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REVIEW

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How to design and establish a national school-based physical fitness monitoring and surveillance system for children and adolescents: A 10-step approach recommended by the FitBack network

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Abstract

Background: Providing individual- and population-level data on children's physical fitness (PF) is a crucial public health and education priority. However, few national fitness monitoring or surveillance systems are currently in practice internationally. We aim to summarize the current European PF monitoring and surveillance systems for school-aged children and to provide experience-based guidelines on how to design such systems.

Methods: The FitBack network consists of experts from diverse backgrounds with the common interest to improve the accessibility of PF monitoring for young people globally. Through FitBack network, we identified and compared the national or regional PF monitoring and surveillance systems currently in operation across Europe. We formulated a 10-step approach for designing and establishing

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one's own system, based on analysis of experienced strengths, weaknesses, opportunities, and threats to monitoring childhood fitness.

Results: We identified a total of eight PF monitoring systems in Finland, France, Galicia of Spain, Hungary, Lithuania, Portugal, Serbia, and Slovenia. The FitBack network recommends the following steps for designing and establishing one's own system: (1) set up mission statements and aims, (2) involve stakeholders, (3) utilize scientific background, (4) governance structure, (5) ensure sufficient funding, (6) data management planning, (7) provide meaningful feedback, (8) conduct pilot testing, (9) plan implementation process, and (10) invest in communication with stakeholders.

Conclusions: This study provides an updated overview of the best practices for school-aged children's fitness monitoring and surveillance in Europe. Additionally, it offers a 10-step approach to assist in the creation of similar systems in Europe or globally.

KEYWORDS

assessment, disease prevention, education, epidemiology, NCDs, physical literacy, policy, population health

1 | INTRODUCTION

Physical fitness (PF) refers to a set of attributes that an individual has or achieves,[1] which provide an ability to carry out daily tasks with vigor, alertness, and ample energy to enjoy leisure-time pursuits or to meet an unforeseen emergency.[2] These attributes include: body composition (proportion of different tissues in the human body), cardiorespiratory fitness (ability of the whole-body to sustain prolonged performance), musculoskeletal fitness with muscular strength and endurance (muscle properties enabling work) and flexibility (range of motion available at a joint or group of joints), and motor fitness (speed of movement, agility, and coordination).[3–5] There is substantial accumulated evidence supporting the importance of maintaining adequate PF at a young age, not only limited to one's functional capacity and performance, but also in terms of encouraging lifelong health and educational aspects. Physical fitness in youth is consistently associated with favorable educational attainment, brain properties and cognitive function,[6–11] somatic and mental health,[12–14] as well as lower morbidity and mortality later in life.[15–18] Physical fitness also associates closely with physical literacy—the “motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life,”[19] a construct that is well-positioned in educational policies as a key component for maintaining a healthy and active lifestyle.[20,21]

The secular trends of children- and adolescent-specific fitness components varies based on the societal and environmental factors children face over time.[22] Fitness monitoring and surveillance is an unavoidable contemporary topic since many global pressures (e.g., conflict, climate change, pandemics, and cultural evolution through technological development) can directly (or indirectly) negatively affect child PF.[23] Surveying childhood fitness at scale can capture a wide variety of physical attributes, which are highly relevant to characterizing children and adolescents' current and future health outcomes, and complements already existing frameworks, which regularly monitor 24-h movement behaviors such as physical activity, sedentary behavior, and sleep.[24] Physical fitness monitoring and surveillance was one of the top 10 priorities outlined by international experts in the fitness domain,[25] and the development of such systems is a high priority to enhance the description of children and adolescents health status globally. Accurate ongoing assessments of the state of a population's fitness can also be used to create more effective policy interventions when future external challenges to society inevitably arise.

Herein, we refer to “monitoring” as observing and/or assessing the changes of one's fitness over time, usually for a special purpose (e.g., educational or health-related), whereas “surveillance” emphasizes the importance of disseminating the data and related findings to parties responsible for preventing and controlling public health concerns.[26] Globally, there are limited examples of at-scale PF monitoring and surveillance systems in operation.[24,25,27,28]

For the ones that do exist, their development is best operationalized through the international cooperation of diverse partners in science, civil societies, and educational organizations.[29] Previously, most of this work regarding systematic fitness monitoring has been rather compartmentalized and localized. To address this disparity, the European Union Erasmus+ Sport funded a large-scale project named "The European Network for the Support of Development of Systems for Monitoring Physical Fitness of Children and Adolescents' (abbreviated as 'FitBack')."[30] FitBack is a nonprofit coalition of 10 European founder-members who have had expertise conducting child fitness assessment, monitoring, or surveillance at the population level. The FitBack project builds on a previous European Union-funded work called the "ALPHA project," which established and evaluated an evidence-based health-related field-test battery for school-aged children.[3,31]

This study communicates the work conducted within the FitBack project 2020-2022. More specifically, the two main aims of this study were as follows: (1) to identify, compare, and contrast examples of current best-practice PF monitoring and surveillance systems among school-aged children in Europe, and (2) to provide an experience-based easy-to-follow set of guidelines for policymakers, which can be used to design their own PF monitoring and surveillance system. Detailed outcomes of the FitBack project can be found by accessing its online, free-for-use, web portal here: https://www.fitbackeurope.eu/en-us/.

2 | METHODS

2.1 | Identifying current PF monitoring best-practices in Europe

The FitBack project was launched on February 12, 2020, just before the COVID-19 global pandemic was declared by the World Health Organization. Despite these challenges, the process began in earnest by identifying and describing existing national or regional PF monitoring and surveillance systems across Europe, *herein* truncated to "systems." Information related to national and/or regional systems was discovered largely from nonacademic publications, and in local languages. Hence, a narrative review approach was selected. Eligible systems were identified by the experts involved in the FitBack consortium, and their respective professional networks.

The FitBack working group then formed a structured questionnaire that was sent to representatives of the identified systems. Representatives were requested to provide descriptions of their fitness system, including details such as the aims, design, relationship to physical education programs in schools, operational time lines, leading institutions, subjects, test items, instructional materials, data collection, feedback, reference values, criteria for possible interventions and sources for further information. All representatives of the identified systems were successful in providing detailed descriptions of their regional works.

2.2 | Compiling guidelines for designing novel school-based PF monitoring and surveillance systems

In the second phase of the process, a key guideline document entitled "How to design a physical fitness monitoring system" was created. These guidelines were prepared in collaboration with five founder-members of the FitBack consortium—Finland, Hungary, Portugal, Serbia, and Slovenia—countries that also possess unique experiences in establishing and operating their own national-level child fitness systems. The formation of the guidelines followed an iterative design, which included an initial planning stage, consideration of requirements, analysis, design, testing, and evaluation. The working group analyzed the Strengths, Weaknesses, Opportunities, and Threats (SWOT) related to each system by filling out a SWOT form, whereafter, answers were thematically clustered. The most common SWOT themes were first discussed within the working group, and potential solutions to address these topics, (e.g., key guidelines), were carefully considered. After several iteration rounds, the working group decided upon 10 priority guidelines. Discussions also included how to list/communicate their order of presentation. The final materials were then prepared in several formats within the working group before being shared with the FitBack consortium at large, and prior to final publication on the FitBack online web portal (www.fitbackeurope.eu/en-us/monitoring-fitness/10-step-to-design). These key guidelines, contents, documents, and the online portal itself have since been successfully piloted among actual policy makers.[32]

3 | RESULTS

3.1 | European national and regional school-based PF monitoring and surveillance systems for children and adolescents

3.1.1 | Existing PF monitoring and surveillance systems

The FitBack network identified eight national- or regional-level systems in operation within Europe. They are: Move!

(Finland), Diagnoform (France), DAFIS (Galicia, Spain), NETFIT (Hungary), The assessment of student's fitness in primary and secondary schools (Lithuania), FITescola (Portugal), the National Physical Fitness Surveillance System (Serbia), and SLOfit (Slovenia). Long-form descriptions of each system are available on the FitBack web portal (FitBack-Identification-and-descriptions-of-good-practices-in-diagnosing-the-physical-fitness.pdf (fitbackeurope.eu)). In this article, we provide an updated summary of these systems' characteristics (Table 1).

The first surveillance system was launched over 40 years ago in Slovenia, back in 1982. Other systems were launched more recently: in France and Galicia 2010–2012, and in Finland, Hungary, Lithuania, Portugal, and Serbia 2015–2020. These systems are located in diverse total populations ranging from approximately 2.1 million inhabitants (Slovenia) to 68 million (France). The systems span Europe, representing geographical areas to the north (Finland), south (Portugal), east (Lithuania), and west (France) (Figure 1). Fitness systems are operating primarily within high-income countries (Finland, France, Galicia, Hungary, Lithuania, Portugal, and Slovenia), and one upper middle-income (Serbia) country whose Gross Domestic Product per capita ranges from 9230 $ (Serbia) to 53 655 $ (Finland).[33]

All systems aim to assess PF among school-aged children, with a specific emphasis on supporting physical education, students' physical and health literacy, and health (for further details, see the long-form descriptions from the FitBack platform). All systems operate in a school context within the physical education subject. In France, Galicia, Lithuania, Portugal, and Slovenia schools are recommended to utilize their regional/national system to assess student's PF, whereas in Finland, Hungary, and Serbia, the use of the system is mandatory part of the curriculum.

The systems encompass a broad range of school-aged children, ranging from 5 years for the youngest (France) to ≥19 year in the oldest (Hungary, Serbia, Slovenia). The majority of systems assess fitness annually as part of the children's educational pathway, with up to 13-year trajectories (Slovenia). As an exception, in Finland, children and adolescents participate in national data collection twice at specific ages (in Grades 5 and 8, at ages 11 and 14).

Based on data from systems with centralized registers (i.e., Finland, France, Galicia, Hungary, Portugal, and Slovenia), approximately one million children and adolescents participate to fitness monitoring per year. The largest absolute number of school-aged children are involved in the Hungary's system, which tests approximately 650 000 students annually, corresponding to approximately 93% of their age-specific population. The second largest system identified based on pure participation rate is Slovenia, with approximately 200 000 annual participants (i.e., ~96% of the age-specific population), followed by Portugal 120 000 (~12%), and Finland 100 000 (~96%). France and Galicia have lower participation rates, with approximately 32 000 and 26 000 participants since their launch, respectively. In Lithuania and Serbia, relevant data were not available at the time of analysis.

3.1.2 | Comparing PF monitoring and surveillance systems

A comparison between systems revealed that, whereas each system assesses similar PF components, they utilize different test items for this purpose (Table 1). The terminology used to compare PF items across systems was adopted from the ALPHA project, which categorizes fitness into body composition, cardiorespiratory, musculoskeletal (including muscular strength and endurance, and flexibility) and motor fitness. In this context, we utilized the terms "musculoskeletal fitness" and "motor fitness," although in many physical education curricula these test items are used to assess a student's "motor competence." Importantly, both Finland and Hungary provide adapted fitness tests for students with special needs.

Anthropometrics and body composition

All systems, except Finland and Lithuania, assess anthropometrics and/or body composition. Most systems assess anthropometrics; body mass index (France, Galicia, Hungary, Portugal, Serbia, and Slovenia), waist circumference (Galicia and Portugal), or waist-to-hip ratio (Galicia). Additionally, Hungary, Portugal, and Slovenia assess body composition by body fat percentage (via bioelectrical impedance [Hungary, Portugal], or skinfolds [Portugal, Slovenia]).

Cardiorespiratory fitness is assessed using a variety of techniques. It is most frequently determined using the 20-m shuttle run (Finland, Galicia, Hungary, Lithuania, Portugal, and Serbia). In Lithuania, secondary school students are assessed using the 20-m shuttle run but primary students complete a 6-min run. In Portugal, a 1-mile run is provided as an alternative to the 20-m shuttle run test. In France and Slovenia, cardiorespiratory fitness is assessed using a 6-min "run and walk test" and a 600-m run, respectively.

Musculoskeletal fitness/muscular strength and endurance

Various tests are used to assess muscular strength and endurance. Upper-body strength is assessed by handgrip strength (Galicia, Hungary), bent-arm hang (Galicia, Lithuania [secondary students only], Serbia, and Slovenia), and push-up (Finland, Hungary, and Portugal). Central body assessments include sit-ups (Serbia, Slovenia), curl-up

TABLE 1 Overview of the current school-based physical fitness monitoring and surveillance systems in Europe according to the year of establishment.

	Country							
	Slovenia	**France**	**Galicia, Spain**	**Hungary**	**Portugal**	**Finland**	**Serbia**	**Lithuania**
Descriptives								
Name	SLOfit	Diagnoform	DAFIS (Datos Actividad física Saludable)	NETFIT	FITescola	Move!—monitoring system for physical functional capacity	National Physical Fitness Surveillance System	The assessment of student's fitness in primary and secondary schools
Launched (year)	1982	2010	2012	2015	2016	2016	2017	2020
Population (2021)[33]	2 108 079	67 749 632	2 696 880[52]	9 709 891	10 325 147	5 541 017	6 834 326	2 800 839
GDP/capita (2021)[33]	29 291 $	43 659 $	31 272 $[52]	18 728 $	24 567 $	53 655 $	9230 $	23 723 $
Measurements								
Timeline	Annually during April	No mandatory timeline	No mandatory timeline	Annually between January and May	No mandatory timeline	Annually during August/September	Annually during September/October and in May	Annually between February and May
Age groups	6–19-years	5–11-years	6–17-years	10–19-years	10–18-years	11 and 14-years[a]	9–19-years	7–18-years
Annual participants (% of age-specific population)	200 000 (~96%)	~3500	~2600	650 000 (~93%)	120 000 (~12%)	100 000 (~96%)	NA	NA
Anthropometrics and body composition	BMI, body fat percentage (skinfold)	BMI	BMI, waist circumference, waist-to-hip ratio	BMI, body fat percentage (BIA)	BMI, waist circumference, body fat percentage (BIA, skinfold)	NA[b]	BMI	NA
Cardiorespiratory fitness	600-m run	6-min run and walk test	20-m shuttle run	20- or 15-m shuttle run	20-m shuttle run or 1-mile run	20-m shuttle run	20-m shuttle run	6-min run[P], 20-m shuttle run[S]
Musculoskeletal fitness/ Muscular strength and endurance	Bent-arm hang, sit-ups, standing long jump	Standing long jump	Handgrip strength, bent-arm hang, standing long jump	Handgrip strength, push-up, curl-up, trunk lift, standing long jump	Push-up, curl-up, squad jump or vertical jump, standing long jump	Push-up, curl-up	Bent-arm hang, sit-ups, standing long jump	Standing long jump, bent-arm hang[S]
Musculoskeletal fitness/ Flexibility	Stand and reach	Lower-back extension in standing position	Back-saver sit and reach	Back-saver sit and reach	Sit and reach, shoulder stretch	Squat, lower-back extension in sitting posture, shoulder stretch	Sit and reach	Sit and reach[S]
Motor fitness	20-s arm plate tapping, Obstacle course backwards, 60-m dash	5-s run test, Hopscotch test	4×10-m shuttle run	NA	4×10-m shuttle run Speed in 20- or 40-m	5-leaps test, Throwing-catching combination test	4×10-m shuttle run	Tennis ball throw, 10×5-m shuttle run, Flamingo balance[S]
Adapted fitness tests	No	No	No	Yes	No	Yes	No	No

(Continues)

TABLE 1 (Continued)

	Country							
	Slovenia	**France**	**Galicia, Spain**	**Hungary**	**Portugal**	**Finland**	**Serbia**	**Lithuania**
Feedback								
Normative-related feedback (main age- and sex-specific centiles)	≥40th fit zone (Green), 10th–40th need to improve (yellow), <10th strongly recommended to improve (Red)[34]	≥90th very high, 70th–90th high, 30–70th medium, 10th–30th low, <10th very low for all	≥80th green, 60th–80th blue, 40th–60th yellow, 20th–40th orange, <20th red, for bent-arm hang,[35,36] standing long jump,[35,36] and 4×10-m shuttle run[35]		Healthy Zone ≥50th for 4×10-m shuttle run, ≥20th for vertical and standing long jump,[39] and ≥50th for 20- or 40-m sprint test[46]	>66th good, 33rd–66th sufficient, <33rd needs improvement, for others than flexibility	25th–75th healthy zone <25th needs improvement zone for all[49]	≥40th healthy, 40th–5th needs improvement, <5th health risk, for others than specified
(Varying age- and sex specific centiles or other thresholds)	Centiles for all[34]	NA	Waist circumference, and waist-to-hip ratio,[37] 20-m shuttle run,[35] handgrip strength,[35,38] back-saver sit and reach[39,40]	For others than specified[44]	For others than specified[39]	Flexibility: 0/1 p per measurement. 4 p Good flexibility, 1-3p Needs some improvement, 0p Needs improvement		<60th Healthy, 60th–95th Needs improvement, >95th Health risk, for 10×5-m shuttle run
Health-related feedback (Thresholds derived from ROC curve or other analysis in relation to a health outcome)[c]	BMI[41]	NA	BMI[41]	BMI,[41] Body fat percentage,[42] 20-m shuttle run,[43] Handgrip strength[45]	BMI,[47] 20-m shuttle run test and 1-mile run[48]	NA	NA	NA
Athletic capacity (Age- and sex-specific centiles)	NA	NA	NA	NA	≥90th the athletic profile	NA	>75th potential sport talent zone	NA
Resources								
Website	https://en.slofit.org/	https://irfo.fr/	https://dafis.xunta.es/es/	https://www.netfit.eu/public/pb_netfit.php	https://fitescola.dge.mec.pt/home.aspx	https://www.oph.fi/en/move	NA	NA

Note: The terminology for fitness components follows definitions of the ALPHA project. In this context, we utilize the terms musculoskeletal fitness and motor fitness although in many physical education curricula these test items are used to assess student's motor competence.

Abbreviations: BIA, bioimpedance analysis; BMI, body mass index; GDP, gross domestic product; NA, not applicable; p, points; P, primary school students (7–10-years); ROC, receiver operating characteristic; S, secondary school students (11–18-years).

[a]National results are gathered from 11- and 14-years students. However, normative reference values are available for 9–16 year-olds and the schools are encouraged to use the measurements annually.

[b]Measurements are addressed in school healthcare where height, weight and waist circumference are measured separately.

[c]The age- and sex-specific BMI cut-points proposed by the International Obesity Task Force (Cole et al. 2000), World Health Organization or similar, for example, the U.S Centers for Disease Control and Prevention, have been linked to future health widely and consistently, including large cohort studies and evidence that childhood obesity (defined with those cut-points) associates with future mortality and morbidity therefore providing strong level of evidence. So even if the cutoff points in pediatric ages are generated based on centiles or growth curves, the FitBack network considers them validated against health outcomes and classify them as health-related feedback; The long form of system descriptions is available at the FitBack webpages (FitBack-Identification-and-descriptions-of-good-practices-in-diagnosing-the-physical-fitness.pdf(fitbackeurope.eu)).

FIGURE 1 Identified eight national- or regional-level physical fitness monitoring and surveillance systems in Europe: Move! (Finland), Diagnoform (France), DAFIS (Galicia, Spain), NETFIT (Hungary), The assessment of student's fitness in primary and secondary schools (Lithuania), FITescola (Portugal), National Physical Fitness Surveillance System (Serbia), and SLOfit (Slovenia).

(Finland, Hungary, Portugal), and trunk lift (Hungary), and lower body assessments standing long jump (Galicia, Lithuania [primary students only], France, Hungary, Serbia, and Slovenia), and squat jump or vertical jump (Portugal).

Musculoskeletal fitness/flexibility

All systems include at least one assessment of flexibility. Sit-and-reach (Lithuania [only for secondary students], Portugal, and Serbia) or back-saver sit-and-reach tests (Galicia, Hungary) are most utilized. Slovenia utilizes a stand-and-reach test, while Finland and France use different versions of lower back extension. Shoulder stretch is utilized in Finland and Portugal, and in Finland also squat.

Motor fitness

Except for Hungary, all systems assess at least one measure of motor fitness. A 4×10-m shuttle run test is utilized in Galicia, Portugal, and Serbia. An additional 12 items are system-specific: 5-leap test and throwing-catching combination test in Finland; 5-s run test and Hopscotch test in France; tennis ball throw, 10×5-m shuttle run, and flamingo balance (only in secondary students) in Lithuania; 20- or 40-m sprint test in Portugal; and 20-s arm plate tapping, obstacle course backwards, and a 60-m dash in Slovenia.

All systems provide feedback directly to students, and other stakeholders as well, (e.g., parents, teachers, school administrators, and medical professionals) on health-related fitness. Additionally, Portugal and Serbia provide feedback on athletic potential. Systems utilize normative-related feedback (Finland, France, Galicia, Hungary, Lithuania, Portugal, Serbia, and Slovenia) and health-related feedback (Hungary, Galicia, Portugal, and Slovenia) from unpublished national research studies or published scientific literature.[34–49] Health-related feedback refers to thresholds derived from receiver operating characteristic (ROC) curve or other analysis in relation to a health outcome, and normative-related feedback to others.

The child's individual results are addressed within the physical education curriculum in all systems. Furthermore, individual follow-up data are also available for later personal use in Finland, Galicia, Hungary, Portugal, and Slovenia. Data are linked to health care in Finland, Galicia, and Slovenia. In Finland, Galicia, Hungary, Portugal, and Slovenia, regional/national data are made available for policymaking (for further details, see the long form of descriptions from FitBack-Identification-and-descriptions-of-good-practices-in-diagnosing-the-physical-fitness.pdf (fitbackeurope.eu)).

3.1.3 | Commonly experienced strengths, weaknesses, opportunities, and threats

Figure 2 presents the most commonly experienced strengths, weaknesses, opportunities, and threats related to monitoring and surveilling PF in school-aged children. Strengths include providing a solid scientific and theoretical foundation for determining the benefits of PF, feasibility in school settings, the usefulness of the system to various professionals, and the provision of valuable data for education, health policy, and sports. The relevance to public health is evident as monitoring the PF status and trends of children and adolescents can provide comprehensive assessment for their health, responsiveness to acute crises such as pandemics, collaboration with healthcare providers, and high-quality evaluation of community interventions.

The identified weaknesses to establishing fitness surveillance systems include a potentially long implementation process. The system might not be well-adopted by the end users and/or the system evaluators may lack relevant expertise if not properly trained. The existing system might be difficult to evolve due lack of funding or information, or the complexity of current governmental structures.

Opportunities include the further development of PF, physical and health literacy, and physical education curricula, and the potential to identify children and families for fitness and health interventions. The knowledge gained from the system has the potential to inform decision-making at local, regional, and national level.

Insufficient funding and changes in legislation, such as Data Protection laws, may pose threats to establishing or already established fitness surveillance systems. Additionally, the system may not be able to operate if its philosophy is not adopted across professional disciplines, reputational crises emerge, or political support fluctuates.

3.2 | Ten-steps for designing a PF monitoring or surveillance system

These guidelines are designed to offer practical steps, examples, and solutions to overcome commonly-observed challenges when one is working toward establishing a novel system. The infographic is presented in Figure 3. The interactive version of this infographic is displayed on the FitBack web portal and currently available in six language versions (English, Estonian, German, Spanish, Italian, and French) (10 steps to design a physical fitness monitoring system | FitBack (fitbackeurope.eu)). In addition, a classical PDF infographic is currently available in 15 language versions (Brazilian Portuguese, Croatian, English, Estonian, French,

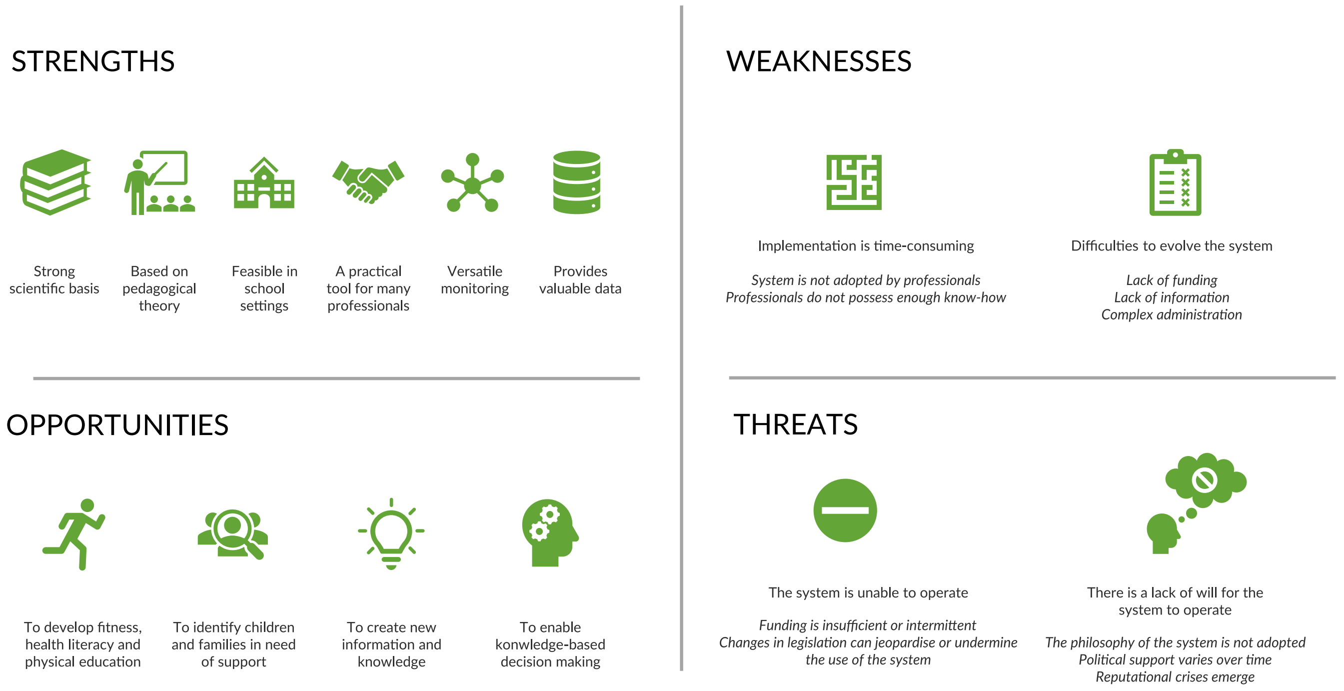

FIGURE 2 Commonly experienced strengths, weaknesses, opportunities, and threats in population level physical fitness monitoring among school-aged children.

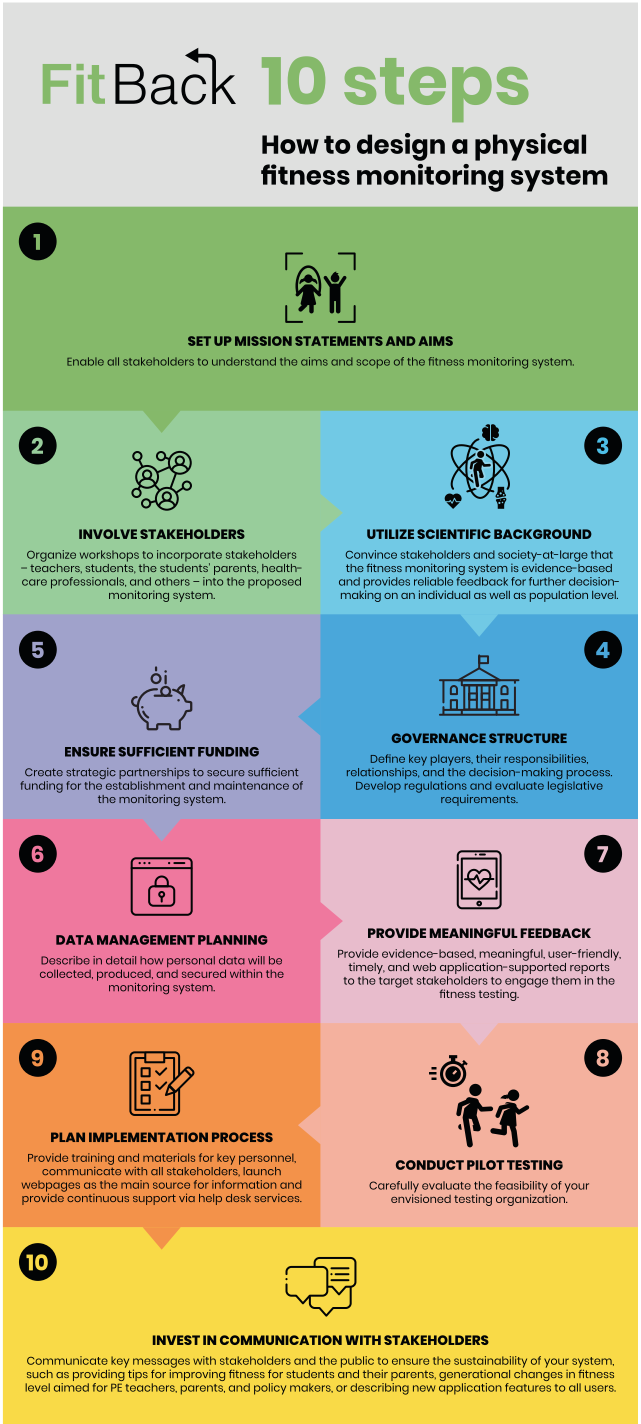

FIGURE 3 Experience-based and easy-to-follow 10-step guidelines to design a physical fitness monitoring and surveillance system for school-aged children.

German, Greek, Hungarian, Italian, Lithuanian, Persian, Polish, Serbian, and Spanish, Turkish) with more to be added. For those interested, a more extensive document is provided on the FitBack web portal, which includes detailed descriptions of each step, including cases which are accompanied by real-life experiences from operating systems (Key-guidelines-for-designing-monitoring-system-for-physical-fitness-FITBACK.pdf (fitbackeurope.eu)). The FitBack 10-steps for designing fitness monitoring or surveillance systems are:

3.2.1 | Set up mission statement and aims

A clear mission statement was considered crucial for creating and maintaining a successful system. It helps to clarify the purpose and goals of the system, ensuring that all stakeholders have a common understanding of its objectives and scope. FitBack members suggest outlining the aims of your system with general statements of the purpose and overall aspiration. For more specific aims, it is best to outline what one hopes to achieve specific to the various stakeholders such as teachers, students, parents, healthcare professionals, and policymakers.

3.2.2 | Involve stakeholders

It is recommended that the design and implementation of the system consider the perspectives and requirements of all relevant stakeholders, including teachers, parents, healthcare professionals, and other parties, with the students at the forefront during the development phase. Engaging all stakeholders through co-design strategies during the conception phase and through post-implementation workshops (to account for minor adjustments) will enable the system to align itself with the needs and expectations of each group.

3.2.3 | Utilize scientific background

The scientific integrity of the system was highlighted as highly valuable to establish confidence in the fitness system's results and outcomes. By demonstrating an evidence-based approach, the system can inspire trust among stakeholders and the broader public by being sensitive enough to detect meaningful changes in the population. Current data trends can then provide reliable feedback for invested stakeholders and users to make more informed decisions at both the individual and population level.

3.2.4 | Governance structure

Establishing and maintaining operating governance is critical for a fitness system to remain functional. It is recommended that key participants, their roles and responsibilities, and the decision-making processes are detailed and well-outlined. Experience from various national systems over decades has found that without central governance, the widespread adoption of a robust, long-lasting surveillance system is difficult to achieve. Furthermore, it is recommended that the required regulation, and/or legislation are prepared in parallel with the system.

3.2.5 | Ensure sufficient funding

Securing adequate start-up funding is crucial to establish a strong and sustainable system. Sufficient funding provides opportunities not only to develop a fully operational system, but also makes it easier to maintain or modify the system in the long term. Insufficient funding is a challenge, and in the most extreme cases, it can lead to system collapse. To secure funding, the system is recommended to form strategic and diverse partnerships with educational and healthcare authorities at the national, regional, and municipal levels, including foundations or institutions whose interests align with those of the system.

3.2.6 | Data management planning

Designing a system involves choices regarding data management. Systematic PF testing generates a large amount of personal data. Data access and privacy is a critical issue; creating a comprehensive data-management plan is crucial for any system. The plan should outline how personal data will be collected, processed, and protected within the system, including data collection and cleaning, management, description, data standards, presentation to target users, and data storage, even after users eventually leave the system. Adhering to national data protection legislation can be challenging, and it is advisable to have expert legal counseling.

3.2.7 | Provide meaningful feedback

Evidence-based, informative, user-friendly, and timely feedback reports, which target various stakeholders, (including students and their parents, teachers, healthcare professionals, schools, and policymakers) at local and national levels, are an essential part of any fitness system. Meaningful feedback will help promoting physical and health literacy among children and adolescents, supporting effective interventions in schools, and addressing the health needs of children and their families. Accurate, timely feedback supports the sustainability of a system. It should include the status of students' current PF, be aligned with the aims of the system (e.g., health risk assessment, fitness development), provide detailed instructions on how to interpret the results and tips for improvement.

3.2.8 | Conduct pilot testing

Prior to implementing the national-level system, pilot testing is recommended to assess the functionality and identify potential risks. Assessment of PF testing in schools is an essential part of this piloting process. It is recommended that the utilized fitness tests, equipment, space, personnel, and time are evaluated. Pilot testing can be time-consuming, but it is highly advisable since user comfortability will be key to the longevity of the system. Fitness testing should be integrated in a manner that minimally disrupts regular school activity.

3.2.9 | Plan implementation process

A proper implementation plan is key to any program's success. Thorough consideration is recommended for both the initial launch phase of the system and its long-term implementation. Communication with target groups is essential to clearly conveying the philosophy of the system. Providing resources upfront, for example, webpages, materials, and videos, can aid in this communication step and facilitate implementation, alongside with adequate training and education. It is recommended that stakeholders are involved from the very beginning (e.g., Step 2), and not neglected to the later implementation phases either. Training in pre-service teacher education is recommended to support the implementation in the long term.

A direct communication channel between the system manager and schools is required in order to quickly disseminate important information to schools. In addition to informative webpages, a help desk service is often required, particularly during at the launching phase. Finally, it is advisable to gather annual feedback from system's key actors, such as teachers and healthcare professionals, and from end-users, particularly students and their parents, since they may identify weak-points or help troubleshoot early problems that emerge in a new system. Do focus on being responsive to suggestions from end-users; positive critical feedback improves implementation, the quality of the system, and its operational longevity.

3.2.10 | Invest in communication with stakeholders

The importance of communication between stakeholders is key for maintaining a sustainable system. It is recommended that clear messaging is used with stakeholders on the main topics that the system aims to address. To effectively communicate with the public, collaboration with communication experts is recommended. This will ensure the information is presented in professional and clear manner. A communication plan is highly advisable. The added value of the fitness system should be highlighted to keep stakeholders involved in the long term. This approach may also increase funding opportunities and promote the potentially required legal and regulatory amendments.

4 | DISCUSSION

Systematic PF monitoring and surveillance can inform decision-making, impact educational and public health policy, and encourage greater improvements in the PF levels of children and adolescents worldwide, thereby reducing future disease state burdens. This paper communicates the work conducted by the FitBack network to design and establish national school-based PF monitoring and surveillance systems for children and adolescents. Three main issues are noted.

First, prior to this FitBack project, PF monitoring and surveillance systems across Europe had not been clearly identified. The eight identified national/regional systems, which currently operate within Europe are found mainly in high-income countries. The systems share many like aims and characteristics; however, each system is structured as its own distinctive entity. All systems operate within the school setting, with measurements being conducted during physical education classes. There is a lot of variation between systems, particularly in terms of the selection of fitness tests between regions. The harmonization of fitness testing is a high international priority,[25] to enable greater cross-border data comparisons, and allow for better secular trend evaluations across Europe and internationally, including providing high-quality feedback for the participants. Therefore, selecting a uniform testing approach is a key factor to consider when establishing new systems of measurement. It is advised that any new systems consider the scientifically validated ALPHA-fit test items as their core set of tests (i.e., weight, height, waist circumference, 20-m shuttle run test, standing long jump, and if feasible, handgrip strength), and to complement these items with system-specific tests. While it may not be feasible for existing systems to significantly alter their test batteries without sacrificing follow-up trends, it is recommended that even the established systems consider adopting missing core elements from the ALPHA-fit battery. These harmonization efforts will enhance comparability within and between countries, and better inform policy making, as was recently done by the FitBack network through its European fitness map (Fitness Map | FitBack (fitbackeurope.eu)).[29] Notably, the quality of school-administered fitness testing programmes can be of concern to policymakers or researchers in terms of its reliability compared to measures made in national surveys, for example. Current data indicate that the reliability and validity of teacher-administered fitness testing is at an acceptable level provided the teachers have had sufficient training on administering and evaluating the tests being performed.[31,50]

Second, this work found that establishing a monitoring and surveillance system is a long and complex process, often taking up to a decade to properly launch, and involving numerous operations that require nimble maneuvering. This complex process was decomposed into 10 simple guidelines. Simplifying this process, sharing the accrued experience, and avoiding repeating major errors were a priority rationale for the FitBack network, who aimed to provide readers significant value in terms of time and resource efficiency from their own experiences.

Third, the FitBack project developed a multilingual web portal, which is designed to describe how systematic fitness testing can be used as a powerful educational and health diagnostic tool. This platform is free of charge and provides immediate, individualized, normative, and health-related feedback based on the results entered for ALPHA-fit test items.[51] Nearly 8 million test results from 34 European countries were collected in order to create the back-end reference-values.[29] Furthermore, adapted versions for the core ALPHA-fit tests are also provided to support inclusion of children with special needs. The platform improves PF monitoring and surveillance capacity for places where political or infrastructure capabilities may be lacking, or not yet be available. No data are stored on the online system, so users can be confident their information is not collected or saved in any way.

The nonprofit FitBack network currently consists of 23 members from 18 countries. New members are invited to participate at any time and are immediately included into the mentoring processes for future endeavors.[51] The FitBack network has since been granted an Erasmus+ Sport program satellite project called “FitBack4Literacy,” which will build a toolkit aimed for PE teachers to better describe how fitness monitoring can support the development of lifelong physical literacy. Fitness testing amongst school-aged children has often been associated with negative experiences and stigma of poor performance. The aim of FitBack4Literacy is to address these negative barriers, and provide practical tools on how systematic fitness testing can positively affect lifelong physical activity habits. This work will increase the competencies of fitness monitoring and enable teachers, using a bottom-up approach, to participate in the establishment of fitness surveillance systems. FitBack4Literacy will also add languages to the FitBack web portal's content and structure, based on the growing interest in providing adequate fitness surveillance as a fundamental public health tool to future generations.

4.1 | Limitations

We acknowledge there are some limitations to this work. Although unlikely, there is a possibility that the FitBack consortium may have missed identifying an established PF monitoring and/or surveillance system within the European context, especially if that system was regionally based, or in a language that was not represented within the original FitBack group. Further work is needed to determine whether there are specific barriers of access for lower income countries, or those from regions other than Europe, to create their own monitoring or surveillance systems. We acknowledge that our 10 steps guidelines were developed by countries who already operate fitness monitoring systems; this may have created an unintended bias to the rankings of the experienced strengths, weaknesses, opportunities, and threats. There were no open-ended qualitative data collected in a systematic way to provide direct quotations during this SWOT analysis. Cultural, social, and/or political variations may cause some regions to emphasize different key steps when they begin their system design process compared to others.

4.2 | Perspectives

Through the FitBack network, current PF monitoring and surveillance practices among school-aged children in Europe were identified and eight regional or national systems were detailed. A simple, 10-step approach to plan and establish one's own PF monitoring and surveillance system was developed with the intent of overcoming pre-existing barriers for regions interested in creating their own quality health-related data monitoring systems of child and adolescent fitness. The FitBack web-based portal provides free, multi-lingual resources to support the establishment of novel systems. PF monitoring and surveillance can impact public health and educational policy, and foster evidence-based decision-making which in turn, encourages a greater emphasis on improving child fitness levels worldwide.

AUTHOR CONTRIBUTIONS

LJ, SAM, FBO, THT, and GJ conceptualized the paper. Data collection, synthesis, drafting the descriptives, and key guidelines were conducted by LJ, TC, KK, SAM, JM, IM, LBS, THT, and GJ. LJ, FBO, SAM, GS, THT, and GJ drafted the original manuscript. All authors contributed equally to the intellectual content and critical revision of the final manuscript. All authors gave approval for the final version to be published and agree to be countable for all aspects of the work.

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CONFLICT OF INTEREST STATEMENT

Authors declare no competing interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in FitBack webpage at https://www.fitbackeurope.eu/en-us/.

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