

## THE PRESENT AND FUTURE

### JACC STATE-OF-THE-ART REVIEW

# Lessons Learned From 10 Years of Preschool Intervention for Health Promotion



## JACC State-of-the-Art Review

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### ABSTRACT

Implementing a health promotion program for children is a complex endeavor. In this review, we outline the key lessons learned over 10 years of experience in implementing the SI! Program (Salud Integral-Comprehensive Health) for cardiovascular health promotion in preschool settings in 3 countries: Colombia (Bogotá), Spain (Madrid), and the United States (Harlem, New York). By matching rigorous efficacy studies with implementation science, we can help bridge the divide between science and educational practice. Achieving sustained lifestyle changes in preschool children through health promotion programs is likely to require the integration of several factors: 1) multidisciplinary teams; 2) multidimensional educational programs; 3) multilevel interventions; 4) local program coordination and community engagement; and 5) scientific evaluation through randomized controlled trials. Implementation of effective health promotion interventions early in life may induce long-lasting healthy behaviors that could help to curb the cardiovascular disease epidemic. (J Am Coll Cardiol 2022;79:283-298) © 2022 by the American College of Cardiology Foundation. Published by Elsevier. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**R**esearch on cardiovascular disease (CVD) prevention has been a global priority in recent decades,<sup>1,2</sup> and interest has increased further during the coronavirus disease-2019 pandemic, which has exposed unexpected cardiovascular vulnerabilities.<sup>3</sup> CVD is strongly associated with unhealthy habits such as a nutritionally poor diet, sedentary

lifestyle, and smoking,<sup>4</sup> and these unhealthy habits are alarmingly prevalent among children and adolescents.<sup>5,6</sup> Studies have reported a relationship between low cardiovascular health in childhood and poor cardiometabolic outcomes in adulthood<sup>7</sup>; it therefore seems reasonable to initiate healthy lifestyle education as early in life as possible.<sup>5</sup> The school



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## ABBREVIATIONS AND ACRONYMS

**BH** = body and heart

**BMI** = body mass index

**CVD** = cardiovascular disease

**KAH** = knowledge, attitudes,  
and habits

**PA** = physical activity

**SES** = socioeconomic status

environment has great potential as an intervention setting because children spend so much of their time there.<sup>2,8</sup> However, more research is needed to define which specific intervention characteristics and strategies contribute to the effectiveness of school-based interventions for health promotion and obesity prevention.<sup>9,10</sup>

The SI! Program (Salud Integral-Comprehensive Health) is a multilevel and multicomponent school-based program for the promotion of cardiovascular health, aimed at achieving lasting lifestyle changes in children from preschool age.<sup>11-14</sup> The SI! Program for preschoolers has been assessed by using cluster-randomized trials in 3 countries with different socioeconomic contexts: Colombia,<sup>15</sup> Spain,<sup>12,16</sup> and the United States.<sup>17,18</sup> Schools were randomized to receive the SI! Program for 4 months or to the control group, and a structured survey was conducted at baseline and at the end of the intervention to assess changes in KAH (knowledge, attitudes, and habits) toward a healthy lifestyle. These studies included >3,800 children from 50 schools, their parents/caregivers, and teachers. Children in the intervention group reported a significantly larger increase in KAH scores after the implementation of a 4-month health promotion program compared with those in the control group.<sup>15-17</sup> However, until now, the SI! Program has not consistently shown a sustained improvement in relevant cardiovascular health metrics across the life span of a child beginning at 3 to 5 years of age.<sup>15-17,19</sup> In the absence of definitive evidence to determine best practices, we can, in the interim, value and continue to apply the evidence we have.<sup>20</sup>

The current review describes lessons learned from the implementation of the SI! Program for 10 years in the context of Rogers' Implementation Science Model<sup>21,22</sup> adapted to health promotion: 1) dissemination (conveying information about the existence of a health promotion program to potentially interested parties); 2) adoption (explicit decision by a local unit or organization to try the program); 3) implementation (executing the health intervention effectively when it is put in place); 4) evaluation (assessing how well the health promotion program achieved its intended goals); and 5) institutionalization (the local unit or organization incorporates the intervention/program into its continuing practices). **Table 1** outlines the main stages of the implementation science framework adapted to school-based health promotion

## HIGHLIGHTS

- Health promotion from early childhood is a global priority and can be delivered effectively to preschool-aged children.
- Lasting lifestyle changes can be promoted by health promotion strategies initiated in early childhood through locally coordinated and community-supported science-based multidimensional and multilevel programs.
- Further research is needed to clarify the factors such as socioeconomic status that influence child health and effectiveness of intervention.

programs and the specific actions conducted as part of the SI! Program.

## DISSEMINATION

Dissemination is an active approach to spreading evidence-based interventions to a target audience via determined channels by using planned strategies.<sup>23</sup> The school environment has great potential for effectively disseminating health promotion strategies. The literature of implementation science suggests that evidence-based interventions should be appropriately disseminated, to the right audiences, and implemented at the right time.<sup>24</sup> There are noted time points in a child's trajectory when improvements can be made to enhance long-term cardiovascular health status. A recent study of 51,505 children found that almost 90% of those who were obese at 3 years of age were overweight or obese in adolescence, and the most rapid weight gain occurred between 2 and 6 years of age among obese adolescents.<sup>25</sup> Another study conducted in 62,565 children found that overweight at 7 years of age was associated with increased risk of adult type 2 diabetes only if it continued until puberty or later ages.<sup>26</sup> Consequently, children's health during the preschool years in particular is a key determinant of obesity later in life. Compared with 3- to 4.5-year-olds, children aged 4.5 to 6 years display a model of attention much closer to that of adults.<sup>27</sup> This suggests that 4 to 5 years of age is the most favorable time to start a school-based intervention focused on healthy habits. To reach this audience, it is necessary to distill theory and evidence and translate this knowledge into user-

**TABLE 1 Implementation Science Framework Stages and Actions Conducted in the SI! Program (Salud Integral-Comprehensive Health)**

Implementation Framework Stages <sup>a</sup>	Example Actions From the SI! Program
I: Dissemination	Dissemination strategy relies on the most effective methodologies for generating significant learning in children.
1. Intervention components	The SI! Program breaks down cardiovascular health into 4 interrelated components: diet, physical activity, emotions management, and body and heart.
2. Intervention design	A multidisciplinary team of experts facilitating successful assimilation of diverse methodologies designs the activities and resources.
3. Intervention strategy	The intervention includes the classroom, teachers, families, and school environment so children are more effectively involved.
II: Adoption	The local and/or regional educational administrative agencies authorized the program to be included in their school system and helped to obtain the initial acceptance of the school community.
III: Implementation	The SI! Program includes diverse activities led by specifically trained teachers.
1. Initial considerations regarding the host setting	The intervention and the assessment strategies are tailored to the local population and the corresponding environment to increase the likelihood of behavioral change.
2. Structure for implementation	The introduction of a school team coordinator within the school staff helps teachers and school leaders to ensure an effective implementation and allows for cascade training of teachers unable to attend the training sessions.
3. Ongoing support strategies	In the SI! Program, a local program coordinator (a nonschool staff layperson) supports the school community, the school team coordinator (school staff), and the teachers.
4. Improving future applications	Improving strategies aim to increase adherence; for example, repetition of simple messages for children and families, constant support and motivation for teachers, and simple recommendations for a healthy school environment.
IV: Evaluation	The effectiveness of the program was evaluated through randomized controlled trials in 3 countries with different socioeconomic contexts: Colombia, Spain, and the United States.
V: Institutionalization	The SI! Program is expanding to >250 schools in Spain and to >40 schools in the 5 boroughs of New York City.

<sup>a</sup>Adapted from Rogers<sup>31</sup>, and Meyers et al.<sup>32</sup>

friendly resources<sup>22</sup> using the expertise of a multidisciplinary team and formative qualitative research to test appeal and comprehension of messaging to maximize uptake and impact (Key Element #1 of the **Central Illustration**).

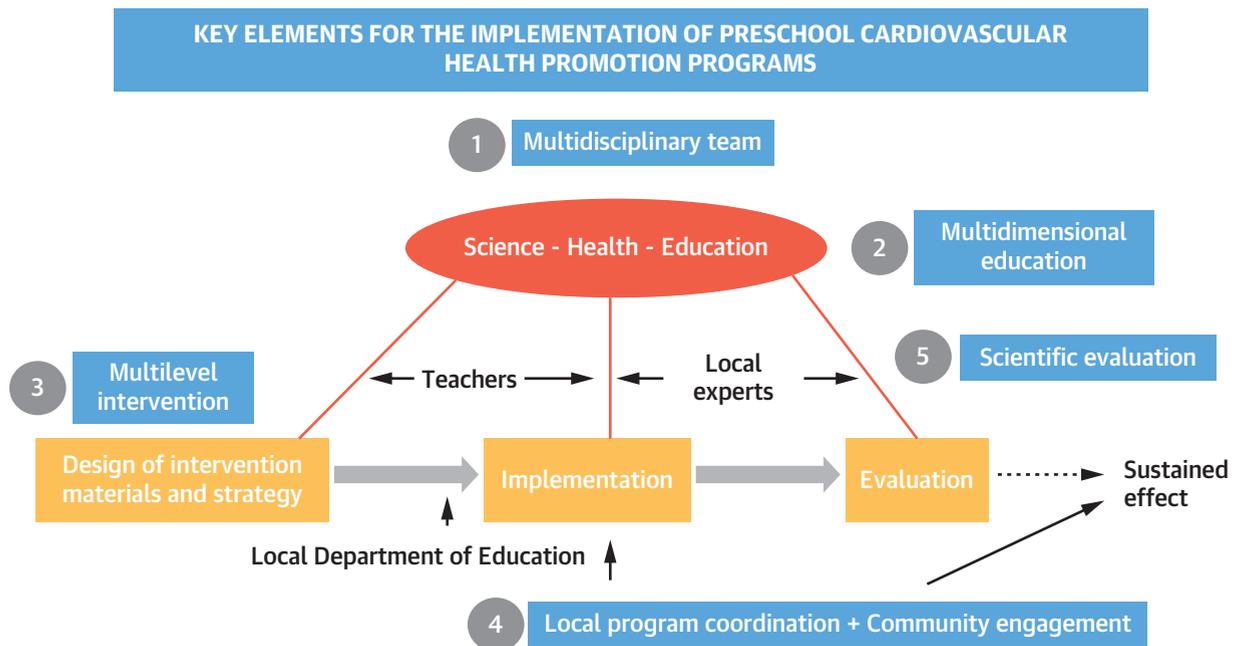
**INTERVENTION COMPONENTS.** A systematic review of childhood obesity prevention programs showed higher significant effects on body mass index (BMI) with interventions that involve multiple components.<sup>28</sup> However, most preschool interventions have targeted only physical activity (PA) and/or diet components alone.<sup>9,29-34</sup> The SI! Program has a multifaceted and cross-sectional vision that breaks down cardiovascular health into 4 interrelated components that interact and add up (**Figure 1**; Key Element #2 of **Central Illustration**). Through the components diet and PA, children learn how a well-balanced diet and an active life are directly connected to a healthy heart. The most innovative component, emotions management, seeks to instill protective behavioral mechanisms against substance abuse (mainly smoking) and other health behaviors such as dietary decisions later in life by working on self-awareness, self-esteem, decision-making, listening, and communication skills. This component is fundamental to improving healthy lifestyles in children.<sup>5,35,36</sup> Finally, the body and heart (BH) component helps the children to understand how the human body works and how it is affected by behavior and lifestyle (and therefore by the 3 other

components). Appropriate goals for preschool children in each component are presented in **Table 2**.

Furthermore, health educational programs that are multidimensional, offering a comprehensive view of health as a function of lifestyle and body, may encourage the adoption and ownership of a health curriculum by children.

**INTERVENTION DESIGN.** The multifaceted nature of CVD requires complex interventions targeting several behaviors and/or levels of influence.<sup>33,37</sup> A successful school-based health intervention program will therefore benefit from a core team comprising specialists from several fields related to education and health. Likewise, the intervention strategy needs to be logistically feasible and effective from the educational point of view. Combining the scientific evidence with optimal teaching strategies requires synergy between experts in each domain to ensure that the message reaches the target population in the most effective way. To support the considerable complexity of stages and processes that this implies, multimethod approaches may be required.<sup>38</sup> Based on these premises, the SI! Program activities and materials were designed by a multidisciplinary team of experts (nutrition, PA and sport sciences, education, and psychology) facilitating successful assimilation of methodologies from different fields proven to be the most effective at generating significant learning.<sup>15,39-45</sup>

The program aims to generate positive habits and attitudes related to body self-care and health-related

**CENTRAL ILLUSTRATION** Key Elements in Preschool-Based Interventions on Cardiovascular Health Promotion

Santos-Beneit, G. *et al*. *J Am Coll Cardiol*. 2022;79(3):283-298.

Locally coordinated and community supported science-based multidimensional and multilevel programs can improve health promotion strategies in early childhood to achieve lasting lifestyle changes.

matters.<sup>12</sup> These positive attitudes are generated through knowledge acquisition,<sup>15</sup> motivation, and content reinforcement by using animated characters, which help to make abstract concepts concrete and provide the children with a role model. Furthermore, to accommodate the symbolic thinking typical of this age group,<sup>46</sup> the SI! Program featured a heart-shaped mascot named Cardio who complies with all the recommended healthy behaviors. The program also uses Sesame Street characters such as Dr. Ruster, a Muppet doctor based on one of the authors (V.F.), who introduces and conveys most messages and activities (Supplemental Figure 1). The design of the materials can help to hold the attention not only of the children but also of teachers and families. Other materials include video segments with a “view and do” approach for use in classrooms and printed materials made to fit the distribution strategy in school settings; these include a colorful storybook, an interactive board game on healthy behaviors, flash cards on emotions management, family activities, and a teacher’s guide.<sup>11</sup>

Learning is most effective when the activities are related to direct experimentation,<sup>47,48</sup> artistic

expression, play,<sup>49</sup> viewing videos,<sup>50</sup> reading stories,<sup>51</sup> and group activities.<sup>47,48</sup> In summary, a multidisciplinary team is essential for ensuring a more complex tailoring of the program from curricular messaging to implementation.

**INTERVENTION STRATEGY.** The SI! Program includes 4 levels of intervention: classroom, teachers, families, and the school environment (Figure 1; Key Element #3 of Central Illustration). According to Cognitive Social Theory, the environment has a fundamental influence on the learning process and behavior change,<sup>52</sup> and children are engaged more effectively if the intervention includes their immediate surroundings.<sup>75</sup> The SI! Program primarily follows a teacher-delivery model used in other prior interventions in preschool.<sup>31,32,53-54</sup> Teachers are crucial to the success of school-based interventions, especially those involving preschool-aged children. The trusting relationship developed between children and teachers allows the message to be received with greater attention and credibility than if it came from external personnel.<sup>36</sup> In addition, family members are young children’s primary social context, providing

experiences and access to food and PA through which children begin to acquire healthy or unhealthy lifestyles.<sup>55-61</sup> To facilitate participation of family members, the SI! Program includes simple and accessible activities (Supplemental Figure 2). Lastly, the school environment can have a significant effect on the success of school-based interventions<sup>38,62</sup> by fostering a community of health, and thus it may be appropriate that the intervention program includes recommendations for the whole school environment. In the SI! Program, a healthy school environment is promoted through simple messages on posters or flyers distributed throughout the school (Figure 2).

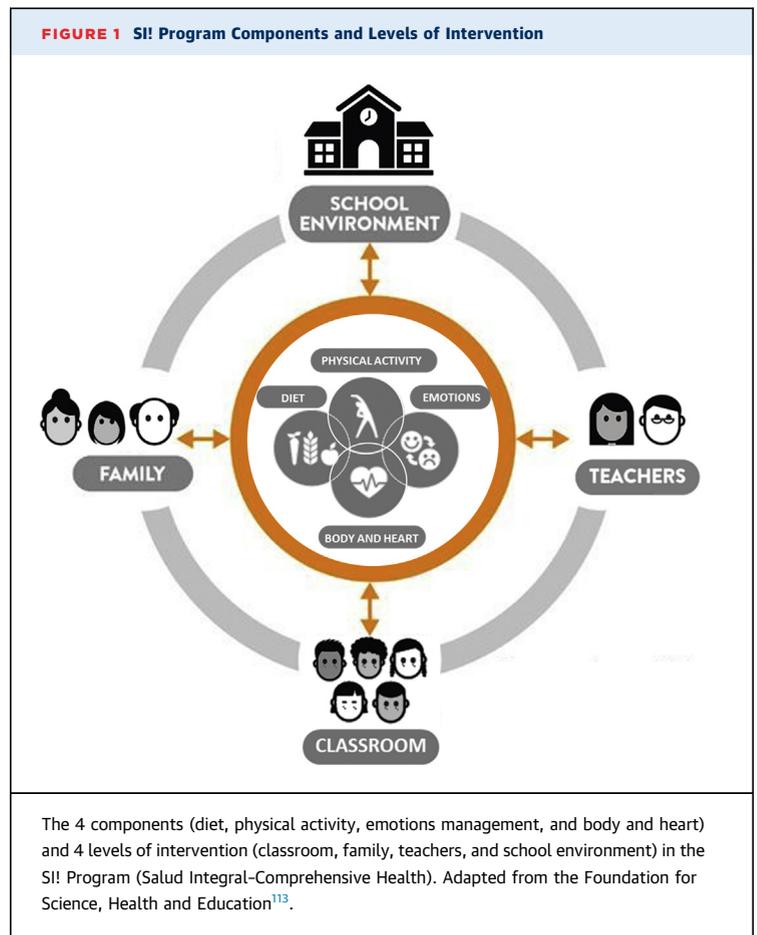
In summary, a multilevel approach targeting not only children but also their families, teachers, and the school environment is likely needed for the success of a school-based health promotion program.

### ADOPTION

Adoption is the decision of an organization or a community to commit to and initiate an evidence-based intervention.<sup>23</sup> Establishing a close relationship with stakeholders and building trust in the community are essential for generating support for school-based health promotion interventions.<sup>63</sup> This requires working partners and leaders who have a long-standing relationship with and deep commitment to their local community. The SI! Program obtained the support of the local and/or regional educational administrative bodies. The corresponding education administrations authorized the program to be included in their school system and curriculum, and then helped to identify eligible schools for the implementation and to obtain the initial acceptance of the school community. The eligible schools were invited to participate in a 1-day meeting during which the fundamentals of the SI! Program were presented. To formally volunteer to participate in the health promotion program, a designated staff person in a leadership role (eg, director/principal, site director, education director) submitted an application/approval letter on behalf of the school. In summary, the support of corresponding educational administrative entities is crucial to successfully introducing a health promotion program into the school system.

### IMPLEMENTATION

The implementation process of the SI! Program in the context of external literature is described in the following sections by using a meta-framework called the Quality Implementation Framework<sup>22</sup> comprising the following 4 phases: 1) initial considerations



regarding the host setting; 2) creating a structure for implementation; 3) ongoing structure once implementation begins; and 4) improving future applications. Each stage includes critical steps in the implementation process. When coordinated with specific step-related actions, this tiered design can allow for effective implementation of health education programs.

### PHASE I: INITIAL CONSIDERATIONS REGARDING THE HOST SETTING. Assessment strategies.

Interventions can be tailored to the study population and the local environment to increase the likelihood of behavioral change. As an effective qualitative analysis tool, focus groups conducted in a pilot phase of the study before initiation of the health program ensure that the intervention is adapted to the needs and cultural preferences of the targeted community.<sup>64</sup> Accordingly, it might be necessary to include local health and educational advisors to adjust both the educational strategies and the assessment tools to the socioeconomic and cultural context of each setting. This strategy may help the research team to adapt the

**TABLE 2 Goals Per Component for Preschoolers**

Component	Goals
Diet	Acquiring knowledge of different food groups (eg, fruit, vegetables, cereals, greens) and their beneficial properties Understanding the importance of a balanced diet (different colors and varied foods) Learning the different foods recommended for each daily meal Learning food portion sizes and the difference between hungry and full Awakening taste and curiosity about different types of cuisine and trying new foods
Physical activity	Understanding the relationship between the energy we get from healthy foods and movement (physical activity) Understanding the function of the muscles and bones through physical activity Developing gross motor skills Developing coordination through dance and play, and learning how to get the body moving Acquiring healthy routines and habits around physical activity
Emotions management	Identifying, representing, and naming the basic emotions that human beings commonly experience Understanding and expressing how emotions make us feel and what they feel like Exploring the causes of different emotions and how they differ from person to person Knowing strategies to manage and self-regulate emotions such as breathing and painting, with the guide of an adult Knowing the external and internal body parts and working on body function
Body and heart	Caring for the body and heart Learning about the heart, its function in the body, its movement, and the relationship between movement and the heart Understanding the senses, their functions, and how the senses give us information about our environment

Adapted from Fernandez-Jimenez *et al*.<sup>4</sup>

whole approach of the intervention to each country. The specific issues considered in the SI! Program were local and cultural health beliefs or practices related to food, facilities, and daily time allocated for PA in school; children’s transportation methods to school (eg, walking, public transportation); meals provided in school; popular songs or stories; local everyday rituals; and their celebrations in schools (eg, birthdays).

**Decisions about adaptation.** An important characteristic of implementation science is using malleable designs that allow for changes and modifications to achieve the best and most impactful results.<sup>65</sup> Flexibility within the implementation design is crucial to adapt to key variables such as the starting age for the health promotion program. According to the teachers involved in the SI! Program, the first year of preschool is unlikely to be the most appropriate for an intervention. In this period, the class group is being formed, and it takes time for relationships between the children and the teacher to become fully settled. It is likely more efficient to implement the intervention when the group has already acquired a series of daily routines because it is easier to incorporate new content and activities into a familiar schedule. Despite this, the choice of starting age for a comprehensive school health intervention is also determined by the structure of educational stages in each country.

The SI! Program objectives within each component are addressed in a very direct and simple way so they

can be easily adapted to different socioeconomic settings or coexist with health promotion strategies at the local level. This is important to avoid an inequitable administration of the intervention that may lead to further enhancing the existing divide in childhood obesity.<sup>66</sup> For example, goal #1 in Table 2, “Acquiring knowledge of different food groups (eg, fruit, vegetables, cereals, greens) and their beneficial properties,” can be approached by using examples of accessible food and can coexist with any school or community food program. Moreover, the SI! Program materials can be distributed via hard copy in a teacher kit portable file box or digitally accessed, thus building flexibility into the intervention delivery.

**Capacity-building strategies.** Teachers have a fundamental role in transmitting knowledge and shaping children’s behavior during learning.<sup>67</sup> A school-based program encouraging behavior change goes beyond standard preservice teacher education, and specific training is therefore fundamental to helping teachers implement the intervention correctly, improve instructional practices in this area, and thus foster high fidelity.<sup>68</sup> Professional development opportunities, when properly designed, also serve as motivational mechanism and increase trust with the intervention developers. The SI! Program includes formal training to teachers in skills needed to promote healthy habits in children; this training also addresses teacher motivation and self-reflection on their own health to help teachers set an example of healthy living. The core concepts of such a teacher-

training program are as follows: 1) the relationship between healthy habits acquisition from childhood and improved quality of life in adulthood; 2) the SI! Program teaching approach; and 3) the concept of whole health as the interrelation between a healthy diet, PA, emotional education, and the BH.<sup>69</sup> Teacher training also includes in-depth work on the course materials, analysis of teaching plans, and proposed measures to improve the school environment. The SI! Program teacher training may last from 10 to 50 hours depending on local requirements on formal professional development.

**PHASE II: STRUCTURE FOR IMPLEMENTATION.**

**Implementation teams.** The introduction of a school team coordinator greatly helps teachers and staff leaders (eg, director/principal, site director, education director) to ensure effective implementation of the program. The school team coordinator can be a teacher or any other staff member and should be an active part of the faculty with an interest in health, good social and communication skills, and an empathetic manner. The presence of a school team coordinator can facilitate teacher training, as he or she can conduct “cascade training” (“train-the-trainers”) of teachers unable to attend the training sessions. The school team coordinator can also act as a link between parents, teachers, and the school leadership to promote decision-making related to the school’s health needs and participation in the annual Healthy Week. Ultimately, responsibility for conducting the program is shared proactively across the entire educational community.

**Implementation plan.** The SI! Program includes various types of activities with different learning goals that take between 5 and 50 minutes to complete (Table 3), totaling a minimum of 40 hours; they are distributed through teaching units of diet, PA, emotions management, and BH in a balanced way. The activities should be repeated whenever possible to instill deep-seated healthy attitudes and behaviors. To achieve a minimum daily practice of PA needed to improve children’s health,<sup>53,70-74</sup> the SI! Program includes a 20-minute PA routine (eg, a choreography in video format to practice throughout the school year). Thus, with the complementary activities, the overall program exposure can increase up to 70 hours. The success of a health promotion program requires a minimum of 30 to 40 hours of exposure annually.<sup>53,75</sup>

The family activities are related to classroom activities, providing a direct link between home and school (Supplemental Figure 2). At least 6 family activities are distributed across the teaching units, covering the 4 SI! Program components as follows: 1

**TABLE 3 Types of Activity for the Classroom**

Teaching Goal	
Initiation	Introduce or activate knowledge
Development	Acquisition of knowledge and skills
Synthesis	Consolidate new learning and understand its usefulness in daily life
Complementary (optional)	More in-depth exploration of corresponding content
Family	Application at home of the acquired knowledge

Adapted from Carral et al.<sup>69</sup>

activity for diet, 1 for PA, 3 for emotions management, and 1 for BH. These activities are divided into 2 parts: 1) a short explanation of the importance of the specific health-related topic; and 2) a component-related game or activity that the child is expected to undertake together with family members, to create daily routines.<sup>69</sup> Furthermore, schools participating in the SI! Program are provided with a document presenting 10 action recommendations for the school environment (Figure 2) and a poster with simple key health messages for families. The SI! Program’s health awareness messages are further reinforced through an annual Healthy Week or a “Celebrating what we have learned” week, which fosters an inclusive, playful community atmosphere in which habits and concepts are better retained.<sup>36,76</sup> Schools participating in the SI! Program are provided with a model itinerary for this special week, including content and activities designed to include all family members and encourage their full participation.

**PHASE III: ONGOING SUPPORT STRATEGIES.**

The effectiveness of a health promotion program depends not only on the quality of the materials and curriculum offered to teachers and families but also on the follow-up and support provided by the program developers.<sup>40</sup> Teachers take on the role of intervention facilitator alongside their primary role as a teacher. A recent study of school-based interventions in adolescents found that a passionate, well-trained layperson can effectively change students’ and teachers’ practices.<sup>77,78</sup> Given the role model status of preschool teachers and their primary responsibility to teach the designated syllabus (as well as ancillary academic and administrative tasks), there is a risk that these responsibilities might undermine or conflict with the ethos of the intervention.<sup>79</sup>

In this context, the inclusion of a local program coordinator (a nonschool staff layperson) is a recommended strategy to support the school community, the school team coordinator (school staff), and the teachers (Figure 3; Key Element #4 of Central Illustration). This nonschool staff role can be

**FIGURE 2** SI! Program Guidelines for a Healthy School Environment

print & web 4C/FFPO

## OUR TEN STEP GUIDE FOR A HEALTHY SCHOOL ENVIRONMENT

- 1 We organize healthy celebrations**  
The SI! Program proposes breaking the connection between celebrations and food and creating new connections with alternatives such as physical activity and emotions, to avoid the consumption above recommended levels of 'occasional' foods such as sweets, soft drinks and pastries.


- 2 We promote active school break periods**  
Having an active life means taking the opportunity to exercise throughout the day, not just during the PE class. Releasing energy through play allows us to wake ourselves up and provides oxygen to our body and brain.

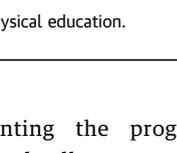

- 3 We encourage body awareness**  
It is important to know how to interpret the messages our body sends us. Meeting the biological, rest and relationship requirements of our body helps us pace ourselves through the day.

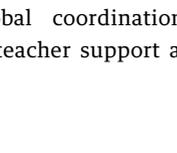

- 4 We look after personal hygiene needs at school**  
The school should encourage and promote hygiene, and not just washing the hands and face.


- 5 We recommend healthy snacks**  
If your school usually has a mid-morning snack, you can make recommendations to families to make sure the children alternate between fruit, sandwiches, drinking yogurt, cereal bars and nuts.


- 6 We respect the importance of reflection**  
One of Dr. Fuster's recommendations is to devote a few minutes every day to reflection before activity. We recommend that the school respects established rest periods and encourages time for reflection.


- 7 We maintain a good atmosphere in school**  
Relationships created in school act as a framework for the work and study environment. Conflict is part of normal life; crises can encourage personal and school growth, but should always be managed to ensure dialogue, understanding and agreement.


- 8 We involve the school canteen in school activities**  
Involving the school canteen is more than just checking the school menu and the way the food is cooked. It means using the space and the staff, listening to their ideas and working with them as a team.


- 9 We encourage family involvement in program activities**  
Improving children's lifestyles requires team work. Encourage parents to put forward ideas and to take part in implementing them.


- 10 We encourage the children to come to school on foot or by bicycle**  
Promoting healthy and sustainable transport is recommended. This means we can raise environmental awareness, encourage independence and improve motor skills and physical health, in addition to creating healthy habits which can last a lifetime.

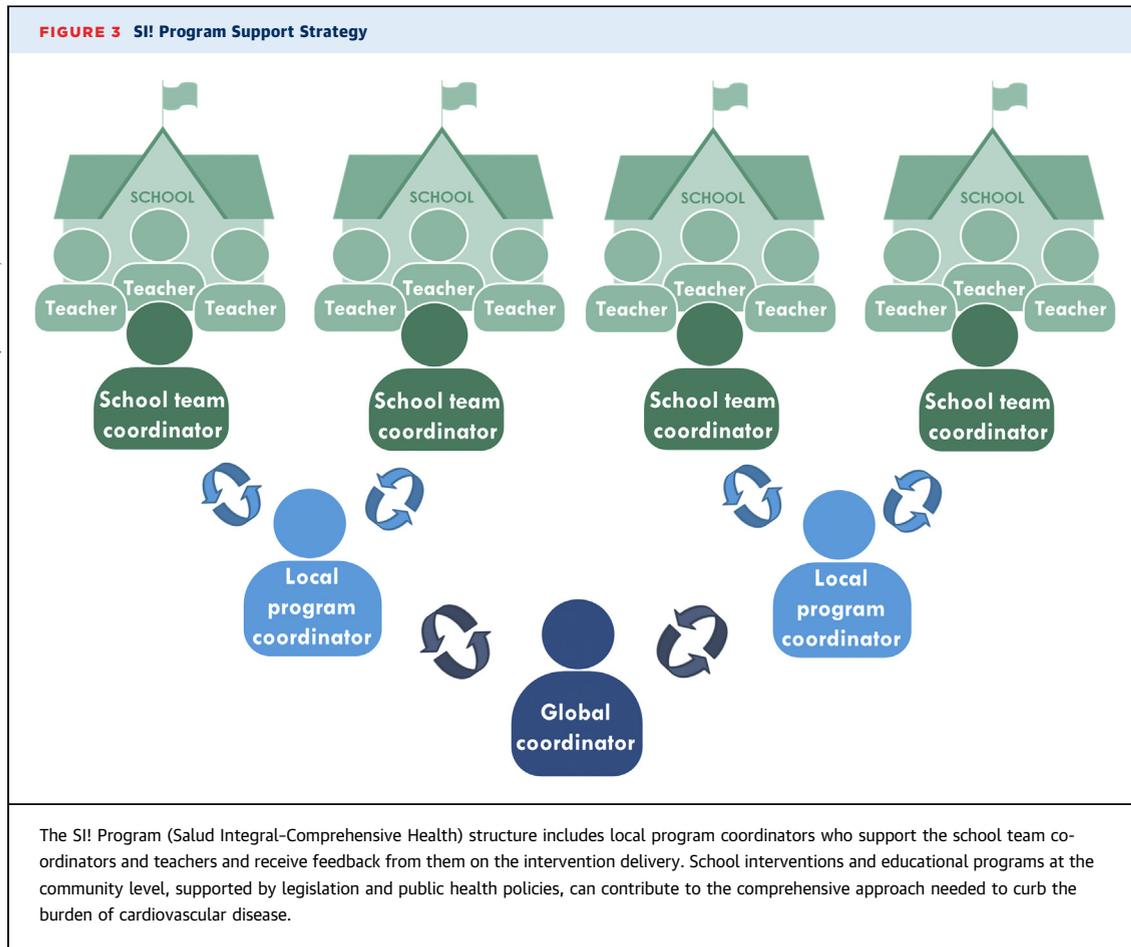




The SI! Program (Salud Integral-Comprehensive Health) school health recommendations at school. PE = physical education.

performed by any specifically trained person who has the skills to communicate with the various members of the educational community. The local program coordinator has 2 main tasks: 1) to ensure the quality of the intervention by monitoring its implementation; and 2) to secure and sustain the commitment of the

teaching staff implementing the program (and therefore achieving optimal adherence to the program). The local program coordinator may receive training through a global coordination system, including guidelines for teacher support and implementation monitoring.



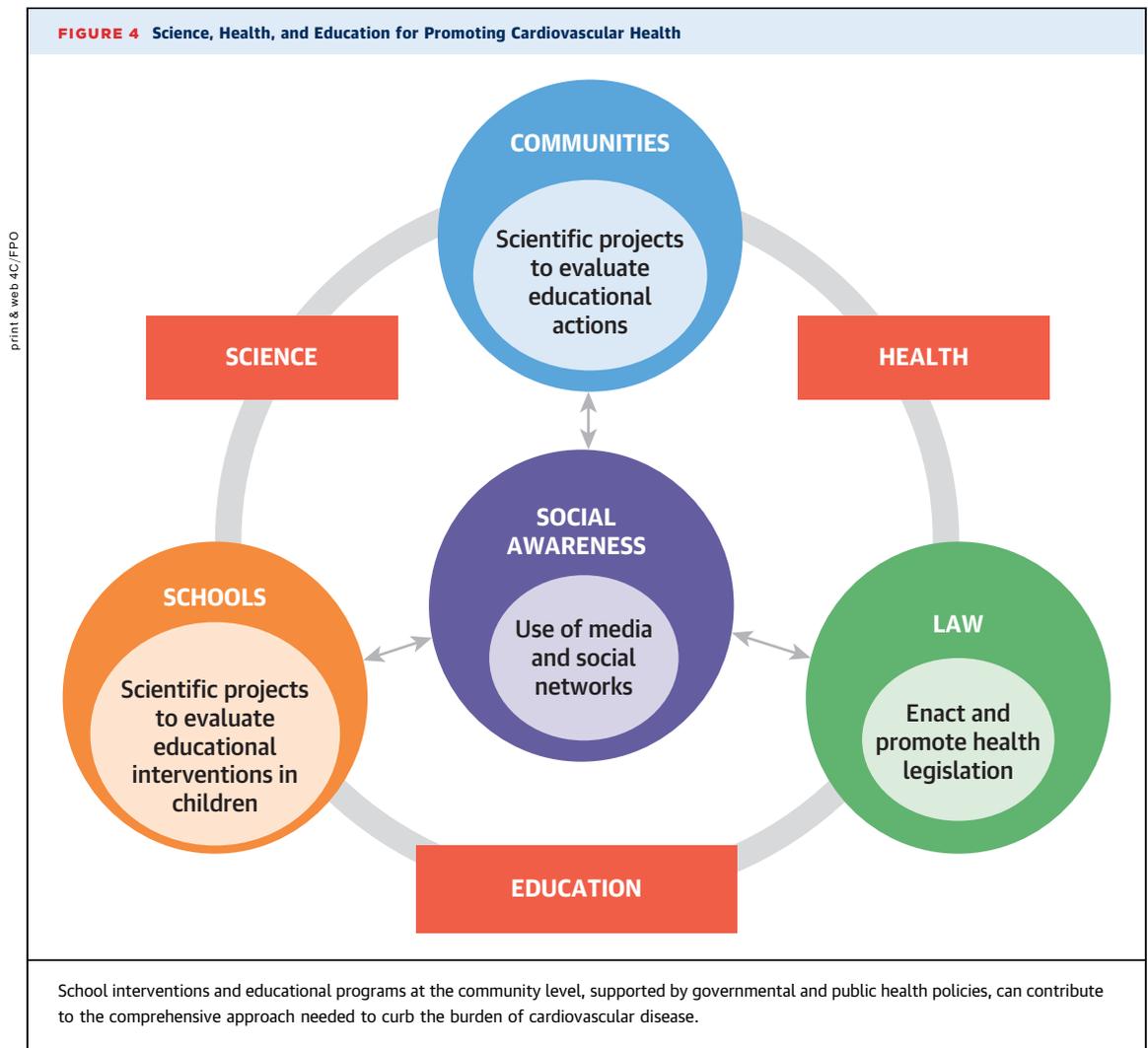
The local program coordinator's key contact point in the school is the school team coordinator. The creation of an standardized monitoring and feedback system for implementation allows the research team to evaluate intervention adherence and also to improve or adapt the strategy based on the school community's feedback.<sup>62</sup> The local program coordinator, in communication with school-level actors, ensures effective coordination of teacher training, meetings (in-person or remotely), curriculum presentation, frequent motivational communication, and provision of information about recent publications related to cardiovascular health and findings from the global developer team's projects. Successful engagement of the educational community will mostly depend on whether people believe the issue is directly relevant to them, see evidence of progress, and have a sense that their actions can make a difference.<sup>79</sup>

Teacher motivation is crucial for optimal implementation because highly motivated teachers are more engaged, and their motivation is linked to that

of their students.<sup>80</sup> The local program coordinator will help to increase and sustain teacher motivation by providing mentorship and encouragement during check-ins, aside from simply providing technical assistance with the curriculum. This will provide the teachers with the opportunity to feel supported during check-ins throughout the school year. To assess how well different aspects of the SI! Program are being implemented, teachers are required to provide reports on the number of activities delivered to children and the families. This becomes a key aspect for process evaluation because accurate interpretation of outcomes depends on knowing what aspects of the intervention were delivered and how well they were conducted.<sup>62</sup>

**PHASE IV: IMPROVING FUTURE APPLICATIONS.**

**Main challenges.** The involvement of families in health promotion interventions is challenging, and family socioeconomic status (SES) may play a crucial role in its success. Previous findings showed that children from families with low SES generally



respond less well to lifestyle interventions than those from families with higher SES.<sup>16,17,81</sup> Therefore, concern exists that such interventions could increase inequalities rather than reduce the gap. Nevertheless, the risk of increasing health disparities is generally lower for complex interventions acting on multiple targets and in multiple settings<sup>66</sup> such as the SI! Program. Because the SI! Program curriculum includes a minimum of 40 hours of exposure annually, it could be inequitably administered. However, because schools are required to implement a number of hours of health education as part of the standard curriculum, the SI! Program helps the participating schools meet local health education standards. Health education is a vital tool for improving health and lifestyle decisions; it is fair to acknowledge, however, that many structural factors, including food accessibility and affordability, exist and create health

disparities that are difficult to target with education alone.

Obesity prevention strategies shown to be effective in lower SES participants often include community-based strategies or policies aimed at structural changes to the environment, whereas interventions primarily based on directing information at individual behavior change tend to be ineffective in this group.<sup>82</sup> Based on these premises, and to facilitate family member participation, the SI! Program includes simple and accessible activities for the whole community. The key messaging for families focuses on simple recommendations that encourage widespread adoption by family members. Moreover, the integration of web applications may increase family engagement.<sup>83</sup>

Another valuable resource may be to provide schools with an extended document containing

healthy school recommendations encouraging school management teams to assess the school environment and identify any shortfalls related to health promotion. In addition, specific workshops or training for school staff and families may increase their awareness through education and personal feedback, which could improve adherence to these recommendations. A collaborative approach is recommended, in which families and school staff form a partnership in developing a plan for behavior change tailored to the needs of the local community.<sup>84</sup>

Regarding the curriculum, some content could be considered novel by teachers if the topic is not commonly taught in-depth within the regular curriculum. In this regard, some concepts may need to be reinforced. As an example, in the SI! Program, the emotions management unit has been revised based on teachers' feedback and reinforced with a guide on how to integrate the development of emotional competence through day-to-day classroom activities as well as at home. This guide supported teachers in creating emotionally reassuring environments, encouraging family involvement, and assessing students' progress toward desirable emotional management abilities. In addition, it is necessary to develop materials to address specific needs, such as activities for remote learning, or alternative resources that do not require the use of electronic or web-based materials if access to such technology is limited.

**Improving adherence.** Fidelity to the delivery protocols supporting evidence-based practice is a source of outcome variation.<sup>38</sup> In Spain, an intensive monitoring and teacher support system was established, and nearly 100% adherence was achieved, meaning that the health promotion curriculum was nearly completely delivered. However, in the SI! Program study in Harlem, a potential dose-response effect of the intervention was assessed. The differences in KAH scores between children receiving <50% of the program modules (low adherence) versus those receiving 50% to 75% (intermediate adherence) or >75% (high adherence) were analyzed. Compared with the low-adherence group, the high-adherence group showed a significantly larger change from baseline in overall KAH score.<sup>17</sup> A dose-response effect was also observed after delivering the SI! Program in community centers to children aged 9 to 13 years in Bogotá.<sup>19</sup> The impact of intervention adherence highlights the importance of strategies promoting intervention fidelity to achieve the highest benefits for the targeted population.<sup>62</sup> In this regard, and as mentioned previously, the SI! Program uses a coaching approach for teachers through a local program coordinator and a methodology based on up-to-date

findings. The intervention design allows for continuous improvement of materials through focus groups, annual feedback from teachers, and review of the scientific evidence. Furthermore, it includes some proven strategies to increase the adherence, such as repetition, constant support and motivation, and, most importantly, simple messages, as lower health literacy is associated with greater risk of nonadherence.<sup>84</sup>

## EVALUATION

Before expanding a health promotion program, it may be appropriate to evaluate the effectiveness of the intervention while adhering to evidence-based practice (Key Element #5 of the **Central Illustration**). Randomized controlled trials are the reference standard for assessing relationships between intervention and outcomes.<sup>85</sup> Therefore, scientific evaluations through randomized controlled trials are one of the most reliable ways to test the efficacy of school-based interventions.

Published trial results about preschool-based interventions could help to ensure the replicability of interventions in diverse settings and socioeconomic backgrounds.<sup>9,10,29,33,36,86,87</sup> There are several scientific challenges to measuring the efficacy of an intervention in the school setting. One of the main challenges, particularly for research on preschoolers, is the nature of the assessment tools. The methodology (individual vs group administration), and design (number and complexity of items) have to be adapted to the stages of maturation in children.<sup>15,40,88</sup> Preschool-aged children cannot yet read well, and thus questionnaires in the SI! Program included simple pictures to support both questions and answers and were administered individually by trained early child education professionals. Questions were adapted to the sociocultural context by using names and pictures of local foods, pictures of local playgrounds, and images reflecting local ethnic diversity. In the SI! Program, the overall questionnaire assessed children's KAH in relation to a healthy lifestyle. This metric is based on a progressive acquisition and retention of healthy habits in children according to the Trans-theoretical Model of Health Behavior Change, which includes 5 stages of behavior modification.<sup>44</sup> The KAH score aggregates the "pre-contemplative" and "contemplative" stages as the acquisition of knowledge (K), the "preparation" phase as setting this knowledge into attitudes (A), and the final "action" and "maintenance" stages as the acquisition of the desired habit (H). This was translated into component-specific KAH scores plus an

overall score representing the intervention as a whole.<sup>89</sup> The KAH system has been shown to serve as a surrogate of improved lifestyle and therefore may be a successful measure of the ability of the intervention to instill these concepts and provide children with tools for self-promotion of health.<sup>36,90-95</sup> However, there is a lack of consistent evidence about the association between KAH scoring systems and health indicators such as BMI, waist circumference, or blood pressure. In the SI! Program trial in Spain, a positive trend in the intervention group both for KAH score and adiposity indicators was found<sup>16</sup>; in contrast, other studies showed no significant differences between the intervention and control groups in any of the anthropometric variables, even though several components of knowledge, attitudes, and behaviors score were significantly changed by the intervention.<sup>96</sup>

Questionnaires can carry a subjective component that may affect the results; however, individual administration by trained staff can help to standardize the process and minimize this problem. In contrast, direct measurements are an accurate and reliable source of information, and a combination of questionnaires and direct measurements allows for cross-validation. Data collection should be standardized and conducted by trained technical personnel such as nutritionists, nurses, and child assessors. Given the lack of consensus regarding BMI cutoffs, large-scale comparisons might be aided by using both local percentiles and growth charts from the World Health Organization or the U.S. Centers for Disease Control and Prevention.<sup>97</sup> Some indicators of fat amount and distribution, such as skinfolds or circumferences, may add valuable information widely used in the pediatric setting.<sup>98</sup> Other health indicators, such as a blood glucose or lipid profile, or accelerometers to assess PA have been included in other interventions in preschoolers and in the SI! Program for Secondary Schools trial.<sup>14,99-101</sup> Providing information and guidance to families based on their children's results was a great incentive for participation, especially in communities with low access to medical care such as the population of the study conducted in Harlem.

## INSTITUTIONALIZATION

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Transferring and sustaining effective programs in real-world settings is a complex, long-term process that requires effective strategies for dealing with the subsequent phases of program scale-up.<sup>62</sup> The

institutionalization stage takes place when the local unit or organization incorporates the health promotion program into its continuing practices.<sup>22</sup>

The SI! Program is expanding and thus far has been successfully implemented in >250 schools in Spain, reaching >30,000 children and providing training to an average of 170 teachers per school year. The corresponding local government's Education Departments have recognized the SI! Program training as part of teachers' certified training, which is a strong motivating factor for teachers and schools.

Implementation and evaluation of the SI! Program for >10 years have yielded several lessons and insights regarding the challenging task of promoting cardiovascular health in the school setting, starting with preschool-aged children. To promote the commitment of the educational community, the SI! Program team is providing feedback on the results through meetings and social- and/or mass media, forging a lasting connection with the community and creating a feeling of belonging.<sup>87</sup> This feedback includes the accumulated experience of the implementation and teachers' suggestions and comments.

The SI! Program is now expanding across the 5 boroughs of New York City through a new project called the CHSEI (Children's Health and Socioeconomic Implications) project. This study is putting in place all the accumulated experience acquired over the last 10 years to improve the development of materials, implementation strategy, and scientific evaluation. The diverse ethnic and socioeconomic backgrounds in New York City offer a unique opportunity to expand our health promotion program and to explore which socioeconomic factors, at both the family and borough level, may eventually affect children's health, how they are implicated in the intervention's effectiveness, and how they can be addressed to reduce the gap in health inequalities.

The sustainability of school-based interventions can be promoted by interventions at different strata, such as workplace health promotion programs,<sup>102,103</sup> active aging programs,<sup>104-107</sup> or more intense parallel health promotion programs specifically targeting parents/caregivers.<sup>108</sup> Although the maximum possible sustained public health benefit would come from implementing multiple interventions at all levels of the ecological model, the single interventions with the greatest impact on population health are those focusing on the physical and social environmental context and on socioeconomic and policy factors.<sup>109</sup> It is crucial to engage all potential

partners as strategic collaborators to ensure that interventions address the full spectrum of CVD, from prevention and risk factor reduction to diagnosis and treatment.<sup>63,110</sup> Moreover, the collaboration of community health and government agencies is necessary to provide the public with a coherent message on health matters; for example, through advertising, food labeling, adaptation of local infrastructures to promote PA as healthy leisure, and price regulation of healthy foods.<sup>111</sup> All these strategies, added to school programs and legislative actions (Figure 4), can contribute to the comprehensive approach needed to curb the burden of CVD.<sup>112</sup>

Thus, community engagement (Key Element #4 of the Central Illustration) is crucial to introduce and maintain an effective sustained health promotion program in the school system.

## CONCLUSIONS

Transferring effective programs into real-world settings is a complicated, long-term process that requires effective integration of implementation research. This review has presented key lessons learned from implementing the SI! Program for over a decade in different educational settings around the world. Some key elements in the promotion of cardiovascular health in the school setting have been identified: 1) multidisciplinary teams; 2) multidimensional educational programs; 3) multilevel interventions; 4) local program coordination and community engagement; and 5) scientific evaluation through randomized clinical trials.

A core challenge in global health is translating scientific evidence into educational and community practices. This challenge becomes more complex when it requires individual, organizational, and systemic behavior change. By matching rigorous scientific impact studies with implementation framework analysis, we can help bridge the divide between science and educational practice.

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**KEY WORDS** cardiovascular disease, child, health promotion, implementation science, lifestyle, prevention

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**APPENDIX** For supplemental figures, please see the online version of this paper.