the case in Ireland with the Irish Primary school PE curriculum which states that a "child holistic development, stressing personal and social development, physical growth and motor development" should be a core focus while teaching primary school PE (Department of Education and Skills, 1999, p.9). In reality, however, this is not the case as according to O' Brien et al. (2015) (which assesses children's FMS as they enter post primary education). Children are entering secondary schools lacking in basic FMS proficiency. It is logical therefore to suggest that although FMS may be present as a key feature in the primary school curriculum, it requires much more of a focus in the actual teaching of PE lessons. If FMS were taught at primary level as intended in the curriculum, then children would all have achieved mastery by the age of 10 and therefore there would be no requirement for FMS to be a part of the secondary school curriculum. Strong et al. (2005) acknowledge that there is less emphasis placed on the development of FMS during adolescence but argues that mastery of FMS and the development of more advanced skills is important during this time as it can contribute to maintain an active lifestyle. Since adolescents are not at the required level of FMS proficiency to advance to sport specific skills (O' Brien et al., 2015), it is crucial that an intervention is developed to target this specific lack of motor skill proficiency among this age group as it can have a direct effect of PA participation (Cliff, Okely, Smith, & McKeen, 2009).

When targeting a group such as adolescents who are at a high risk of PA drop out, and are not at the required level of FMS proficiency, it is important to intervene while taking into account the needs of this population. Y-PATH (Youth-Physical Activity Towards Health) is an example of one such intervention (Belton et al., 2014). Similar to previous effective interventions (McKenzie, Sallis, & Rosengard, 2009; Salmon et al., 2008; Saunders, Ward, Felton, Dowda, & Pate, 2006), the Y-PATH intervention is a multi-component school-based intervention containing a family component which is implemented over the academic year (8 months). Timperio et al. (2004) encourage targeting family or community settings to ensure the maximum possibility of long-term behavioural change, as oppose to a curriculum only approach. The purpose of Y-PATH is to increase PA levels of adolescent youth, through "enabling youth to positively re-evaluate their predisposing factors 'Am I able' (e.g. self-efficacy) and reinforcing factors 'Is it worth it' (e.g. enjoyment, attitudes), while also addressing the enabling factors (e.g. skill level) that influence participation" (Belton et al. 2014, p.8). In a pilot trial of the Y-PATH intervention (O' Brien, Issartel, & Belton, 2013) data was collected on 174 aged 12-14 years old boys and girls. The outcome measures were BMI, PA and FMS proficiency. The results of this study provide evidence to suggest that it is an effective intervention to improve PA level and FMS proficiency. The intervention group saw a significantly greater increase of 7.2 minutes more daily MVPA than participants in the control group at the retention phase of the intervention (O' Brien et al., 2015). The intervention and control groups both saw an improvement in FMS, however the improvement observed in the intervention group was significantly greater that the one in the control group (O' Brien et al., 2013). O'Brien et al. (2013) cautioned for the need for the evaluation of the Y-PATH intervention with a larger sample in a controlled trial to confirm their positive findings.

It is evident that there is a lack of FMS proficiency among adolescents which may lead to difficulties in developing more advanced sport specific skills (Gallahue & Ozmun, 2006). If this lack of FMS proficiency is disregarded, it may result in adolescents reduction of PA and sport participation (Gallahue & Ozmun, 2006). Since these FMS must be taught (Strong et al., 2005) and do not naturally develop, it is essential that an effective intervention such as the Y-PATH program targeting FMS proficiency is implemented. Prior to long-term implementation it is essential that the Y-PATH intervention is subjected to a robust method of assessment (Campbell et al., 2000). The purpose of this study was to evaluate the efficacy of the Y-PATH intervention, in improving adolescent FMS in a cluster randomised controlled trial and to determine whether the intervention had differential effects by gender.

6.3 Methods

Procedures

All mixed-gender second level schools in County Dublin, Ireland (n=104) were sent a letter inviting their participation in a cluster randomised controlled trial (RCT) of the Y-PATH intervention. Limited information could be given on the intervention due to potential contamination of the intervention and control groups, however information on testing requirements was provided as well as the main objectives of the intervention. On receipt of the expression of interest from 26 schools another letter was sent to the PE teacher requesting basic information to ensure the school satisfied the inclusion criteria: mixed-gender, qualified PE teacher, first years timetabled for a double PE class (min 70 minutes) each week. Once inclusion criteria were met, and principals and PE teacher consented to participate, one first year class (age 12 – 14) per school, proposed by the principal, was selected. In total 22 schools consented to participate in the study (see figure 6.1 for response rate and participant breakdown). However, 2 schools had to withdraw from the study prior to baseline testing (due to a change in PE teacher and principal). Schools were pair-matched prior to data collection on the following criteria: socio-economic status (disadvantaged, non-disadvantaged and fee paying), school size (small 0-299, medium 300-599, large 600+) and facilities (school hall, size of hall, basketball courts, etc.). One school from each pair was then randomly allocated to the control group or the intervention group. Twenty schools completed all measures at three time points, with 532 participants (baseline mean age 12.7, SD=± 1.02 years). Informed consent for participation was granted by each participant and their parent/guardian; all participants were free to withdraw from the study at any stage. Full ethical approval for this study was granted by Dublin City University research ethics committee (DCUREC/2010/081). PE teachers in the intervention schools received in-service training for implementing the intervention prior to the beginning of the school year.

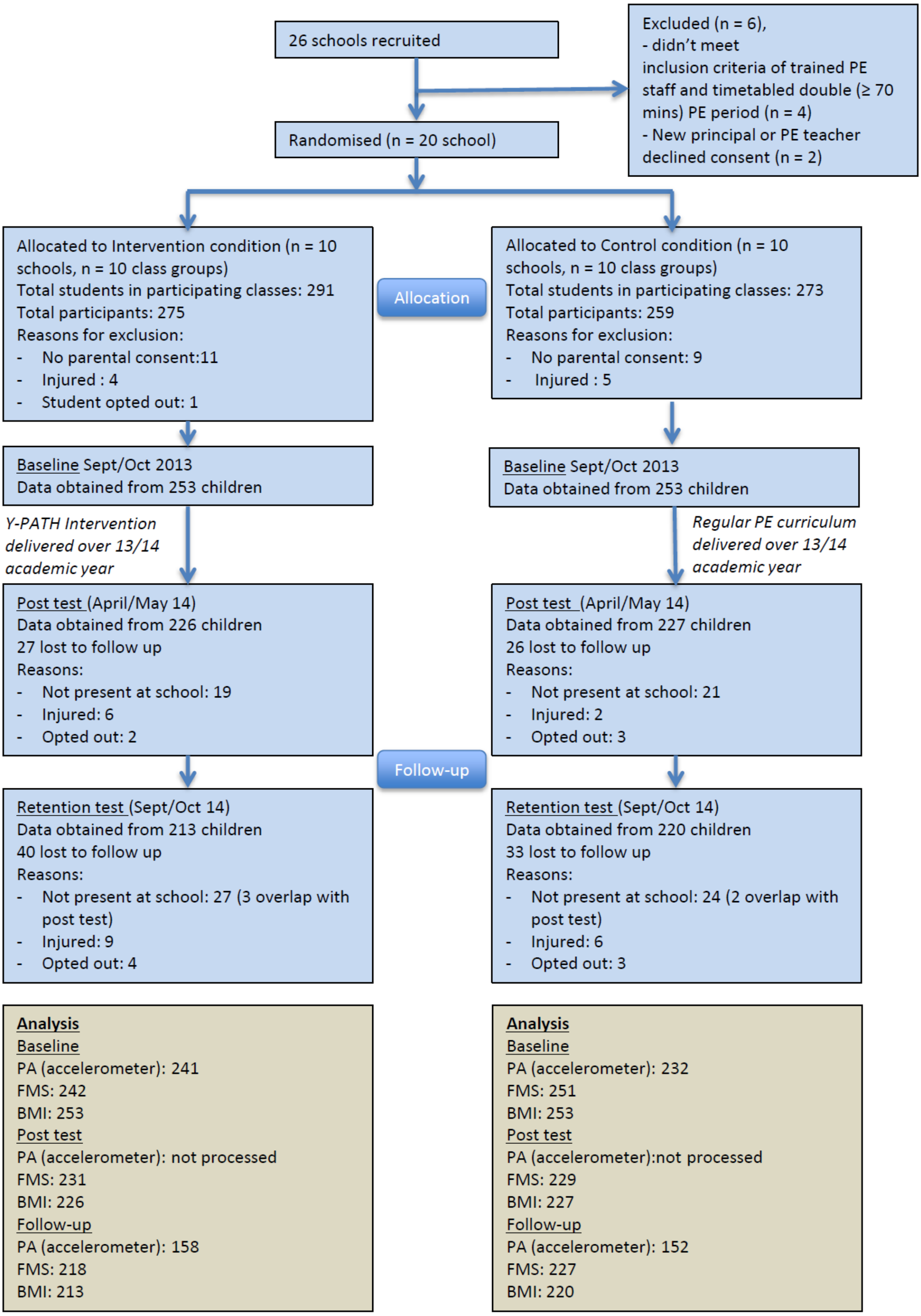

Figure 6.1. Description of participants included in the study

Intervention

The Y-PATH intervention is a multi-component school-based intervention which consists of 4 components 1) The student component: specific focus on HRA and FMS in PE , 2) Parent/guardian component: parents and guardians are educated about the health benefit of PA, 3) Teacher component: all school staff participate in 2 workshops with the main objective to promote PA participation among staffs and students during school time, and 4) The website component: resources are made available online (Belton et al., 2014). (See Appendices C-F for all resources).

Data Collection

Data was collected at 3 time points: pre-intervention (September 2013), post-intervention (May 2014) and retention (September 2014). (See Appendix B for data collection set-up). Between September and May the schools in the control group continued with regular PE, while the intervention schools implemented the Y-PATH intervention.

Measures

The TGMD-2 (Ulrich, 2000) was used to assess participants' ability in 7 FMS: run, gallop, horizontal jump, hop, dribble, roll, and kick. Though the TGMD-2 is comprised of 12 skills with 2 sub-domains – locomotor and object control. It has been validated up to the age of 10. Research carried out in preparation for this study has validated the TGMD-2 for an adolescent population (under review). The main findings illustrated that the 2 sub-domains remain the same for the adolescent population with 5 skills not contributing anymore to the overall assessment of FMS proficiency level. Hence, Leap, Slide, Strike, Catch and Throw were subsequently removed from the final model. The new model contains the following FMS: 3 object control skills (Bounce, Kick and Roll) and the 4 locomotor skills (Run, Gallop, Hop and Horizontal Jump).

Consistent with the TGMD-2 protocol, to ensure accurate measurement of the FMS trained researchers demonstrated each of the skills once. Participants received a brief description of each skill. They then completed one practice go and two trials of each skill with no feedback given at any stage. All trials were accurately videoed with full body movement in view. These videos were then labelled and saved for later assessment.

All demographic information on participants (see Figure 6.1) was collected using a questionnaire which was completed under the supervision of their class teacher and 2 researchers.

Data Management

Researchers were trained to assess these videos accurately by completing inter-rater and intra-rater reliability. All researchers were blinded to the intervention condition. They then completed assessment of the skills as per TGMD-2 guidelines scoring a "1" if the component of the skills is present and a "0" if it is absent. For each FMS, the two test trials were added together to get the total for each skill score. The maximum possible scores for each skill were as follows; Hop=10, Gallop=8, Run=8, Horizontal jump=8, Dribble=8, Kick=8 and Roll=8 and an overall total=58. Mastery for this study was calculated by dividing by 58 (maximum possible score) and multiplying by 100 to give a % mastery (for example if a participant got 58 out of 58 then they were at100% mastery of the skills).

Data Analysis:

Data was cleaned and only participants with all skills measured at at least two time points were retained (n=464). Of these remaining participants, data was imputed for participants missing one data point (20.6%) from the mean values of participants in the same school and same gender (Nelson & Gordon-Larsen, 2006). A repeated measures analysis of variance was conducted to assess the difference between genders and intervention conditions in overall FMS scores across the 3 time points. Separate repeated measures analysis of variance were also conducted to assess the difference between genders and intervention conditions on lcocomotor skill proficiency, object control skill proficiency and each individual skill proficiency across the 3 time points. The Bonferroni method was used for post hoc comparison.

6.4 Results

A total of 532 participants participated in this study, with 464 participants (male=235, female= 229, mean age=12.7, SD=±0.91) having full data from two of more time points. The repeated measures analysis of variance on the total 7 skills highlighted a significant main effect for time (Wilk's Lamda=.46, $F(2,459)=272.66$, $p<0.001$ and partial eta squared=0.543). There was a significant interaction effect for time*gender (Wilk's Lamda=.95, $F(2,459)=12.3$, $p<0.001$ and partial eta squared=0.051). This interaction effect between time and gender demonstrated that both genders improved significantly over time ($p<0.01$). Males improved from 80% to 86% mastery and females improved from73% to 83% mastery. It also highlighted that males were significantly more proficient at FMS than females at all 3 time points ($p<.001$). There was also a significant interaction effect between time*intervention (Wilk's Lamda=.86, $F(2,459)=38.3$, $p<0.001$ and partial eta squared=0.143), The interaction effect between time*intervention highlighted that there was no significant difference between intervention and control groups at time one (intervention mean=43.96, control mean=44.76, p=0.09), however there was a significant difference between them at time 2 (intervention mean=48.95, control mean=45.8, $p<0.001$), and time 3 (intervention mean=51.26, control mean=48.43, $p<0.001$). This highlighted that both intervention and control groups improved over time however the intervention group improved by a greater amount than the control group (see Figure 6.2). The control group increased from 77% mastery to 83% mastery while the intervention group increased from 75% mastery to 88% mastery. There was no significant interaction effect for time*gender*intervention (Wilk's Lamda=.99, $F(2,459)=1.02$, p=0.36 and partial eta squared=0.004).

As can be seen from Table 6.2, for both locomotor and object control sub-domains, findings from the repeated measures analysis of variance followed a similar pattern as with the total 7 FMS with males performing significantly higher than females at each time point, and both intervention and control groups increasing over time but with the intervention group increasing significantly more than the control group. For the locomotor skills the post hoc tests highlighted that there was no significant difference between intervention and control groups at time one (intervention mean=25.76, control mean=25.95, p=0.42), however there was a significant difference between them at time 2 (intervention mean=28.62, control mean=26.76, p<0.001), and time 3 (intervention mean=29.72, control mean=28.45, p<0.001). This highlighted that both intervention and control groups improved over time however the intervention group again improved by more. For the object control skills the post hoc tests highlighted that there was a significant difference between intervention and control groups at time one (intervention mean=18.24, control mean=18.83, p=0.04) with the control group scoring higher, however this changed as the significant difference between them at time 2 (intervention mean=20.71, control mean=18.55, p<0.001), and time 3 (intervention mean=21.54, control mean=20.00, p<0.001) highlighted that while both groups improved over time the intervention group surpassed the control group.

There is also a difference in the control and intervention groups across each individual skill with the intervention group making a marked increase compared to the control group (see Table 6.3). This is the case for most skills, however with the hop both groups decrease over time and this decrease was significant for the control group (p=0.04) where as it was not significant for the intervention group.

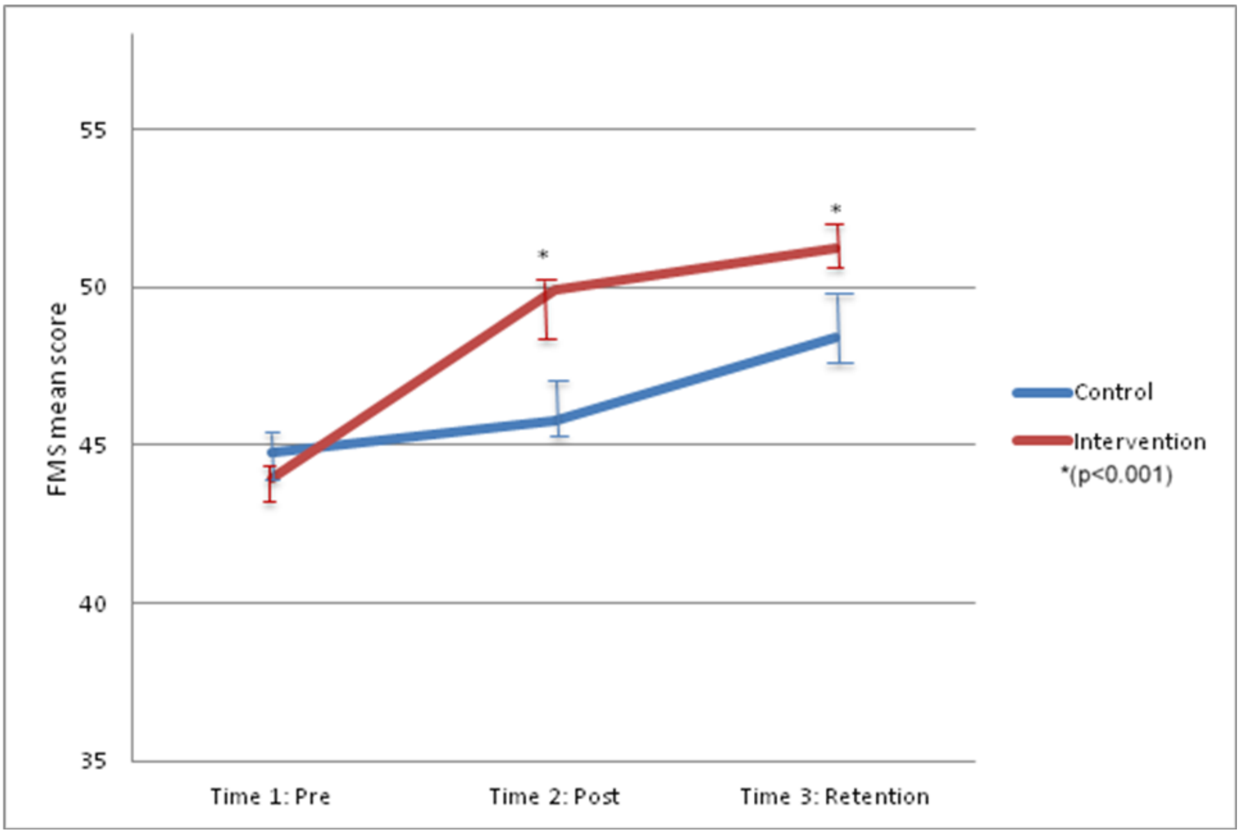

Figure 6.2. Difference in control and intervention group's FMS proficiency over time

Table 6.1. FMS means across 3 time points

		Time 1: Pre Test	Time 2: Post Test	Time 3: Retention
7 Skills	Control	44.76	45.80	48.44
	Intervention	43.97	48.95	51.26
	Male	46.26	49.47	50.90
	Female	42.43	45.17	48.72
Locomotor	Control	25.95	26.76	28.45
	Intervention	25.76	28.62	29.72
	Male	26.92	28.58	29.58
	Female	24.87	26.77	28.56
Object Control	Control	18.82	18.55	20.00
	Intervention	18.24	20.71	21.54
	Male	19.35	20.90	21.39
	Female	17.74	18.20	20.04

6.2. Results of repeated measures analysis of variance on 7 skills total, locomotor and object control skills

Skills	Main effect and Interaction effect	df	Errors	F	p	partial eta square
Locomotor	time	2.00	315.00	115.79	0.00	0.42
	time*intervention	2.00	315.00	11.85	0.00	0.07
	time*gender	2.00	315.00	3.70	0.03	0.02
	time*gender*intervention	2.00	315.00	0.10	0.91	0.00
Object Control	time	2.00	328.00	76.51	0.00	0.32
	time*intervention	2.00	328.00	30.19	0.00	0.16
	time*gender	2.00	328.00	7.23	0.00	0.04
	time*gender*intervention	2.00	328.00	0.83	0.44	0.01

Table 6.3. Skill by skill differences in mean FMS scores across 3 time points

Skill	Group	Max. score	Pre	Post	Retention	Normalised % Pre	Normalised % Post	Normalised % Retention	% diff pre-retention
Gallop	Control	8	6.22	6.18	6.82	77.7	77.31	85.27	7.56
	Intervention	8	6.09	6.57	6.78	76.12	82.08	84.71	8.59
Hop	Control	10	7.92	7.57	7.45	79.18	75.71	74.52	-4.66
	Intervention	10	7.93	8.06	7.91	79.26	80.62	79.08	-0.17
HJ	Control	8	4.51	6.03	6.45	56.33	75.34	80.63	24.31
	Intervention	8	4.26	6.43	7.17	53.31	80.4	89.64	36.34
Run	Control	8	7.42	7.04	7.74	92.77	88.01	96.71	3.94
	Intervention	8	7.43	7.36	7.81	92.83	92.04	97.58	4.75
Bounce	Control	8	6.58	6.81	7.2	82.22	85.13	90.01	7.79
	Intervention	8	6.31	7.09	7.55	78.93	88.67	94.38	15.46
Roll	Control	8	5.48	5.34	5.25	68.52	66.8	65.6	-2.93
	Intervention	8	5.3	6.41	6.5	66.19	80.11	81.31	15.12
Kick	Control	8	6.66	6.7	7.45	83.22	83.78	93.14	9.92
	Intervention	8	6.51	7.06	7.39	81.35	88.22	92.33	10.97

(Normalised %= mean score/maximum possible score*100)

6.5 Discussion

The results of this study indicate that FMS proficiency levels at baseline in this cohort of adolescents are well below the expected levels for their age group. Participants in this study are aged 12-14 years, and therefore should have achieved mastery across FMS and be at the sport specific skill development stage (Gallahue &

Ozmun, 2006). It is evident from Table 6.3 however that they are performing below expected levels with participants' performance particularly low in the horizontal jump and roll. The mean age at retention was 13.7 years (SD=±0.91) which is almost 4 years after the age children should have mastered all FMS (Gallahue & Ozmun, 2006). These results confirm that children are leaving primary school lacking in these basic FMS supporting O' Brien et al. results (2015). This highlights the requirement for a school-based intervention such as Y-PATH to overturn this lack of proficiency. This is also important when one considered that FMS are the building blocks for sport skill development (Gallahue & Ozmun, 2006) and also predictors for future participation in PA (Cliff, Okely, Smith, & McKeen, 2009; Lubans, Morgan, Cliff, Barnett, & Okely, 2010).

The results of this study highlight that overall FMS, locomotor and object control skills all improved significantly over time (see Figure 6.2 and Table 6.1) irrespective of whether participants were in the intervention or control groups. This is likely due to maturation, as suggested by Iivonen, Sääkslahti, & Nissinen, (2011) where they found an improvement of FMS proficiency of children due to age. It is well known that children naturally develop a rudimentary form of fundamental movement pattern, however, it is argued that teaching is required to further develop specific FMS (Lubans et al., 2010). As stated by Clark (2007) "motor skills do not just come as birthday presents. They must be nurtured, promoted, and practiced." (p.43). Clark (2007) argues the importance of teaching FMS right through both primary and secondary school, suggesting that if these skills are not taught then they will not develop to the expect level of proficiency.

Participants in this study were assessed at the beginning of their first year in secondary school, at the end of their first year and again at the beginning of second year. Over this time, they all showed a significant improvement which would suggest that having a specialised PE teacher in secondary school (which children do not have at primary level in Ireland) may have also contributed to this increase in skill proficiency with further improvement for the intervention group due to the specific characteristics of the Y-PATH intervention targeting the weak components of FMS across all skills. Research highlights that with the correct teaching FMS can be improved (Lubans, Morgan, Cliff, Barnett, & Okely, 2010), therefore it is logical to suggest that children are leaving primary school lacking in FMS due to many reasons such as having a non-specialist PE teacher who may lack confidence and motivation in teaching FMS (Hardy et al., 2013). In terms of FMS development it would be beneficial to have specialist PE teacher in primary school to help improve FMS proficiency. This lack of proficiency may also be as a result of the change in environment in the last 20 years with less time spent in free-play and more time spent in sedentary activities such as computers (Hands et al., 2011).

Gender differences also existed in the performance of FMS in this study, with males performing FMS significantly better than females, consistent with previous studies (Hardy et al., 2013; Lubans et al., 2010; O' Brien et al., 2015). The findings in relation to the object control sub-domain are also consistent with previous research (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2010; O' Brien et al., 2015; Wrotniak et al., 2006), with males performing significantly better than females. However, there has been conflicting findings in research when assessing gender differences in locomotor proficiency. Results of this study found males to perform locomotor skills significantly better than females which is consistent with O' Brien et al. (2015) but contradicts the findings of Barnett et al. (2009). This may be population specific as O'Brien et al.'s study (2015) was on an Irish population whereas Barnett et al.'s study (2009) was on an Australian population. Hume et al., (2008) who also did a study in Australia found no significant difference between genders in the performance of locomotor skills. The interaction effect between gender and time was significant with a significant difference between males and females at all 3 time points. While males did perform significantly better than females, both males and females performance significantly improved over time with females increasing by a greater amount than males resulting in a decrease in the gender difference over time. Males increased from 80% to 86% mastery whereas females increased from 73% to 83% mastery (see Table 6.1 for mean scores). This highlights that the gap between males and females proficiency levels could be reduced if females are provided with the same opportunities for instruction, practice, feedback and encouragement as males (Rowe, Raedeke, Wiersma, & Mahar, 2007).

The efficacy of the intervention was highlighted by the post hoc results from the repeated measure ANOVAs. Results demonstrate that at pre-test there was no significant difference between intervention and control groups, though the scores for the control group were slightly higher (control group = 77% mastery, intervention group = 75% mastery). At post-test and retention, this was not the case with the intervention group scoring significantly higher than the control group at both time points. The control group improved by 6% whereas the intervention group improved by 11% reaching 88% mastery at retention. It is important to highlight the positive results that there was an improvement in FMS proficiency at post test, however the fact that these positive results were retained 3 months later at retention confirms the efficacy of the Y-PATH intervention as not only are they improving FMS proficiency during the 8 month intervention but they are retaining these results. Research has suggested that interventions can improve FMS among children (Van Beurden et al., 2003), however there were limited research so far assessing if this is also the case with an adolescent population. The results of the pilot trial for the Y-PATH intervention (O' Brien et al., 2013) and the results of the current study strongly suggest that school based multi-component interventions can help rectify the lack of FMS proficiency among adolescents. It is important that this lack of FMS proficiency is targeted as these are the building blocks for sport and PA participation (Gallahue & Ozmun, 2006). Since adolescence is a period where PA participation decreases (Nelson, Neumark-Stzainer, Hannan, Sirard, & Story, 2006), then an effective intervention such as Y-PATH which targets FMS proficiency while also focusing on improving PA levels may assist in stemming this trend (Stodden et al., 2008).

Individual skill differences are also evident across the 3 time points (see Table 6.3) with the intervention group performing better than the control group at retention testing. It is important to note that the horizontal jump which was the weakest skill at pre-testing made the greatest improvements. This was the case for both intervention (increase in mastery by 36%) and control groups (increase in mastery by 24%). The fact that the control group achieved this improvement highlights the benefit of a specialist PE teacher to aid FMS development. This result also supports the efficacy of the intervention programme which supports the original Y-PATH findings which highlighted that the intervention group improved by significantly more than the control group (O' Brien et al., 2013). Similar to this study the control group did make improvements, however these improvements were significantly greater in the intervention group.

6.6 Conclusion

This study highlights the lack of FMS proficiency among Irish adolescent youth as they make the transition from primary to post primary education, with participants scoring below the expected proficiency levels for their age group at baseline. Since FMS are seen as a contributor to future participation in PA and sport it is essential that the development of these FMS becomes a priority in both primary and secondary schools. This study highlights that having a specialist PE teacher may assist in achieving improvements in FMS proficiency and should be considered as an option for primary school PE in order to address this problem. Although a specialist PE teacher may assist in achieving improvements the results of this study also highlight that the Y-PATH programme is effective in achieving significantly greater improvements than the PE curriculum and the PE teachers input on their own. This intervention should be considered as an effective method to overturn the lack of FMS proficiency among current adolescents. This study emphasises that multi-component school-based interventions are an effective method of improving FMS proficiency levels among adolescents. While this study highlights the effectiveness of the Y-PATH intervention there are also limitations of this study, for example, allowing the principal in each school to select the class may result in potential bias. Another limitation may be due to it only being implemented in mixed gender schools as it is not a true representation of all school settings. Future research should assess the effectiveness of the Y-PATH programme in single gender schools to ensure it can be implemented effectively in a variety of school settings. It is also important to assess the impact the intervention may have on physical self-confidence using the scale validated in chapter 3. Information was obtained on BMI, physical activity levels and fitness levels should be used in future to assess the impact the intervention had on these variables. Some feedback was also obtained from teachers in order to complete a process evaluation; the information obtained from this process evaluation should be used to adapt/further improve the intervention where necessary.

6.7 CONSORT Guidelines Checklist

Identification as a randomised trial in the title ☑

Structured summary of trial design, methods, results, and conclusions ☑

Introduction

Scientific background and explanation of rationale ☑

Specific objectives or hypotheses ☑

Methods

Description of trial design (such as parallel, factorial) including allocation ratio ☑

Important changes to methods after trial commencement (such as eligibility criteria with reasons ☑

Eligibility criteria for participants ☑

Settings and locations where the data were collected ☑

The interventions for each group with sufficient details to allow replication, includin how and when they were actually administered ☑

Completely defined pre-specified primary and secondary outcome measures, includin how and when they were assessed ☑

Any changes to trial outcomes after the trial commenced, with reasons ☑

How sample size was determined ☑

When applicable, explanation of any interim analyses and stopping guidelines

Method used to generate the random allocation sequence ☑

Type of randomisation; details of any restriction ☑

Mechanism used to implement the random allocation sequence (such as sequentiall numbered containers), describing any steps taken to conceal the sequence unt interventions were assigned ☑

Who generated the random allocation sequence, who enrolled participants, and wh assigned participants to interventions ☑

If done, who was blinded after assignment to interventions (for example, participant care providers, those assessing outcomes) and how

If relevant, description of the similarity of interventions

Statistical methods used to compare groups for primary and secondary outcomes ☑

Methods for additional analyses, such as subgroup analyses and adjusted analyses ☑

Results

For each group, the numbers of participants who were randomly assigned, receive intended treatment, and were analysed for the primary outcome ☑

For each group, losses and exclusions after randomisation, together with reasons ☑

Dates defining the periods of recruitment and follow-up ☑

Why the trial ended or was stopped

A table showing baseline demographic and clinical characteristics for each group

For each group, number of participants (denominator) included in each analysis an whether the analysis was by original assigned groups ☑

For each primary and secondary outcome, results for each group, and the estimate effect size and its precision (such as 95% confidence interval)

For binary outcomes, presentation of both absolute and relative effect sizes recommended

Results of any other analyses performed, including subgroup analyses and adjuste analyses, distinguishing pre-specified from exploratory

All important harms or unintended effects in each group ☑

Discussion

Trial limitations, addressing sources of potential bias, imprecision, and, if relevan multiplicity of analyses ☑

Generalisability (external validity, applicability) of the trial findings☑

Interpretation consistent with results, balancing benefits and harms, and considerin other relevant evidence ☑

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Chapter 7

Overview of Thesis, Strengths, Limitations and Future Directions.

7.1 Overview of thesis

This study was based around the randomised controlled trial of the Y-PATH intervention. The Y-PATH intervention is a multi-component school-based intervention which was developed as a result of low levels of physical activity (PA) participation (Belton, O' Brien, Meegan, Woods, & Issartel, 2014), which is a worldwide issue (Hallal et al., 2012) but is very much a growing problem in Ireland with 12% of 12-18 year olds meeting the recommended PA guidelines for health (Woods, Tannehill, Quinlan, Moyna, & Walsh, 2010). A recent study highlighted the lack of FMS proficiency among adolescents in Ireland (O' Brien, Belton, & Issartel, 2015), which could potentially have a knock on effect on PA participation and consequently health (Lubans, Morgan, Cliff, Barnett, & Okely, 2010; O' Brien et al., 2015). The World Health Organisation identifies interventions targeting an increase in PA among youth as a necessity (Currie, Zanotti, Looze, Roberts, & Barnekow, 2012). It was also recommended by the CSPPA study that interventions to improve the PA levels of adolescents must be developed and implemented in Ireland (Woods et al., 2010).

When developing an intervention to target PA participation it is important to consider the various correlates of PA such as FMS, self-efficacy, parental involvement and potential barriers to PA. FMS are seen as a contributor to PA participation, and are also a predictor of PA and sport participation later in life (Cliff, Okely, Smith, & McKeen, 2009). The Y-PATH intervention was developed and previously piloted with the aim of providing a cost efficient and sustainable programme to improve PA levels, attitudes towards participating in PA and FMS proficiency among adolescents in Ireland (Belton et al., 2014). This PhD focused on the clustered randomised controlled trial of the Y-PATH intervention in order to evaluate Y-PATH's efficacy and improving adolescent's FMS proficiency.

Developing and implementing an intervention is a complex process. For this reason it is necessary that previous literature, methods and theories are reviewed prior to choosing outcome measures, approaches and designing the intervention itself. It is important that previous interventions are reviewed and that effective strategies are highlighted. The MRC developed a framework in 2000 which may assist in the development and evaluation of a randomised controlled trial with the aim of long-term implementation (Campbell et al., 2000). The Y-PATH intervention to date have been following the MRC framework which recommends that after the exploratory trial a definitive randomised controlled trial should be carried out to specifically evaluate the overall intervention effectiveness (Campbell et al., 2000; O' Brien et al., 2015). Prior to implementation of the randomised controlled trial all resources were refined as per feedback received from the exploratory trial. The results of the exploratory trial (which included 2 schools) highlighted the effectiveness of Y-PATH at improving PA participation and FMS proficiency during adolescence.

In Chapter 3, the importance of assessing physical self-confidence was highlighted. This chapter was not based on the Y-PATH intervention itself, but during the implementation of the intervention physical self-confidence was highlighted as a potential mediator for performance of FMS and participation in PA (Lubans, Foster, & Biddle, 2008). Despite physical self-confidence being linked with FMS performance (Barnett, Morgan, Van Beurden, & Beard, 2008), a gap existed in the literature as there was no skill-specific assessment tool validated for use with adolescents. Chapter 3 highlights the importance of using a valid and reliable assessment tool and assessing self-confidence at skill level. This resulted in the development of the physical self-confidence scale. The development of this scale was based on the self-efficacy likert scale developed by Nigg and Courneya (1998), using various skills which were deemed suitable to the Irish sporting context (O' Brien et al., 2015; Woods et al., 2010). This chapter provides future researchers with a valid ($r=0.72$, $p<0.001$) and reliable ($r=0.92$) scale to assess physical self-confidence at skill level among adolescents. The results of this study highlight gender differences in physical self-confidence with males reporting higher confidence levels than females ($p<0.001$). Results also supported the importance of measuring confidence at skill level as these differences were task specific. According to McAuley and Gill (1983), self-confidence is a necessity for achieving success in a sporting performance, and as such its assessment is very important. They also state that this confidence may be skill and situation specific. Assessing adolescent's physical self-confidence at skill level will allow practitioners and researchers to highlight particular skills that may need attention and also highlight particular groups that may need encouragement and feedback to gain confidence in performing skills.

The validity of this physical self-confidence scale also allows researchers to assess the relationship between physical self-confidence and FMS proficiency. In Chapter 4, this relationship was assessed among a sample of 395 participants. Fifteen FMS were assessed using the TGMD-2, the TGMD and the Victorian Skills Manual. A significant correlation was found between female FMS and physical self-confidence overall ($r=0.305$, $p<0.001$), but not for males ($r=0.101$, $p=0.209$). This results is similar to Barnett et al. (2008) which highlights that a significant correlation between actual and perceived FMS ability in locomotor skills only exists among girls due to boys overestimating their skill level, however up until this study this was not been assessed among adolescents using a skill specific confidence scale. Despite there being no significant correlation between physical self-confidence and FMS proficiency among males, the results of this study also highlighted that males were not only more confident in their ability to perform FMS than females; they were also more proficient at FMS ($p=0.023$). This study highlights the importance of assessing the physical self-confidence and FMS proficiency of adolescents. Confidence level and FMS proficiency need to be considered on an individual basis showing the importance to develop specific interventions targeting either a lack of confidence in performing FMS or/and a lack of ability to perform FMS (Piek, Baynam, & Barrett, 2006; Viholainen, Aro, Purtsi, Tolvanen, & Cantell, 2014). These two correlates of PA may have been overlooked if they were not been assessed with the relevant tools preventing practitioners and researchers to understand the reasons behind experience of failure, lack of confidence and decline in adolescents' PA participation (Hardy, King, Farrell, Macniven, & Howlett, 2010; Piek et al., 2006). Assessing both FMS and physical self-confidence not only highlights those in most need of an intervention but will also facilitate in the development of the intervention.

As stated, when assessing physical self-confidence it is important to use a valid and reliable tool. This is also true for the assessment of FMS proficiency. The Test for Gross Motor Development-2 (TGMD-2) (Ulrich, 2000) has been extensively used as a process assessment tool of children's motor skill performance (3 to 10 years old) (Cohen, Morgan, Plotnikoff, Callister, & Lubans, 2014; Logan, Robinson, Wilson, & Lucas, 2011). The TGMD-2 is widely considered as a robust process-oriented tool to assess FMS in children up to the age of 10 years of age but it has not previously been validated for an adolescent population. With research suggesting that this current generation of children and adolescents underperform previously recognized norms in terms of FMS proficiency and PA participation (O' Brien et al., 2015; Woods et al., 2010), there is a need for scientists, teachers, health professionals and policy-makers to consider this situation in their respective domains. Unfortunately, this cannot be done efficiently unless one develops a way to assess adolescent FMS proficiency levels with scientifically robust instruments; and preferably through the extension of existing tests to an adolescent population.

For this reason, Chapter 5 assessed the reliability and validity of the TGMD-2 for use with an adolescent population. The reliability coefficients obtained are in line with those presented in the TGMD-2 manual with values ranging between 0.85-0.91, and are deemed acceptable. In terms of validity, while the original two factor model holds with an adolescent population, the model with best fit does not encompass such a broad range of skills as the original research carried out on younger children. As some variables did not sufficiently load the model they were consequently excluded from it. This was due to a low level of multi-colinearity between these excluded variables (leap, slide, strike, catch and throw) and those which remained in the model. In line with Larwin and Harvey (2012), reducing the number of variables in the model makes it more parsimonious. Despite having fewer skills in the model, the goodness-of-fit indices for the model were good. Various studies highlight reasons which may explain why these specific skills are not required/deemed appropriate when assessing FMS among adolescents. Some plausible reasons were: a possible ceiling effect (Okely, Booth, & Chey, 2004), cultural differences in performance, and finally the skills not being age appropriate. This extension of the TGMD-2 to an adolescent population opens the door for longitudinal studies targeting the observation and development of FMS across childhood and adolescence. FMS may be age-related (Gallahue et al., 2012) but are not age-determined (O' Brien et al., 2015). For this reason, the shift from FMS to sport specific skills (Gallahue, Ozmun, & Goodway, 2012) may now happen at a later stage for most adolescents highlighting the requirement for a process orientated FMS assessment tool appropriate for adolescents. The extension of the TGMD-2 to the adolescent population, as demonstrated in Chapter 5, offers an effective movement skill assessment tool to carry out such an evaluation.

It is evident there is a lack of FMS proficiency among adolescents which may lead to difficulties in developing more advanced sport specific skills. If this lack of proficiency was to be disregarded it may result in adolescents participation in PA and sport decreasing (Gallahue & Ozmun, 2006). Since these FMS must be taught and do not just naturally develop (Strong et al., 2005), it is essential that an effective intervention such as the Y-PATH program targeting FMS proficiency is implemented. However, prior to long-term dissemination, it is essential that the Y-PATH intervention is subjected to a robust method of assessment (Campbell et al., 2000).

Chapter 6 investigates the efficacy of the Y-PATH intervention in improving adolescent FMS proficiency in a cluster randomised controlled trial. One first year class from each of 20 mixed gender schools in Dublin, Ireland were included in the randomised controlled trial. The baseline results of this study support previous findings that adolescents both male and female are below the expected levels of FMS proficiency (O' Brien et al., 2015). The post-intervention and retention results highlighted that both the intervention and control groups improved in FMS proficiency over the one year period of assessment however, the intervention group improved by significantly more than the control group which highlights that the Y-PATH intervention is successful at improving FMS proficiency. Not only did the intervention help improve FMS proficiency but when participants were assessed 3 months post intervention, they also retained these improvements.

The results also highlighted that although males were significantly better at FMS than females, and both groups improved significantly at each time point, females improved at a greater rate than males thus narrowing the gap in FMS proficiency between genders. This indicates that the gap between males and females proficiency levels could be reduced if females are provided with the same opportunities for instruction, practice, feedback and encouragement as males (Rowe, Raedeke, Wiersma, & Mahar, 2007). FMS should be developed by the age of 10 (Gallahue & Ozmun, 2006), yet children are leaving primary school lacking in these basic movement skills (O' Brien et al., 2015; Woods et al., 2010). This highlights the requirement for a school-based intervention such as Y-PATH to overturn this lack of proficiency. It is important that such an intervention is implemented, as FMS are highlighted as the building blocks for sport skill development (Gallahue & Ozmun, 2006) and are a predictor for future participation in PA (Cliff, Okely, Smith, & McKeen, 2009; Lubans, Morgan, Cliff, Barnett, & Okely, 2010). It is logical to suggest that this problem of low FMS proficiency is as a result of a variety of correlates for example, an increase in sedentary activities such as computer games and a decrease in PA, particularly free-play PA is reported to be having a negative effect on FMS development among youth (Dollman, Harten, & Olds, 2008). Another correlate which has been highlighted in this thesis is self-confidence. If children/adolescents are not confident at performing FMS then they are less likely to participate in activities where they may develop FMS (Bandura, 1997). This study highlights that having a specialist PE teacher may assist in achieving improvements in FMS proficiency, and should be considered as an option for primary school PE in order to address this problem. Although a specialist PE teacher may assist in achieving improvements, the results of this study also highlight that the Y-PATH programme is effective in achieving significantly greater improvements than the PE curriculum alone, and should be considered as an effective method to overturn the lack of FMS proficiency among current adolescents. This study emphasises that Y-PATH as a multi-component school-based interventions is an effective programme of improving FMS proficiency levels among adolescents (Timperio, Salmon, & Ball, 2004).

7.2 Research strengths

Results from this thesis have introduced the reader to a vast array of themes among early adolescent youth: FMS proficiency, physical self-confidence, validation of assessment tools and scales, school based interventions and the importance of novel research while addressing gaps in literature. There are various shortcomings of this study which will be highlighted in the limitations section however, there is strong evidence encompassed in this thesis supporting various innovative studies including the efficacy of the Y-PATH intervention in improving FMS proficiency. These strengths can be discussed as follow:

- This thesis offers, for future studies, two valid assessment tools for use with adolescents. 1) A physical self-confidence scale which will allow for the comparison of confidence at performing a skill with actual FMS proficiency. It may also be used to examine the relationship between physical self-confidence with its other correlates such as fitness, BMI and PA participation. 2) The extension of the TGMD-2 to an adolescent population which will allow researchers and educators to track FMS development from childhood into adolescence.

- This thesis also assessed the relationship between physical self-confidence and FMS proficiency using a comparable scale which was developed for this specific purpose and those for 15 FMS as opposed to a general confidence scale (i.e. not skill specific).

- The robust evaluation the Y-PATH intervention evaluation has followed the MRC guidelines and therefore this study encompassed the randomised controlled trial. CONSORT guidelines were also followed during this evaluation to ensure no bias in the results.

- A detailed process evaluation was carried out throughout the implementation of the intervention. The results of this process evaluation go beyond this thesis, however they will be used by the wider research team to help make Y-PATH a sustainable, successful intervention suitable for national dissemination.

- Finally the results of the assessment of randomised controlled trial not only highlight that the intervention was successful at significantly improving FMS proficiency by a greater amount than the control group, but that these positive results were retained 3 months post-intervention.

7.3 Research limitations

- Feasibility of Y-PATH: In this thesis Y-PATH was implemented in one first year class in 20 schools in Dublin, Ireland. This implementation was monitored by 2 full time postgraduate students which were available to answer and deal with any queries as they occurred. For Y-PATH to be disseminated nationally it would need sufficient man power/financial support to provide this amount of support to ensure that the intervention was implemented as intended. If not, adjustment to the intervention implementation would be required.

- Longitudinal study: Y-PATH was assessed over a one year period in this study. Although the results were positive and were retained after 3 months post-intervention it is important that the efficacy of Y-PATH is assessed longitudinally to ensure that these positive results are maintained over time.

- FMS: Reality versus science. The results of Chapter 5 suggest that when assessing adolescents FMS proficiency, it is only necessary to assess 7 specific FMS. It is important to note however that as a PE teacher one could argue that there is a certain duty of care to assess a larger number of FMS in order to identify any FMS which an individual student may be poor at. By assessing 7 FMS, these skills may be overlooked and may become un-identified and therefore un-treated.

- When validating the physical self-confidence scale the PSPP was used as a comparative scale. This may be highlighted as a limitation as it is not a likert scale, however as there is no other likert scale validated for use with adolescents which assesses physical confidence/ perceived competence this was deemed the most appropriate.

- During FMS data collection, participants get 1 practice go and 2 trials which they are assessed on, therefore there is a possibility of a learning effect as this process occurs at 3 time points over a 1 year period.

- During FMS data collection, participants receive 1 demonstration from a trained researcher of the correct skill performance, however if their peers perform it incorrectly prior to their performance there is a possibility that they too may perform as their peer demonstrated rather than the researcher.

- The physical self-confidence scale was validated post intervention; therefore any change in physical self-confidence across the 3 time points was not assessed.
- The extent the intervention was implemented varied from school to school due to a variety of reasons such as staff strikes preventing some staff workshops, principal support, parental support and teacher's priorities.

7.4 Future directions for Y-PATH

Results of this study highlight that Y-PATH is an effective intervention at improving adolescents FMS. During the data collection for each of the 3 time points, there were numerous other variables assessed such as PA (using both with accelerometry and self-report measures), BMI, fitness and various psychological correlates of PA. Although the assessment of these variables go beyond the scope of this thesis, it is important that they are assessed to highlight the impact the Y-PATH intervention has not only on FMS but also on PA, fitness, BMI and various psychological correlates of PA. The analysis of this data will also allow for the examination of the inter-relationship between these variables in an adolescent population. It is also important that despite this thesis assessing participants at three time points over a one year period that the efficacy of Y-PATH is examined longitudinally to ensure that the positive results can be retained over time. This research is currently ongoing with 10 (n=5 control) of the original 20 schools remaining involved for 24 months (until Sept. 2015).

To date, the exploratory and randomised controlled trials of Y-PATH have taken place in mixed gender schools only. In the future the efficacy of the intervention in single gender schools must be also be assessed to ensure it is effective in achieving these positive results in all post-primary school settings in Ireland. There is also potential for the international dissemination of Y-PATH to evaluate its efficacy with other populations.

Following this randomised controlled trial, according to the MRC framework the next step for Y-PATH is long term dissemination to ensure others can reliably replicate this intervention long term without the support of a research team (Campbell et al., 2000).

This thesis highlights a lack of FMS proficiency among Irish adolescents when leaving primary school, therefore it is logical to suggest that there needs to be more emphasis on motor skill development in primary school PE to prevent this issue. This may also be helped by introducing a PE specialist teacher at primary school level, as it was evident in chapter 6 that after 1 year with PE specialist teacher improvements in FMS proficiency were observed.

Results also highlight that girls are less proficient at FMS and less confident at performing FMS than boys. Therefore future interventions should look at developing gender specific components in order to decrease this gap in FMS proficiency and improve girls' confidence levels at performing FMS.

Future research should also assess the effect of gender specific PE on adolescent girls' FMS development and physical self-confidence as having a mixed-gender PE class may contribute to this low FMS proficiency and physical self-confidence among girls at this age. Results of this thesis also highlight that girls FMS proficiency and physical self-confidence is correlated where as boys is not. This inconsistency across genders must be taken into consideration in future studies.

Finally, 2 of the 4 studies in this thesis are based on the assessment of physical self-confidence. Due to the lack of a valid suitable assessment scale for use with adolescents prior to this thesis, there is no baseline data on this variable. Therefore the effect of Y-PATH on participants' physical self-confidence is unknown. Post baseline testing the physical self-confidence scale has been validated for use allowing future research to track the effect Y-PATH has on participants' physical self-confidence, and also the relationship between physical-self confidence and FMS over time.

7.5 Closure

The conclusion to my PhD journey

The original aim of this thesis as stated in chapter 1 was to implement the randomised controlled trial of the Y-PATH intervention to evaluate its efficacy in improving adolescents FMS proficiency. In Chapter 6, the efficacy of the Y-PATH intervention was highlighted as the intervention group improved by significantly more than the control group. While this was the original aim for the thesis there were many other findings which proved essential to assessing this overall aim. Like any adventure, 'the journey became as important as the destination,' and in terms of this thesis, this meant taking a step back and looking at the assessment tools which were being used before evaluating the efficacy of the intervention. This review led to the validation of two assessment tools i.e. the physical self-confidence scale and the extension of the TGMD-2 to an adolescent population.

- The validation of the physical self-confidence scale will allow for future researchers to assess the relationship between FMS and physical self-confidence using a skill specific tool as shown in Chapter 4.
- Since adolescents FMS proficiency are below the expected levels, this also presented a new methodological issue for researchers as there was no appropriate assessment tool which would allow the tracking of FMS development from childhood through to adolescence. This is an issue which has previously been overlooked (O' Brien et al., 2015), but in this thesis the matter was addressed and therefore, led to the extension of the TGMD-2 to an adolescent population.

To summarise, during the last 3 years I have observed and participated in the complex, challenging, unpredictable and at times monotonous tasks which I now know are integral to the research process. While I noticed some gaps in research during the implementation and evaluation of the Y-PATH intervention which could have been overlooked to make this thesis as smooth and incessant as possible. Instead, I enjoyed the challenge of addressing these issues along the way. Despite the validation of the physical self-confidence scale and the extension of the TGMD-2 to adolescence not being part of the original aim, they will certainly enhance future research as strong methodological tools. And finally, in terms of Y-PATH, while this thesis highlights the interventions strengths, further analysis must be carried out longitudinally including other outcome measures, but to date Y-PATH presents as a viable solution to help equip adolescents with the motor skills they are lacking.

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Appendices

Appendix A

Physical Self-Confidence Scale

Perceived Motor Competency Questionnaire Y-PATH

Code

1. What is your gender?

- ◯ Female
- ◯ Male

***2. What is your Date of Birth?**

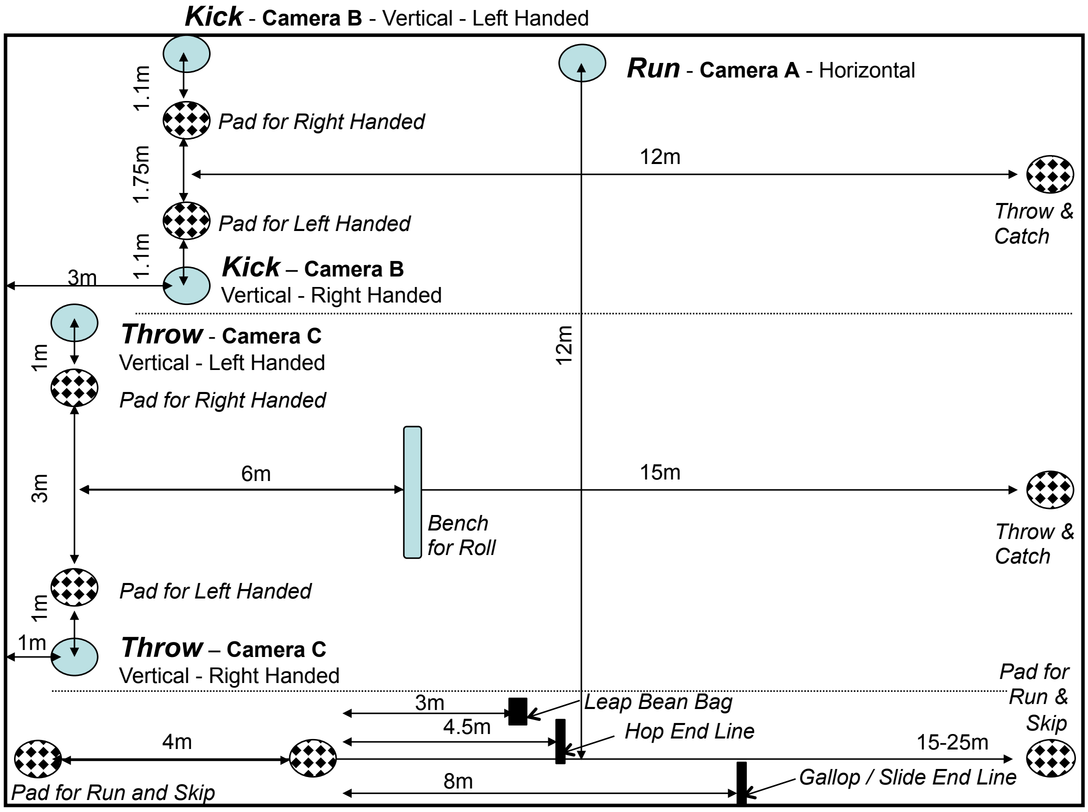
	MM		DD		YYYY
Date of Birth:		/		/	

3. Use the scale below (0-10) to indicate how confident you are to correctly perform the following skills:
0=Not at all confident
5=Somewhat confident
10= Very Confident

	1	2	3	4	5	6	7	8	9	10
Run in a straight line	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Skip in a straight line	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Leap over a bean bag	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Gallop in a straight line	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Side shuffle(slide) in a straight line	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Jump in the air for height from standing still	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Jump for distance from standing still	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Throw a tennis ball overarm	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Catch a tennis ball using two hands	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Kick a ball placed in front of you on the floor	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Strike a non-moving ball placed in front of you at hip height with a bat	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Bounce a ball with your hand five time in a row while standing	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Balance on a bench using one foot	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Hop 3 time on your right and left foot	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Roll a ball underarm	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Appendix B

Fundamental Movement Skill Data Collection Layout



Allocation of the Motor Skills for each station

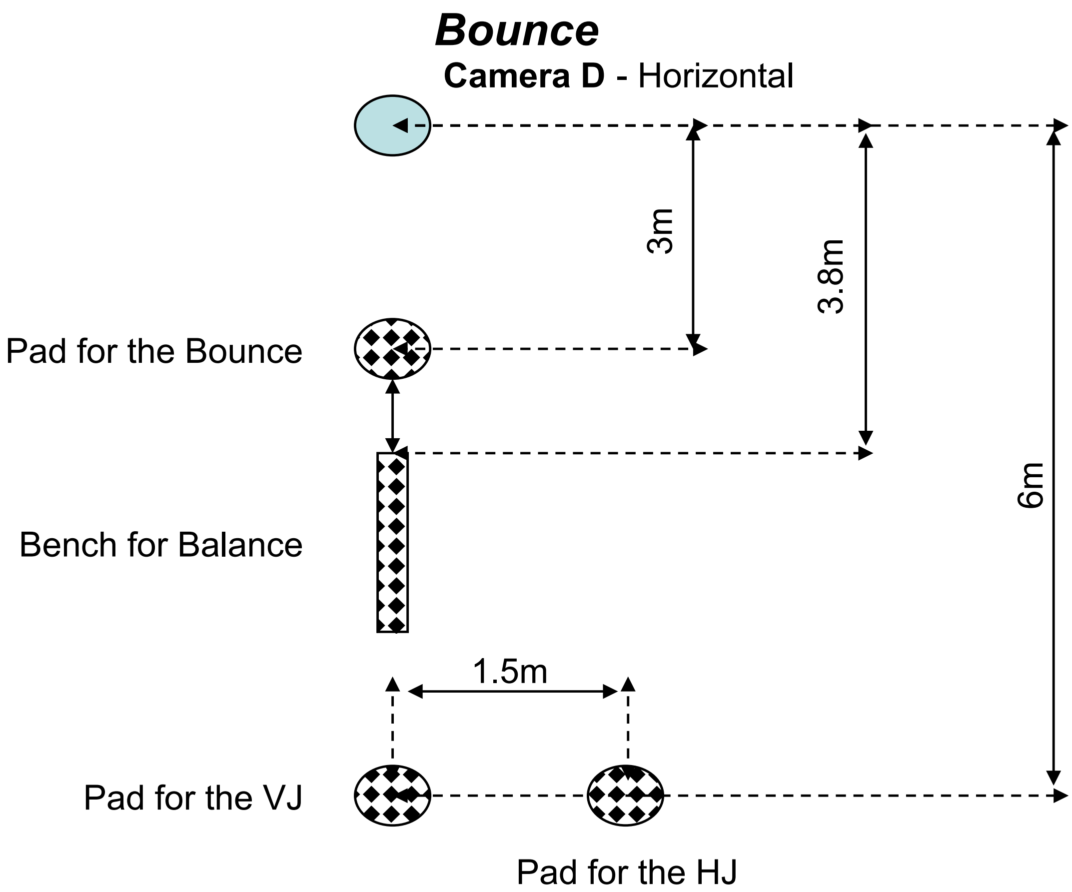
Station A:Run Station **=** Run / Skip / Leap / Gallop / Slide (camera 1)

Station B: Throw Station **=** Throw / Catch / Underhand Roll (camera 2)

Station C: Kick Station **=** Kick / Strike/ Hop (camera 3)

Station D: Bounce Station= Bounce/ Balance/ Vertical Jump/ Horizontal Jump (camera 4)

Station E: Step test& BMI Station= Fitness test & Height/ Weight



Allocation of the Motor Skills

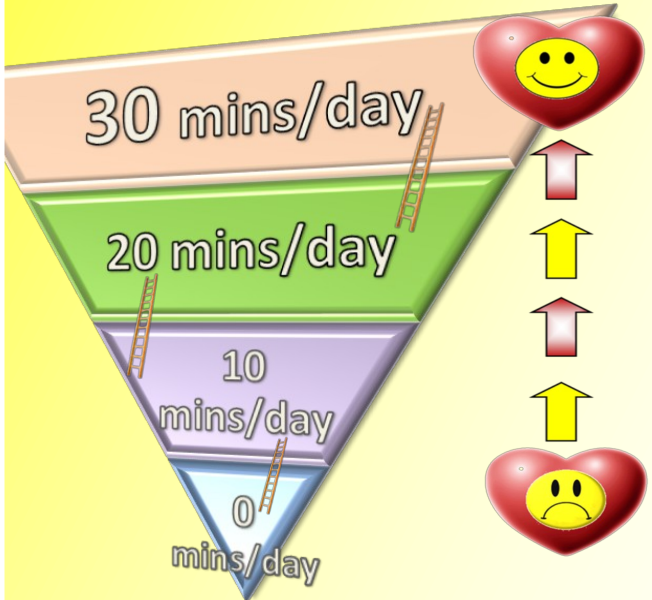
***Bounce* Station =** Bounce / Balance / Vertical Jump / Horizontal Jump (Camera 4)

Appendix C

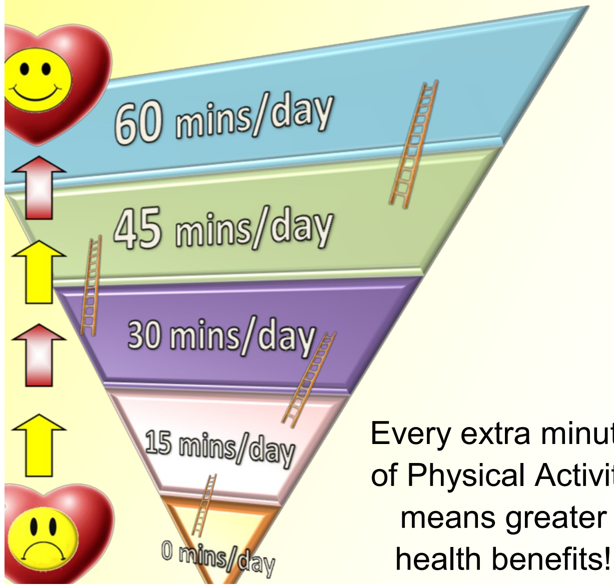
Parent/Guardian and Staff Information Leaflet

ow can I work towards meeting the recommendations?

Adults



Children and Adolescents



Every extra minute of Physical Activity means greater health benefits!

Dún Laoghaire - Rathdown Sports Partnership — An Irish Sports Council Initiative

Comhairle Contae Fhine Gall — Fingal County Council

sdcsp.ie South Dublin County Sports Partnership

DCSN Dublin City Sports Network — Baile Átha Cliath Dublin City — PROMOTING SPORT & ACTIVE LIVING — www.dublinsport.ie

-PATH

Youth - Physical Activity Towards Health

School of Health and Human Performance,

Dublin City University,

Glasnevin,

Dublin 9.

http://www.dcu.ie/shhp/y_path.shtml

Email: sarahjane.belton@dcu.ie

-PATH

Youth - Physical Activity Towards Health

Would you like your child to get 5 EXTRA years of life?

FREE

with 60 mins of Physical Activity daily!

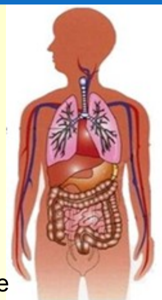
DCU

What is Physical Activity?

ysical Activity is any body movement that results in energy expenditure. As well as sport and structured exercise, this includes day to day activities that get you moving.

y is Physical Activity important?

Risks of most common diseases and conditions can be reduced through egular Physical Activity



Stroke	Type-2 Diabetes
Respiratory Problems	High Cholesterol
oronary heart disease	High blood pressure

aking Physical Activity a part of everyday life can have enormous physical and emotional benefits especially for youth

uced anxiety and stress	Self-discipline
nteraction with new people	Positive self-image
etter concentration	Greater confidence
Healthy weight	Better sleep

The World Health Organization (2010) identifies Physical Inactivity as:

he **4th leading risk factor** of global mortality ahead of verweight and obesity.

ausing **6% (5.2million) deaths globally** each year.

What are the recommendations for Physical Activity?

The National Physical Activity Guidelines for Ireland

Adults
(aged 18-65)

At least **30 minutes** a day of **moderate activity** on **5 days a week**

Moderate intensity activity	Vigorous intensity activity
Breathing is harder	Breathing is heavy
Heart rate is slightly increased	Heart rate is significantly increased
Warm and sweating slightly	Sweating a lot
Still able to carry on a conversation	Difficult to carry on a conversation

Children & Adolescents
(aged 2-18)

At least **60 minutes** of **moderate to vigorous** activity **every day**

This can be accumulated throughout the day in smaller blocks of Physical Activity.

Only 1 in 5 children are meeting the 60 minute Physical Activity recommendation for health on all 7 days (Y-PATH, 2010).

Remember, these guidelines are minimum recommendations; the more Physical Activity you do the greater the health benefits!

How can I encourage my child be more physically active?

1) Facilitate and encourage your child's participation in Physical Activity .

2) Be an active role model and take part in Physical Activity with your child.

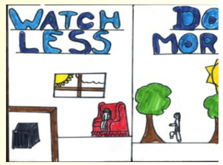
Facilitate and Encourage

- Take a committee position on child's team or volunteer to at matches and events.
- Encourage your child to try new sports and activities.
- Praise and reward effort.
- Remember that there is more to Physical Activity than sport.
- Encourage your child to try extra curricular activities available in school.
- If transport is an issue, try organising a car pool with other families in the area.

Active Role Model

Children are up to 10 times more likely to watch excessive amounts of TV if their parents watch 2-4 hours per day (Ja 2010).

- Cut down on sedentary activities such as TV/computer.
- Take up a new sport or start a new exercise regime.
- Make it a family tradition to go for a walk together once a week.
- Walk or cycle where possible instead of taking the car.
- Look in your local area or the Y-PATH online directory to find facilities and clubs that might interest you and your child.



For more tips and advice go to www.GetIrelandActive.ie

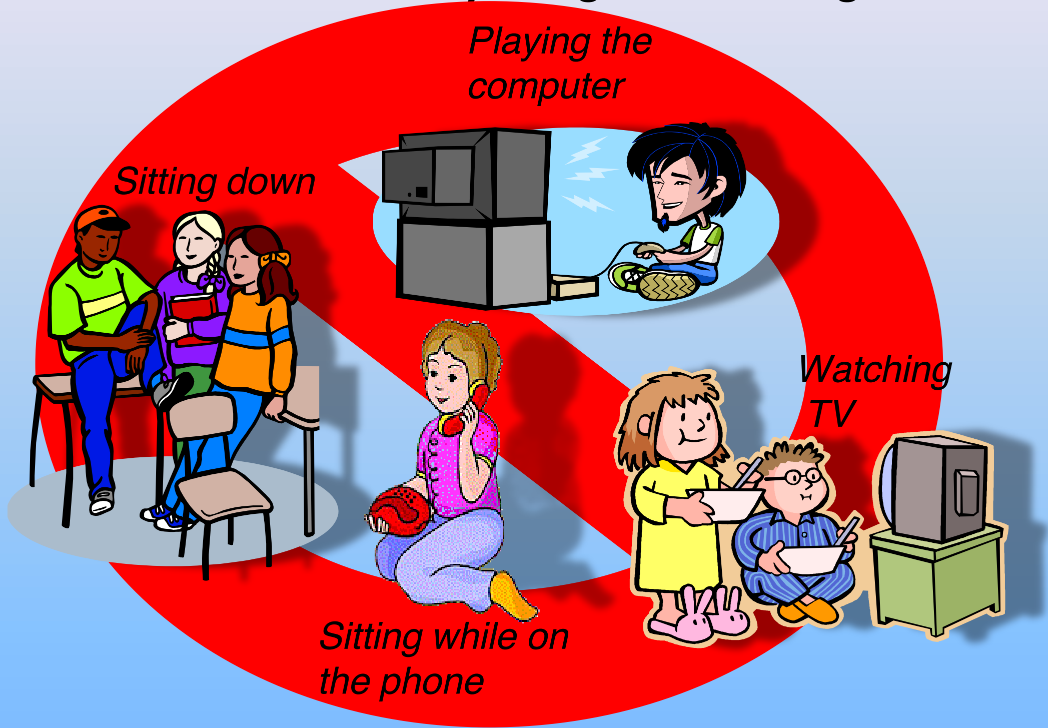
Appendix D

Intervention Posters

Are YOU leading a sedentary lifestyle?

Y-PATH — Youth - Physical Activity Towards Health

Yes, you are leading a sedentary lifestyle if you spend more than 2 hours a day doing the following:



Even if you are active for 60minutes per day you may still be spending too long doing sedentary activities.

Risks of sedentary behaviour:
- type 2 diabetes
- cardiovascular disease
- metabolic syndrome
- lower levels of aerobic fitness

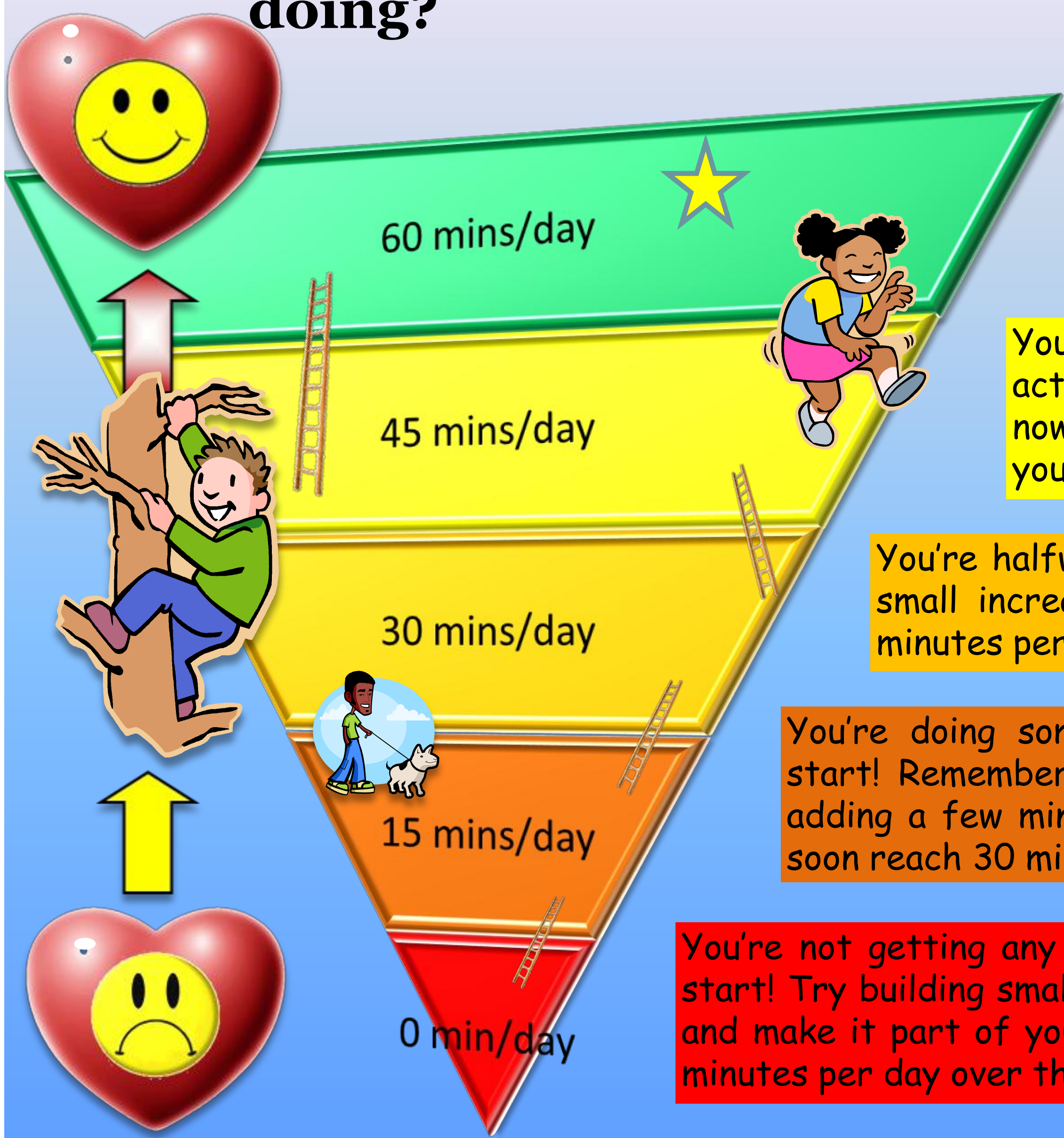
Here's how to improve....it's easy!

- Wake up
- Go to School — Instead of sitting in the car or on the bus, walk or cycle to school.
- School — Instead of sitting chatting at break-time, chat on the move with friends.
- After School
- Leisure Time — Break up sitting watching TV by going for a walk/cycle or playing with your family and friends.
- Bed Time

Get up and Get Active!

Steps To Physical Activity

How much Physical Activity are YOU doing?



That's great, you're meeting the 60 minute guideline; Keep it up! Try to make sure physical activity stays a part of your daily routine. The more you do the greater the health benefits!

You're well on your way to being physically active for 60 minutes every day. Don't stop now, you only have to do a small bit more and you will be meeting the guidelines!

You're halfway to meeting the guidelines. Try to make small increases each week and you'll be reaching 45 minutes per day very soon!

You're doing some physical activity; you've made a great start! Remember small changes make a big difference. By adding a few minutes of physical activity each day you will soon reach 30 minutes per day .

You're not getting any physical activity but it's never too late to start! Try building small amounts of physical activity into each day and make it part of your daily life. Aim to reach a minimum of 15 minutes per day over the next few weeks.

Youth - Physical Activity Towards Health

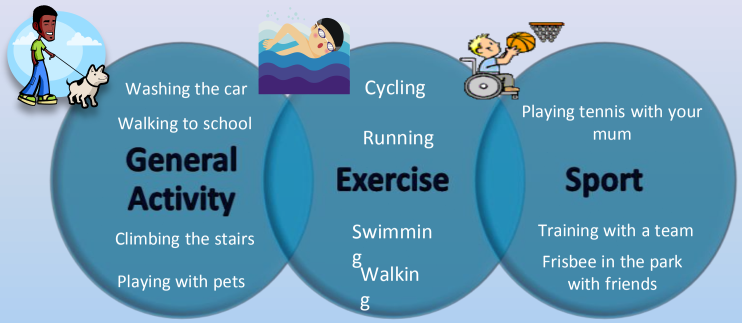
Physical Activity is For EVERYONE!

DCU | DCSN PROMOTING SPORT & ACTIVE LIVING www.dublinsport.ie | Baile Átha Cliath Dublin City

Y-PATH Youth - Physical Activity Towards Health

What is Physical Activity?

Physical activity is *any* body movement



How much Physical Activity should I be doing?

The recommendation is to be physically active for at least
60 minutes per day,
7 days a week

The good news is that this 60 minutes can be broken down throughout the day!

60 minutes =

15 minutes: Walking/cycling to and from school

15 minutes: Playing basketball at lunchtime with friends

20 Minutes: Cycling/ walking/ playing games with family and friends

10 minutes: Tidying your room

Why should I take part in regular Physical Activity?

Risks of Inactivity

Risks of common diseases and conditions can be reduced by being physically active

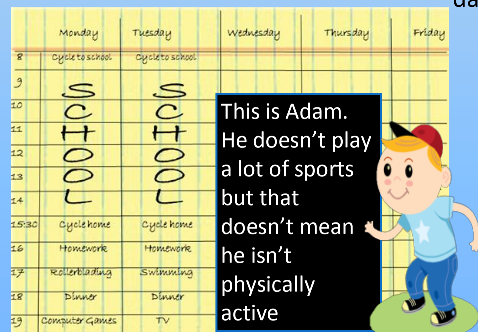
- × Diabetes
- × Heart Problems
- × High Cholesterol
- × High Blood Pressure
- × Breathing Problems
- × Obesity

Benefits of Regular Physical Activity

- ✓ Improved academic performance
- ✓ Reduced Stress
- ✓ Healthy Weight
- ✓ More energy
- ✓ Learning new skills
- ✓ Making friends
- ✓ Strong bones and healthy heart

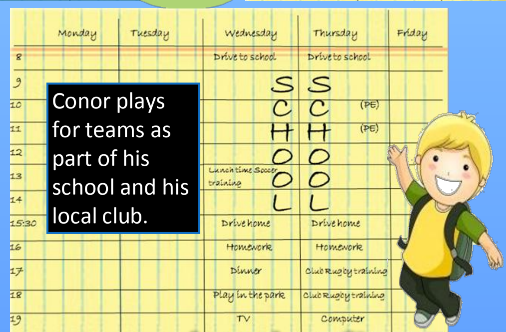
How can I fit more Physical Activity in to each day?

Fitting Physical Activity around school and family life needn't be hard work.
Take a look at how different people fit at least 60 minutes of Physical Activity into their days.



This is Adam. He doesn't play a lot of sports but that doesn't mean he isn't physically active

Lucy loves to stay physically active and has fun doing it!



Conor plays for teams as part of his school and his local club.

Remember, Small changes make a big difference so take the first step today!


DCU
DCSN
Dublin City Sports Network
Baile Átha Cliath
Dublin City
PROMOTING SPORT & ACTIVE LIVING
www.dublinsport.ie
Why not join a club?
Y-PATH
Youth - Physical Activity Towards Health
Making friends!
Having lots of energy!
Feeling great!
Learning new skills!
Learning how to get fit!
For more details about clubs ask your PE teacher.
There are lots of options, so choose your own path.

DCU

sdcsp.ie
South Dublin County Sports Partnership

Coláiste Cois Life's
Physical Activity Targets for the Year

Y-PATH
Youth - Physical Activity Towards Health

	To Be Started	In Progress	In Place
Extra curricular physical activity notice board			
Teachers act as active role models e.g. Lunchtime walks			
Greater variety of activities offered especially for girls i.e. Non competitive			
Activity breaks during class e.g. Jumping jacks			
Encourage participation in clubs outside of school using the physical activity directory			
Encourage active transport to and from school e.g. Walk to school Wednesdays			
Teacher student competitions e.g. Pedometer challenge			
Sports day for all including non competitive activities			
Reinforce the importance of physical activity and healthy eating with students			
Reward system for students who are physically active e.g. Certificate			

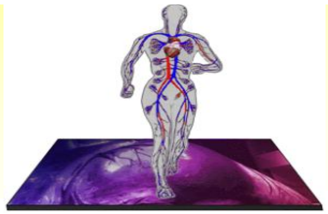
Appendix E

Health Related Activity Lessons 1-6

Y-PATH

Youth—Physical Activity Towards Health

HEALTH RELATED ACTIVITY
LESSON 1
School of Health & Human Performance Dublin City University



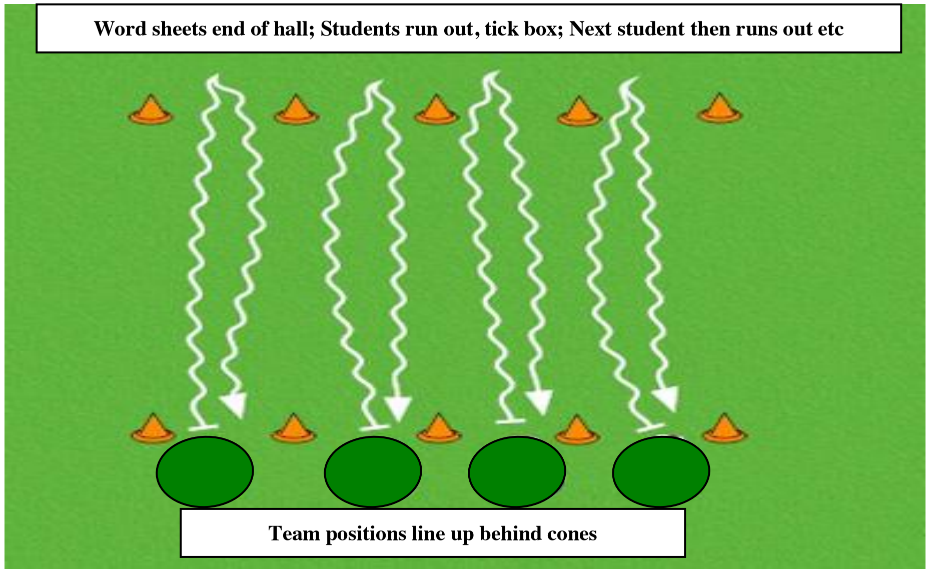
"Low active students must believe that they can succeed in physical activity situations" – *__Improve Self - Efficacy__*

[AI]M: Teacher will introduce 1st year students to the general principles and guidelines associated with regular physical activity. It is important that the teache[r] creates a learning environment in which physical activity is attainable, fun and universal to each class member within the unit.

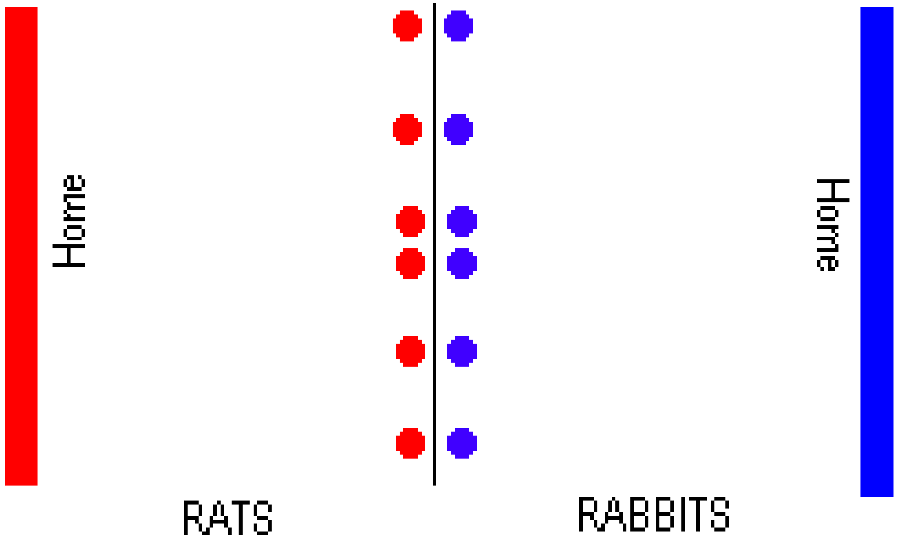
HRA Topic Lesson 1 60mins	Learning Outcomes	Class Structure & Content	Resources / Equipment	Assessment Strategy
[H]ealth benefits of physical [a]ctivity: self esteem sense of well-being lifelong physical activity 	<u>Psychomotor:</u> Engage in a variety of physical activities specific to individual, pair and teamwork challenges. <u>Cognitive:</u> Comprehend the importance of meeting the physical activity (PA) daily guidelines. <u>Affective:</u> Participate in class discussions and show ability to problem solve collectively.	<u>Warm Up (15 mins)</u> 1.Team Challenge –Word Run *Principles and Guidelines of PA taught* – <u>Progress Intensity.</u> <u>Development Stage 1 (10 mins)</u> 2.Rats & Rabbits or alternative. *PA is fun, enjoyable and helps student make friends*. <u>Development Stage 2 (20 mins)</u> 3.Students exposed to 3 mins each of individual, pair, team and sedentary activities. *Students explore different types of activities*. <u>Cool-Down (15 mins)</u> 4.Thematic expression: students express the number "60" on the ground followed by PA Journal week 1. *Students lower heart rate through group reflection*.	Warm – Up: Teacher needs true / false statement sheet, word sheets & pencils/pens. Development Stage 1: Cones or court markings for boundaries in rats & rabbits. Development Stage 2: Cones to divide 4 zones into individual, pair, team and sedentary areas. Writing paper and sheets for sedentary task. Specific equipment for activities pending the teacher decision. Cool – Down: No equipment needed: maximum use of hall and space for final activity. PA journal week 1.	Teacher Assessment: Visually observe both child motor skill proficiency and activity engagement in lesson 1. Self-Assessment: Individual student must reflect upon content of lesson within the re-capitulation phases particularly during the cool – down activity. Peer Assessment: Students give feedback to each other during development stage 2 and the cool down activity. Homework: Fill out student physical activity journal week 1.

HEALTH RELATED ACTIVITY
LESSON 1
School of Health & Human Performance Dublin City University

1. Team challenge: word run
"Run out to sheet on ground, tick box and return back"



2. Fun game: rats & rabbits
Teacher calls rats or rabbits; students then run to their zone



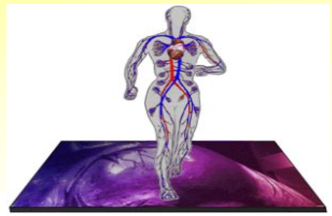
3. Individual, pair, team & sedentary activities
Students exposed to 3 minute activities including sedentary writing task

4. Thematic expression
Class challenge: represent number 60 on floor or alternative word if time

Y-PATH

Youth—Physical Activity Towards Health

HEALTH RELATED ACTIVITY
LESSON 2
School of Health & Human Performance Dublin City University



"Low active students must believe that they can succeed in physical activity situations" – *Improve Self - Efficacy*

IM: Teacher will further enhance students' knowledge of the concept of physical activity. Teacher will strive to create a learning environment in which pup can positively engage and adapt to the health related education lesson.

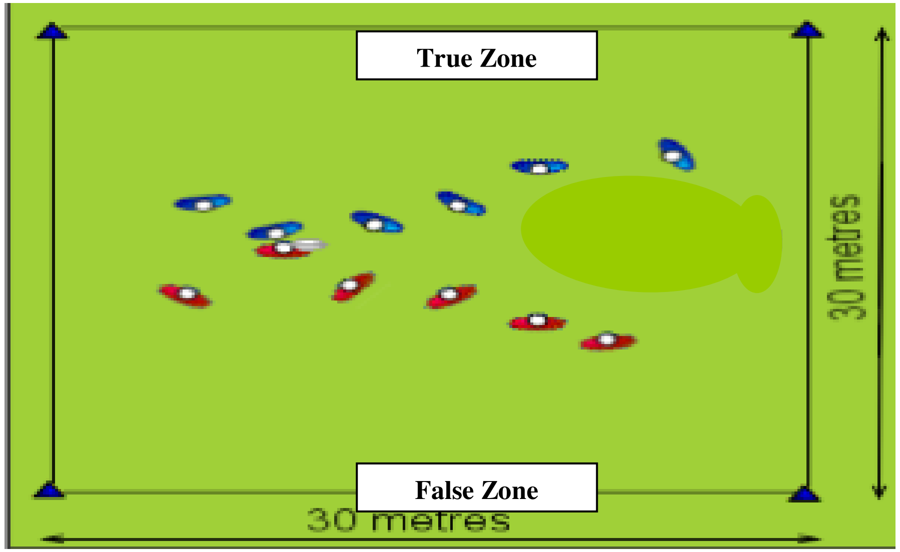
HRA Topic Lesson 2 60mins	Learning Outcomes	Class Structure & Content	Resources / Equipment	Assessment Strategy
Iealth benefits of physical ctivity: self esteem sense of well-being lifelong physical activity 	Psychomotor: Partake in a selected variety of physical activities specific to general exercises (jogging, jumping) and sport (basketball, dancing). Cognitive: Recognise and appreciate that physical activity choice is specific to individual preference. Affective: Conceptualise the importance of comradeship and teamwork within physical education; Respect individual choice within the physical activity environment.	Warm Up (15 mins) 1.Moderate Dance Warm-Up True/false statements – zones. *Re – cap lesson 1 through activity*. Development Stage 1 (10 mins) 2.Students re-cap 5 key words & design fun body movement. *Task to express PA*. Development Stage 2 (20 mins) 3. Six stations – MVPA activities. Individual choice at each station – autonomous decision making. *PA highly individualised*. Cool-Down (15 mins) 4.Group Interaction – students given task card to perform. *Focus on variety within PA*.	Warm – Up: Music player, cones for designating zone A (true) and zone B (false). Development Stage 1: Worksheet to jot down 5 key words associated with lesson 1 & 2 – learning to date. Task card for prompts – dictionary of movement. Pencils and pens. Development Stage 2: each station pending teacher decisions will have specific equipment – e.g. skipping ropes, benches, basketballs, footballs. Cool – Down: Task Cards with specific group performance – cater for 4 groups within the lesson (4 physical activity scenarios need to be set).	Teacher Assessment: Teacher question students understanding of previously acquired knowledge during re-cap phases : warm up and development stage 1 Self-Assessment: Within this lesson, students are expected to make independent activity choices highlighting that physical activity is individualised : development stage 2 Peer Assessment: Work collaboratively to re-cap during the pair work task within development stage 1 Homework: Fill out student physical activity journal week 2.

HEALTH RELATED ACTIVITY
LESSON 2

School of Health & Human Performance Dublin City University

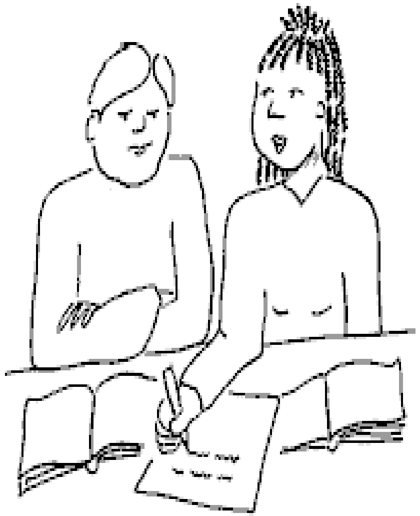
1. Moderate dance warm-up

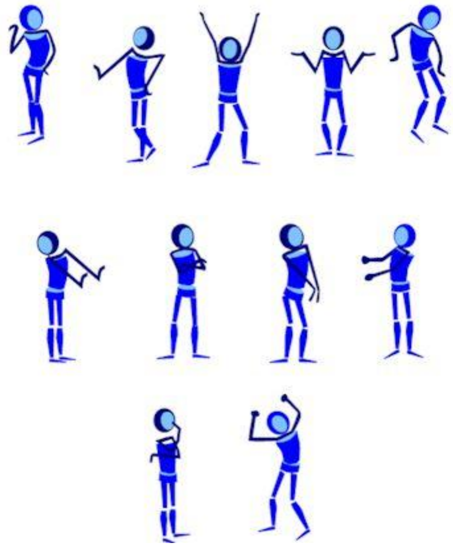
Dance to music - when question asked, run to either true or false zone



2. Re-cap & design fun body movement

Students in pairs write 5 key words, then proceed to design body action





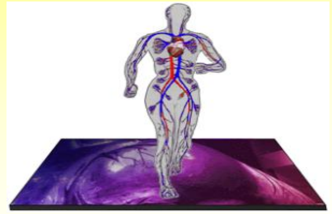
3. Six stations – choice in physical activity

Students have an option at each station e.g. type/speed of skipping

4. Group interaction

Groups given a physical activity scenario to rehearse and perform e.g. wash car

HEALTH RELATED ACTIVITY
LESSON 3
School of Health & Human Performance Dublin City University



"Low active students need to develop positive physical activity perceptions and awareness" – *Improve physical activity attitude*

[M: During lesson 3, the teacher shifts the learning towards the body's response during physical activity. The teacher within this lesson must emphasise tha physical activity has a positive effect on the body; In particular, teacher will familiarise students with the concept of increased heart rate (HR).

HRA Topic Lesson 3 60mins	Learning Outcomes	Class Structure & Content	Resources / Equipment	Assessment Strategy
ıctivity and the body: heart increased heart rate Iealth related fitness: physical education activities 	Psychomotor: Practice recording their heart rate through 2 x pulse taking methods (radial wrist and carotid neck regions). Cognitive: Identify that their heart rate increases as a result of activity intensity. Affective: Students demonstrate a strong class rapport through peer work activity tasks.	Introduction (15 mins): 1.Teach pulse taking. Record resting heart rate. Warm Up (15 mins) 2.Moderate intensity warm up station choices: individual, peer & group tasks- record HR *Re – cap lesson 2 through activity choice warm up.* Development Stage 1 (10 mins) 3.Moderate activity engagement – record HR *Students understand intensity.* Development Stage 2 (10 mins) 4. Vigorous activity engagement – record HR *Students understand intensity.* Cool-Down (10 mins) 5.Slow walk modified game *Resting HR post-exercise.*	Introduction: Worksheet for student to record heart rate in introduction, warm up and development stage 2. Pencils and pens. Warm – Up: 3 zones laid out, pending the tasks specific sporting equipment may be needed Development Stage 1 & 2: Pending the teacher's decisions for moderate and vigorous activities specific equipment will be needed for pupil engagement. Cool – Down: Worksheet as needed in development stages 1 & 2 to record heart rate post exercise in cool down. Also modified game equipment.	Teacher Assessment: Teacher visually observes pupils adaptation and application to the pulse taking methods during introduction Self-Assessment: Students ability to differentiate heart rate at varying activity levels within their engagement of light, moderate and vigorous activities: development stage 2 Homework: Fill out student physical activity journal week 3.

HEALTH RELATED ACTIVITY

LESSON 3

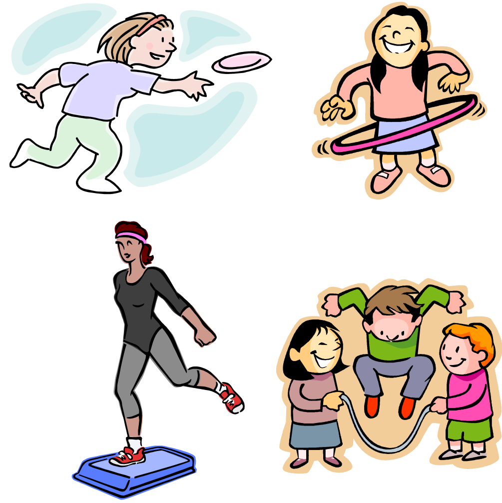
School of Health & Human Performance Dublin City University

1. Introduction- pulse taking (radial & carotid)

eacher introduces students to 2 x pulse taking methods at resting heart rate (HR)

2. Moderate Intensity Warm Up Choices

Students different types of moderate activity - record HR on sheet after eacl



Heart Rate Tally Sheet

Student's Name: ____________________

Record your heart rate as beats per minute.

Date	Prediction	Actual	Prediction (After 10 Minutes of Exercise)	Actual (After 10 Minutes of Exercise)

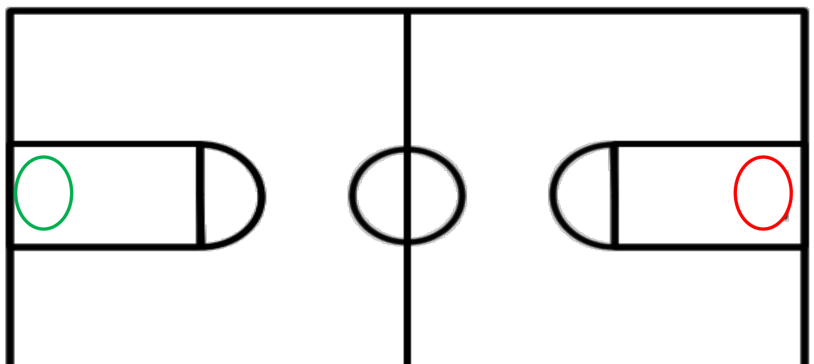
3 & 4. Moderate & vigorous activity engagement

'tudents recognise difference in heart rate intensity – record HR after both intensities

Ioderate activity – e.g. crab soccer/volleyball Vigorous activity – tag belt snatch

5. Cool Down – walking modified game

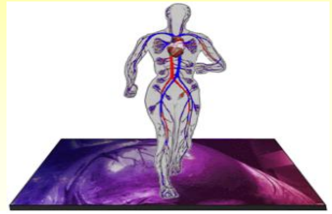
Slow walking pace activity – students HR back to normal (record on shee



Walking Game: Example Olympic Handball shoot in hula hoop (no running)

Y-PATH
Youth—Physical Activity Towards Health

HEALTH RELATED ACTIVITY
LESSON 4
School of Health & Human Performance Dublin City University



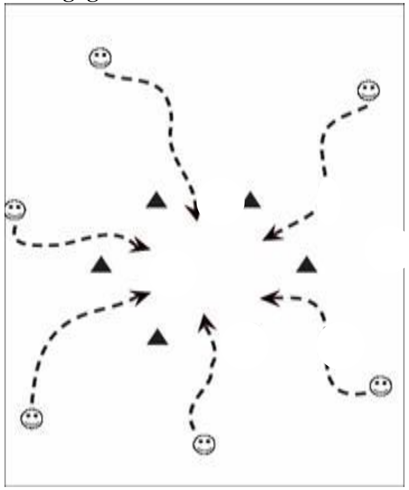
"Low active students need to develop positive physical activity perceptions and awareness" – ***Improve physical activity attitude***

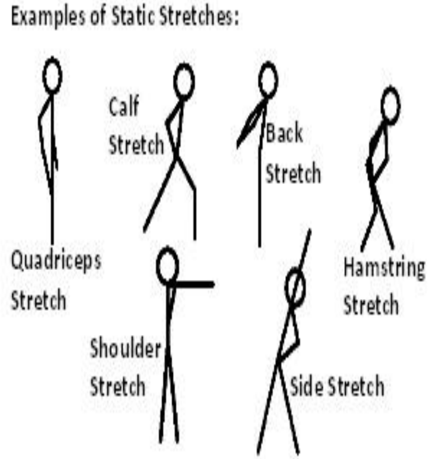
[A]IM: During lesson 4, the teacher will introduce and practically engage students within two components of health – related fitness. The lesson will aim to educate students on the importance of both flexibility and cardiovascular endurance within physical activity.

HRA Topic Lesson 4 60mins	Learning Outcomes	Class Structure & Content	Resources / Equipment	Assessment Strategy
[A]ctivity and the body: heart increased heart rate [H]ealth related fitness: [c]ardiovascular endurance flexibility physical education activities [W]arm-up and cool-[d]own: distinction and purpose	Psychomotor: Perform flexibility stretching exercises with an emphasis on the major muscle groups. Cognitive: Identify the principle of endurance within activity: sustained and continuous period of activity. Affective: Recognise individual differences associated with flexibility and cardiovascular endurance.	Warm Up (15 mins) 1.Increased HR warm up Everybody's it/ Stuck in the mud 2.Flexibility –stretch *Re-Cap HR intensity & introduce purpose of warm-up.* Development Stage 1 (15 mins) 3.Fun Game – e.g. Dodge Ball/parachute *Increase HR, teamwork & fun.* 4.Student re – cap: brainstorm questioning session on HR. Development Stage 2 (20 mins) 5.Cardiovascular endurance – 4 activities x 3 minute duration Record HR after each activity *Long periods – continuous PA at 120-140 HR fat burning.* ** Cool-Down (10 mins) 6.Walking game endzone ball 7.Flexibility – teacher led *HR & purpose of cool down*	Warm – Up: Court markings needed for the boundaries within everybody's it game/ stuck in the mud. Task card prompts for major muscle group stretching. HR record sheet. Pencils/pens. Development Stage 1: Dodge ball activity requires foam balls/ Parachute Whiteboard/ flipchart brainstorming re – cap. HR record sheet. Development Stage 2: The 5 stations may require skipping ropes, footballs, basketballs, music players, benches & steps. HR record sheet for students after each activity. Cool – Down: Endzone ball activity requires benches/ cones as goals and ball.	Teacher Assessment: Teacher will visually observe and monitor students control and technique of stretching during flexibility phases – warm up and cool down Self Assessment: Students will have to self evaluate and record their HR after each of the 4 CVE activities in development stage 2 Homework: Fill out student physical activity journal week 4. Go home and find out a new muscle stretch in advance of next week's lesson. Teach that to your partner.

HEALTH RELATED ACTIVITY
LESSON 4
School of Health & Human Performance Dublin City University

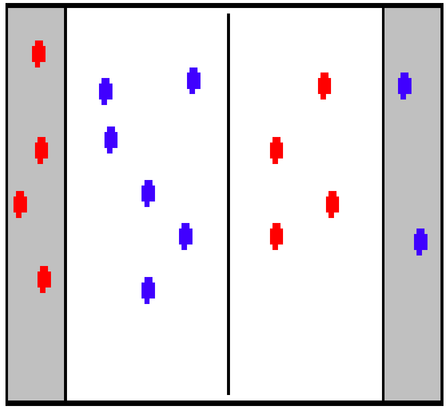
1 & 2. Warm-Up- increase HR activity & flexibility
Tag game to increase HR; teacher led stretching exercise





Everybody's it – tag game/ stuck in the mud   *Teacher led flexibility in warm up*

3 & 4. Fun game & brainstorm session (teacher led)
Students engage in fun, inclusive game followed by lessons 1-4 re-cap



Dodge ball- hit opposing team with sponge balls from shoulder down to get them out

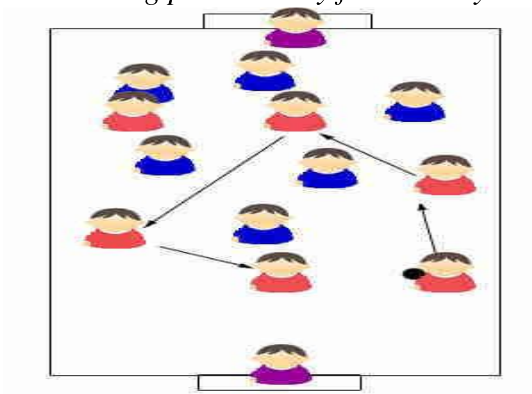
Brainstorm- teacher lea re-cap lessons 1-4

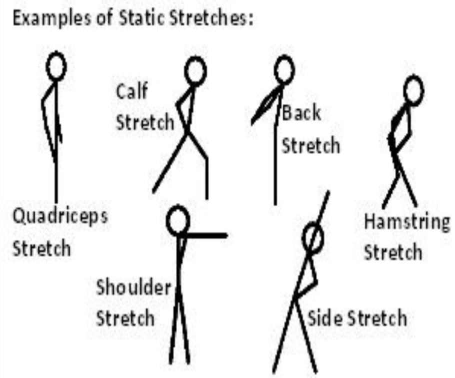
5. Cardiovascular endurance activities
Students record HR after each of the 3 min CVE activities
ıese can be any CVE activities such as running, obstacle course, jumping jac

Dance aerobics 3 mins

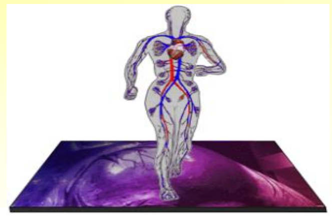
Skipping with or without rope 3 mins

6 & 7. Cool Down – walking modified game & flexibility
Slow walking pace activity followed by teacher led cool down stretching





HEALTH RELATED ACTIVITY
LESSON 5
School of Health & Human Performance Dublin City University



"Low active students must believe that they can succeed in physical activity situations" – *Improve Self - Efficacy*
"Low active students need to develop positive physical activity perceptions and awareness" – *Improve physical activity attitude*

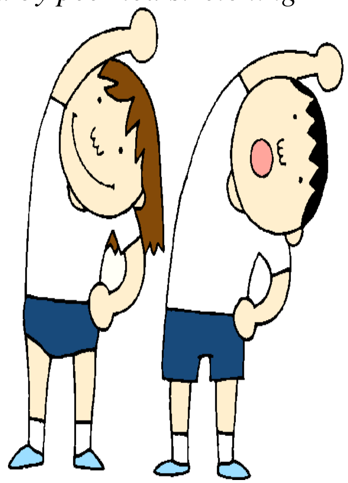
IM: Lesson 5 will introduce students to the principles of pedometer step counts. The teacher will implement activities of intensity progression. Students are required to make independent decisions in order to meet the moderate intensity recommendation of "100 steps per minute".

HRA Topic Lesson 5 60mins	Learning Outcomes	Class Structure & Content	Resources / Equipment	Assessment Strategy
ctivity and the body: *heart* *increased heart rate* Iealth related fitness: *flexibility* *physical education activities* Varm-up and cool-down: *distinction and purpose*	Psychomotor: Engage in light and brisk walking movements; carry out the physical movements necessary to obtain the pre – determined goal of "100 steps per minute" Cognitive: Apply the mathematical formula needed to calculate the average step count per minute based on the pedometer output. Affective: Experience success based on the completion of the pedometer step challenge and achievement of the target step count.	Warm Up (15 mins) 1.Crab soccer 2.Peer led stretching *pulse raise/reciprocal teaching* Development Stage 1 (15 mins) 3.Pedometer introduction; demo& explanation teacher 4.Slow walk challenge 3mins *device introduction and arithmetic avg. step / min.* Development Stage 2 (20 mins) 5.Brisk walk, jog & run challenge – 3 mins per activity Development Stage 3 (time**) 6.Modified game – step count Cool-Down (10 mins) 7.Flexibility stretching in pairs	Warm – Up: 2 separate courts for crab football games; Bibs to differentiate between teams; cones and increase number of sponge balls as required. Development Stage 1: Zone or grid layout for step challenge – 30 x pedometers. Students need sheets to record avg. steps/min and HR. Pencils/pens. Development Stage 2: Progression within intensity during the challenge of stage 2; 30 x pedometers needed again. Cool – Down: No equipment needed for closing activity.	Teacher Assessment: Teacher will formally assess student ability to increase step count within the lesson (development stage 1 & 2). Self-Assessment: Students will attempt to calculate avg. step/min following completion of 3 min tasks (development stage 1 & 2). Peer Assessment: Peers observe and correct partner's stretching technique; warm-up and cool-down phases of lesson. Homework: Fill out student physical activity journal week 5.

HEALTH RELATED ACTIVITY
LESSON 5
School of Health & Human Performance Dublin City University

1 & 2. Warm-Up- crab soccer & flexibility
Moderate intensity crab soccer followed by peer led stretching

Crab Soccer – Fun team game warm up



Peer led stretching

3 & 4. Pedometer introduction followed by 3 min light walking
Teacher introduces device: 3 minute walking challenge – record steps & HR

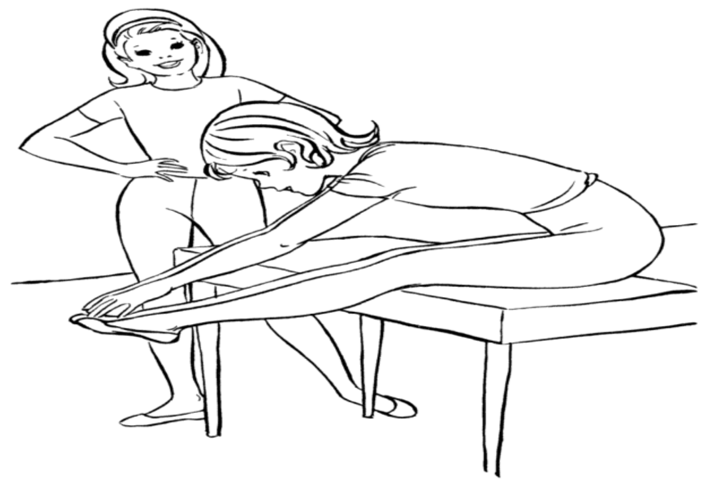
How to wear and use device

3 min slow walk task students – record ste

5 & 6. Brisk walk, jog, run and mini game – pedometer record steps
Students record step count and HR after each 3 minute activity
Moderate intensity = 100 steps per minute

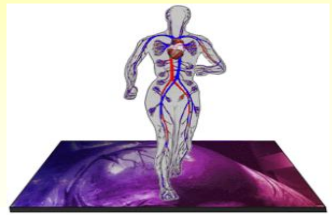
Average step count per minute and heart rate after different intensities

7. Cool Down – flexibility stretching with partner
Peer assessment – observe and correct stretching technique



Y-PATH
Youth—Physical Activity Towards Health

HEALTH RELATED ACTIVITY
LESSON 6
School of Health & Human Performance Dublin City University



"Low active students must believe that they can succeed in physical activity situations" – *<u>Improve Self - Efficacy</u>*
"Low active students need to develop positive physical activity perceptions and awareness" – *<u>Improve physical activity attitude</u>*

IM: The final health related education lesson plan will incorporate the central learning criteria from the previous 5 weeks. The teacher will design activitie specific to the learning content within lessons 1 – 5 with a particular emphasis towards students self efficacy and physical activity attitudes.

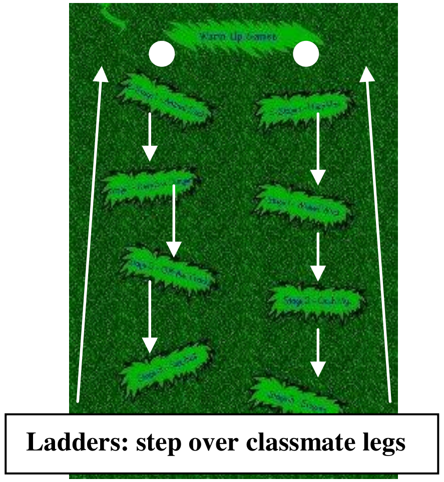
HRA Topic Lesson 6 60mins	Learning Outcomes	Class Structure & Content	Resources / Equipment	Assessment Strategy
ctivity and the body: heart increased heart rate Iealth benefits of physical ctivity: self esteem sense of well-being lifelong physical activity Iealth related fitness: flexibility Varm-up and cool-down: distinction and purpose	<u>Psychomotor:</u> Participate in a variety of moderate to vigorous physical activities through individual and team based challenges. <u>Cognitive:</u> Re-cap on previously learned subject matter. Recognise the health concepts associated with the body, the benefits of physical activity and the components of health related fitness. <u>Affective:</u> Demonstrate a positive attitude towards physical activity engagement. Experience success and feel included within the learning environment.	<u>Warm Up (15 mins)</u> 1.Resting heart rate recorded 2.Pulse raiser: ladders or other 3.Self-led stretching *Re-Cap HR & warm-up*. <u>Development Stage 1 (15 mins)</u> 4.Individual challenge – 500 steps within 5 minute duration 5.Team challenge – Tank tracks carry gym mats overhead *HR, step count & PA benefits*. <u>Development Stage 2 (15 mins)</u> 6.Student Choice – Fun, inclusive game; student decide. *Well-being, self-esteem, heart*. <u>Cool-Down (15 mins)</u> 7. Peer-led stretching: teacher observes. Pupils brainstorm. *Summative HRE assessment*.	Warm – Up: Cones set up boundaries for ladders game; pending teacher decision for pulse raiser equipment may vary. Worksheet for resting HR- pens/pencils. Development Stage 1: Pedometers x 30 for individual challenge, 2 x gymnastic mats for team challenge. Worksheet for HR and step count. Development Stage 2: Based on student enjoyment, desired activity chosen. 2 x playing areas for fun activity choices. Cool – Down: Brainstorming, 30 student worksheets Gold standard summary sheet at end of class to students.	<u>Teacher Assessment:</u> Teacher will assess students at end of 6 week HRE through prescribed brainstorming task during closing phase of lesson. Teacher will collect sheet for grading. <u>Self-Assessment:</u> Individual challenge development stage 1. Identification of individual activity preference development stage 2. <u>Peer Assessment:</u> Peer stretching during cool-down. Homework: Fill out student physical activity journal week 6.

HEALTH RELATED ACTIVITY
LESSON 6
School of Health & Human Performance Dublin City University

1, 2 & 3. Resting heart rate, pulse raiser & flexibility

Students record resting HR, engage in pulse raiser & self led stretching

Resting HR recorded



Ladders Mini Game

Self led stretching

4 & 5. Individual challenge & team challenge

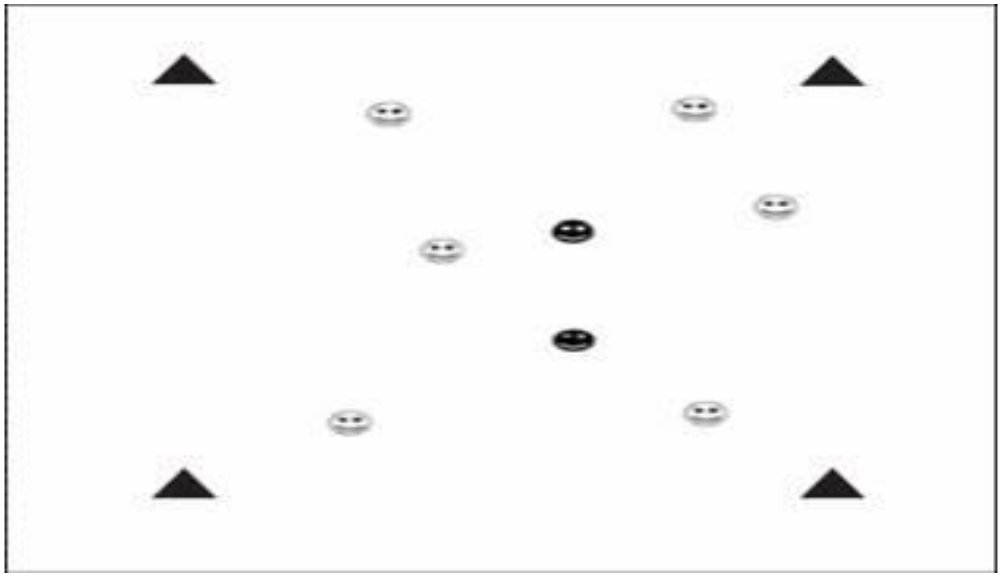
Individual challenge: 500 steps in 5 minutes / Team challenge e.g. tank tra

> 500 steps in 5 min timeframe

Team building activity – fun & inclusiv

6. Student choice – record step count post activity

Culminating HRA activity – student enjoyment; step count & HR recorded



eacher decision based on student enjoyment e.g.'s cannon ball, dodgeball, dance aerobics

7. Cool Down – flexibility with partner & summative assessme

Peer assessment – observe and correct stretching technique

Student re-cap closure; brainstorm sheet

Appendix F

In Strand FMS and HRA Activities

ADVENTURE ACTIVITIES

Integrating HRA & FMS into Unit

School of Health & Human Performance Dublin City University

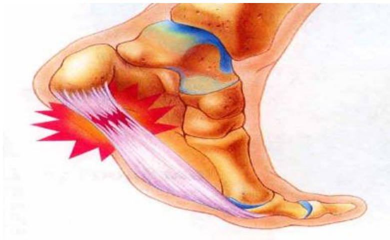
Y-PATH
Youth - Physical Activity Towards Health

Health Related Activity Focus

1. Meeting the daily 60 minutes guideline; 2. Exposure to individual and team-based activities; 3. Choice in the physical activity environment

Fundamental Movement Skill (FMS) Focus

1. Improving ability to crouch; 2. Improving ability to land on the balls of feet; 3. Improving co-ordination of arms and legs



Example of activity 1: *60 min guideline and ability to crouch*	**Example of activity 2:** *Forms of activity and landing on balls of the feet*	**Example of activity 3:** *Choice in physical activity and co-ordination*
Leap Frog Tag & Blind Leap Frog Leap Frog Tag: Students play tag but from a crouched "frog-like" position. Blind-Folded Leap Frog: Student must reach the target based on fellow student directions. Teacher highlights the importance of meeting the 60 min guideline through a variety of daily physical activities. FMS Skills: Horizontal and vertical jump addressed in this crouched action. Components of skip and run incorporated also. **<u>Teacher Reflection:</u>** **Crouch skill addressed in this unit?** **Students aware of the 60 minute guideline?**	*Individual & Team Orienteering* • Individual & Team Orienteering: Students participate in orienteering individually and as part of a team. Using the balls of the feet to sprint to the flag can integrate FMS in this lesson. • FMS Skills: Run and skip addressed through the balls of feet action. Components of both vertical and horizontal jump incorporated also. **<u>Teacher Reflection:</u>** **Landing on balls of the feet addressed in this unit?** **Students aware of individual and team activities?**	*Rock-climbing* • Choice in rock-climbing: Students introduced to rock-climbing - beginner and advanced choice in route. Arm and leg co-ordination inadvertently integrated in this adventure activity. • FMS Skills: Components of over-arm throw, skip, run and balance incorporated in arm/leg co-ordination. **<u>Teacher Reflection</u>:** **Arm/leg co-ordination addressed in this unit?** **Students aware of choice in physical activity?**

Don't be afraid to mix and match the HRA focus with a different FMS focus. For example:

IRA Focus:
xposure to individual and team-based activities
MS Focus:
mproving co-ordination of arms and legs

Team Skis

- Team skis: Students have 2 skis which are made up of a plank of wood with a string handle. Students place feet on wood and hold handle forcing them to lift handle and feet to move one ski at a time. Begin with one person and progress into whole team on the pair of skis working together to move.
- FMS Skills: Co-ordination of arms and legs and balance are incorporated.

<u>eacher Reflection:</u>
rm/leg co-ordination addressed in this activity?
tudents aware of individual and team ctivities?

HRA Focus:
Choice in the physical activity environment
FMS Focus:
Improving ability to crouch

Obstacle course created by the students

- Student obstacle course: Students split into teams create their own obstacle course. Student choose what activities to include which must incorporate specific criteria such as jumps, leap frog etc.
- FMS Skills: Crouch ability is developed while doing the horizontal and vertical jump in obstacle course.

<u>Teacher Reflection:</u>
Crouch addressed in this activity?
Students aware of choice in physical activity?

HRA Focus:
Meeting the daily 60 minutes guideline
FMS Focus:
Improving ability to land on the balls of feet

Orienteering

- Orienteering: Students split into teams and participate in orienteering. At each station they will collect an exercise which they bring back to base and perform before going to next station. Exercises will include jumping jacks, tuck jumps, knees up etc. Highlight how long students have been active for and the different intensity levels.
- FMS Skills: Students will address a variety of FMS such as run and vertical jump and more specifically FMS components such as arm/leg co-ordination and ability to land on balls of feet.
-

<u>Teacher Reflection:</u>
Landing on balls of the feet addressed in this unit?
Students aware of the 60 minute guideline?

AQUATICS
Integrating HRA & FMS into Unit
School of Health & Human Performance Dublin City University

Y-PATH — Youth - Physical Activity Towards Health

Health Related Activity Focus

1. Meeting the daily 60 minutes guideline;
2. Exposure to individual and team-based activities;
3. Choice in the physical activity environment

Fundamental Movement Skill Focus

1. Improving ability to crouch;
2. Improving ability to extend arms;
3. Improving co-ordination of hand and eye

Example of activity 1: *60 min guideline and ability to crouch*	**Example of activity 2:** *Forms of activity and extension of the arms*	**Example of activity 3:** *Choice in physical activity and co-ordination*
Aqua fitness – Water Aerobics Water aerobics: Teacher incorporates crouching actions during water aerobics lesson. Teacher highlights that aqua fitness is an alternative approach to meet the 60 minute guideline. FMS Skills: Components of both the horizontal and vertical jump actions incorporated in the water aerobics lesson. **<u>eacher Reflection:</u>** **rouch addressed in this unit?** **tudents aware of the 60 minute guideline?**	*Individual and Relay Swimming* • Swimming Activities: Teacher addresses the component of arm extension in the freestyle swimming technique. Students exposed to individual and team relay activities in the water. • FMS Skills: Components of the over-arm throw, horizontal and vertical jump incorporated in the arm extension criteria of freestyle swimming. . **<u>Teacher Reflection:</u>** **Extending arms addressed in this unit?** **Students aware of individual and team activities?**	*Water Polo* • Water Polo: 2 x simultaneous games of wat polo (fun and competitive) - student choic Catching and over-arm throwing in water po assesses hand/eye co-ordination. • FMS Skills: The catch and over arm thro addressed during water polo gam Components of the run, skip and balan incorporated also. **<u>Teacher Reflection:</u>** **Hand/eye co-ordination addressed in this unit?** **Students aware of choice in physical activity?**

Don't be afraid to mix and match the HRA focus with a different FMS focus. For example:

IRA Focus:
:xposure to individual and team-based activities and lement of choice in PA environment
'MS Focus:
Improving co-ordination of hand and eye

Volleyball

- Volleyball: Students begin playing volleyball in the water 1v1 passing ball over and back to each other. Allow progression to a game of team volleyball in the water for students who choose.
- FMS Skills: Co-ordination of hand and eye

<u>'eacher Reflection:</u>
Iand/Eye co-ordination addressed in this activity?
:tudents aware of individual and team activities?

HRA Focus:
Meeting the daily 60 minutes MVPA guideline
FMS Focus:
Improving ability to extend arms

Aquafit

- Aquafit: Students will take part in aquafit which will consist of various exercises in the water to music aiming to raise their heart rate above 120bpm.Exercises will include shoulder press with foam float, raising arms over head etc.
- FMS Skills: Will incorporate extending the arms, arm/leg coordination and aspect of the vertical and horizontal jumps.

<u>Teacher Reflection:</u>
Ability to extend arms addressed in this activity?
Students aware of the 60 minute guideline?

HRA Focus:
Meeting the daily 60 minutes guideline
FMS Focus:
Improving ability to land on the balls of feet

Diving

- Diving: Students will take part in a diving lesson. They will be given the choice to dive from outside the water or to just push of the wall in the pool.
- FMS Skills: Will incorporate extending th arms, arm/leg coordination and aspect of the vertical and horizontal jumps includin the crouch.

<u>Teacher Reflection:</u>
Crouch addressed in this unit?
Students aware of choice in physical activity?

ATHLETICS
Integrating HRA & FMS into Unit
School of Health & Human Performance Dublin City University

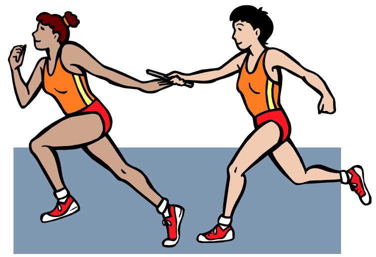
Youth - Physical Activity Towards Health

Health Related Activity Focus

1. Intensity – moderate and vigorous;
2. Record heart rate (HR) – pulse taking
3. Step count increase - pedometers

Fundamental Movement Skill Focus

1. Improving ability to crouch and extend arms
2. Improving ability to land on the balls of the feet
3. Improving co-ordination of hand/eye & leg/a



Example of activity 1: *2 x Intensities, ability to crouch and extend arms*	**Example of activity 2:** *Record heart rate and landing on balls of the feet*	**Example of activity 3:** *Increase step count and body co-ordination*
Jogging and Sprinting Jogging and Sprinting: Address moderate and vigorous intensity in both types of activities. Heart rate can be recorded. Starting position technique of the sprint incorporates both the crouch and arm extension focus. FMS Skills: Run addressed in this activity. Components of the over-arm throw (arm extend), horizontal & vertical jump incorporated also. **Teacher Reflection:** **Crouch and arm extension addressed in this unit?** **Students aware of moderate/vigorous intensity?**	*Hurdles* • Hurdles: Students record HR pre and post hurdles activity. Landing on the balls of the feet is a key skill component to be addressed when performing the hurdle jump. • FMS Skills: Run addressed in this activity. Components of skip (opposite arm/leg), horizontal and vertical jump (balls of feet) incorporated also. . **Teacher Reflection:** **Landing on balls of the feet addressed in this unit?** **Students able to record pulse pre/post activity?**	*Relay-Running* • Relay-Running: Wear pedometer during rel running, record step count. Baton exchan focuses on hand/eye and arm/leg co-ordinatio • FMS Skills: Run (leg/eye) addressed in th activity. Components of the catch, over ar throw (hand/eye) and kick (arm/le incorporated also during baton exchange. **Teacher Reflection:** **Body co-ordination addressed in this unit?** **Students aware of step increase in relay run?**

Don't be afraid to mix and match the HRA focus with a different FMS focus. For example:

IRA Focus:
Record heart rate (HR) – pulse taking
'MS Focus:
Improving ability to crouch and extend arms

Jumps

- Jumps: Students begin jumps doing standing jumps either into sand pit or onto high jump mat. Emphasis must be on use of crouch to begin and then use of arm extension while in the air. Get students to take pulse to highlight that even doing jumps they increase their heart rate as it is physical activity.
- FMS Skills: Aspects of vertical and horizontal jumps addressed such as crouch, arm extension and landing on balls of feet.

<u>'eacher Reflection:</u>
'rouch and arm extension addressed in this unit?
'tudents able to record pulse pre/post activity?

HRA Focus:
Intensity – moderate and vigorous
FMS Focus:
Improving co-ordination of hand/eye & leg/arm

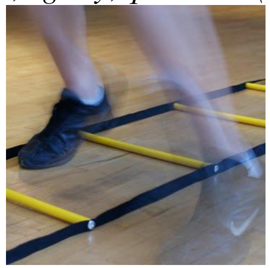
Relays

- Relays: Students with baton changeover practice and progress into race situation. Highlight the change in intensity levels from practice to race situation.
- FMS Skills: Run (leg/eye) addressed in this activity. Components of the catch, over arm throw (hand/eye) and kick (arm/leg) incorporated also during baton exchange.

<u>Teacher Reflection:</u>
Body co-ordination addressed in this unit?
Students aware of moderate-vigorous intensity in practice and race situations?

HRA Focus:
Step count increase - pedometers
FMS Focus:
Improving ability to land on the balls of the feet

Speed, agility, quickness (SAQ)



- SAQ: Students will wear pedometers whil doing SAQ training. SAQ training will include ladders, hurdles, shuttle runs. Students will be aware of the amount of steps they are taking in this activity.
- FMS Skills: Run (leg/eye) and balan addressed in this activity. Emphasis should on landing on balls of the feet.

<u>Teacher Reflection:</u>
Landing on balls of the feet addressed in this unit?
Students aware of step increase in speed training?

DANCE

Integrating HRA & FMS into Unit

School of Health & Human Performance Dublin City University

Health Related Activity Focus

1. Cardiovascular endurance (CVE) 2. Flexibility 3. Intensity – moderate and vigorous

Fundamental Movement Skill Focus

1. Improving ability to crouch and extend arms 2. Improving ability to land on the balls of the feet 3. Improving co-ordination of leg and eye

Example of activity 1: *CVE, ability to crouch and extend arms*	**Example of activity 2:** *Flexibility and landing on balls of the feet*	**Example of activity 3:** *2 x intensities, improving co-ordination leg and e*
Dance Aerobics Dance aerobics: Students engage in sustained and continuous periods (3 – 5mins) of dance aerobics. Crouch movement and arm extension included in aerobic routine. FMS Skills: Horizontal and vertical jump addressed in dance aerobic routine. Components of the balance and run also incorporated in routine. **<u>eacher Reflection:</u>** **rouch and arm extension addressed in this unit?** **tudents aware of cardiovascular endurance?**	*"Cha Cha Slide" Routine* • Cha cha slide: Flexibility addressed during warm up and cool down. This specific dance routine challenges students to land on the balls of their feet. <u>http://www.youtube.com/watch?v=wZv62ShoStY</u> • FMS Skills: Components of run, skip, horizontal and vertical jump incorporated in this dance routine. . **<u>Teacher Reflection:</u>** **Landing on balls of the feet addressed in this unit?** **Students conscious of flexibility component?**	*"Hip-Hop Sequence"* • Hip-hop: Moderate intensity introduction, th perform at vigorous intensity (with musi Heart rate can be recorded. Leg and eye c ordination addressed in the step routine actio *(Hip hop for beginners you tube routines.)* • FMS Skills: Components of kick and balan actions incorporated in the hip-hop routine **<u>Teacher Reflection:</u>** **Leg-eye co-ordination addressed in this unit?** **Students aware of moderate/vigorous intensity**

Don't be afraid to mix and match the HRA focus with a different FMS focus. For example:

IRA Focus: ntensity – moderate and vigorous **'MS Focus:** Improving ability to crouch and extend arms	**HRA Focus:** Intensity – moderate and vigorous **FMS Focus:** Improving ability to crouch and extend arms	**HRA Focus:** Intensity – moderate and vigorous **FMS Focus:** Improving ability to crouch and extend arms
Routine Creation  • Routine Creation: Students in groups must create a dance routine including specific criteria. The criteria will include crouch and use of arm extension. They will also include a mix of intensity e.g. fast forward and slow motion. • FMS Skills: Aspects of vertical and horizontal jumps addressed such as crouch, arm extension and dancing on balls of feet. **<u>'eacher Reflection:</u>** **'rouch and arm extension addressed in this unit?** **'tudents able to identify difference in moderate** **nd vigorous intensity in dance?**	*Capoeira*  • Capoeira: (Marshall arts in dance) Students will learn part of a capoeira routine (see Youtube), they will then create their own endings to this routine. Students will be aware of the importance of flexibility in this style of dance. • FMS Skills: Aspects of vertical and horizontal jumps addressed such as crouch, arm extension and dancing on balls of feet. Leg/eye co-ordination will also be addressed. **<u>Teacher Reflection:</u>** **Leg-eye co-ordination addressed in this style of dance?** **Students conscious of flexibility component?**	*Zumba*  • Zumba: Students will take part in a zumba class (see Youtube). Students will be awar of the importance of CVE in this type of activity. • FMS Skills: Students will be dancing on balls of the feet. Leg/eye co-ordination wi also be addressed. **<u>Teacher Reflection:</u>** **Landing on balls of the feet addressed in this unit?** **Students aware of cardiovascular endurance?**

INVASION GAMES

Integrating HRA & FMS into Unit

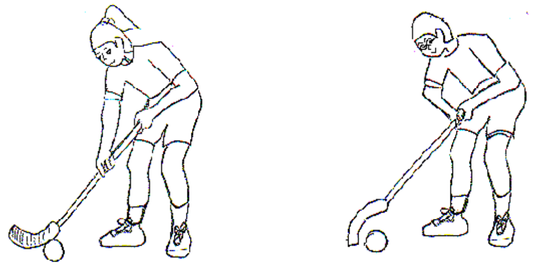
School of Health & Human Performance Dublin City University

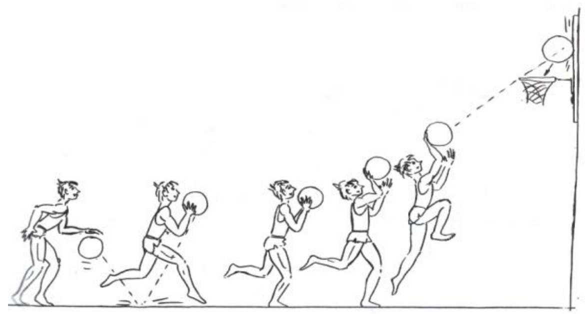
Health Related Activity Focus

1. Increased Heart Rate (HR)
2. Physical activity – well being/self - esteem
3. Flexibility

Fundamental Movement Skill Focus

1. Improving co-ordination of arm / leg
2. Improving co-ordination of leg / eye
3. Improving co-ordination of hand/eye





Example of activity 1: *Increase HR and co-ordination arm / leg*	**Example of activity 2:** *Health benefits of PA and co-ordination leg / eye*	**Example of activity 3:** *Flexibility and co-ordination hand / eye*
Hockey Indian Dribble Hockey: Possession games x 2 (light and moderate intensity). Record HR after each game. Focus on Indian dribble assesses student ability to co-ordinate opposite arm/leg and hand/eye. FMS Skills: Components of balance, bounce and strike incorporated in the co-ordination of this skill. **Teacher Reflection:** **Arm/leg co-ordination addressed in this unit?** **Students aware of increase in HR with intensity?**	*Punt Kick Countdown* • Countdown: Fun, inclusive and physically engaging gaelic football activity; students kick as many points possible in 60 second time frame (retrieve and collect football after each kick). Punt kick practice improves co-ordination of leg/eye. • FMS Skills: Kick and balance addressed in this punt kick routine. **Teacher Reflection:** **Leg/eye co-ordination addressed in this unit?** **Students can identify benefits of PA participation?**	*Basketball Lay-Ups* • Lay-ups: Teacher sets up competitive and fi lay-up activities – student choice. Flexibili addressed during warm up and cool down. L up focus improves co-ordination of hand / eye • FMS Skills: Components of vertical jump, ru catch and bounce incorporated in this lay-activity. **Teacher Reflection:** **Hand/eye co-ordination addressed in this unit?** **Students conscious of flexibility component?**

Don't be afraid to mix and match the HRA focus with a different FMS focus. For example:

IRA Focus: ncreased Heart Rate (HR) **'MS Focus:** mproving co-ordination of hand/eye	**HRA Focus:** Flexibility **FMS Focus:** Improving co-ordination of leg/eye	**HRA Focus:** Physical activity – well being/self - esteem **FMS Focus:** Improving co-ordination of arm / leg
Ultimate Frisbee  • Ultimate Frisbee: Students will take part in a game of ultimate Frisbee. They will take their pulse before and after this class and see how much it has increased by. • FMS Skills: Hand/eye co-ordination will be addressed in this game as well as using balls of feet and arm extension. **<u>'eacher Reflection:</u>** **Iand/eye co-ordination addressed in this unit?** **'tudents aware of increase in HR with intensity?**	*Keepy Uppies*  • Keepy Uppies: Students will take part in a game of keepy uppies. They must keep the ball off the ground using their feet. The team able to do this the longest wins. Students will see how important it is to be flexible in this game as they will be force to stretch to keep the ball off the ground. • FMS Skills: Leg/eye coordination will be addressed in this game as well as balance and aspects of the kick. **<u>Teacher Reflection:</u>** **Leg/eye co-ordination addressed in this unit?** **Students aware of importance of flexibility?**	*Rugby*  • Rugby: Students will take part in a small sided game of rugby. All restarts will be with a kick into the opponent territory. Kicker must rotate so everyone gets a chance to kick. Highlight also, how active the students are and the importance of this • FMS Skills: Arm/leg coordination will be addressed in this game as well as balance and aspects of the kick. **<u>Teacher Reflection:</u>** **Arm/leg co-ordination addressed in this unit?** **Students can identify benefits of PA participation?**

NET & FIELDING GAMES

Integrating HRA & FMS into Unit

School of Health & Human Performance Dublin City University

-PATH
Youth - Physical Activity Towards Health

Health Related Activity Focus

1. Meeting the daily 60 minutes guideline;
2. Individual and partner-based activities;
3. Physical activity – wellbeing/self-esteem

Fundamental Movement Skill Focus

1. Improving ability to crouch;
2. Improving ability to land on the balls of feet;
3. Improving ability to extend arms

Example of activity 1: *Meet 60 mins and ability to crouch*	**Example of activity 2:** *Forms of activity and landing on the balls of feet*	**Example of activity 3:** *Choice in physical activity and extend arms*
The Dig Volleyball The dig pair work: student 1 feeds the ball 10 times, student 2 returns the ball through the dig action (rotate roles); 60 minute PA guideline addressed by teacher. Crouched action needed to perform the volleyball dig successfully. FMS Skills: Components of the strike, balance, horizontal and vertical jump incorporated in this volleyball skill. **<u>eacher Reflection:</u>** **rouch skill addressed in this unit?** **tudents aware of the 60 minute guideline?**	*Court positioning badminton* • Reaction game: Students respond to partner commands such as "right", "left", "forward" and "back". Without racket initially, add in racket after few minutes. Objective – remain on the balls of the feet when on court (responsive and reactive). • FMS Skills: Balance and run addressed in this activity. Components of horizontal jump, vertical jump and skip incorporated also. . **<u>Teacher Reflection:</u>** **Landing on balls of the feet addressed in this unit?** **Students aware of individual and partner activities?**	*Over arm throw rounders* • Target throwing: students have choice to u underarm or over arm throw to hit target on wa Teacher promotes use of over arm throw f power and precision. Arm extension focus. • FMS Skills: Over arm throw skill addressed this lesson. Components of balance and cat incorporated also. **<u>Teacher Reflection:</u>** **Arm extension addressed in this unit?** **Element of choice in physical activity?**

Don't be afraid to mix and match the HRA focus with a different FMS focus. For example:

<table>
<tr>
<td>IRA Focus:
'hysical activity – wellbeing/self-esteem
'MS Focus:
mproving ability to crouch</td>
<td>HRA Focus:
Individual and partner-based activities
FMS Focus:
Improving ability to extend arms</td>
<td>HRA Focus:
Meeting the daily 60 minutes guideline
FMS Focus:
Improving ability to land on the balls of feet</td>
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<tr>
<td>Badminton

• Badminton: Students will take part in a conditioned game of badminton. They will receive extra points for using the drop shot this is to encourage them to crouch down low.
• FMS Skills: Hand/eye co-ordination will be addressed in this game as well as using balls of feet, arm extension and crouch.

<u>'eacher Reflection:</u>
rouch skill addressed in this unit?
udents aware of self-esteem in physical activity?</td>
<td>Handball

• Handball: Students will take part in a game of handball first 1v1 and then in teams. They will note the difference in being a member of a team.
• FMS Skills: Hand/eye co-ordination will be addressed in this game as well as using balls of feet and arm extension.

<u>Teacher Reflection:</u>
Ability to extend arms addressed in this unit?
Students aware of individual and team activities?</td>
<td>Tennis

• Tennis: Students will take part in a reactions game. Their partner will throw the ball anywhere in the court and the player must ru and return the pass. Emphasis will be on the balls of the feet. Highlight how active students are and the importance of the 60minute guideline. Link in with length of a real tennis match.
• FMS Skills: Hand/eye co-ordination will be addressed in this game as well as using balls of feet and arm extension.

<u>Teacher Reflection:</u>
Landing on balls of feet addressed in this unit?
Students aware of importance of 60 minute physical activity guidelines?</td>
</tr>
</table>

GYMNASTICS
Integrating HRA & FMS into Unit
School of Health & Human Performance Dublin City University

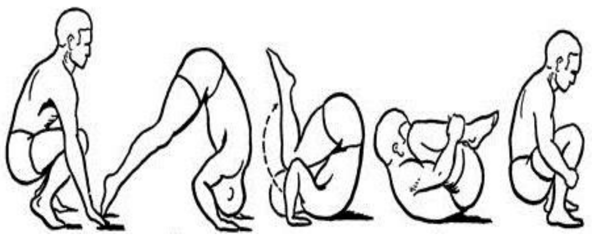
Youth - Physical Activity Towards Health

Health Related Activity Focus

1. Cardiovascular Endurance;
2. Flexibility;
3. Choice in the physical activity environment

Fundamental Movement Skill Focus

1. Improving ability to crouch;
2. Improving ability to land on the balls of feet;
3. Improving leg/eye and arm/leg co-ordination



Example of activity 1: *CVE and ability to crouch*	**Example of activity 2:** *Flexibility and landing on the balls of feet*	**Example of activity 3:** *Choice in physical activity and co-ordination*
90 second gymnastics routine Gymnastics routine: Students work in groups and conduct a continuous 90 second gymnastics routine. Forward roll emphasis in routine performance (encourages pupils to conduct crouching action in starting position.) FMS Skills: Balance, skip and run addressed in the routine performance. Components of horizontal and vertical jump incorporated also. **<u>Teacher Reflection:</u>** **Crouch skill addressed in this unit?** **Students aware of cardiovascular endurance?**	*Springboard Landing* • Springboard: Teacher introduces springboards to gymnastics lesson. All students opportunity to use equipment in class – landing on the balls of the feet from the spring. Flexibility addressed during warm up and cool down. • FMS Skills: Run, vertical and horizontal jump addressed in this activity. Components of balance and skip incorporated also. . **<u>Teacher Reflection:</u>** **Landing on balls of the feet addressed in this unit?** **Students conscious of flexibility component?**	*Balance on beam/bench* • Beam/bench: Students have the option to walk, crawl, skip or jump etc on beam or bench. Use of beam and bench improves co-ordination of leg/eye when landing and opposite arm/leg when moving. • FMS Skills: Balance, run and skip addressed in this activity. Components of horizontal and vertical jump incorporated also. **<u>Teacher Reflection:</u>** **Leg/eye and arm/leg co-ordination addressed in this unit?** **Element of choice in physical activity?**

Don't be afraid to mix and match the HRA focus with a different FMS focus. For example:

IRA Focus:
:hoice in the physical activity environment
'MS Focus:
mproving ability to land on the balls of feet

Jumps and Leaps

- Jumps and Leaps: Students will be given a resource card/ shown a variety of jumps and leaps. They will then choose 3 and perform them. Emphasis will be on landing on the balls of feet.
- FMS Skills: Landing on balls of feet will be addressed in this activity as well as balance and aspects of the vertical and horizontal jump.

<u>'eacher Reflection:</u>
.anding on balls of the feet addressed in this unit?
:lement of choice in physical activity?

HRA Focus:
Flexibility
FMS Focus:
Improving ability to crouch

Floor exercises

- Floor exercises: Students will complete a variety of floor exercises such as the forward roll, teddy bear roll and straddle forward roll. They will see the importance of flexibility in executing these rolls.
- FMS Skills: Ability to crouch will be addressed in this activity.

<u>Teacher Reflection:</u>
Crouch skill addressed in this unit?
Students aware of flexibility in this activity?

HRA Focus:
Cardiovascular Endurance
FMS Focus:
Improving leg/eye and arm/leg co-ordination

Routine performance

- Routine Performance: Students will create and perform a routine including specific criteria such as 2 jumps, 2 rolls, 1 balance etc. They will be aware of the importance of CVE when performing a routine like this.
- FMS Skills: Leg/eye and arm/leg co-ordination will be addressed along with landing on balls of feet and balance.

<u>Teacher Reflection:</u>
Leg/eye and arm/leg co-ordination addressed in this unit?
Students aware of cardiovascular endurance?

<u>Appendix G</u>

Example of the Process Evaluation

PE teacher visit 1

PE teacher: **School:** **Date:**

School Environment

-Did you put up the 4 Y-PATH posters? ***Yes*** ☐ ***No*** ☐ **Where?** ________________

-Did you use the physical activity directory? ***Never*** ☐ ***Seldom*** ☐ ***Often*** ☐ ***V. Frequently*** ☐

-Was there a physical activity week in your school? ***Yes*** ☐ ***No*** ☐

-Was there a Physical activity day in your school? ***Yes*** ☐ ***No*** ☐

-Is your school involved in the active schools flag program? ***Yes*** ☐ ***No*** ☐

If yes, since when?______________________

- Were there messages about physical activity in your school newsletters throughout the year? ***Never*** ☐ ***Seldom*** ☐ ***Often*** ☐ ***V. Frequently*** ☐

Staff Meeting:

Happened yet? **Planned?**

Parent meetings:

Happened yet? **Planned?**

6 HRA lessons:

Do them all?

Back to back?

Interruptions, if any?

Any comments on them?

More than one class?

More than one teacher?

Any additional comments for researcher: