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Review

Motor competence and health related physical fitness in youth: A systematic review

Maria Teresa Cattuzzo[a,*,1], Rafael dos Santos Henrique[a,1], Alessandro Hervaldo Nicolai Ré[b,2], Ilana Santos de Oliveira[a,1], Bruno Machado Melo[a,1], Mariana de Sousa Moura[a,1], Rodrigo Cappato de Araújo[c,1], David Stodden[d]

[a] Higher School of Physical Education, University of Pernambuco, Recife, Brazil
[b] School of Arts, Sciences and Humanities—EACH/USP, University of São Paulo, São Paulo, Brazil
[c] Campus Petrolina, University of Pernambuco, Petrolina, Brazil
[d] Department of Physical Education and Athletic Training, Blatt Physical Education Center, University of South Carolina, Columbia, USA

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ABSTRACT

Objectives: This study aimed to review the scientific evidence on associations between motor competence (MC) and components of health related physical fitness (HRPF), in children and adolescents.
Design: Systematic review.
Methods: Systematic search of Academic Search Premier, ERIC, PubMed, PsycInfo, Scopus, SportDiscus, and Web of Science databases was undertaken between October 2012 and December 2013. Studies examining associations between MC and HRPF components (body weight status, cardiorespiratory fitness, musculoskeletal fitness and flexibility) in healthy children and adolescents, published between 1990 and 2013, were included. Risk of bias within studies was assessed using CONSORT and STROBE guidelines. The origin, design, sample, measure of MC, measure of the HRPF, main results and statistics of the studies were analyzed and a narrative synthesis was conducted.
Results: Forty-four studies matched all criteria; 16 were classified as low risk of bias and 28 as medium risk. There is strong scientific evidence supporting an inverse association between MC and body weight status (27 out of 33 studies) and a positive association between MC and cardiorespiratory fitness (12 out of 12 studies) and musculoskeletal fitness (7 out of 11 studies). The relationship between MC and flexibility was uncertain.
Conclusions: Considering the noted associations between various assessments of MC and with multiple aspects of HRPF, the development of MC in childhood may both directly and indirectly augment HRPF and may serve to enhance the development of long-term health outcomes in children and adolescents.

1. Introduction

Health-related physical fitness (HRPF) is demonstrated by a variety of factors including body weight status, cardiorespiratory fitness, musculoskeletal fitness (muscular strength and endurance) and flexibility and are related to health outcomes and/or health markers in youth.[1,2] Healthy levels of HRPF allow individuals to perform physical activities with vigor and promote resistance to fatigue. Positive trajectories of HRPF in children and adolescents require an understanding of behavioral attributes and causative mechanisms that promote these outcomes.[3]

A recently developed theoretical model has emphasized the role of developing motor competence (MC) on the development of HRPF, physical activity (PA) and obesity prevention throughout childhood.[4] However, the association between MC and aspects of HRPF across childhood and adolescence has not been thoroughly examined. The field of motor development as a distinct discipline gained widespread attention in the 1970s and, over the next few decades, promoted the development of various process (i.e., technique) and product (i.e., outcome) oriented assessments. In general,

* Corresponding author.
E-mail address: mtcattuzzo@hotmail.com (M.T. Cattuzzo).
[1] Tel.: +55 81 3183 3354.
[2] Tel.: +55 11 3091 8808.

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assessments vary in their purported measurement of "motor skill" or MC and the language expressing the nature of MC has not been consistent across studies (e.g., fundamental movement skill, motor development, motor proficiency, motor coordination, motor ability, and motor fitness).

Stodden et al.[4] defined an important aspect of general MC as proficiency in fundamental motor skills including locomotor and object control skills. MC also has been defined as the degree of skilled performance in a wide range of motor tasks as well as the movement coordination and control underlying a particular motor outcome.[5] Although language and assessments describing and defining MC vary in the literature, in this paper the term MC is used as a global term to encompass all forms of goal-directed tasks involving coordination and control of the human body. In addition, the development of MC also may be essential in the promotion of an active lifestyle in childhood and adolescence.[6] Importantly, a recent meta-analysis indicated that school- and community-based programs that include developmentally appropriate FMS learning experiences delivered by physical education specialists are a critical medium for the development of MC in youth.[7]

In 2010, Lubans et al.[6] conducted a review on the association of fundamental movement skills with health-related variables including HRPF. They reported a consistent positive association between cardiorespiratory fitness and MC and an inverse association between MC and weight status. Improving HRPF levels across childhood and adolescence is important from a public health perspective,[6] specifically from an intervention standpoint, as it will further promote lifelong physical activity and health.[7] As there has been increasing interest in the health-related benefits of different components of HRPF[1,8] and their relationship to motor competence, the aim of this systematic review was to examine the scientific evidence on associations among MC, and components of HRPF in children and adolescents.

2. Methods

A systematic literature search was carried out for articles examining associations of MC and HRPF components (body composition, cardiorespiratory, muscle strength and endurance and flexibility) in childhood and adolescence, published between January 1990 and December 2013. Cross-sectional, longitudinal, experimental and quasi-experimental studies were considered for the purpose of this review. The study was conducted and reported according to the PRISMA statement.[9] Both process- and product-oriented assessments of MC were used for this review. Seven electronic databases were systematically searched: Academic Search Premier, ERIC, PsycInfo, PubMed, Scopus, SportDiscus and Web of Science. Search strategies included the combination of variations between two groups of key-words/terms including, but not limited to the following examples: (1) MC ("motor competence"; "motor development", "gross motor skill", "fundamental motor skill", "fundamental movement skill", "fundamental movement", "basic motor skill", "basic movement skill", "basic movement", "movement skill", "motor coordination", "motor ability", "locomotor skill", "manipulative skill", "object control", "balance", "hop", "jump", "throw" and "kick"; and (2) HRPF ("physical fitness", "body composition", "body weight status", "BMI", "body fat", "cardiorespiratory fitness", "cardiorespiratory endurance", "muscle strength", "muscular endurance", "flexibility" and "pliability"). Terms were combined using the logical operators available as search tools. The authors also consulted experts in the field to include any additional studies published or accepted after December, 2013. The authors believed the inclusion of recent studies was important as interest in this topic has recently gained momentum in the scientific community.

The search for articles and removal of duplicates was performed by one author (RSH). The selection of studies by titles and abstracts was carried out independently for two authors (RSH and BMM) according to the following inclusion criteria: (a) participants aged between 3 and 18 years without physical or cognitive impairment; (b) quantitative analysis of relationships between at least one measure of MC and HRPF; (c) published in indexed journals in English. Studies that evaluated only fine motor skills or only subjects with overweight/obesity were not included. Review articles, validation studies, conference abstracts, monographs, dissertations and theses were not included. Reference lists from identified studies were examined for additional relevant studies. The extraction of data informed: (a) author(s)/year/location; (b) design/sample/age; (c) type (product or process) and measure of MC; (d) measure of the HRPF; (e) statistics and (f) main results.

The risk of bias within studies was assessed using guidelines from STROBE and CONSORT, based on Lubans et al.[6] A score of 0 (absent or inadequately described) or 1 (present and properly described) was assigned to six questions and are described in Supplementary file 1. A score for each article ranged from zero to six points. Studies with scores ≤2 were considered high risk of bias, studies that achieved 3–4 points were classified as medium risk and those that had scores of 5–6 were classified as low risk of bias. Two independent researchers performed this step (RSH and ISL), and the lead researcher solved the disagreements (MTC).

The judgment of overall scientific evidence was based on Lubans et al.,[6] with the following criteria adopted: (a) *Lack of scientific evidence*, if less than 33% of the studies indicated a significant association between variables or none of the studies deemed as low risk of bias found a significant association; (b) *Uncertain evidence*, if 34–59% of the studies indicated a significant association between variables and at least one of them was deemed low risk of bias; (c) *Positive evidence*, if 60–100% of the studies indicated a significant association between variables and 34–59% of the studies deemed low risk of bias found a significant association (in the same direction); (d) *Strong evidence*, if 60–100% of the studies indicated a significant association between variables (in the same direction) and more than 59% of the studies deemed low risk of bias (score ≥5) found a significant association.

3. Results

The initial search identified 6478 possible references (Fig. 1). Forty-five studies were selected to read in full with the risk of bias evaluated independently by two researchers (see Supplementary material 1). Only one article demonstrated a risk score of 2 and was classified as high risk of bias.[10] It was subsequently excluded at this stage. Since we wished to address scientific evidence, we decided to remove the high risk of bias studies from data analysis, which could affect the results. Thus, the final sample in this review included 44 studies. 36% of the studies ($n = 16$) demonstrated a score of 5 and were classified as low risk of bias and the remaining 64% were classified as medium risk of bias ($n = 28$). Reporting statistical power was the main limiting factor in terms of risk of bias as only 5 studies (11%) fulfilled this criterion (Supplementary material 1).

The details of selected studies are presented in Supplementary material 2. Most studies (82%) employed a cross-sectional design, and the remaining 18% were longitudinal. Sample sizes ranged from 18 participants[11] to 7175;[12] 19 (43%) of the studies evaluated only children, 21 (48%) children and adolescents and 4 (9%) only adolescents. Studies were conducted in Australia,[13–23] United States,[24–32] Belgium,[5,33–36] Portugal,[12,37–40] Norway,[11,41–43] Iran,[44–46] Germany,[47,48] Brazil,[49] Canada,[50] Denmark,[51] Italy[52] and South Africa.[53] Most studies (68%) examined associations between MC (i.e., subscale score, index score or individual component