**Motor competence among children in the UK and Ireland: An expert statement on behalf of the International Motor Development Research Consortium**

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**Introduction**

Motor competence (MC) represents a key enabler of children’s Physical Activity (PA). MC is a critical aspect of development (Adolph & Hoch, 2019) as it enhances a child’s capacity to participate meaningfully in play, games, and activities (Rudd, et al., 2020). Children with higher MC are more likely to be physically active during childhood, which in turn tracks into adolescence (Foweather et al., 2015; Holfelder & Schott, 2014; Lai et al. 2014; Cohen et al. 2015), prefacing positive trajectories of health (Barnett et al., 2021). Conversely, poor MC may have wide-reaching adverse effects on young children’s physical, cognitive, social and emotional development, and health (Libertus & Hauf, 2017; Leonard & Hill, 2014). The development of MC is also associated with positive trajectories of academic achievement (Harrowell, et al., 2018), mental health (Lingam, et al., 2012) and quality of life (Zwicker, et al., 2013). Consequently, the development of MC is a key objective of Physical Education (PE) Curricula in England (Department for Education, 2013), Wales (Department for Children, Education, Lifelong Learning and Skills, 2008), Scotland (Education Scotland, 2017), Northern Ireland (Council for Curriculum Examinations and Assessment, 2007) and the Republic of Ireland (Government of Ireland, 1999). Explicit reference is made to fundamental movement skills (FMS) and psychomotor development is recognised as one of PE’s unique contributions to the whole curriculum (Council for Curriculum Examinations and Assessment, 2007; Department for Education, 2013).

In accordance with the suggestions of Newell (2020), we conceptualise MC as encompassing postural stability (e.g. balancing, twisting), locomotion (e.g. running, jumping), and object manipulation (e.g. grasping, handling, throwing, catching, tool use). Competency in the three motor skill categories is regarded as a prerequisite for functioning on a daily basis, and for participation in PA or sport-specific activities (Stodden et al., 2008; Utesch & Bardid, 2019; Venetsanou & Kambas, 2011) whilst positively influencing children’s future health (Clark & Metcalfe, 2002; Goodway et al., 2020). MC increases the likelihood of children and adolescents participating in different forms of PA throughout life (Lloyd et al., 2014; Utesch et al., 2018) although it is not naturally acquired (Hardy et al., 2010), but develops through instruction and practice (Holfelder & Schott, 2014; Logan et al., 2015; Xin et al., 2020).

The importance of PA for health and development is well established in the UK (Chief Medical Officers, 2019), and worldwide. Considerable efforts continue to be put in place to help children engage in PA for both acute and longer-term benefit. However, there is continued concern that children may not be engaging in the level of PA that will confer these health benefits. In the United Kingdom, current data suggests that 44.9% of children aged 5-18 years met the Chief Medical Officer’s guidelines of taking part in sport and PA for an average of 60 minutes per day, with nearly a third (31.3%) of English children engaging in less than 30 minutes PA per day (Sport England, 2021). Data from Wales suggest 51% of children, aged 5-17 years meet the guidelines of 60 minutes PA per day, although when only adolescents are considered (aged 11-17 years), only 17% of children meet these guidelines (National Assembly of Wales, 2019). Likewise, parental report of children’s PA levels in Scotland suggests that 69% of children aged 2-15 years met the PA guideline of 60 minutes per day (Secretary for Health and Social Care, 2020). This is allied with data on overweight and obesity for the UK which show that 9.9% of reception age children (age 4-5) are obese, with a further 13.1% overweight. At age 10-11 (School Year 6), 21.0% are obese and 14.1% overweight (UK Parliament, 2021). Similarly, in Ireland, 13% of children meet the National PA guidelines of at least 60 minutes of moderate-to-vigorous PA every day (17% primary school pupils and 10% post primary school pupils) (Woods, et al., 2019) and 16% of children were classified as overweight and obese (O’Donnell, et al., 2020). Consequently, the promotion of PA and efforts to reduce overweight and obesity in children remain key public health priorities in both the UK and Ireland.

The UK and Ireland has a well-established research base in MC, ranging from reporting and monitoring levels of MC, developing assessment tools for MC, providing innovative curriculum and intervention design to support learning and development, as well as providing advocacy for particular groups, such as those with motor impairments (Blank et al, 2019). This expert statement, on behalf of the International Motor Development Research Consortium, draws together what is currently known about levels of MC in pre-school and school-age children in the UK and Ireland as well as current approaches to intervention in both countries. We present this as two key issues. For each issue, evidence is presented, followed by recommendations. Finally, general conclusions are made. Note that the current Expert Statement will refer to MC assessments in the context of different studies but there is not the scope to provide a review of assessments within this expert statement. Readers are referred to Barnett, Stodden, Hulteen and Sacko (2020) for further information about MC assessment in children and youth.

**Key Issue 1: The MC of children and adolescents in the UK and Ireland is concerningly low and does not currently provide a satisfactory foundation for children to build physically active lives. If schools, community sports, and healthcare systems do not focus on enhancing MC in children and adolescents, the potential long-term impacts of low MC, including higher rates of inactivity and poorer health and well-being will likely create a significant social, health and economic burden for the UK and Ireland**

Prior to establishing effective policy or practice, it is important to establish a current baseline for MC in children and adolescents. Without baseline data, evidence-based decisions cannot be made. The following section details what we currently know regarding pre-school and school-age children’s levels of MC in the UK and Ireland.

*Irish-Specific MC Levels*

The development of MC is a core objective of the Irish Primary PE curriculum and features as a component of PE from infant classes to the end of children’s primary school years (Government of Ireland, 1999). There is however, no explicitly stated benchmark of MC which children are expected to achieve within the curriculum. Empirical evidence from Irish children and adolescents broadly indicates inadequate levels of MC (Bolger et al., 2018; Farmer et al., 2017; Kelly et al., 2018; O’Brien et al., 2016a; O’Brien et al., 2018). Such assertions are based on performance classification from motor competence assessment(s), often using USA norm data, rather than a distinct developmental stage where children are expected to perform to a given standard for the school curriculum. For example, a recent study of 2098 children highlighted that just over 50% of Irish children, between the ages of 5-12 years old, displayed proficiency across locomotor and object-control skills as measured by the Test of Gross Motor Development-3 (TGMD-3) (Behan et al., 2019). In this work, there was an increasing gradient of proficiency (determined by correct performance of all skill components in both TGMD trials) with increasing age where 25% of five year older were classified as proficient rising to 57% proficiency in 11- and 12-year-olds (Behan et al., 2019). The Irish PE curriculum explicitly states locomotor skills (running, jumping, travelling) and object control skills (throwing, sending, receiving) as aspects of MC that children should be proficient in by the end of primary school. However, Philpott et al., (2020) reported that, by the end of their third year of secondary school (age 13-14 years), less than 40% of participants displayed proficiency in three locomotor skills (vertical and horizontal jump, skip), and less than 20% displayed proficiency in four object-control skills (throw, strike, kick, dribble), supporting concerns of stagnating development (Lester et al., 2017; Philpott et al., 2020). Further disconcerting trends were reported by Lester et al., (2017) who reported, that less than 40% of Irish adolescents displayed proficiency in two locomotor skills (vertical and horizontal jump), and four object-control skills (kick, dribble, strike, throw), by 15-16 years of age. This is alarming as MC in these skills should have been developed by this point in life and adolescents should be applying these MC foundations in games, sport and physical activity. The aforementioned data supports concerns of stagnating development and collectively warn of delays in MC for this population (Lester et al., 2017; Philpott et al., 2020).

*UK-Specific MC Levels*

The National Curriculum for PE in England states that children should be mastering running, jumping, throwing, and catching, and using these skills effectively, in sports situations in Key Stage 1 (ages 5-7 years) and Key Stage 2 (ages 7-11 years), respectively (Department for Education, 2013). Research by Foulkes et al. (2015), and Morley et al. (2015), in pre-schoolers and 4–7 year-olds, respectively, also reported that mastery or proficiency in FMS does not meet National Curriculum targets with the exception of run, leap, and slide movements. Similarly, Duncan et al., (2019a) found that less than one-fifth of children aged 6–9 years have mastered the four key motor skills (run, jump, throw, catch) identified by the PE National Curriculum and only ~25% of Year Two and Three pupils (6-8 years of age), respectively, were fundamentally competent in all four skills, as measured by the Test of Gross Motor Development 2 (TGMD-2, Duncan et al., 2019a). Moreover, Duncan’s et al.’s study highlighted that children attending schools in England, aged 6–7 years, are typically only at an elementary stage of motor skill development (i.e., where performance of skills is judged to be incorrect on two or more behavioural components of a skill). Further, Lawson et al (2021), in English 7–10-year-olds, and using the TGMD-2, reported that that no children, aged 7-10 years of age, achieved mastery in all skills assessed and over a quarter (27%) did not achieve mastery in any of the skills within the TGMD-2. Eyre and colleagues (2018) similarly identified overall ‘poor’ FMS performance (via the TGMD-2) in English 5-year-olds and significantly poorer locomotor skill in English children from South Asian backgrounds, compared to their white and black counterparts. Although there are fewer studies reporting levels of MC in Wales and Scotland, and none representing Northern Ireland, similar trends have been observed for Welsh 10–12-year-olds, using the Dragon Challenge assessment tool (Stratton, et al., 2017), where 60% of children did not achieve the expected level of MC, and inequalities were observed by gender (girls scored lower), ethnicity (Asian children scored lower), and deprivation level (children with free school meals scored lower) (Stratton, et al., 2017). Likewise, Scottish data from two studies with children aged 5-10 years and using gross motor quotient (GMQ) from the TGMD-2, reported that levels of MC were low with GMQ in the 19th (Johnstone et al., 2017) and 26th (Johnstone et al., 2019) percentiles respectively.

**Children with Developmental Coordination Disorder**

A separate body of literature has focused on children with motor impairments, particularly those with developmental coordination disorder (DCD), also known as dyspraxia, which is a condition affecting physical co-ordination. It causes a child to perform less well than expected in daily activities for their age and appear to move clumsily (Blank et al, 2019). Researchers from the UK have contributed to international recommendations on the diagnosis, assessment, and intervention for this condition (Blank et al, 2019). This is particularly important as prevalence of DCD is between 2-6% of children aged 6-18 years in the UK (Cleaton, et al., 2019) and 5-6% of the child population in the Republic of Ireland (National Council for Special Education, 2020). Research from the UK has described the difficulties experienced by children with DCD in areas of postural control, locomotion, and in object manipulation (Cleaton, et al., 2019). Comparative data on DCD from the Republic of Ireland is not available. Poor MC in children with DCD extends beyond sport and PE. Difficulties with hand control and manipulation skills are prevalent in this group and can have a negative impact on everyday tasks, such as eating and dressing (Dunford et al, 2005), as well as classroom related tasks, including handwriting (Barnett & Prunty, 2020).

**Key Issue 2: Although there is evidence to suggest MC interventions can be effective, there is a need to invest in the development of MC beyond schools and physical education (PE). A systems and community-based approach to intervention is needed with links between school PE and community-based programmes. This should be coupled with continued development of quality research and additional clarity in describing MC interventions in this area.**

Despite the benefits of MC for health, the low levels of MC observed in children and adolescents from the UK and Ireland emphasises the need for interventions to improve MC. Evidence from a number of systematic reviews demonstrates that MC interventions are effective in improving MC levels in different populations, including children and adolescents (Strooband et al., 2020; Van Capelle et al, 2017; Wick et al., 2017; Collins et al., 2019; Logan et al., 2012; Morgan et al., 2013; Lai et al., 2014; Eddy et al., 2019), and clinical populations, such as those who are overweight/obese (Han et al., 2018), or have been diagnosed with DCD (Preston et al., 2017; Smits-Engelsman et al., 2018), intellectual disabilities (Maïano et al., 2019) and Autism (Columbo-Dougovito, & Block, 2019). Readers are referred to Foweather and Rudd (2020) and the above systematic reviews to examine the wider international evidence base on MC interventions.

Within the UK and Ireland, the number of published gross MC intervention studies have proliferated over the preceding decade. Table 1 presents an overview of published MC interventions developed in the UK and Ireland over the last decade. These interventions employ different approaches including modified PE, free play and sports-based interventions. Two studies have examined the effectiveness of interventions to improve MC in pre-school children (Foulkes et al., 2017; Duncan et al., 2019c). In a cluster randomised controlled trial, Foulkes et al. (2017) found that a 6-week Active Play intervention (n=162), delivered by the local government in nursery settings, had no effect on FMS outcomes in 3–5-year-old children (n=162) from low socioeconomic status areas. However, of note, the duration of Foulkes et al (2017) intervention is relatively short, and the process could be methodologically critiqued in relation to the nature of training received by those delivering the intervention. Thus, underlining the importance of providing comprehensive guidance to those delivering MC interventions, particularly where they have no specific qualifications or prior training in MC. In a similar age group (n=74), Duncan et al. (2019c) reported that children who received a novel combined movement and story-telling intervention improved their MC, compared to a control group who did not. This led Duncan et al (2019c) to suggest that integrating MC intervention with story-telling augmented gains in MC potentially due to children being more invested in the intervention due to the story-telling element. However, although children improved their MC, these gains were not sustained at 8 weeks post intervention follow-up. An intervention period of six weeks is however very short to realise consolidated change in MC over the longer term. Longer duration interventions are therefore needed to retain the gains in MC reported during these interventions, in the longer term and once the intervention has been withdrawn.

\*\*\*Table 1 Here\*\*\*

Over the past decade, most MC interventions conducted in the UK and Ireland have targeted primary school aged children (Bryant et al., 2016; Duncan, Eyre & Oxford, 2018; Duncan et al., 2020; Eyre et al., 2020; Farmer, Cahill & O’Brien, 2020; Johnstone et al., 2017; Johnstone et al., 2019, Wainwright et al., 2020). These interventions have been evaluated through strong methodology with cluster randomised (Duncan, Eyre & Oxford, 2018; Duncan et al., 2020; Johnstone et al., 2019) or non-randomised controlled trials (Bryant et al., 2016; Eyre et al., 2020; Farmer, Cahill & O’Brien, 2020; Johnstone et al., 2017, Wainwright et al., 2020). All these interventions reported improvements in MC as assessed using the TGMD. Farmer, Cahill & O’Brien (2020) was the only community-based intervention and was conducted in organised youth sport settings in Ireland. Most other studies were conducted in primary school settings and delivered by researchers (n=4 studies) or facilitated by play workers (n=2 studies), with some assistance from primary school teachers and teaching assistants. Interventions were typically delivered once per week, within PE classes/organised sport clubs, ranging from six weeks to five months in length, and 30-60 minutes in session duration. Interventions were varied, consisting of neuromuscular and resistance training activities, prescribed FMS activities within skill stations, circuits, sport (Badminton, Gaelic Football) and dance activities, as well as imaginative and creative based methods, such as active and free play outdoors and combined storytelling and movement approaches. Pedagogical approaches were inconsistently reported, which is reflective of the wider international literature (Lander, et al., 2017), although direct and explicit teaching strategies, alongside provision of corrective skill feedback was apparent in some studies (Duncan, Eyre & Oxford, 2018; Duncan et al., 2020; Eyre et al., 2020). Studies involving active and free play outdoor activities reported no effects on object-control skills (Johnstone et al., 2017; Johnstone et al., 2019). Of note, the SKIP-Cymru approach used by Wainwright et al (2020, see Table 1), also fed into policy recommendations for the Welsh government that they should ensure every child in Wales is enabled to develop the essential fundamental movement skills required at an early age in school, and that investment for programmes such as SKIP-Cymru was needed to ensure schools are adequately support children to learn these skills (National Assembly for Wales, 2019).

Adolescents are an under-researched population when examining the efficacy of MC interventions (Lopes, et al., 2021). Ireland has paved the way here with two controlled school-based trials (randomised and non-randomised) in which the interventions have resulted in improved MC in adolescents (McGrane et al., 2018; Lester et al., under review). The Y-PATH intervention (Belton et al., 2014; McGrane et al., 2018), a multi-component school-based PA intervention with a parent educational component, was delivered for eight months, with FMS activities delivered by school PE teachers following a one-day training workshop to enable the school PE specialists to deliver the intervention. MC outcomes significantly increased following the 8-month intervention and gains were maintained at 3 months post intervention. More recently, Lester et al. demonstrated that a 13-week whole school multi-component intervention (Project FLAME) improved FMS outcomes, relative to controls (Lester et al., under review). The intervention was delivered by a PE specialist training in the intervention. The volume of the intervention included 15-20 minutes of prescribed movement activities (using external cues), delivered by a PE specialist within the weekly PE lesson with supporting physical and digital resources, alongside classroom movement integration activities. These studies demonstrate that it is never too late for adolescents to benefit from MC interventions and this population is an important focus for future research.

In summary, there are examples of promising and successful MC interventions within the UK and Ireland. These studies demonstrate that interventions targeting motor skills are effective in enhancing MC and other health-related (e.g., PA) or academic (e.g., language) related constructs. Most have been conducted within educational settings. Given increasing curricular pressures on PE in schools in the UK and Ireland, exploring interventions in home and community settings is also warranted.

The quality of the intervention studies published to date is mixed. Some studies report intervention content in depth, process evaluation and intervention fidelity type outcomes whilst others present only minimal information relating to intervention content or do not report any form of process evaluation. Few intervention studies conducted fidelity measures of either the training of intervention personnel or the actual intervention itself. This subsequently hampers researchers and practitioners in understanding what works and why it might do so. Researchers should be clear on what constructs of fidelity are being measured and use robust measures to do so. There is a need for better quality research evidence, blinding assessors to intervention conditions, inclusion of follow-up measures at least 3 months (preferably 6-12 months) post-intervention, clearer description of randomization and using an intention-to-treat protocol for analysis (Tsiatis, 2006). In addition, analyses need to account for the nested effect of children within the classroom as the ‘treatment’ is delivered at the level of the classroom in most cases. Most interventions to date have been delivered by external staff (researchers) and there is a need for theoretically designed and driven interventions using key constructs of behaviour change which are socially valid and delivered by practitioners rather than researchers alone.

To advance the field, study protocols should clearly describe who benefits from intervention, the pedagogical/theoretical approach used to underpin professional development training and intervention, including how such approaches were applied (e.g., Rudd et al., 2020). Process evaluation is under used in the interventions that have taken place in the UK and Ireland. Process evaluation should also be employed to explore contextual factors, implementation processes and whether interventions were delivered as intended (See Ma, et al., 2021a and Ma, et al., 2021b for recommendations). A key challenge for the field to address in the UK, Ireland and internationally is the sustainability and adoption of MC interventions into practice.

**Recommendations**

* + - * Given the available evidence, decision makers in local and national government and research funding bodies in the UK and Ireland need to better acknowledge the importance of MC and should position the development of MC as a fundamental priority to benefit children and adolescents.
      * The development of positive trajectories of MC for health benefit in children and adolescents should not solely be left to school PE. Cross-sector collaboration including public health, local and national government, and community groups need to play a part, and to acknowledge the important role that developing MC plays in enabling PA for lifelong health and well-being.
* Developmentally appropriate and evidence-based interventions, targeted to different age groups alongside sustained opportunities to practice a variety of skills, are needed to enhance the MC of children in the UK and Ireland.
* Researchers need to ensure fidelity measures; process evaluation and implementation information are also collected when trialling or evaluating interventions to enhance MC. Intervention mapping needs to occur where the intervention is theoretically designed with fidelity measures mapped to the key goals and pedagogies of any intervention.
* Practitioners need to be better trained to understand and develop MC in children and adolescents, across school (both within PE and the wider curriculum), community sport, and public health.
  + - * National observatories focusing on MC for health, alongside regional and national surveillance research programmes are needed. Such surveillance data would be impactful in ensuring evidence informed practice to improve the health and general development of children and adolescents through MC.

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