

HOW CAN WE ASSESS PHYSICAL LITERACY IN GYMNASTICS? A CRITICAL REVIEW OF PHYSICAL LITERACY ASSESSMENT TOOLS

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Review article

Abstract

Non-competitive gymnastics can contribute to the development of physical literacy (PL) that is widely recognized as a promising foundation of active living. Assessing PL is the first step for the design and evaluation of effective gymnastic programs aiming at PL enhancement, as well as for the empowerment of children's PL journey. This study attempted a comprehensive analysis of available PL assessment tools. Upon searching in five electronic databases, three multi-component tools that attempt to assess PL holistically and can be used in gymnastics were identified and were critically analyzed in relation to their content, target-population, feasibility and psychometrics. This process revealed that, despite their similarities, differences among assessment tools are evident, mainly on their primary focus, context(s) of application, age-groups they are designed for, criteria used for PL evaluation. Moreover, limitations were identified in every tool, including administration time; assessors' training required; not designed for individuals with disabilities; limited evidence for their psychometrics, raising concerns about those tools' feasibility, usefulness, and technical adequacy. As PL advancement demands valid and reliable assessment tools, the improvement of the existing ones to face their shortcomings and/or the development of new sound ones seems imperative.

Keywords: *gymnastics, Physical Literacy Assessment tool for Youth, Passport for Life, Canadian Assessment of Physical Literacy, review.*

INTRODUCTION

Across the globe, the elevating rates of childhood obesity (World Health Organization; [WHO], 2018) along with the predominance of physically inactive lifestyles among children and youth (WHO, 2018), are worrying phenomena related to health implications, such as cardiovascular (Cohen, 2004; Goran, Ball, & Cruz, 2003) and metabolic disease (Krekoukia et al., 2007; Singla, Bardoloi, & Parkash, 2010). As an answer to the above problems and their consequences, WHO (2018) highlights the value of both participating in regular physical activity (PA) and enhancing Physical literacy (PL).

As projected by the International Physical Literacy Association (IPLA, 2014) and also advocated by Canada's PL consensus statement (2015), PL can be defined as the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life. PL addresses a human "disposition" (Whitehead, 2013a, p. 29) and a personal lifelong journey (Taplin, 2013; Whitehead, 2013b), which relates not only to physical, but also to affective, cognitive and behavioral skills and characteristics (components of PL). The

interaction of these components which are shown to associate with children's PA participation (i.e. motor competence [Robinson et al., 2015; Venetsanou, & Kambas, 2017]; fitness level [Hands, et. al, 2009]; motivation/confidence [Cardinal, Yan, & Cardinal, 2013]; perceived motor skill competence [Barnett, et al., 2008]; heart-related fitness knowledge [Thompson, & Hannon, 2012]) is central to PL, contributing to its holistic nature. Although it is pertinent to all ages, PL promotion during childhood is of great importance since, during this period, health behaviors such as PA participation are formed (Pate et al., 2004).

Non-competitive forms of gymnastics, such as educational and recreational gymnastics, are ideal foundations for the reinforcement of PL (Baumgarten, & Pagnano-Richardson, 2010; Flemons, 2013). Several researchers have showed that gymnastics enhances children's motor competence (Culjak, Miletic, Kalinski, Kezic, & Zuvela 2014; Garcia, Barela, Viana, Barela, 2011; Fallah, Nourbakhsh, & Bagherly, 2015; Karachle, Dania, & Venetsanou, 2017; Kochanowicz, Kochanowicz, Niespodziński, Mieszkowski, & Sawicki, 2017; Yilmaz, & Sicim-Sevim, 2018); physical fitness (Akin, 2013; Lyulina, Zakharova, & Vetrova, 2013; Trajković et al., 2016) social and life skills (Baumgarten, & Pagnano-Richardson, 2010; Mandigo, Francis, Lodewyk, & Lopez, 2009; Shamshiri, Bagheri, Hashemy Doostan, & Yazdani, 2013). Most importantly, the specific forms of non-competitive gymnastics are assessable to all children regardless of their physical condition (Kalkhoran, Amini, Salman, & Zareiyan, 2018; Popescu, Dina, Stroiescu, & Dina, 2013). Gymnastics can contribute to the holistic development of each participant (Sloan, 2007), offering a context where every child can participate at his/her own level, set personal goals and satisfy his/her innate need of goal achievement, thus developing competence, motivation and

confidence for participation in a wide range of PA (Whitehead, 2010). Due to the aforementioned, gymnastics are thought to offer several benefits to children with disabilities (Campain, 2014), so it could be an ideal context for those children's PL development and PA enhancement (Dudley, Kriellaars, & Cairney, 2016; Longmuir, 2015).

If effective gymnastic programs aiming at PL enhancement are to be planned and implemented, PL assessment is the first step to be made. In that direction, PL holistic nature should be taken into account, so as the assessment to provide valuable information for identifying participants' progress and/or deficiencies on the whole construct of PL. In that way, participants' PL level would be fully depicted and individualized assistance could be provided to them, targeting on empowering specific physical, affective, cognitive and behavioral PL skills and characteristics. Moreover, the administration of valid and reliable holistic PL assessment tools would significantly contribute to the evaluation of gymnastics program' effectiveness. -This study aimed to gather, critically analyze and compare PL assessment tools, in an attempt to help researchers and professionals of gymnastics to select among them, according to their objectives.

METHOD

Five electronic databases (Scopus, ScienceDirect, ERIC, PubMed and Google Scholar) were used to search the available literature about PL assessment tools. The main identifiers were "physical literacy" AND (assessment OR evaluation OR tool OR instrument). Only articles meeting the following criteria were selected for the review: a) published in peer-reviewed sources; b) written in English language; c) presenting a research study attempted to assess PL in children and/ or evaluating a PL program or describing the development and/or the standardization process of a PL

assessment tool. The search was conducted between the 2nd and the 12th September 2018. In the searching procedure no time limitation criterion was adopted.

From the above search 35 peer-reviewed articles rendered. Due to the small number of available articles an additional search, following a similar procedure, was applied to locate relevant theses and dissertations on Google Scholar. Four theses were located and added to the total. In addition, ten peer-reviewed articles were traced among the references of the above studies, increasing the number of the located studies to 49. Excluding three duplicated articles that were identified, the remaining studies were 46. The screening of those studies' abstracts resulted in the exclusion of four review studies and 12 studies that proved to be irrelevant to PL assessment. After the completion of the screening process a total of 30 studies remained and were examined in their full-texts for eligibility. In this final stage, it was concluded that ten studies did not meet the selected criteria for this review (i.e. present a research study attempting to assess PL in children and/ or evaluate a PL program or describe the development and/or the standardization process of a PL assessment tool). These studies were excluded (Figure 1).

RESULTS

A total of 20 studies were included in this review study (16 peer-reviewed articles and four theses). Among them, 12 presented research studies focused on the PL assessment and/or the evaluation of PL programs, while eight provided information for the standardization/development of certain PL assessment tools. Almost all of the above studies were conducted in Canada, whereas only one took place in Northern Ireland.

Reviewing the above studies, it was revealed that two different approaches to PL assessment were evident. The dominant approach relates to the attempt of several

researchers to develop and use multi-component PL assessment tools (the studies reflecting this approach are presented in Table 1). Three Canadian multi-component tools were used in studies representing this approach: a) the Physical Literacy Assessment tool for Youth (PLAY tools; Canadian Sport for Life [CS4L], 2013), b) the Passport for Life, (PFL; Physical & Health Education Canada [PHE Canada], 2013) and c) the Canadian Assessment of Physical Literacy (CAPL; Healthy Active Living and Obesity Research Group [HALO], 2014).

The second approach in PL assessment can be identified in three studies (Buckler, et al., 2016; George, Rohr, & Byrne, 2016; McKee et al, 2013) in which a variety of standardized instruments (such as the Bruininks-Oseretsky Test [Bruininks, 1978], the Self-perception Profile for Children [Harter, 1985], or the Physical Activity Enjoyment Scale [Kendzierski, & de Carlo, 1991]) were used to assess one or more components of PL. However, those studies do not provide information about all PL components.

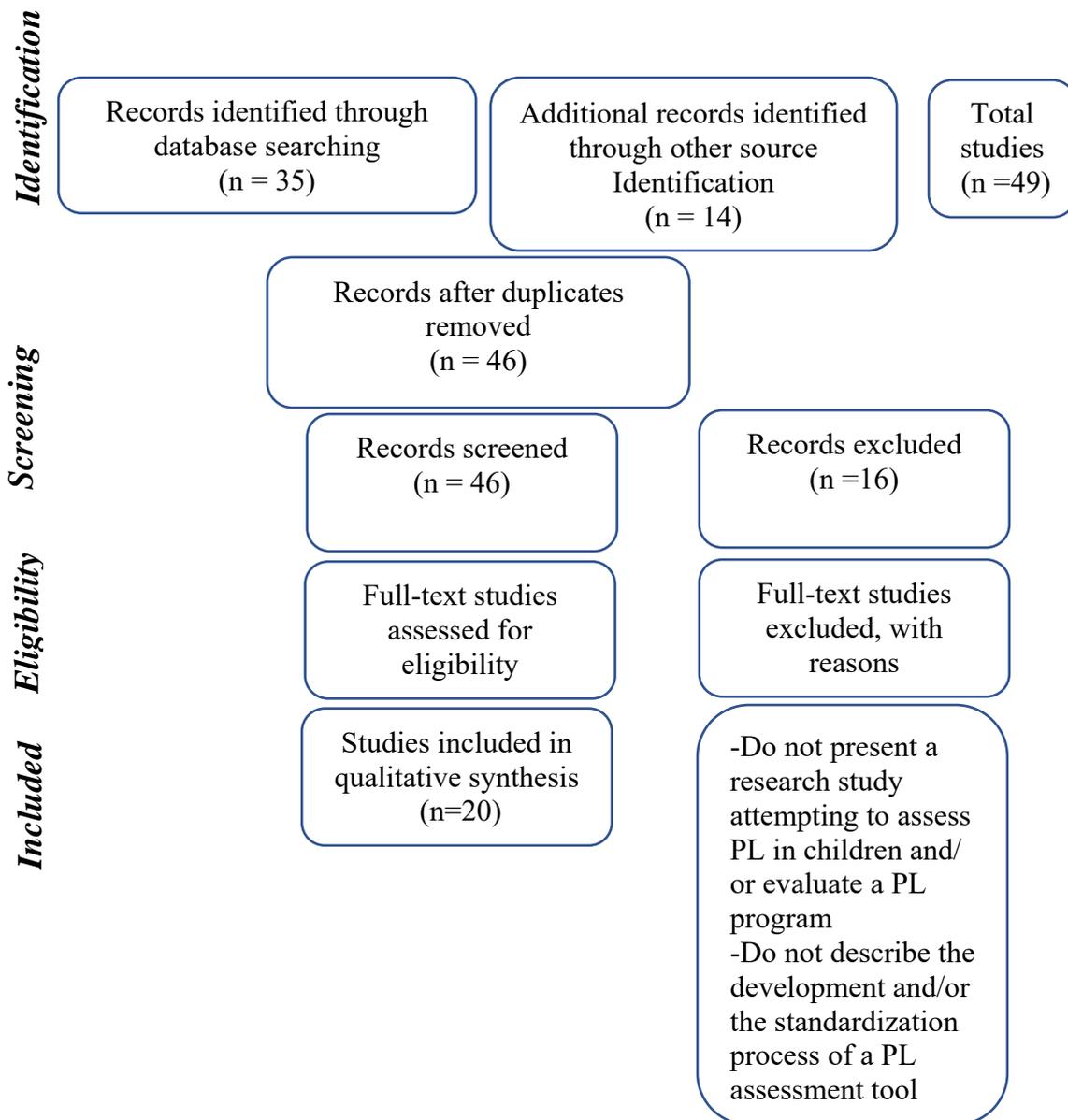


Figure 1. Process of screening and selecting studies for inclusion in the review (Moher, Liberati, Tetzlaff, Altman et al., 2009).

Table 1
Studies in which multi-component PL tools were used.

	Aim of the study	Authors	Tool
Studies presenting the development and/or psychometrics investigation of a PL tool	• Examination of PLAYfun's construct validity	Cairney et al., 2017	PLAY
	• Presentation of PFL as a formative assessment	PHE, 2014	
	• Establishment of validation evidence for PFL as a formative assessment in relation to content, response processes, internal structure and associations with other variables	Lodewyk & Mandigo, 2017	PFL
	• Development of CAPL	Longmuir, 2013	
	• Development of the Canadian Agility and Movement Skill Assessment (CAMSA)	Longmuir et al., 2015a	
	• Examination of feasibility, objectivity and reliability		
	• Validity of CAPL scoring system	Longmuir et al., 2015b	CAPL
	• Investigation of CAPL theoretical model by an expert panel	Francis et al., 2016	
• Examination of age effect bias due to age grouping by cut-off dates on CAPL scores	Dutil, 2017		
Studies focusing on PL assessment and/or PL program evaluation	• Evaluation of PL in multiple education sectors	McCallum, & Sheehan, 2015	CAPL
	• Examination of validation of PL screening tasks	Alpous, & Longmuir, 2016	CAPL
	• Investigation of the relationship between PL elements and daily PA on weekends and weekdays	Gregg, & Hall, 2016	CAPL
	• Inspection of new correlates of children's PL	Lizotte et al., 2016	CAPL
	• Association between children's physical competence and their perceived adequacy and predilection for PA	MacDonald, Kays & Saunders, 2016	CAPL
	• Examination of the effect of exergames on PL	Thomas, 2016	CAPL
	• Associations between FMS and health indicators	Comeau et al., 2017	PLAY (specific protocols) PFL (specific protocols)
	• PL in children with physical disabilities	Dugas, 2016	PLAY (modified form)
• Assessment of PL in Canadian children/youth, evaluation of a PL intervention in PE	Kozera, 2017	PLAY	

Table 2
PLAY suite of tools.

Tool	Aim	Description
PLAYfun	Assessment of motor competence, confidence and comprehension of performance	Tool of 18 fundamental movement skills/tasks; administered by trained professionals
PLAYbasic	Assessment of motor competence, confidence and comprehension of performance	Simplified version of PLAYfun, consisting of 5 fundamental movement skills/tasks; administered by trained professionals
PLAYparent	Assessment of parents' perceptions about child's fitness level; motor skills; motivation; confidence for PA; related knowledge; PA participation in different environments	20-item questionnaire; completed by parents
PLAYcoach	Assessment of coaches' (or other administrators') perceptions about child's fitness level; motor skills; motivation; confidence for PA; related knowledge; PA participation in different environments	17-item questionnaire; completed by coaches (or other administrators)
PLAYself	Assessment of children's self-evaluation of their motivation/confidence for PA, fitness level and interest in PL comparing to other school literacies, i.e. literacy and numeracy	22-item questionnaire; completed by children
PLAYinventory	Recording of children's leisure-time activities throughout the year	List of 95 potential activities; completed by children or anybody from their environment

Table 3
PFL assessment components.

Components	Aim	Description
Active Participation	Assessment of variety/frequency/different environments of PA participation and interest/intention for PA	On line 21-item questionnaire; completed by students
Living Skills	Assessment of motivation for PA (e.g. feelings of enjoyment, self-efficacy, anxiety, autonomy, perceived value of PA) and variety of skills (e.g. conceptual knowledge, critical thinking, problem solving, goal setting, self-regulation, interacting skills)	On-line 21-item questionnaire; completed by students
Fitness Skills	Assessment of cardiovascular endurance, balance/dynamic stability, core muscle endurance	Set of fitness tests including a 4-station sub-maximal exertion circuit, a lateral bound test, and a front plank test; administered by physical education/health teachers
Movement Skills	Assessment of lower limb object manipulation, upper limb object control, locomotion	Set of tasks including kicking, throwing/catching, and running; administered by physical education/health teachers

Table 4
CAPL domains.

Domains	Aim	Description
Daily Behavior	Assessment of PA levels and sedentary behavior	Information is gathered through: <ul style="list-style-type: none"> – Pedometers – 5 items of CAPL PA questionnaire
Motivation and Confidence	Assessment of perceived motor competence, adequacy, predilection for PA	Information is gathered through: <ul style="list-style-type: none"> – 16 items of CSAPPA (Hay, 1992) – 4 items of CAPL PA questionnaire Completed by children
Physical Competence	Physical fitness	Set of standardized protocols: <ul style="list-style-type: none"> – PACER shuttle run (Scott, Thompson, & Coe, 2013), – Grip strength (Tremblay et al., 2010), – Plank (Boyer et al., 2013), – Sit and reach (Tremblay et al., 2010), – Weight, height, waist circumference Administered by a trained adult
	Motor Competence	Assessment of fundamental, combined, and complex movement skills
Knowledge and Understanding	Assessment of heart-related fitness knowledge and safety issues	10 items of CAPL PA questionnaire; completed by children

The presence of different approaches to PL assessment is not surprising since research in the area is still in the developmental and explanatory stages. Besides, the range of available PL assessment tools is restricted and only prevalent to Canadian settings. This limitation may have led some researchers to select some of the commonly used tools and use them to assess some components of PL. Finally, the initial lack of consensus on the interpretation of the PL concept, the range of skills and characteristics it encompasses and how these are weighed within it, which have already been noticed by Edwards et al. (2017), may be an explanation for the differentiation in the PL assessment methodology. For example, most commonly, PL is mistakenly associated with the Fundamental Movement Skills (FMS), thus mainly focusing on the promotion of motor competence (Almond, 2013). However, this implies a narrow perspective of PL and inevitably results in its deficient

assessment because essential components of PL are excluded. As reported earlier in this article, PL is a holistic concept, thus pertinent assessments must refer to its multidimensional and holistic nature and attempt to measure it entirely as a composite entity. Therefore, this review will focus only on the three aforementioned Canadian multi-component tools (i.e. PLAY, PFL and CAPL). Each tool's manual(s), website and research papers referring to their development/standardization are used as primary sources for their presentation below. Relevant information deriving from literature is also discussed.

MULTI-COMPONENT PL ASSESSMENT TOOLS

Physical Literacy Assessment for Youth (PLAY tools)

The PLAY suite of tools, also referred as PLAY, is a PL assessment for children 7 years and older, developed by Kriellaars

for Canadian Sport for Life (CS4L, 2013), a non-profit organization that is devoted to enhancing active living and health through sport/PA and PL programming (CS4L, n.d.).

PLAY (<https://play.physicalliteracy.ca/>) can be applied for research purposes, program evaluation, engagement in PA and also for surveillance and awareness about PL among population and the leaders, aiming at contributing to either individual or group programming for PL enhancement among the young population.

PLAY consists of six independent tools (PLAYfun, PLAYbasic, PLAYparent, PLAYcoach, PLAYself and PLAYinventory) (Table 2) which can be either applied separately or in combination to assess the different components of a child's PL (CS4L, 2013). Among them, PLAYfun and its simplified version, PLAYbasic, are considered the main assessments, while PLAYparent, PLAYcoach and PLAYself function as their supplements (CS4L, 2013). Recently, Cairney et al. (2018), who are involved in PLAY's validation, stated that PLAYpe for Physical Education (PE) teachers and PLAYcreativity will be added to the suite of PLAY tools. However, no further clarifications were given about what these assessments entail, while there is no reference of them in the relative website.

The administration of PLAYfun (and PLAYbasic) requires an indoor or outdoor activity space with cones and balls. The administrator, based on specific criteria, evaluates the ability of the child to perform every single task, marking his/her performance in a visual analogue 100mm scale. Top scores represent proficiency of the task as required in the sport context regardless of the examinee's age. Moreover, the examinee's level of confidence and comprehension of the performance is recorded but not scored. PLAYbasic provides a total score which is the sum of the five tasks scores; whereas PLAYfun provides also subsection scores (running, locomotor, object control – upper

body, object control – lower body, balance, stability & body control), which are summed to provide total PLAYfun score. The examinee's performance level can be characterized as Developing (including Initial [0-25mm] and Emerging [25-50mm] level) or Acquired (including Competent [50-75] and Proficient [75-100] level). Regarding PLAYfun's completion time, no clear estimation is given. However, in their critique about Canada's PL assessment tools, Robinson and Randall (2016) estimated that the administration of PLAYfun in a group of children equal to a school class would take approximately four class sessions.

PLAYparent, PLAYcoach and PLAYself questionnaires are completed via paper. For PLAYparent and PLAYcoach, questions are summarized in four subsections (i.e. cognitive, motor competence, environment and fitness). In PLAYself, relative information is also gathered in four subsections (i.e. environment, PL self-description, relative ranking of literacies and fitness). Subsections scores (all but fitness) are summed to provide a PL score for each tool. PLAYinventory, though taken into consideration, is not scored. PLAY does not provide a composite score resulting from the combination of all PLAY tools scores; however, coaches and parents/guardians are advised to compare PLAY tools outcomes to gain a better insight into a child's PL. Moreover, a list of recommendations and actions to take in order to improve PL correspond to each PLAY tool score. Finally, comparisons between children are not recommended; instead, tracking forms are provided in order to detect individual weaknesses that can be improved by establishing realistic goals for each child (CS4L, 2013).

As far as PLAY's technical adequacy is concerned, only PLAYfun gathers published evidence for its psychometrics in ages 7-14 years, since recently two aspects of its construct validity (factor structure; score variation in relation to sex and age)

were examined by Cairney et al. (2018). According to the confirmatory factor analysis results, the hypothesized model of the five domains within PLAYfun (running, object control – upper body, object control-lower body, locomotion, and balance) was supported (RMSEA = 0.055, 90% CI = 0.03 to 0.075; CFI=0.95; TLI=0.94); whereas PLAYfun score differentiated children's performance according to patterns observed in literature, i.e. motor skill performance improving with age (Payne, & Isaacs, 2011) and boys performing better than girls only in the object control domains (Barnett et al., 2010). No other PLAY assessment is technically supported at the moment. In respect of PLAY's use in research, in its website (<https://play.physicalliteracy.ca/>) it is stated that it has been implemented to assess PL of over 25,000 children and youth across Canada; however, there is no published data to support this statement.

It seems that PLAY can be used for the assessment of young children participating in gymnastics at school or other recreational settings. The space and the equipment required for PLAYfun application can be found easily in most of the gymnastic settings. Moreover, PE specialists and coaches could be potential administrators with the proper training. The movement skills/tasks selected for assessment, e.g. run, jump, land on two feet, skip, gallop, hop, one-handed catch, balance walk (heel-to-toe), lift and lower etc., are fundamental for the learning of more complex tasks taught in gymnastics. Since gymnastic programs include task performances requiring locomotor, object control, and stability skills, professionals who work with young gymnasts can apply an assessment like PLAYfun that covers a large range of such skills.

What is more, additional information, e.g. participants motivation and confidence for PA, comprehension of movement terms etc., which can be gathered by PLAYcoach, should be of some concern for the professionals of gymnastics, who

aim at the holistic development of the young participants. Moreover, the potential involvement of children's parents/guardians in the assessment by the application of PLAYparent could provoke their awareness on the importance of participating in gymnastics at any level. Alike, PLAYself and PALYinventory could be used by those concerned as a motivational tool for maintaining young participants' engagement with gymnastics and PA. It should be mentioned that for a PE specialist or a professional of gymnastics it will take a considerable amount of time to gather information from all the PLAY tools. However, the combination of PLAYfun and PLAYcoach would compromise the time burden and provide them with valuable information that could be used for the enhancement of their participants' PL.

Passport For Life (PFL)

PFL is a formative PL assessment that was launched in 2013 by the professional organization for physical and health educators of Canada (PHE Canada, 2013). It is actually a curricular-based program designed to stimulate awareness, assessment, development and advancement of PL in the educational context, among teachers and their students (PHE Canada, 2014). An alternative goal of PFL is to accumulate data over time that will facilitate the information of the public or other stakeholders about the level of PL among children and youth. PFL has been designed for students across the grades 3 to 12 (ages 8-18), while it will soon be available for the first grades (1 to 2, ages 6-8) and the kindergarten (ages 5-6) (Dutil, 2017; Lodewyk, & Mandigo, 2017). PFL (<http://passportforlife.ca/>) assesses PL in four distinct components: a) Active Participation, b) Living Skills, c) Fitness Skills and d) Movement Skills. A summary of PFL components is provided in Table 3.

The tests used for the assessment of fitness and movement skills respectively are administered during the PE class and

require an activity space (indoor or outdoor) along with cones and balls. Movement tasks are combined and performed in a dynamic activity environment, so that students' ability to adjust their movement according to changing conditions is identified. These activities are modified in relation to the grade (Lodewyk, & Mandigo, 2017). Students' performance on each fitness/movement skill is graded according to criteria provided and located into one of the four PL levels/categories (Emerging, Developing, Acquired and Accomplished), in line with curricula objectives for their age. PFL questionnaires' scores are independent of the above fitness/movement one; a composite PFL score is not calculated as, according to PFL authors, PL is a complex concept and PFL is just a close reflection of students PL; it does not represent the entire picture of it (PHE Canada, 2013). With regard to PFL administration duration, if a single assessor is available, the amount of time needed for the completion of all the assessments is considerable. In the research of Lodewyk, & Mandigo (2017), a wide range of completion time is reported (2.5 to 6 PE sessions). However, this time can be shortened as there is the choice for students to complete the on-line questionnaires either during or after school hours.

The PL assessment with the PFL within Canadian educational context is held twice a year; at the start and near the end of each school year or semester. An electronic registration is necessary to input and administer students' data. After creating on-line profiles for each student, teachers are able to download the Teacher's Guide, which helps them to organize the assessment, interpret the results and implement personalized strategies to encourage their students' PL. Once they complete each round of assessments, students receive a Passport with summary of individual data, as well as suggestions for personal improvement.

This informative document, which is not a grade for the PE course, is also accessible to parents/guardians. Additionally, a database with students' assessment results across multiple years is provided. A Class Passport, which summarizes students' results, is also generated by the system to assist teachers set attainable goals for their group of students.

With regard to PFL psychometrics, Lodewyk, & Mandigo (2017) gathered evidence for its use in grades 3 to 6 (ages 8-12) and 7 to 9 (ages 12-15), both through a preliminary (n=860) and a full-scale study (n=5110). Starting with content validity, authors state that it was established by a process of consultation, involving PE experts from across Canada. Additionally, statistically significant ($p < 0.001$), although weak to moderate, correlations were revealed between movement and fitness tests scores ($r = 0.28-0.45$) and between those scores and students' self-reported participation in fitness activities at school ($r = 0.11-0.20$, $p < 0.01$). Moreover, the factor structure of living skill component was investigated through an exploratory factor analysis (factor loadings 0.53-0.81; variance explained 42.07-54.53%). Finally, response process evidence was gathered and it was found that students across all grades easily comprehended and were able to complete all assessments, while teachers found PFL to be relevant and easily administrated. More than 80% of the teachers considered that PL was better understood by the students after the assessment procedures and that the outcomes would help them enhance their PL (Lodewyk, & Mandigo, 2017). In reference to PFL's reliability, Lodewyk, & Mandigo (2017) examined interrater (ICC=0.65-0.82) and test-retest reliability ($r = 0.72-0.89$) for the fitness and movement PFL components, whereas they report that most of the PFL assessment scales presented a sufficient stability and internal consistency between fall and spring assessment times within an academic year.

As far as PFL's use in research is concerned, it is limited, although the tool is widely used within Canadian educational context (Mandigo, et al., 2013). Only PFL movement and fitness skill components have been used in FMS research so far (Comeau et al., 2017).

In the school environment, students have the opportunity to engage with several sport/PA, with gymnastics to be one of those. PFL can be used to assess basic movement skills, e.g. kicking, throwing/catching, running etc., that are necessary building blocks for educational gymnastics, as it is for every PA. Given that the participation in gymnastics and in most of the PA practices is facilitated by the good physical condition of the participants, the assessment of their fitness is important and can be easily conducted by PFL. It should be noted that the PE specialists should have been trained to conduct such assessments and the school gyms are the proper environments for them to use.

Furthermore, PFL can provide multiple information for a variety of living skills, which are essential for every student participating in educational sport programs. Particularly, skills, such as critical thinking, problem solving, goal setting, self-regulation included in PFL, it is important to be assessed if intelligent participants are to be developed. In addition, through PFL, significant affective skills and characteristics, e.g. self-efficacy, anxiety, autonomy, perceived value of PA etc., are evaluated, offering the PE specialists a rich pool of useful information. Such an information can be used to enhance the motivation and confidence of their students to participate in various PA, including the demanding activity of gymnastics. However, it should be taken into consideration that the completion of all the PFL assessments could be time-consuming due to the limited availability of PE specialists in schools.

Canadian Assessment of Physical Literacy (CAPL)

The Healthy Active Living and Obesity research group (HALO) has been systematically involved in the development of CAPL tool since 2008 (HALO, 2014). According to Longmuir et al. (2015b) the fundamental goal of CAPL's developers is to offer a valid and reliable tool to monitor children's PL (target age range: 8 to 12 years old) within sport, recreation and educational contexts (<https://www.capl-ecsf.ca/>). In an attempt to represent PL's definition, CAPL assesses a wide variety of skills, characteristics and active habits of the child in four domains: a) Daily Behavior, b) Motivation and Confidence, c) Physical Competence, and d) Knowledge and Understanding (Table 4). For CAPL's development, its authors used both standardized tools (e.g. Children's Self-Perceptions of Adequacy in and Predilection for PA questionnaire [CSAPPA]; Hay, 1992) and created new ones (the Canadian Agility and Movement Skill Assessment [CAMSA]; Longmuir et al., [2015a] and the CAPL PA questionnaire [Longmuir et al., 2015b]). According to Tremblay and Longmuir (2017), a new shortened version of CAPL (CAPL-2) is in progress; however, as there is no data regarding this version so far, this study has focused on the original version of CAPL (HALO, 2014).

A gymnasium or an open activity space with hula hoops, cones, balls, CD player, sit and reach flexometer, handgrip dynamometer, etc. is necessary for administering CAMSA and physical fitness assessments, whereas pedometers should be worn for seven consecutive days. According to CAPL's authors (HALO, 2014), teachers, PA professionals, public health practitioners, recreational leaders, even parents/guardians can administer CAPL protocols as long as they undergo appropriate training, whereas CAPL questionnaires can be completed on-line by utilizing hand electronic devices (e.g. tablets).

Each child's performance in CAMSA is assessed through the time needed for its completion and the quality of movement skills execution, assessed according to detailed criteria. Detailed description of the procedures and evaluation criteria for the fitness tests are also provided. Each child's scores in all CAPL tasks and questionnaire items are summed into the PL domains described above and a total CAPL score is then computed (Francis et al., 2016). Due to an algorithm provided by the manual (2014), this total score can be calculated even if one domain score is entirely missing. A child's total CAPL score can be classified into four categories (Beginning, Progressing, Achieving and Excelling) reflecting the child's PL current level in regard to his/her age and gender (HALO, 2014). Interpretive remarks and general suggestions for encouraging PL accompany each of the above levels. Apart from the total CAPL score, each domain score, as well as each individual protocol score within a domain can be interpreted independently, according to the child's age and gender, enabling the assessor to pinpoint deficits on specific aspects of child's PL. In relation to CAPL's administration duration, excluding the one-week period of pedometer activity measurement, the completion of all protocols by one child takes approximately 60 minutes; whereas for a group of 25-30 children with one or two assessors available, four days with a 30-40-minute session/day are needed. That means that CAPL's administration is lengthy and cannot be easily conducted by a single assessor, as also Longmuir et al. (2015b) acknowledge.

In regard to its technical adequacy, CAPL's theoretical PL assessment model approved by Francis et al. (2016), was tested and supported by Longmuir et al. (2015b) through confirmatory factor analysis (Goodness of Fit Index=0.96; Bentler Comparative Fit Index=0.94; Bentler-Bonett NFI=0.91; Bentler-Bonett Non-normed Index=0.91; RMSEA=0.057).

In the study of Longmuir et al. (2015b), it was also found that CAPL raw scores follow expected patterns according to age and gender; whereas interpretive categories (in relation to age and gender adjustive normative data) revealed no association with age. Moreover, the total and most domains scores of participants were significantly associated with their teachers' ratings, supporting CAPL's convergent validity. Dutil (2017), who investigated the potential age effect bias in CAPL (due to grouping by cut-off dates), came to the conclusion it is not affected and therefore is a valid measurement of children's PL. Finally, the technical adequacy of CAMSA (Longmuir et al., 2015a) was examined and it was proved to be a valid, objective, reliable and feasible measure of the specific combination of fundamental, complex and combined movement skills it contains (Longmuir et al., 2015a)

In respect of the use of CAPL in research, it is true that CAPL appears in several studies. Among them, some utilized CAPL to assess children's PL (McCallum, & Sheehan, 2015), investigate the relationships among its components (Gregg, & Hall, 2016; Lizotte et al., 2016; MacDonald, Kays, & Saunders, 2016) and evaluate the impact of interventions (Thomas, 2016). Apart from the above, CAPL was used in two cross-cultural studies. One conducted in Kenya (Tremblay et al., 2014), comparing CAPL scores between Canadian and Kenyan children and one conducted in South Africa (Uys et al., 2015), attempting to investigate the validation of key-components of CAPL in local 10-year-old children. Finally, CAPL used as a criterion for the examination of sensitivity and specificity of PL screening tasks (Alpous, & Longmuir, 2016).

Alike PLAY, CAPL can be used in gymnastics within several settings, e.g. education, recreation; however, the difference between the two is that, CAPL can directly assess the children's performances and responses, whereas

PLAY also uses other people's beliefs about them. Although, CAPL does not include additional assessments from parents and coaches, completion time still remains a problematic issue, because at a recreational level or at the school environment the weekly participation is limited to a few sessions. Other administration issues, such as the availability of more than one assessor and the demanding training of them on the CAPL protocols could be of some concern, but in most of the gymnastics settings these issues could be manageable. Additional concern could be the provision of pedometers; however, their usage is a pleasant experience for the young participants and enhances their motivation to take part in the assessment. Other equipment and the activity space required for the application of CAPL protocols are typically available in the gymnastic settings.

It is worth mentioning at this point that CAMSA, CAPL's movement skill assessment, is developed to assess a sequence of movement skills performed in a dynamic environment, offering this way an alternative form of assessment. Control of acceleration/deceleration, rhythmic movement, balance, core stability, coordination, equilibrium, precision, are within the complex and combined skills included in CAMSA and are designed to simulate the real conditions that participants face during their practice in gymnastics and in several other PA. Furthermore, through CAPL's fitness protocols professionals of gymnastics can obtain multiple useful information about their participants' fitness status, e.g., about their cardiovascular endurance, strength and flexibility, with the aim of improving their overall fitness. Considering that the weight status of the participants in gymnastics is of great interest and also relates to better health, the somatometric information gathered through CAPL is critical.

DISCUSSION

The aim of the present study was to review PL assessment tools in an attempt to provide those who are involved in non-competitive gymnastics with a useful stepping stone for selecting the appropriate tool for their objective(s). After reviewing relevant literature, it was found that only three tools were purposely designed to assess PL, and those were PLAY (CS4L, 2013), PFL (PHE Canada, 2013) and CAPL (HALO, 2014). All of them are multi-component tools that address the variety of PL components described in IPLA's (2014) definition and were initiated by the efforts of Canadian research groups. Canada's progress in PL assessment is justifiable, since the country has dynamically embraced the concept and implicated it in education, sport development and recreation (Spengler, 2015). Besides, the development of PL assessment tools was among the objectives of the Canada's PL consensus statement (2015), endorsed by the Public Health Agency of Canada and signed by many domestic organizations.

From this review it becomes clear that PLAY, PFL, and CAPL represent a meaningful effort to contribute to PL assessment and advancement at an individual and societal level and can be used in gymnastics. The similarities that these tools share are several, e.g. identification of PL deficits, encouragement of individual progress, tracking of PL over time; it is more informative, however, to discuss their differences. Starting with the content of the assessments, a different philosophy is observed among them, as each tool assesses an alternative combination of skills, characteristics and behaviors attributed to PL. Being an educational tool, PFL focuses on the all-round development of the child in the physical, cognitive and psychosocial domain. Communication skills and features, such as goal-setting or self-regulation, detected in PFL living

skills component, emphasize its holistic nature. On the other hand, CAPL puts greater emphasis on the PA behavior and physical competence domain, including pedometers as an objective measure of PA, lots of fitness tests, and anthropometric measures. As far as PLAY is concerned, although it seems that by the combination of all the PLAY tools the core PL components are addressed, its main assessment, i.e. PLAYfun, is movement skill-oriented and vaguely succeeds to encompass the affective and cognitive PL components.

With respect to the population these tools are designed for, PFL can be utilized only in the school context, across all grades (3-12, ages 8-18); whereas PLAY and CAPL can be applied in various contexts, e.g. sport, education, after school-programs, recreation, to assess PL across different age ranges. Between the last two, CAPL concerns the assessment of children of a limited age range (8-12 years), while PLAY is applicable both in children and youth. At this juncture, PL assessment in children with disabilities should be discussed, as a research shortcoming is noticed regarding assessment tools aiming at assessing PL in individuals with disabilities. Only Dugas (2016) piloted an assessment tool for children/youth with physical disabilities by modifying elements of PLAY. In reference to the original PLAY, PFL and CAPL, they are not designed to cover PL evaluation of children with disabilities. Nevertheless, both CAPL's (HALO, 2014) and PLAY's (CS4L, 2013) developers acknowledge the necessity to facilitate these children's PL assessment; whereas at PLAY's website (<https://play.physicalliteracy.ca/>) the initiations of research procedures to develop assessments for individuals sitting on wheelchairs, having limited mobility, cerebral palsy and autism are announced. Moreover, at PFL website (<http://passportforlife.ca/>) it is stated that PFL assessments are possible to be

adjusted for children with mobility impairments or cognitive/behavioral challenges. From the above it can be concluded that although the importance of PL assessment in disabled children is recognized, there is a long way ahead for the publication of sound PL tools for this population. Nevertheless, the need for further research on this topic is imperative, since the exclusion of disabled children from assessment procedures eliminates their opportunities to make improvements in their PL.

In terms of PL tools' administration, although there is evidence for their feasibility (Cairney et al., 2018; Lodewyk, & Mandigo, 2017; Longmuir et. al., 2015b), few problematic areas should be discussed. An important drawback of PLAY, PFL, and CAPL is that they are time consuming; therefore, their repetitive application to track PL overtime may be discouraging. The availability of many assessors could moderate the problem; however, at most of the PA settings, especially at school, the engagement of many assessors is difficult, if not impossible. Nevertheless, it should be mentioned that, although the elimination of the administration time is important for measurement feasibility, the multidimensionality and the holistic nature of these tools should not be compromised by future modifications on them. Another issue that should be noted is assessors' training required for their administration. Although PFL can easily be applied by PE educators with no additional training on the assessments (Lodewyk, & Mandigo, 2017), potential assessors of CAPL should undergo thorough training on its protocols, whereas PLAY's main assessments can only be applied by trained PA professionals.

In regard to motor competence assessment, although specific criteria are described by each PL tool, there are concerns about their objectivity. Starting with PFL, Dutil (2017) reports that it allows subjective movement skill

assessment. Moreover, in PLAY's movement skills component, the considerable large score scale (0-100) seems to lead to a relatively subjective assessment. However, in CAPL, detailed criteria provided for movement skills assessment do not allow for the assessor's subjective decisions. Additionally, the interpretation of each examinee's performance is not the same across all tools. For PFL and CAPL, skills performance is interpreted in relation to age, whereas for PLAY, proficiency in a task requires athletic performance regardless examinee's age. Although Cairney et al. (2018) advocate that PLAY's scaling, based on predetermined outcomes (e.g., such as the time of completing a task), is advantageous comparing to others, the fact that PLAY's results are not age corrected can lead to misconceptions, as also Robinson and Randall (2016) highlight.

The last but of equally importance issue that should be discussed is PL assessment tools' psychometrics. Among the three tools reviewed in this study, PLAY is that most lacking evidence for its technical adequacy, as only construct validity for one of its tools (PLAYfun) has been examined in children 7-14-year-old (Cairney et al., 2018) and not in its entire target-age range. PFL presents published evidence regarding its content and construct validity as well as its reliability (stability; internal consistency); however, construct validity has not been investigated for the PFL as a whole; instead, different criteria were examined for different PFL components (internal consistency was examined only in movement and fitness components; factor structure was examined only in living skill component) (Lodewyk, & Mandigo, 2017). Furthermore, the above evidence refers only to students of grades 3 to 9 (ages 8-15), although PFL aims at assessing PL in grades 10-12 (ages 15-18) too. CAPL is the only tool with published evidence in regard to the validity (construct validity; convergent validity) of

the entire instrument as an entity (Dutil, 2017; Francis et al., 2016; Longmuir et al., 2015b) in children aged 8-12 years old, whereas separate data are available for CAMSA's validity and reliability (Longmuir et al., 2015a). However, until now there is no information regarding the reliability of CAPL, which is of concern for its use when repeated measures are needed. From the above it is obvious that among the three, CAPL's technical adequacy is better supported; however, due to their recent development, the research behind PLAY, PFL and CAPL continues. Further research is needed so that their validity and reliability can be established.

Taking the aforementioned into account, it is obvious that despite the significant contribution of these tools to PL assessment, additional improvements should be made. As PL gains attention around the world, feasible, non-costly, valid, reliable and culturally-relevant PL tools are needed. By this means, people who teach gymnastics would be able to easily, effectively and frequently implement the suitable assessment procedures to ensure progress in PL of young participants.

CONCLUSIONS

Up to the present, the assessment of PL is at a beginning stage with no gold standard to follow. This review revealed that there are three multi-component tools (PLAY, PFL, CAPL) initiated in Canada that were designed to address the interactive components within PL. These holistic tools are currently leading the way in PL assessment and are already being used in several contexts with the aim of promoting PA participation. Thus, they can be used in gymnastic programs to facilitate learning evaluation and monitoring. In line with their objectives, PFL can be utilized in educational gymnastics; whereas the other two can be used both in educational and recreational gymnastics. In addition, these tools can also be used for research

purposes. The critical analysis of them in relation to content, target-population, feasibility and psychometrics, despite observing their similarities, highlighted their differences mainly in terms of primary focus, context(s) of application, age-groups they are designed for and criteria used for physical literacy evaluation. Limitations were also identified including administration time; assessors' training required; not designed for individuals with disabilities; limited evidence for their psychometrics, raising concerns about those tools' feasibility, usefulness and technical adequacy. Nevertheless, research behind (and with) PLAY, PFL, and CAPL continues. As PL advancement demands valid and reliable assessment tools, the improvement of the existing ones to face their shortcomings and/or the development of new sound ones seems imperative.

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