An evaluation of the coverage of theoretically based implementation factors in disseminated classroom physical activity programs

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Abstract

Classroom-based physical activity (CBPA) is increasingly recommended as a method to support children’s physical activity, health, and academic performance. Many adoption-ready programs exist to aid in the implementation of CBPA in schools; yet, implementation rates remain low. The purpose of this study was to evaluate the extent to which resources provided by adoption-ready CBPA programs addressed theory-based implementation contextual factors to support implementation. Existing CBPA programs (N = 37) were identified through Internet searches and all materials (e.g., implementation guides) provided by each program were coded for their inclusion of 51 implementation factors based on the Consolidated Framework for Implementation Research (CFIR). Analyses were conducted to compare inclusion of implementation factors across CFIR Domains and by three program groupings: free (yes/no), research evidence (yes/no), and targeted to teacher only (vs. school). Programs covered a mean of 25.9 per cent (SD = 18.7 per cent) of the 14 Inner Setting implementation factors, 34.2 per cent (SD = 18.0 per cent) of the 6 Characteristics of Individuals implementation factors, and 34.8 per cent (SD = 24.3 per cent) of the 8 Process implementation factors. Programs with research evidence covered more implementation factors than programs without research evidence (43.7 vs. 25.9 per cent; p < .05). Although numerous adoption-ready CBPA programs are available and have many strengths, their inclusion of theory-based factors that support or inhibit implementation is generally low. Consideration of such factors, including organizational climate and teacher-level behavior change, is likely critical to supporting ongoing school-wide implementation of CBPA. Research is needed to develop and test effective strategies for addressing these factors to support more widespread CBPA implementation.

Key words

Consolidated Framework for Implementation Research, Teacher, Dissemination, School, Behavior change

BACKGROUND

Reimagining ways to promote and provide physical activity (PA) opportunities to children and youth is especially important now, considering the prevalence of childhood obesity in the USA [1]. Given the volume of time children spend at school, efforts to provide PA opportunities in school settings are increasingly common. Schools are encouraged to establish a Comprehensive School Physical Activity Program, with PA opportunities before, during, and after school. Along with quality physical education [2] and daily recess, offering classroom-based physical activity (CBPA) is an integral part of a Comprehensive School Physical Activity Program that optimizes PA during school hours [3–5]. Multiple studies have shown that CBPA can be effective for increasing children’s PA [6–12]. Interest in school-based PA and CBPA has grown rapidly over the last two decades [13], in part due to PA’s ability to improve student learning outcomes [14,15] and on-task behavior [7,10,16].

Many entities, including nonprofit organizations (e.g., American Heart Association, Let’s Move Active Schools); businesses (e.g., Recess Rocks, Go Noodle); individuals, and organizations such as universities, state departments of education, and local educational agencies, have developed packaged,
adoption-ready programs that include structured materials to aid in CBPA delivery. Despite the wide availability of such programs, national data suggest that less than 50 per cent of teachers offer CBPA opportunities to their students [17], and intervention studies have shown low rates of implementation after school- or district-level adoption, with even lower maintenance at long-term follow-up [7,18,19]. Both classroom-level contextual factors, such as resource availability and teacher attitudes and perceived confidence, and school-level contextual factors, such as school climate, district and school-level leadership engagement, and process monitoring, influence implementation and maintenance of CBPA [20–27]. It is posited that CBPA programs will have higher rates of implementation and maintenance when theory-based implementation contextual factors [28] are addressed.

To date, the breadth and depth of implementation support provided for schools, teachers, and other school stakeholders by CBPA programs has not been systematically studied. A logical next step toward supporting successful CBPA implementation is to identify the extent to which existing adoption-ready programs address multilevel implementation supports.

**Purpose**

The primary purpose of this study was to use the Consolidated Framework for Implementation Research (CFIR) [28] to investigate the inclusion of factors related to school- and classroom-level implementation among existing free and fee-based CBPA programs. A secondary aim examined program inclusion of implementation factors across Intervention Characteristics of interest, including program cost, availability of research evidence, and target audience (teacher vs. school). This research focused on adoption-ready programs accessible to school stakeholders for use in real-world contexts.

**METHODS**

**Identification of programs**

A systematic search was conducted in mid-2017 in PubMed, Google Scholar, and Google, to review both scientific and grey literature and identify adoption-ready programs directed at supporting delivery of CBPA. Search terms included classroom physical activity + programs + interventions; active classroom; activity breaks; active lessons; classroom breaks + exercise; and classroom physical activity. Programs typically had their own website, were available for purchase on a marketplace website (e.g., Amazon), or were hosted on another website such as a state health department or department of education website. Included programs were as follows: (a) published in English language; (b) at least partially aimed to increase PA in the classroom (could also address other sources of PA during school); and (c) targeted any grade K-6th. Programs were excluded if they: (a) did not address classroom physical activity; (b) were created as part of a research study but were not available to the public, even upon request; (c) were once available, but no longer had active websites (i.e., materials were no longer accessible due to broken links); and (d) were from a country other than the USA. All materials for each program, including PDFs, PowerPoints, manuals/guides, handouts, and posters, were downloaded or purchased. We contacted programs that offered training but did not include training materials on their website to request these materials. Two contacts stated that they did not have training materials because the training was more informal. Two provided a training PowerPoint, but the PowerPoint did not include information that was not already included in other materials.

**List of implementation factors and definitions**

CFIR was selected to guide this work due to its wide coverage of multiple levels (i.e., individual and organizational) of implementation contextual factors [28,29], evidence of explaining variation in implementation in previous work [30], relevance to setting/organizational-based interventions such as school PA, and familiarity among the investigators. The CFIR includes 36 constructs that reflect barriers and facilitators to implementation, grouped under five domains: Intervention Characteristics (key attributes of interventions), Outer Setting (factors outside the organization), Inner Setting (factors within the organization), Characteristics of Individuals (perceptions, attitudes, and motivation of individuals), and Process (strategies to support implementation) [31].

For the present study, 22 CFIR constructs were selected for inclusion and one or more CBPA-specific implementation factors were mapped to each CFIR construct. The identification of constructs drew on the authors’ experience and knowledge of the literature and was conducted using an iterative approach that involved four meetings among the authors. The primary investigator and a research assistant first drafted the initial list of CBPA-specific implementation factors and definitions, mapped to CFIR. The list was then discussed with the other study team members over the four meetings, and refinements were made until consensus was reached. This resulted in a list of 51 CBPA-specific implementation factors, which is presented in Appendix A. There were 23 CBPA-specific implementation factors for the Intervention Characteristics domain of CFIR, 14 for the Inner Setting, 6 for the Characteristics of Individuals, and 8 for Process. We also categorized each CBPA-specific implementation factor as being related to the school-teacher relationship (i.e., teacher and systems change; N = 7 implementation
The number and percent of programs receiving a score of 1 for each implementation factor was reported using frequency statistics. These descriptive statistics were calculated for all programs together and then calculated only for programs that were viewed as more comprehensive because they included an implementation manual, guide, or other material/resource beyond simple activity demonstrations/instructions. Inter-rater agreement was calculated for each of the 28 double-coded implementation factors using percent agreement, and for index scores using intraclass correlations (ICCs). Percent agreement was evaluated with the criteria of ≥75 per cent as good to excellent, 60%–74% as moderate, and <60 per cent as poor [32]. ICC magnitude was classified using criteria of poor (≤0.40), fair (0.41–0.60), good (0.61–0.80), and excellent (0.81–1.0) [31]. Logistic regression was used to investigate differences in the inclusion of each of the 28 double-coded implementation factors (dependent variable) by three Intervention Characteristics that were considered key factors related to program selection (independent variables, entered in separate models): (i) free (yes/no), (ii) research evidence (yes/no), and (iii) targeted to teacher only (vs. school) (yes/no). Chi-square statistics are presented when an odds ratio was not able to be calculated due to no inclusion of the implementation factor in one of the groupings (e.g., free vs. cost). Index scores were summarized using means and standard deviations. Differences in the index scores (dependent variables) by the aforementioned three key Intervention Characteristics (independent variables) were investigated using t tests.

RESULTS

Of the 42 programs initially identified, four were excluded because they were not from the USA and one was excluded because it was deemed to be an opinion blog rather than a packaged program. A list of the 37 included programs is provided in Appendix B. Across all programs, 20 of the 28 dichotomous implementation factors had good-to-excellent percent agreement (75.7%–97.3%) between coders, and the other 8 had moderate percent agreement (64.9%–73%). ICCs for the index scores demonstrated fair agreement for Inner Setting (ICC = .592), good agreement for Characteristics of Individuals (ICC = .614), Process (ICC = .765), school-teacher relationship (ICC = .638), and excellent agreement for teacher–student relationship (ICC = .877).

Inclusion of implementation factors across programs

The least commonly included Intervention Characteristics implementation factor was train the trainer (individuals receive training on how to train others; 5.4 per cent), whereas the most commonly included was original activities (original activity ideas or instructions; 94.6 per cent; Table 2). Of the 15 programs that involved a fee, four (26.7 per cent) had research evidence. Most program fees were one time...
fees ranging between US$10 and US$100, though some program fees were higher, for example, US$10 per month. Across the Inner Setting, Characteristics of Individuals, and Process domains, 24 of the 28 implementation factors were included in <50 per cent of programs (Table 1). The least commonly included implementation factor from these domains was accountability (enforcement or accountability; 2.7

Table 1 | Inclusion of implementation factors related to the CFIR Inner Setting, Characteristics of Individuals, and Process Domains

| CFIR Domain and CBPA-specific Implementation Factor | Brief description | No. (%) of all programs that included factor N = 37 programs | No. (%) of programs with Implementation Materials that included factor N = 28 programs |
|---------------------------------------------------|------------------|-----------------------------------------------------------|-----------------------------------------------------------|
| **Inner Setting (14 factors)**                    |                  |                                                           |                                                           |
| Communicationa                                   | Creating a network or changing the communication structure | 7 (18.9%)                                                  | 6 (21.4%)                                                  |
| Policy Incorporationa                            | Incorporating the program into policy, or reference school/district policy | 9 (24.3%)                                                  | 9 (32.1%)                                                  |
| Marketing Materials Teachersa                    | Post school-level adoption marketing focusing on teacher-level implementation | 14 (37.8%)                                                  | 14 (50.0%)                                                  |
| Marketing Materials Students/Parentsa            | Post school-level adoption marketing targeting students and/or parents | 10 (27.0%)                                                  | 9 (32.1%)                                                  |
| Gauging/Affecting Climatea                       | Gauging or affecting the school climate regarding classroom PA | 6 (16.2%)                                                  | 6 (21.4%)                                                  |
| Leadership Initial Buy Ina                       | Increasing administrator buy-in for program adoption | 9 (24.3%)                                                  | 9 (32.1%)                                                  |
| Student Managementb                              | Managing student behavior in the classroom during PA | 15 (40.5%)                                                  | 13 (46.4%)                                                  |
| Compatibility Adaptationsb                       | Adapting activities based on early implementation and compatibility | 21 (56.8%)                                                  | 19 (67.9%)                                                  |
| Incentivesa                                       | Providing incentives for teachers | 7 (18.9%)                                                  | 7 (25.0%)                                                  |
| Goal Settinga                                     | Setting goals to support teacher implementation of classroom PA | 3 (8.1%)                                                  | 3 (10.7%)                                                  |
| Monitoringa                                       | Monitoring teacher implementation of classroom PA | 11 (29.7%)                                                  | 11 (39.3%)                                                  |
| School Readinessa                                | Scaling/tailoring the program based on the school's level of readiness | 2 (5.4%)                                                  | 2 (7.1%)                                                  |
| Leadership Engagement Post Adoptiona             | Increase leadership support and/or involvement around implementation | 6 (16.2%)                                                  | 5 (17.9%)                                                  |
| Classroom Structureb                              | Restructuring the physical classroom environment or tailor activities based on classroom structure | 14 (37.8%)                                                  | 14 (50.0%)                                                  |
| **Characteristics of Individuals (six factors)**  |                  |                                                           |                                                           |
| Health Benefitsa                                 | Health benefits of classroom PA | 28 (75.7%)                                                  | 25 (89.3%)                                                  |
| Non-Health Benefitsa                             | Non-health benefits of classroom PA (e.g., academics, behavior management) | 30 (81.1%)                                                  | 26 (92.9%)                                                  |
| Teacher Motivation/Attitudes Around Programa     | Increasing teacher motivation/attitudes to implement/support the program | 5 (13.5%)                                                  | 5 (17.9%)                                                  |
| Self-efficacya                                    | Increasing teacher confidence/self-efficacy for implementing the program | 5 (13.5%)                                                  | 4 (14.3%)                                                  |
| Teacher Stage of Changea                         | Gauging a teacher's stage of change and/or tailoring approaches on this | 2 (5.4%)                                                  | 2 (7.1%)                                                  |
| Teacher Attitude/Value toward PAa                 | Improving teacher attitudes/values about their own PA | 6 (16.2%)                                                  | 6 (21.4%)                                                  |
| **Process (eight factors)**                       |                  |                                                           |                                                           |
| Scheduling Materialsb                            | Scheduling classroom PA | 17 (45.9%)                                                  | 16 (57.1%)                                                  |
| Dose/Dose Quantityb                              | A specific number of minutes and/or frequency of activity blocks | 29 (78.4%)                                                  | 26 (92.9%)                                                  |
| Teacher Participationb                           | Increasing teacher participation in the activities | 15 (40.5%)                                                  | 14 (50.0%)                                                  |
| Implementation Leadersb                          | Identifying/appointing champions or creating new leadership roles for implementation | 7 (18.9%)                                                  | 7 (25.0%)                                                  |
| External Involvementb                            | Involving parents or community members to support/assist in the intervention | 11 (29.7%)                                                  | 10 (35.7%)                                                  |
| External Information Sharingb                    | Networking or sharing implementation information with external organizations or individuals? | 14 (37.8%)                                                  | 12 (42.9%)                                                  |
| Accountabilitya                                  | Enforcement or accountability | 1 (2.7%)                                                  | 1 (3.6%)                                                  |
| Outcomesa                                        | Assessing desired outcomes | 9 (24.3%)                                                  | 9 (32.1%)                                                  |

*aFactor affects school–teacher relationship for implementation. 
*bFactor affects teacher–student relationship for implementation.

Materials provided by these programs were considered more comprehensive because they included guides or other content that supported implementation rather than solely activity instructions.

CFIR Consolidated Framework for Implementation Research; CBPA classroom-based physical activity.
per cent), whereas the most commonly included was nonhealth benefits (nonhealth benefits of classroom PA [e.g., academics and behavior management]; 92.9 per cent). The inclusion of implementation factors was slightly higher when only considering the subset of programs that included any implementation materials (N = 28). However, 20 of the 28 implementation factors were included in <50 per cent of programs.

The index scores, representing the number of factors included, differed by CFIR domain and school/teacher grouping. Fewer Inner Setting implementation factors (index score of 3.6 out of 14; 25.9 per cent inclusion) were included across programs, when compared with implementation factors related to the Characteristics of Individuals (index score of 2.1 out of 6; 34.2 per cent inclusion) and Process (index score of 2.8 out of 8; 34.8 per cent inclusion) domains (p < .05). Fewer implementation factors related to the school-teacher relationship (index score of 5.2 out of 21; 24.7 per cent inclusion) were included across programs, when compared with factors related to the teacher–student relationship (index score of 3.3 out of 7; 46.7 per cent inclusion, p < .05).

### Implementation factor inclusion by key Intervention Characteristics

There were no significant differences in the inclusion of individual implementation factors between programs that were free (N = 22) versus fee-based (N = 13) (Table 3). For programs that had no research evidence (N = 28) versus programs with research evidence (N = 9), four implementation factors had significantly higher odds of being included in research-based programs. These included policy incorporation (incorporating the program into policy, or reference school/district policy), school readiness (scaling/tailoring the program based on the school’s level of readiness), teacher attitude/value of PA (improving teacher attitudes/values about their own PA), and implementation leaders (identifying/appointing

### Table 2 | Inclusion of implementation factors related to the CFIR Intervention Characteristics Domain

| CFIR Domain and CBPA-specific Implementation Factor | Brief description | No. of (%) programs including factor (N = 37 programs) |
|-----------------------------------------------------|-------------------|-----------------------------------------------------|
| Research Evidence                                   | Published research on the classroom PA part of the program | 9 (24.3%)                                           |
| Grade Specific                                      | Separate activities targeted at different/specific grade levels | 9 (24.3%)                                           |
| Original Activities                                 | Original activity ideas or instructions | 35 (94.6%)                                          |
| Short Activities                                    | Activities of 5 min or less | 14 (37.8%)                                          |
| Long Activities                                     | Activities of 6–10 min | 12 (32.4%)                                          |
| Extra-long Activities                               | Activities of more than 10 min | 7 (18.9%)                                           |
| Flexible Activity Duration/No Duration Listed       | Activity duration is flexible | 22 (59.5%)                                          |
| Curriculum Integration                              | Activities that are integrated into the academic curriculum | 15 (40.5%)                                          |
| Activity Video(s)                                   | Videos to use during classroom PA | 15 (40.5%)                                          |
| Music                                               | Music to use during activities | 8 (21.6%)                                           |
| Educational Handout(s)                              | Brief materials/resources detailing the program or school PA | 14 (37.8%)                                          |
| Educational Booklet(s)                              | More extensive resource guides or manuals | 15 (40.5%)                                          |
| Educational Powerpoint(s)                           | Visual slide show for training | 8 (21.6%)                                           |
| Visiting Training                                   | Trainer(s) come to the school/district | 6 (16.2%)                                           |
| Send for Training                                   | Teachers/staff are sent to program’s facility for training | 2 (5.4%)                                            |
| Online Training                                     | Teachers/staff complete online training | 5 (13.5%)                                           |
| Train the Trainer                                   | Individuals receive training on how to train others | 2 (5.4%)                                            |
| Advanced Implementation Support                     | Person/consultant that provides tailored/custom support | 3 (8.1%)                                            |
| Targeted to School                                  | Material that targets school-level adoption | 20 (54.1%)                                          |
| Implementation Material(s)                          | Material that facilitates implementation of program (e.g., manual, guide, detailed website content) | 28 (75.7%)                                          |
| Funding                                             | Materials/resources addressing how/where to apply for funds to support implementation | 4 (10.8%)                                           |
| Program Fee                                         | Fee to obtain program (excluding cost for training) | 15 (40.5%)                                          |
| Training Fee                                        | Fee-based training offered | 8 (21.6%)                                           |

CFIR Consolidated Framework for Implementation Research; CBPA classroom-based physical activity.
Table 3 | Differences in inclusion of implementation factors across key Intervention Characteristics

| Inner Setting                     | Free (0) vs. Cost (1) | No Research Evidence (0) vs. Research Evidence (1) | Targeted to teacher only (0) vs. targeted to school (1) |
|-----------------------------------|-----------------------|---------------------------------------------------|--------------------------------------------------------|
| Free: N = 22; Cost: N = 15        | %0)                  | %1) | OR (O) or $\chi^2$ | %0) | %1) | OR (O) or $\chi^2$ | %0) | %1) | OR (O) or $\chi^2$ |
| Communication$^a$                 | 27.3 6.7               | 0.19 (0.02, 1.78)                                     | 17.9 22.2                                                  | 1.31 (0.21, 8.32)                  | 11.8 25.0                                                  | 2.50 (0.42, 14.96)                     |
| Policy Incorporation$^a$         | 22.6 26.7               | 1.24 (0.27, 5.64)                                     | 14.3 55.6                                                  | 7.50 (1.39, 40.56)*                | 17.6 30.0                                                  | 2.00 (0.42, 9.63)                      |
| Marketing Materials Teachers$^a$ | 36.4 40.0               | 1.17 (0.30, 4.50)                                     | 32.1 55.6                                                  | 2.64 (0.59, 12.25)                | 23.5 50.0                                                  | 3.25 (0.78, 13.48)                     |
| Marketing Materials Students/Parents$^b$ | 27.3 26.7               | 0.97 (0.22, 4.26)                                     | 25.0 33.3                                                  | 1.50 (0.29, 7.65)                | 11.8 40.0                                                  | 5.00 (0.89, 28.08)                     |
| Gauging/Affecting Climate$^a$    | 22.7 6.7               | 0.24 (0.03, 2.33)                                     | 14.3 22.2                                                  | 1.71 (0.29, 11.40)                | 5.9 25.0                                                  | 5.33 (0.56, 51.09)                     |
| Leadership Initial Buy In$^a$    | 27.3 20.0               | 0.67 (0.14, 3.22)                                     | 17.9 44.4                                                  | 3.68 (0.72, 18.82)                | 5.9 40.0                                                  | 10.67 (1.17, 97.19)*                   |
| Student Management$^b$           | 40.9 40.0               | 0.96 (0.25, 3.67)                                     | 35.7 55.6                                                  | 2.25 (0.49, 10.34)                | 41.2 40.0                                                  | 0.95 (0.26, 3.55)                      |
| Compatibility Adaptations$^b$    | 68.2 40.0               | 0.31 (0.08, 1.22)                                     | 53.6 66.7                                                  | 1.73 (0.36, 8.35)                | 52.9 60.0                                                  | 1.33 (0.36, 4.93)                      |
| Incentives$^a$                   | 22.7 13.3               | 0.52 (0.09, 3.14)                                     | 14.3 33.3                                                  | 3.00 (0.53, 17.16)                | 11.8 25.0                                                  | 2.50 (0.42, 14.96)                     |
| Goal Setting$^a$                 | 9.1 6.7                 | 0.71 (0.06, 8.67)                                     | 7.1 11.1                                                   | 1.63 (0.13, 20.36)                | 0.0 15.0                                                  | 2.78$^c$                                |
| Monitoring$^b$                   | 27.3 33.3               | 1.33 (0.32, 5.55)                                     | 21.4 55.6                                                  | 4.58 (0.93, 22.59)                | 5.9 50.0                                                  | 16.00 (1.77, 144.72)*                 |
| School Readiness$^a$             | 4.5 6.7                 | 1.50 (0.09, 26.01)                                     | 0.0 22.2                                                   | 6.58$^*$$^c$                      | 0.0 10.0                                                  | 1.80$^c$                                |
| Leadership Engagement Post Adoption$^a$ | 22.7 6.7               | 0.24 (0.03, 2.33)                                     | 14.3 22.2                                                  | 1.71 (0.29, 11.40)                | 5.9 25.0                                                  | 5.33 (0.56, 51.09)                     |
| Classroom Structure$^b$          | 40.9 33.3               | 0.72 (0.18, 2.84)                                     | 28.6 66.7                                                  | 5.00 (0.99, 25.02)                | 29.4 45.0                                                  | 1.96 (0.50, 7.69)                      |
| Characteristics of Individuals   |                        |                                                  |                                                        |                                        |                                                        |                                        |
| Health Benefits$^a$              | 77.3 73.3               | 0.81 (0.18, 3.69)                                     | 67.90 100.0                                                | 3.82$^c$                         | 64.7 85.0                                                  | 3.09 (0.64, 15.00)                     |
| Non-Health Benefits$^a$          | 72.7 93.3               | 5.25 (0.56, 49.08)                                     | 78.6 88.9                                                  | 2.18 (0.23, 21.04)                | 70.6 90.0                                                  | 3.75 (0.62, 22.58)                     |
| Teacher Motivation/Attitudes Around Program$^a$ | 13.6 13.3               | 0.97 (0.14, 6.69)                                     | 10.7 22.2                                                  | 2.38 (0.33, 17.17)                | 11.8 15.0                                                  | 1.32 (0.19, 9.02)                      |
| Self-efficacy$^a$                | 9.1 20.0                | 2.50 (0.36, 17.17)                                     | 10.7 22.2                                                  | 2.38 (0.33, 17.17)                | 23.5 5.0                                                  | 0.17 (0.02, 1.71)                      |
| Teacher Stage of Change$^a$      | 4.5 6.7                 | 1.50 (0.09, 26.01)                                     | 7.1 0.0                                                   | 0.68$^c$                         | 11.8 0.0                                                  | 2.49$^c$                                |
| Teacher Attitude/Value toward PA$^a$ | 13.6 20.0                | 1.58 (0.27, 9.17)                                     | 7.1 44.4                                                  | 10.4 (1.48, 72.99)*               | 11.8 20.0                                                  | 1.88 (0.30, 11.78)                     |
| Process                          |                        |                                                  |                                                        |                                        |                                                        |                                        |
| Scheduling Materials$^b$         | 40.9 53.3               | 1.65 (0.44, 6.20)                                     | 39.3 66.7                                                  | 3.09 (0.64, 15.00)                | 17.6 70.0                                                  | 10.89 (2.26, 52.42)$^*$                |
| Dose/Dose Quantity$^b$           | 77.3 80.0               | 1.18 (0.24, 5.89)                                     | 75.0 88.9                                                  | 2.67 (0.28, 25.25)                | 70.6 85.0                                                  | 2.36 (0.47, 11.82)                     |
| Construct                                | Free (0) vs. Cost (1) | No Research Evidence (0) vs. Research Evidence (1) | Targeted to teacher only (0) vs. targeted to school (1) |
|-----------------------------------------|-----------------------|-----------------------------------------------------|-------------------------------------------------------|
| **Teacher Participation**               | % (0) 31.8            | % (1) 53.3                                          | % (0) 53.3                                            |
|                                         | % (1) 53.3            | % (1) 53.3                                          | % (1) 53.3                                            |
|                                         | OR (CI) 2.45 (0.63, 9.49) | OR (CI) 1.24 (0.27, 5.64) | OR (CI) 3.50 (0.87, 14.44) |
| **Implementation Leaders**              | % (0) 39.3            | % (1) 44.4                                          | % (0) 39.3                                           |
|                                         | % (1) 44.4            | % (1) 44.4                                          | % (1) 44.4                                           |
|                                         | OR (CI) 1.24 (0.27, 5.64) | OR (CI) 1.25 (0.25, 6.26) | OR (CI) 1.25 (0.25, 6.26) |
| **External Involvement**                | % (0) 18.2            | % (1) 20.0                                          | % (0) 18.2                                           |
|                                         | % (1) 20.0            | % (1) 20.0                                          | % (1) 20.0                                           |
|                                         | OR (CI) 1.13 (0.21, 5.95) | OR (CI) 7.1 (0.16, 3.75) | OR (CI) 7.1 (0.16, 3.75) |
| **External Information Sharing**        | % (0) 7.1             | % (1) 55.6                                          | % (0) 7.1                                            |
|                                         | % (1) 55.6            | % (1) 55.6                                          | % (1) 55.6                                           |
|                                         | OR (CI) 16.25 (2.32, 114.06) | OR (CI) 0.77 (0.16, 3.75) | OR (CI) 0.77 (0.16, 3.75) |
| **Accountability**                      | % (0) 0.0             | % (1) 6.7                                          | % (0) 0.0                                           |
|                                         | % (1) 6.7             | % (1) 6.7                                          | % (1) 6.7                                           |
|                                         | OR (CI) 1.51c         | OR (CI) 3.20c                                        | OR (CI) 3.20c                                        |
| **Outcomes**                            | % (0) 13.6            | % (1) 40.0                                          | % (0) 13.6                                          |
|                                         | % (1) 40.0            | % (1) 40.0                                          | % (1) 40.0                                           |
|                                         | OR (CI) 4.22 (0.86, 20.85) | OR (CI) 2.68 (0.72, 18.82) | OR (CI) 2.68 (0.72, 18.82) |

*Construct affects school–teacher relationship for implementation.  
*Construct affects teacher–student relationship for implementation.  
*OR not calculable, $\chi^2$ value provided.  
*Indicates significant difference, p < .05.  
CFIR Consolidated Framework for Implementation Research, CBPA classroom-based physical activity.
The research identified a large number of packaged, adoption-ready programs for supporting CBPA in schools. Programs ranged in their adaptability, delivery mode (e.g., teacher-delivered vs. online video modules), intended audience, and PA delivery mode, providing a plethora of options end users with. However, no programs extensively addressed/supporting implementation, such as improving school climate, facilitating teacher-level behavior change techniques, and evaluating program maintenance. Although some programs offered detailed support manuals, they were most often related to skill-building, targeting program-level adoption. It is likely that more extensive implementation supports, particularly those that address ways to overcome the many organizational- and individual-level barriers within the program, features of CBF, and individual-level barriers to ongoing implementation effectiveness of CBF, are needed to improve the real-world effectiveness of CBF.

Within the Intervention Characteristics domain of CBF, which generally represented the packaging of and options within the program, features varied largely across programs. This is potentially Table 4 | Differences in index scores across key Intervention Characteristics

| CFIR Domains                  | Groupings                  | Free (0) % (SD) | Cost (1) % (SD) | T-statistic | No Research Evidence (0) % (SD) | Research Evidence (1) % (SD) | T-statistic | Targeted to teacher only (0) % (SD) | Targeted to school (1) % (SD) | T-statistic |
|-------------------------------|----------------------------|----------------|----------------|-------------|-------------------------------|-------------------------------|-------------|-------------------------------------|--------------------------------|-------------|
| Inner Setting                 | Free (0) vs. Cost (1)      | 28.57 (18.18)  | 21.90 (19.37)  | 1.05        | 21.17 (17.44)                 | 40.48 (15.15)                 | -2.97*      | 15.97 (15.47)                      | 34.29 (17.28)                    | -3.37*      |
| Characteristics of Individuals| No Research Evidence (0) vs. Research Evidence (1) | 31.82 (17.75)  | 37.78 (18.33)  | -0.99       | 30.36 (17.60)                 | 46.30 (13.89)                 | -2.47*      | 32.35 (21.63)                      | 35.83 (14.58)                    | -0.58       |
| Process                       | Targeted to teacher only (0) vs. targeted to school (1) | 31.82 (22.07)  | 39.17 (27.49)  | -0.90       | 30.80 (22.17)                 | 47.22 (27.80)                 | -1.82       | 22.79 (13.43)                      | 45.00 (27.02)                    | -3.24*      |
| School/Teacher Grouping      | No Research Evidence (0) vs. Research Evidence (1) | 24.68 (15.10)  | 24.76 (19.81)  | -0.02       | 20.41 (14.48)                 | 38.10 (17.66)                 | -3.02*      | 16.25 (12.15)                      | 31.90 (17.28)                    | -3.13*      |
| Teacher–Student Relationship | Targeted to teacher only (0) vs. targeted to school (1) | 46.75 (27.94)  | 46.67 (28.29)  | 0.01        | 42.35 (29.22)                 | 60.32 (17.17)                 | -1.74       | 36.97 (24.77)                      | 55.00 (27.92)                    | -2.06*      |

*Indicates significant difference, p < .05.
beneficial for teachers, since many value the ability to tailor programs to meet the specific needs of their classroom [20, 22]. A majority of programs included structured PA that was flexible in duration, which also provides flexibility to teachers. Most programs did not include formal training to implement CBPA and more often included an educational handout or resource guide/booklet. Although the provision of booklet/handout-type resources has value for ongoing implementation support, structured training in the form of professional development or preservice learning—provided in conjunction with ongoing coaching—is likely to be a more effective approach for supporting ongoing implementation when compared with receiving materials alone [33]. Thus, many of the adoption-ready programs identified in this review may be more appropriate for stakeholders who have been introduced to CBPA previously, rather than first-time adopters.

The most commonly included implementation factors within the Inner Setting, Characteristics of Individuals, and Process domains of CFIR, were related to highlighting the physical and mental benefits of CBPA, and supporting adaptations to the delivery of CBPA. The consensus across programs, with regard to increasing teachers’ knowledge of the benefits of CBPA, suggests that this is an essential core component of CBPA programs. However, research shows that knowledge is typically not sufficient for supporting sustainable behavior change [34]. Adaptability is critical for successful implementation, as contextual factors can vary widely across settings and “one size fits all” programs are generally not well received or sustainable [35, 36]. Although many programs are being adapted in local contexts [7], guidance on adaptations can be beneficial for maintaining fidelity to the most critical aspects of the program while permitting flexibility to other aspects. The lack of significant differences in implementation factor inclusion between free and fee-based programs suggests that both have similar potential for supporting successful implementation. Although intervention cost is often a consideration in program adoption [37], school- or district-level leaders should consider whether programs have been empirically tested before making decisions regarding program uptake [38]. Indeed, programs with published research evidence had higher inclusion of implementation factors with organizational-level implications (e.g., incorporating policy and assessing school readiness) than programs without an evidence base. Thus, programs created in research settings should be highlighted when disseminating CBPA programs and resources.

An individual teacher-directed approach was common among programs, illustrated by the higher index scores among the student–teacher relationship implementation factors versus the school–teacher relationship implementation factors. This corroborates previous evidence showing that many school-based PA programs have focused on developing teachers’ skills and knowledge, with less attention paid to behavior change, organizational factors, and other implementation drivers [39]. With so many programs addressing teacher-level factors, it seems that many programs put the responsibility for student behavior change solely in the hands of teachers, which is not supported by recent literature on effective implementation of PA programs [26]. In accordance with systems approaches, multiple stakeholders within a school, not just teachers, play a critical role in the success of CBPA program implementation. Successful implementation efforts are likely to be those that create school-level changes, including changes in norms and culture around PA during the school day, through key features such as administrative buy-in/support, goal setting, and monitoring of progress. Among programs reviewed here, few included these implementation factors, with 24.3, 8.1, and 29.7 per cent including gaining initial administrative buy-in, setting goals for teacher implementation of CBPA, and monitoring progress, respectively. Interestingly, even programs that were targeted to the school (vs. to teacher only) more adequately included implementation factors related to both the school–teacher relationship and the teacher–student relationship, further highlighting the necessity of the whole-of-school approach for increased implementation support.

Regarding teacher factors, although monitoring was included in over a third of programs with implementation materials, it was evident that goal setting, teacher stage of change, teacher attitudes, and other teacher-level behavior change techniques were rarely included. Since goal setting and monitoring in particular have been among the most consistently effective tools in behavior change interventions [40, 41], future CBPA efforts should aim to better incorporate and test these tools. Regarding school-level implementation factors, over one-third of programs included external involvement and information sharing, but leadership engagement and school climate were seldom included. Previous research shows that leadership characteristics (specific to CBPA) and school climate around CBPA are important predictors of implementation [20, 21, 23, 24, 42]. Future CBPA research should aim to develop (or utilize previously developed) theoretically based tools that both support school stakeholders’ ability to implement the program and address the contextual factors that serve as barriers or facilitators to implementation. Improving attitudes toward implementation of CBPA would also likely benefit climate around PA in general and could further aid in implementation of a Comprehensive School Physical Activity Program [3, 4].
In general, CBPA programs are readily available, but likely do not provide enough supporting materials alone to enable broad adoption and implementation across schools. CBPA programs should prioritize the inclusion of these materials to maximize usability. Resources that have been developed and curated by the Centers for Disease Control and Prevention to support school-wide implementation of health interventions [43] and particularly CBPA implementation [44] can provide guidance in this area. Importantly, Leeman and colleagues noted that the complexity of tools was a barrier for school-level uptake; thus, there is a give and take between the complexity of a resource and its utility for facilitating school-wide change [43]. Stakeholders who are disseminating programmatic resources for schools should consider this balance between resource complexity (including the number of implementation factors addressed) and pragmatic usability to ensure that the resource will best fit the needs of a particular school context.

**Strengths and limitations**

This study was among the first to systematically investigate adoption-ready CBPA programs for their inclusion of theory-based implementation context factors. Our coding process yielded acceptable inter-rater agreement, which supports the validity of the data. However, some content could have been missed, which could have led to measurement error, but we made efforts to communicate with program contacts to obtain materials exclusively available by request and allow them to point out potential inaccuracies in our coding. The list of implementation factors was created using the investigators’ knowledge of the literature and experience in CBPA research, but the list may not contain all factors that are important for implementation. Future studies should use other methods to identify and rank the importance of various implementation factors and strategies for supporting CBPA implementation, such as concept mapping or the Delphi method [45, 46].

**CONCLUSIONS**

Although many CBPA programs and resources exist, more work is needed to overcome the numerous barriers to widespread and ongoing implementation of CBPA, as simply training teachers to deliver CBPA is often not sufficient. Existing programs should be supplemented with efforts to deliver implementation strategies that address the unique contextual factors faced by each school. These efforts likely need to address systems’ changes at the organizational and individual levels and should be prioritized in future research. This work can benefit from the use of implementation science frameworks and methods, which is becoming more common in community-based research.

**SUPPLEMENTARY MATERIAL**

Supplementary material is available at Translational Behavioral Medicine online.

**Compliance with Ethical Standards**

**Conflict of Interest:** Authors Hannah G. Calvert, Hannah G. Lane, Carolina M. Seijarino, Kelli Snow, Kate Hoppe, Nicole Alfonsin, Lindsey Turner, and Jordan A. Carlson declare that they have no conflicts of interest.

**Ethical Approval:** This article does not contain any studies with human participants and animals performed by any of the authors.

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**Informed Consent:** This study does not involve human participants and is therefore not required.

**References**

1. Skinner AC, Ravanbakht SN, Skelton JA, Perrin EM, Armstrong SC. Prevalence of obesity and severe obesity in US children, 1999–2016. J Pediatr. 2018;141(3):e20173459.

2. Society of Health and Physical Educators (SHAPE) America. The Essential Components of Physical Education. Reston, VA: SHAPE America; 2015.

3. Centers for Disease Control and Prevention. Comprehensive school physical activity programs: a guide for schools. 2013. Available at http://www.cdc.gov/healthyschools/physicalactivity/cspap.htm. Accessibility verified December 17, 2018.

4. Society of Health and Physical Educators (SHAPE) America. Comprehensive School Physical Activity Programs: Helping All Students Log 60 Minutes of Physical Activity Each Day [position statement]. Reston, VA: SHAPE America; 2013.

5. Institute of Medicine. Educating the Student Body: Taking Physical Activity and Physical Education to School. Washington, DC: National Academies Press; 2013.

6. Calvert HG, Mahar MT, Flay B, Turner L. Classroom-based physical activity: minimizing disparities in school-day physical activity among elementary school students. J Phys Act Health. 2018;15(3):161–168.

7. Carlson JA, Engelberg JK, Cain KL, et al. Implementing classroom physical activity breaks: associations with student physical activity and classroom behavior. Prev Med. 2015;81:67–72.

8. Donnelly JE, Greene JL, Gibson CA, et al. Physical activity across the curriculum (PAAC): a randomized controlled trial to promote physical activity and diminish overweight and obesity in elementary school children. Prev Med. 2009;49(4):336–341.

9. Kelder S, Hoelscher DM, Barroso CS, Walker JS, Cribb P, Hu S. The CATCH Kids Club: a pilot after-school study for improving elementary students’ nutrition and physical activity. Public Health Nutr. 2005;8(2):133–140.

10. Mahar MT, Murphy SK, Rowe DA, Golden J, Shields AT, Raedeke TD. Effects of a classroom-based program on physical activity and on-task behavior. Med Sci Sports Exerc. 2006;38(12):2086–2094.

11. Stewart JA, Derousso DA, Koht HR, Doyle JA. Exercise level and energy expenditure in the Take 10! in-class physical activity program. J Sch Health. 2000;74(10):397–400.

12. Whitt-Glover MC, Ham SA, Yancey AK. Instant Recess®: a practical tool for increasing physical activity during the school day. Prog Community Health Partnersh. 2011;5(3):289–297.

13. Castelli DM, Centeio EE, Hwang J, et al. VII. The history of physical activity and academic performance research: informing the future. Monogr Soc Res Child Dev 2014;79(4):119–148.

14. Rasberry CN, Lee SM, Robin L, et al. The association between school-based physical activity, including physical education, and academic performance: a systematic review of the literature. Med Sci. 2011;152 (Suppl 1):S10–S20.

15. Donnelly JE, Hillman CH, Castelli D, et al. Physical activity, fitness, cognitive function, and academic achievement in children: a systematic review. Med Sci Sports Exerc. 2016;48(6):1197–1222.
16. Grisco LA, Jowers EM, Errisuriz VL, Bartholomew JB. Physically active vs. sedentary academic lessons: a dose response study for elementary student time on task. Prev Med. 2016;89:98–103.

17. Turner L, Chialoupka FJ. Reach and implementation of physical activity breaks and active lessons in elementary school classrooms. Health Educ Behav. 2017;44(3):370–375.

18. Donnelly JE, Lambourne K. Classroom-based physical activity, cognition, and academic achievement. Prev Med. 2011;52 (Suppl 1):536–542.

19. Erwin H, Abel M, Beighle A, Nolan MB, Worley B, Riggs R. The contribution of recess to children’s school-day physical activity. J Phys Act Health. 2012;9(3):442–448.

20. Dinkel D, Schaffer C, Snyder K, Lee JM. They just need to move: teachers’ perception of classroom physical activity breaks. Teach Teach Educ. 2017;63:186–95.

21. Webster CA, Zarrett N, Cook BS, Egan C, Nesbitt D, Weaver RG. Movement integration in elementary classrooms: teacher perceptions and implications for program planning. Eval Program Plann. 2017;61:134–143.

22. McMullen J, Kulimna P, Cothran D. Physical activity opportunities during the school day: classroom teachers’ perceptions of using activity breaks in the classroom. J Teach Phys Educ. 2014;33(4):511–27.

23. Carlson JA, Engelberg JK, Cain KL, et al. Contextual factors related to implementation of classroom physical activity breaks. Transl Behav Med. 2017;7(3):581–592.

24. Goh TL, Hannon KC, Newton M, Webster CA, Podlog L, Pillow W. "I’ll squeeze it in": transforming preservice classroom teachers’ perceptions toward movement integration in schools. Act Teach Educ. 2013;35(4):286–300.

25. Lau EY, Wandersman AH, Pate RR. Factors influencing implementation of youth physical activity interventions: an expert perspective. Transit J Am Coll Sports Med. 2016;1(7):60–70.

26. Moore JB, Carson RL, Webster CA, et al. The application of an implementation science framework to comprehensive school physical activity programs: be a Champion! Front Public Health. 2017;5:354.

27. Webster CA, Buchan H, Pleinraut M, Doan R, Douthit P, Weaver RG. An exploratory study of elementary classroom teachers’ physical activity promotion from a social learning perspective. J Teach Phys Educ. 2015;34(4):474–95.

28. Damschroder LJ, Aon DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci. 2009:4(1):40.

29. CFIR Research Team. CFIR constructs. Available at https://cfirguide.org/constructs/ 2014. Accessibility verified December 17, 2018.

30. Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic review of the use of the Consolidated Framework for Implementation Research. Implement Sci. 2016;11:72.

31. Cicchetti DV. Guidelines, criteria and rules of thumb for evaluating normed and standardized assessment instruments in psychology. Psychol Assess. 1994;6(4):284.

32. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33(1):159–174.

33. Fiksen DL, Naon SF, Blase KA, Friedman RM, Wallace F. Implementation Research: A Synthesis of the Literature. Tampa, FL: University of South Florida, Louis de la Parte Florida Mental Health Institute, The National Implementation Research Network, 2005.

34. Trost SG, Owen N, Bauman AE, Sallis JF, Brown W. Correlates of adults’ participation in physical activity: review and update. Med Sci Sports Exerc. 2002;34(12):1996–2001.

35. Chambers DA, Norton WE. The adaption: advancing the science of implementation adaptation. Am J Prev Med. 2016;51(4 Suppl 2):S124–S131.

36. Greaves CJ, Sheppard KE, Abraham C, et al.; IMAGE Study Group. Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. BMC Public Health. 2011:11:119.

37. Damschroder LJ, Aon DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into prac- tice: a consolidated framework for advancing implementation science. Implement Sci. 2009:4(1):40.

38. Leeman J, Wiecha JL, Vu M, et al. School health implementation tools: a systematic review. Preventive Med. 2012;9(3):442–448.

39. Naylor PJ, Nettlefold L, Race D, et al. Implementation of school based physical activity interventions: a systematic review. Prev Med. 2015;72:95–115.

40. Greaves CJ, Sheppard KE, Abraham C, et al.; IMAGE Study Group. Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. BMC Public Health. 2011:11:119.

41. Michie S, Abraham C, Whittington C, McAteer J, Gupta S. Effective techniques in healthy eating and physical activity interventions: a meta-re- gression. Health Psychol. 2009;28(6):690–701.

42. Webster CA, Russ L, Vazou S, Goh TL, Erwin H. Integrating movement in academic classrooms: understanding, applying and advancing the knowledge base. Obes Rev. 2015;16(8):691–701.

43. Leeman J, Wiecha JL, Vu M, et al. School health implementation tools: a mixed methods evaluation of factors influencing their use. Implement Sci. 2018;13(1):48.

44. Springboard to Active Schools. Springboard to Active Schools. Available at https://schoolspringboard.org/ . 2018. Accessibility verified December 4, 2018.

45. Hasson F, Keeney S. Enhancing rigor in the Delphi technique research. Technol Forecast Soc Change. 2011;78(8):1695–1704.

46. Green AE, Fettes DL, Aarons GA. A concept mapping approach to guide and understand dissemination and implementation. J Behav Health Serv Res. 2012;39(4):362–373.