Title of article: Evaluation of a school-community linked physical activity intervention targeting 7-12 year olds: a sociocultural perspective.

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17 Abstract

18 Public health professionals advocate school-based and community physical activity (PA)
19 interventions as an effective method to increase PA levels and improve physical fitness. This
20 evaluation independently assessed a school-community linked PA intervention by exploring
21 the provision, process, and impact of the program and its outcomes. Students aged 7-12 y
22 [n=468, intervention group (IG); n=128, control group (CG)], teachers (n=19), head teachers
23 (n=4), school program contacts (n=4), and program administrator (n=1) took part in the
24 evaluation. Program content and processes were assessed using questionnaires and semi-
25 structured interviews. A mixed effect model was used to assess changes in physical fitness,
26 PA levels, and attitudes towards PA at baseline and post-intervention. CG increased body
27 mass ($p > 0.001$), aerobic capacity ($p > 0.001$), and push-ups ($p = 0.005$) as well as improved
28 attitudinal scores towards health and fitness and vertigo ($p < 0.05$) compared to the IG.
29 Process evaluation revealed struggles with implementation and design, including pedagogical
30 issues to facilitate program goals. The intervention did not improve attitudinal outcomes, PA
31 levels, or physical fitness above that of the CG. Sustainable PA interventions need to adopt a
32 sociocultural approach which is grounded in learning models and delivered by staff with
33 relevant pedagogical content knowledge.

34

35 *Key Words. Physical activity, fitness and health education; schools and school health*
36 *education; community-based participatory research; conduct evaluation and research*
37 *related to health education.*

38

39 Background

Research has demonstrated a strong association between childhood obesity with an increased risk of morbidity and premature mortality in adulthood[1]. The increasing global prevalence of childhood obesity highlights the importance of positive physical activity (PA) behaviors during childhood to promote sustained active lifestyles throughout the life course[2-4]. Many school-based PA intervention programs advocate a multicomponent approach that has considerable involvement from peers, family, and the external community[2-5]. Yet, despite the need for such programs to acknowledge the complex interactions between individual and social determinants[6], the mechanisms and processes that facilitate behavioral change in PA interventions remain unclear[7-8]. As a result, there is still considerable conceptual and methodological ambiguity regarding the impact claimed by PA intervention programs in schools[9]. This may, in part, contribute to research findings which suggest that PA interventions have had limited impact on students' overall activity levels and metabolic health[10-15].

In much of the PA literature, schools are regarded as optimal environments to deliver PA knowledge. Research suggests that teachers play an important role in the attitudes of students towards PA[12], and schools, in particular physical education (PE) curricula, are an efficient vehicle for PA provision and promotion[11,16]. Indeed, a report by United Nations Educational, Scientific and Cultural Organization (UNESCO)[17] describes quality PE as furnishing individuals with the skills, knowledge, and attitudes to live as active citizens. However, it is clear that aspirations to engender any form of sustained behavioral change with young people require strategies that articulate how an understanding of PA is transitioned between school and community, and how PA is understood and valued across different communities. In this way, PA behaviors in young people are culturally specific[18], and it is clear that more research is needed that addresses school PA intervention programs in the context of community

collaborations, community readiness, local/cultural norms and practices, and cultural renewal[9,18]. To date, empirical research that examines the sociocultural relationship between school and community sites in PA interventions is limited in the extent and scope of application[18], and it is in this space that this paper offers new experiential insights from which to increase understanding of effective/ineffective PA school-community intervention programs.

In a recent report, the World Health Organization[19] suggested that effective school-based health orientated intervention programs should be cognizant of broader educational and community efforts. In this independent evaluation, we were interested in the pathways *between* components of a school-community intervention by critically examining the concept of 'knowledge transfer' that appears to underpin (explicitly and implicitly) many school-community PA programs. Drawing from the education literature, Hager & Hodkinson[20] are critical of the learning metaphor 'transfer' because it implies that knowledge seamlessly moves between contexts. When conceived as a process of boundary crossing (e.g., between school-community), learning is a form of cultural participation involving processes of interpretation, decision-making and perception, rather than learning as a passive process where knowledge is simply acquired[21]. For example, learning and engaging in PA and playing games with peers at school does not necessarily translate to engaging in PA within community/home environments. This may require development of cognitive skills (e.g., problem solving) to adapt knowledge and resources to the new environments and contexts. From this perspective, learning (and the learner) change as contexts change, and therefore the metaphor 'transitioning' is advocated by contemporary literature in capturing the transmission of sustained behaviors between different contexts[20]. In other words, PA

interventions need to develop not only physical fitness but also the physical literacy of young people[22].

## Purpose

In this paper, we report findings of an independent evaluation of a multi-component, school-community linked PA intervention program delivered across an urban school district. To offer new insights, the evaluation team drew from educational sociocultural learning theory to consider both the impact and fidelity of the program in engendering positive PA behavior change within school, and for aspirations beyond.

## Methods

This paper presents an independent evaluation of the intervention outlined below. The evaluators (authors) had no role in the conceptual design, implementation, or delivery of the intervention.

### *Physical Activity Intervention*

A team of public health professionals designed and implemented a school-community linked PA intervention to students aged 7-12 in 72 urban elementary schools. The intervention aimed to: 1) increase awareness of the importance of PA, 2) increase PA levels, increase physical fitness, and 3) reduce levels of childhood obesity. Local agencies involved in the design of the intervention were the health authority, city school council, health administrative agency, and a charitable organization. The charitable organization acted as the 'program administrators' and managed funding and implementation. The intervention program was rolled-out across the region over a 3 yr period. The community demographics

included ~36% of individuals from Black, Asian and minority ethnic groups in which ~ 30% of the children and young people were at risk of living below the poverty line[23]. Of the 72 schools invited, 57 schools (n=7407 students) participated in the intervention. Reasons for not engaging with the program included: declined to take part, program unsuitable for their students, and eight schools were unresponsive to program invitation.

*Intervention Delivery*

An external fitness specialist was employed to deliver a two-phased PA intervention program during the school PE timetable. Phase 1 included showing an educational DVD during school assembly which featured local sport role models. The DVD highlighted: 1) the importance of PA to improve health, 2) the use of circuit training sessions to demonstrate whole body exercise, and 3) the importance of exercise intensity by increasing breathlessness. This was followed by 10-days of introductory circuit training sessions (CTS) within class PE lessons. Students were encouraged to increase exercise duration on each CTS exercise station by increasing number of repetitions and intensity during each subsequent session.

Phase 2 ran over a period of 5 months and had two distinct elements. In the first 4 weeks, students were provided with supervised exercise sessions using children's sized gym equipment including a ski-walker, stepper, elliptical cross-trainer, bicycle, leg extension/leg curl machine, twister, chest press, shoulder press, and bicep curl/tricep extension machine (Phit-Kidz Range, Beny Sports UK Ltd.; EQ Fitness, Sportwise Ltd., UK) during weekly class PE lessons. Students were also allowed access to the gym equipment during recreational times (e.g., lunch recess, before/after school). The second element of Phase 2, included relocating the children's gym equipment to local community facilities (e.g. village hall, community churches) in order to increase access and facilitate sustained community

participation. Both phases included a reward system using PA diaries in which students received prizes, such as medals and certificates, when they achieved a set number of PA goals. Students were encouraged to complete the PA diaries with parental support to record PA performed at school, home and in the community.

Following introduction of the intervention by an external instructor, classroom teachers were then expected to continue the intervention delivery. Classroom teachers were provided a program booklet and 1 hour training session to deliver the CTS and weekly gym equipment sessions. UK schools typically do not have designated PE teachers at elementary level education and the PE curriculum is delivered by classroom teachers.

*Evaluation Design*

In the first year of the intervention, three primary schools (intervention group; IG) and a matched control school (control group; CG) were identified by the intervention program team to take part in the evaluation. The four schools were located in the city center in close proximity, delivered the same national curriculum, and had similar PE equipment and recreational facilities. All students aged 7-12 years were invited to take part in the evaluation. The evaluation team was not given the opportunity to select the evaluation schools or conduct any formative assessments prior to the evaluation. This constraint limited the sample size and any a priori power estimates.

Research design consisted of 3 stages: i) construction of a Logic Model to examine the assumed theory of change, ii) identification and examination of moderating and mediating variables that influenced program implementation, and iii) a multi-level evaluation of program outcomes in terms of intrapersonal, interpersonal, organization and community[24]. This final stage allowed the evaluation team to address the causal relationships between

process and outcomes in terms of spatial (e.g. school-community) and temporal outcomes (e.g. proximal and distal causal factors).

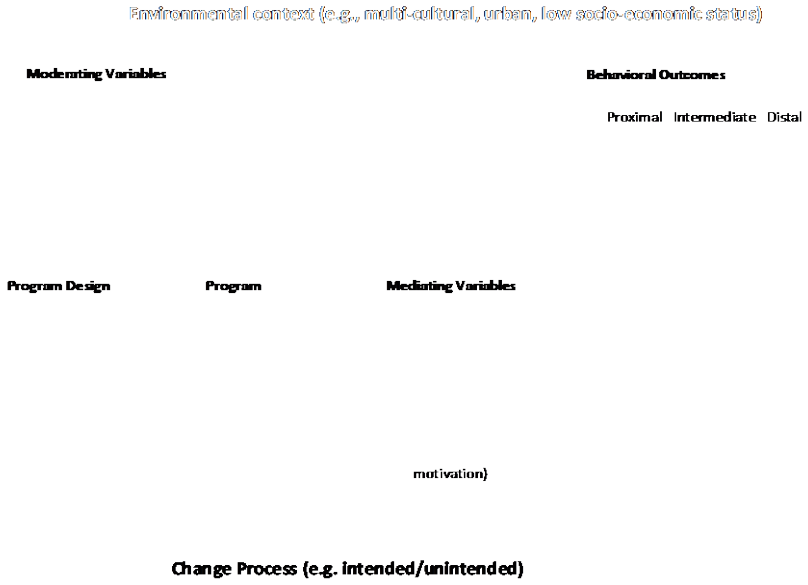


**Figure 1. Contextual model to evaluate physical activity intervention program.**

At the start of the evaluation, the team sought to clarify program expectations and underpinning assumptions. Following recommendations by Armour and Makopoulou [25], a Logic Model[26] (see Table 1) was co-constructed between researchers and key stakeholders (i.e., program designers, program administrators, fitness instructor) to establish the following areas of the program: 1) identify theory of change that underpinned the intervention, 2) resources and activities used to facilitate change, and 3) perceived outputs, outcomes, and impact. The utility of the Logic Model offered evaluators the opportunity to identify implicit and explicit assumptions that shaped, mediated, and delivered program aims and allowed for examination of the theory of change that underpinned the intervention. Interviews with the

Head of PE at the control school, supported by outcome data, allowed us to address a counterfactual account of PA in the CG.

**Table 1. Program Logic Model**

| Underpinning Assumptions | Intended activities | | Expectations | | |
|---|---|---|---|---|---|
| | **RESOURCES/INPUTS** i.e. positive or negative factors influencing your ability to do your work | **ACTIVITIES** i.e. what is done with the resources | **OUTPUTS** i.e. the direct product of activities | **OUTCOMES** i.e. changes in participants due to program | **IMPACT** i.e. changes in organizations, communities or systems due to the program |
| Schools and community health service providers have a role in combating obesity by educating students to increase PA levels<br><br>Educating students about the benefits of PA will increase activity levels<br><br>Schools provide a facility to engage students in PA<br><br>Change is positive | ☐ 1 Fitness Instructor<br>☐ Local sporting role models and team mascot to motivate students<br>☐ Specialist students' gym equipment<br>☐ Program funding administered by local charitable organization<br>☐ Parental support | ☐ Resource materials, DVD and score cards<br>☐ Deliver circuit training sessions<br>☐ School and community based access to specialized kids gym equipment<br>☐ Rewards program<br>☐ Independent evaluation research commissioned | ☐Increasing PA levels in students<br>☐Improving students' awareness of the importance of PA, exercise intensity and the health benefits<br>☐Increase students' overall fitness levels | ☐ Decrease BMI<br>☐ Increase positive attitudes towards PA<br>☐ Increase metabolic health<br>☐ Reduce obesity levels in young people | ☐ Engendering positive health behaviors in young people<br>☐ Formalizing the linkages between school-community linked interventions |

*Participants*

A total of 753 elementary students (aged 7 – 12) from the four schools were invited to participate in the evaluation, of which 694 students' (92% response rate) obtained parental consent and assented to take part in the evaluation. All classroom teachers (n=19) in the intervention schools volunteered and consented to participate in the program delivery and evaluation. Program administrators, Head Teachers, School Program Contacts and Heads of PE were also interviewed or completed a questionnaire during or after the program.

184 Evaluation Measures: outcome and process

185 Drawing on mixed methods, the evaluation design consisted of 2 stages: i) outcome - a
186 multi-level evaluation of program outcomes in terms of quantitative data (e.g., physical
187 fitness and attitudinal data); and ii) process – drawing on qualitative data, identification and
188 examination of moderating and mediating variables that influenced program
189 implementation[24]. Ethical approval was obtained from the university institute ethics review
190 board.

191

192 *Outcome Evaluation*

193 Outcome evaluation included physical fitness tests and PA questionnaires which were
194 administered in class and collected prior to Phase 1 (January) and at the end of Phase 2 (July;
195 end of school year) by the evaluation team. All students completed a standardized test
196 battery[27] (FitnessGram®, The Cooper Institute®) assessing anthropometric measurements
197 (including stature, body mass and BMI), aerobic capacity (15 m PACER test), lumbar
198 flexibility (back-saver sit and reach test), muscular strength and endurance (push-up and curl-
199 up test), and trunk flexibility (trunk lift). BMI percentiles were calculated using growth
200 references based on the LMS method[28]. The LMS method accounts for the BMI distribution
201 adjusted for skewness to create smoothing BMI percentile curves or standard deviation values
202 to develop standardized growth charts[28]. All fitness tests were conducted during class PE
203 lessons, performed in pairs, and led using specialized audio CD's that provided verbal test
204 instruction. Students, with the support of teachers and the evaluation team, recorded fitness
205 scores for the push-ups and curl-ups; the evaluation team recorded all other fitness scores.
206 Immediately following the fitness tests, students completed the Physical Activity
207 Questionnaire for Children (PAQ-C) and Children's Attitudes Towards Physical Activity

(CATPA) inventory. The PAQ-C[29] is a 7-day recall questionnaire which measures the extent to which children engage in physical activities. The PAQ-C composite score provides a summary of nine items to assess habitual moderate-to-vigorous PA levels during the school year. The PAQ-C has been shown to have acceptable reliability, and consistent high convergent and construct validity to assess general activity levels in older children[29-30]. As the PAQ-C is valid for individuals 8-14 years of age[29-30], data from seven year olds were excluded from all analyses which included PAQ-C composite scores.

The CATPA inventory[31] was used to quantify the children's attitudes towards PA at baseline and post-intervention. The CATPA represents a measure of attitudes towards PA and has seven subdomains including: health and fitness (improving health and getting into better shape); catharsis (to reduce stress or to get away from problems); social growth (a chance to meet new people); social continuation (a chance to be with friends); vertigo (risk with speed, change of position and location); aesthetic (involvement in beautiful and graceful movements); and ascetic (sacrificing spare time in order to improve by means of hard and long practices). Each question was presented with a brief description of each subdomain. A five point semantic differential scale was used with each of the bipolar adjectives (good-bad, of no use-useful, pleasant-not pleasant, nice-awful, happy-sad). The scoring for each pair was based on 1 to 5, with the higher value considered the more favorable outcome. The CATPA inventory has previously been examined to establish construct validity of 'physical activity' as an attitude object[32]. High internal consistency as measured by Cronbach's alpha of approximately 0.80[33] which support the use of the CAPTA inventory as a valid and reliable measure for assessing group and status change of children toward the construct of physical activity[32-33].

*Process Evaluation*

Semi-structured interviews and questionnaires generated qualitative data to assess staff and student's perceptions of the program. Evaluators distributed two staff questionnaires during the intervention period that asked teachers (n=19) about information received prior to the intervention (e.g., teacher's pack, staff briefing), the 10-day CTS's, the gym equipment and the rewards program. The first questionnaire was administered to teachers immediately following the CTS and 4 wk gym equipment sessions (April). This questionnaire was designed to assess the teachers' perspectives on the information they had received prior to the programme delivery (i.e., how helpful did you find the staff briefing/information booklet before Phase 1?), the Wolfie's Workouts 10-day circuits (Phase 1) (i.e., How did you find incorporating the CTS into your school routine for 10 days?), the gym equipment (i.e., What did you think of the equipment provided for the CTS?), gym sessions the children received (Phase 2) (i.e., Did most children work to maximal effort on each station?; Did most children work as hard on day 10 as day 1? e.g., were they still motivated to get a reward?), and their overall opinion of the Wolfie's Workouts programme so far. At the follow-up sessions (July), teachers were given a second questionnaire which was designed to gain feedback relating to the children's PA diaries, wall charts and rewards, all of which they had been responsible for coordinating, monitoring, and administering during Phase 2. This questionnaire had 14 questions including, but not limited to, 'How did you find incorporating the diaries, wall chart and rewards into everyday school life?'; 'Was it challenging to get the children to complete the diaries?'; 'Did seeing other children receive rewards for completing their diary seem to encourage other children to do it?'. The questionnaires also invited teachers to offer ways the program might be improved.

The charitable organization acted as program administrators in which they managed the funding and implementation of the program. A telephone interview was conducted with the

charity at the end of the intervention roll-out to discuss program design, funding, and school interaction. The charitable organization also provided the results of 'Program Evaluation Questionnaires' which they requested from Head Teachers and School Program Contacts which supported their statements regarding program implementation and fidelity. The Program Evaluation Questionnaires assessed school engagement in the intervention including number of students who invited/received the intervention, number of visits by the 'program administrator' to monitor and record activity levels, general comments about program delivery and staff, and the strength of the partnerships. In order to provide a counterfactual approach, we interviewed the Head of PE at the control school to provide a better understanding of their existing PE and PA programs.

Following Phase 2, the IG (n=467) completed a second questionnaire to assess students' perceptions of the gym equipment (e.g. access, ease of use, enjoyment). Student interviews (n=11) were conducted to assess the overall impact of the program on individuals. One to two students from each year group were invited by the classroom teachers to take part in the interviews based on student's availability, willingness to participate, and receipt of parental consent to engage in the interviews. Interviews asked students about their perceptions of the intervention, the DVD, the CTS, rewards, and the gym equipment. All interviews were audio recorded and transcribed verbatim. Table 2 provides an overview of the different evaluation methods.

**Table 2. Overview of evaluation methods**

| Measure | Variable | Evaluation method |
|---|---|---|
| **Outcome Data** | | |
| | Anthropometry | Body mass, stature, body mass index (BMI) |
| | Physical fitness | FITNESSGRAM® test battery |
| | Attitudinal components | Children Attitudes towards Physical Activity (CATPA) |
| | PA levels | Physical Activity Questionnaire- Children (PAQ-C) |
| **Context Data** | | |
| | Pedagogical approach | Interview with Program Administrator/ Logic Model |
| | Extent/reach of intervention | Final intervention program report (prepared by Program Administrators for the project funders) |
| | Population demographics | Age/gender data from School Program Coordinators<br>Ethnicity data for each evaluation school<br>HMRC data for socio-economic status and ethnicity data for the city |
| **Process Data** | | |
| | Fidelity | Questionnaires: teaching staff<br>Interview with Program Administrator/Logic Model<br>Final intervention program report (including Head Teacher comments)<br>Letters from School Program Coordinators |
| | Implementation | Questionnaires: teaching staff, students<br>Interviews: teaching staff, students, program administrator<br>Final intervention program report (including Head Teacher and School Program Coordinators comments)<br>Letter from Evaluation School Program Coordinator |

*Data Analyses*

A quasi-experimental research design, drawing on rigorous mixed methods and multidisciplinary approaches (e.g., physiological, educational, sociocultural), were utilized to analyze the data. Quantitative data from the first year of the intervention was analyzed using Statistica v. 13 (TIBCO Statistica™). Independent t-tests were performed to determine between-group differences at baselines. Mean group differences were analyzed using a mixed-effect model containing factors for *treatment group* (IG or CG), *year*, *gender* and the interaction between *treatment* and *year* and *gender* as fixed effects, and *class* nested within

the interaction between *treatment group* and *year* as a random effect. As the intervention was delivered at the class level, a secondary model using *class means*, weighted using class size, was performed using the same fixed effects as the initial model. Models were reduced systematically by removing higher order non-significant interactions. Both models used the baseline variable as the covariate and Type 3 sums of squares to test the effects independent to the order of fitting within the model. Univariate analysis of variance tests were performed to determine between-group differences over time for each dependent variable. Physical fitness and questionnaire data was screened for outliers and normality during the analysis using probability plots. Listwise deletion was used for all variables in which only the cases with data from both test dates were included in the analyses. As some variables presented with non-normal distributions, all data was also analyzed using the Mann-Whitney U test for comparison. Probability values $< 0.05$ were considered significant.

Qualitative data were independently analyzed by the evaluation team inductively drawing on elements from Grounded Theory Method[34]. This process involved two levels of analysis: open and focused coding. Open coding involved going through transcripts line-by-line assigning codes that captured the significance of the text. This was followed by a process of focused coding which involved refining the initial coding process by gathering and consuming them under categories that related to the impact of the intervention in terms of process, context, and pedagogy. Both activities were characterized by a process of 'constant comparison'[35], which involved a process of moving between data and categories resulting in the identification of core conceptual themes. Through this process, three themes were constructed: 1) creating a meaningful space, 2) sustaining participation, and 3) student engagement, and are addressed in the following section.

313 RESULTS

314 *Outcome data*

315 Baseline data (n = 646; 335 males, 311 females) suggests that 32% percent of the students
316 were classified in the overweight or obesity category (>85$^{th}$ percentile) which is consistent
317 with the England national average of ~34%[36]. The majority of students (64%) were in the
318 normal BMI (5$^{th}$ -85$^{th}$ percentile), 14% were classified as obese (>95$^{th}$ percentile), and only
319 3% were classified as underweight (>5$^{th}$ percentile). There were no gender differences in
320 weight classification at baseline; nor were there any group differences for age or gender.
321 Table 3 provides the mean data for anthropometric, physical fitness, PAQ-C and CATPA
322 data at baseline and post-intervention.

323

Table 3. Mean values for anthropometric, physical fitness, PAQ-C and CATPA data.

| Variable | N | Baseline Mean (SD) | Post-intervention Mean (SD) |
|---|---|---|---|
| *Anthropometric Characteristics* | | | |
| Age (y) | | | |
| IG | 468 | 9.4 (1.2) | 9.9 (1.2) |
| CG | 121 | 9.5 (1.2) | 9.9 (1.2) |
| Body Mass (kg) | | | |
| IG | 468 | 34.3 (9.6) | 36.0 (10.1) |
| CG | 121 | 35.2 (8.3) | 37.5 (8.7) |
| Stature (cm) | | | |
| IG | 468 | 136.5 (9.3) | 138.8 (9.4) |
| CG | 122 | 138.1 (8.1) | 141.0 (8.5) |
| Body Mass Index ($kg \cdot m^2$) | | | |
| IG | 467 | 18.1 (3.4) | 18.4 (3.5) |
| CG | 121 | 18.3 (3.1) | 18.8 (3.1) |
| BMI percentile | | | |
| IG | 461 | 65.1 (30.5) | 65.7 (30.2) |
| CG | 121 | 66.5 (31.0) | 70.0 (28.3) |
| *Physical Fitness* | | | |
| $VO_2$ max ($ml.kg.min^{-1}$) | | | |
| IG | 447 | 45.8 (3.3) | 45.3 (3.6) |
| CG | 126 | 45.6 (3.2) | 46.9 (4.1) |
| Push-ups | | | |
| IG | 459 | 7.4 (6.7) | 7.2 (6.7) |
| CG | 121 | 5.2 (3.9) | 7.2 (4.5) |
| Curl-ups | | | |
| IG | 455 | 11.9 (9.9) | 12.6 (11.0) |
| CG | 121 | 5.5 (4.7) | 9.3 (6.8) |
| Sit and Reach (Right) (in) | | | |
| IG | 463 | 8.6 (2.4) | 8.4 (2.5) |
| CG | 128 | 8.8 (2.1) | 8.2 (2.4) |
| Sit and Reach (Left) (in) | | | |
| IG | 460 | 8.5 (2.5) | 8.1 (2.5) |
| CG | 128 | 8.4 (2.3) | 7.6 (2.5) |
| Trunk Lift (in) | | | |
| IG | 466 | 4.9 (1.7) | 5.5 (1.8) |
| CG | 121 | 4.8 (1.8) | 5.7 (1.8) |
| *Physical Activity Questionnaire (excludes data from 7 year olds)* | | | |
| PAQ-C Composite Score | | | |
| IG | 378 | 2.6 (0.8) | 3.0 (0.7) |
| CG | 110 | 2.5 (0.7) | 3.0 (0.6) |

| *Children's Attitude Toward Physical Activity* | | | |
|---|---|---|---|
| Health and Fitness | | | |
| IG | 437 | 4.7 (0.7) | 4.7 (0.7) |
| CG | 127 | 4.6 (0.8) | 4.8 (0.5) |
| Catharsis | | | |
| IG | 444 | 3.8 (1.3) | 3.8 (1.3) |
| CG | 127 | 3.7 (1.3) | 3.9 (1.2) |
| Social Growth | | | |
| IG | 443 | 4.1 (1.2) | 4.1 (1.2) |
| CG | 127 | 4.0 (1.2) | 4.2 (1.1) |
| Social Continuation | | | |
| IG | 441 | 4.7 (0.9) | 4.6 (0.9) |
| CG | 127 | 4.7 (0.8) | 4.8 (0.5) |
| Vertigo | | | |
| IG | 445 | 3.2 (1.5) | 3.1 (1.5) |
| CG | 127 | 3.3 (1.5) | 3.7 (1.4) |
| Aesthetic | | | |
| IG | 444 | 3.5 (1.7) | 3.2 (1.6) |
| CG | 127 | 3.2 (1.5) | 3.0 (1.7) |
| Ascetic | | | |
| IG | 444 | 3.1 (1.5) | 3.1 (1.6) |
| CG | 127 | 3.2 (1.6) | 3.1 (1.5) |

Of the 694 students who consented to take part in the evaluation, 128 students in the control school and 468 students in the intervention schools were available for measurement at both test sessions, giving an overall response rate of 86% (596 students). Table 4 provides the results of the reduced mixed effect model comparing individual mean differences for physical fitness, PAQ-C and CATPA data by treatment group following the intervention. At post-intervention, students in both groups increased mean values for all anthropometric measures. However, no individual mean differences were observed between groups for stature, BMI, or BMI percentile ($p > 0.05$). There was a modest 1.8% increase in body mass in the control students compared to the IG ($p = 0.005$). This may have been due, in part, to gender differences between groups ($F = 3.01$, $p = 0.049$) in which the CG boys had a greater increase in mean stature (2.8 ± 1.8 cm) compared to the IG boys (2.1 ± 1.1 cm) ($F= 3.01$, $p = 0.005$).

There was also a random *class* interaction effect between groups showing mean differences in stature (F = 5.89; $p$ <0.001) and BMI percentile (F=2.41, $p$ <0.001).

Drawing from assumptions identified in the Logic Model, it was expected that the PA intervention would improve attitudes towards PA leading to increases in PA levels. At baseline, the CATPA inventory showed that students exhibited relatively positive attitudes towards PA (scores of > 3.1 for all variables), however 45% of students self-reported low levels of PA (PAQ-C score of 1 or 2 at baseline). By post-intervention, students in both groups had similar increases in their mean PAQ-C composite score showing higher levels of PA levels compared to baseline ($p$ > 0.05). However, the control students showed small improvements in the CATPA inventory with improved attitudes toward PA for health and fitness ($p$ = 0.01) and vertigo ($p$ = 0.002). Gender comparisons showed that girls generally had more positive attitudes towards catharsis ($p$ = 0.023), and aesthetics ($p$ < 0.001) compared to boys, whereas boys had a higher mean attitude towards vertigo compared to the girls ($p$ < 0.001). Bivariate correlations were performed to determine if there was an association between changes in attitudes towards PA and increasing PA levels. Both groups showed a positive relationship between attitudes toward PA and PA levels, in which increasing PA levels were associated with attitudes towards catharsis (*rho* = 0.17; $p$ = 0.001) and vertigo (*rho* = 0.15; $p$ = 0.005) in the IG and towards social continuation (*rho* = 0.35; $p$ > 0.001) in the CG.

The PA intervention aimed to increase physical fitness by introducing circuit training sessions and a range of child-size gym equipment to the IG. At post-intervention, no improvements in any of the physical fitness variables were observed in the IG, however the CG showed a positive increase in mean aerobic capacity ($p$ > 0.001), and push-ups ($p$ = 0.05). Correlations showed only the IG had a weak association between increases in aerobic

capacity and improved attitudes towards health and fitness (*rho* = 0.17; $p = 0.002$) and social continuation (*rho* = 0.11; $p = 0.35$). No other changes or significant correlations were observed in attitudes toward PA ($p > 0.05$), PA levels, or physical fitness between treatment groups ($p = 0.51$).

As some of the data sets had non-normal distributions, all data was further analysed using *class means* mixed effect model and Mann-Whitney U test. Table 4 provides the F and *p* values from the reduced *class mean* fixed effect model and the adjusted Z and *p* value from the Mann Whitney U test for further comparison. These analyses revealed increases in the CG for body mass, stature, BMI percentile, aerobic capacity, push-ups, sit and reach left, and the following attitudinal components: health and fitness, social continuation, and vertigo compared to the IG ($p < 0.05$). These findings lend further support that there were no overall effects on attitudinal or physical health outcomes in the IG compared to the CG.

Table 4. Results of the mixed effects model for physical fitness, PA levels and CATPA by treatment group (intervention vs control), including comparison of fixed effect model for *class means* and Mann-Whitney test.

| Variable | N | *Least Square Means Difference* (SE) | 95% CI | $\eta_p^2$ | F | *p* | *Class Means* | *Mann-Whitney (adjusted)* |
|---|---|---|---|---|---|---|---|---|
| *Anthropometric Characteristics* | | | | | | | | |
| Body Mass | | | | | | | | |
| IG | 468 | 1.72 (0.09) | 1.53 to 1.90 | 0.02 | 8.15 | 0.005*‡ | F = 12.0 *p* < 0.001* | Z = -3.13 *p* = 0.002* |
| CG | 121 | 2.59 (0.31) | 1.97 to 3.21 | | | | | |
| Stature | | | | | | | | |
| IG | 468 | 2.28 (0.06) | 2.15 to 2.40 | 0.07 | 2.84 | 0.09§ | F = 8.01 *p* < 0.006* | Z = -3.38 *p* < 0.001* |
| CG | 122 | 2.66 (0.13) | 2.40 to 2.92 | | | | | |
| Body Mass Index | | | | | | | | |
| IG | 467 | 0.28 (0.05) | 0.19 to 0.37 | 0.003 | 1.76 | 0.19 | F = 2.56 *p* = 0.11 | Z = -1.42 *p* = 0.154 |
| CG | 121 | 0.58 (0.16) | 0.27 to 0.89 | | | | | |
| BMI percentile | | | | | | | | |
| IG | 461 | 0.93 (0.47) | 0.01 to 1.86 | 0.004 | 2.41 | 0.12‡§ | F = 5.76 *p* = 0.02 | Z = -1.63 *p* = 0.10 |
| CG | 121 | 2.61 (0.99) | 0.66 to 4.57 | | | | | |
| *Physical Fitness* | | | | | | | | |
| $VO_2$ max | | | | | | | | |
| IG | 447 | -0.52 (0.15) | -0.81 to -0.23 | 0.06 | 14.71 | >0.001*‡§ | F = 28.9 *p* < 0.001* | Z = -6.40 *p* < 0.001* |
| CG | 126 | 1.31 (0.32) | 0.67 to 1.92 | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Push-ups | | | | | | | | |
| IG | 459 | 0.08 (0.27) | -0.46 to 0.61 | 0.01 | 7.81 | 0.005*‡ | F = 5.22 *p* = 0.03* | Z = -4.39 *p* < 0.001* |
| CG | 121 | 1.75 (0.53) | -0.70 to 2.79 | | | | | |
| Curl-ups | | | | | | | | |
| IG | 455 | 1.43 (0.45) | 0.54 to 2.32 | 0.00 | 0.49 | 0.48‡ | F = 1.01 *p* = 0.32 | Z = -4.01 *p* < 0.001* |
| CG | 121 | 0.72 (0.89) | -1.04 to 2.47 | | | | | |
| Sit and Reach (Right) | | | | | | | | |
| IG | 463 | -0.17 (0.08) | -0.33 to -0.01 | 0.02 | 1.51 | 0.23‡§ | F = 2.61 *p* = 0.11 | Z = 2.61 *p* = 0.009* |
| CG | 128 | -0.33 (0.20) | -0.72 to 0.06 | | | | | |
| Sit and Reach (Left) | | | | | | | | |
| IG | 460 | -0.44 (0.08) | -0.59 to -0.29 | 0.02 | 0.94 | 0.34‡§ | F = 2.95 *p* = 0.09* | Z = 1.39 *p* = 0.161 |
| CG | 128 | -0.58 (0.19) | -0.96 to -0.21 | | | | | |
| Trunk Lift | | | | | | | | |
| IG | 466 | 0.82 (0.08) | 0.67 to 0.98 | 0.004 | 0.14 | 0.71‡§ | Z = 0.11 *p* = 0.74 | Z = -0.22 *p* = 0.823 |
| CG | 121 | 0.86 (0.19) | 0.49 to 1.25 | | | | | |
| *Physical Activity Questionnaire (excludes data from 7 year olds)* | | | | | | | | |
| PAQ-C Composite Score | | | | | | | | |
| IG | 378 | 0.48 (0.04) | 0.41 to 0.55 | 0.005 | 0.44 | 0.51‡§ | F = 0.12 *p* = 0.74‡ | Z = 0.15 *p* = 0.87 |
| CG | 110 | 0.40 (0.09) | 0.22 to 0.58 | | | | | |
| *Children's Attitude Toward Physical Activity* | | | | | | | | |
| Health and Fitness | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| IG | 437 | 0.01 (0.03) | -0.04 to 0.07 | 0.01 | 6.11 | 0.01*‡ | F = 10.7 *p* = 0.002*‡ | Z = -2.06 *p* = 0.04* |
| CG | 127 | 0.12 (0.05) | 0.02 to 0.22 | | | | | |
| Catharsis | | | | | | | | |
| IG | 444 | -0.009 (0.07) | -0.14 to 0.12 | 0.002 | 0.19 | 0.66‡§ | F = 2.24 *p* = 0.14‡ | Z = -1.28 *p* = 0.19 |
| CG | 127 | 0.07 (0.15) | -0.23 to 0.38 | | | | | |
| Social Growth | | | | | | | | |
| IG | 443 | 0.03 (0.06) | -0.08 to 0.15 | 0.000 | 0.01 | 0.92‡§ | F = 3.28 *p* = 0.08‡ | Z = -1.06 *p* = 0.29 |
| CG | 127 | 0.02 (0.14) | -0.25 to 0.28 | | | | | |
| Social Continuation | | | | | | | | |
| IG | 441 | -0.05 (0.04) | -0.13 to 0.03 | 0.01 | 2.03 | 0.16‡ | F = 5.20 *p* = 0.03*‡ | Z = -1.09 *p* = 0.28 |
| CG | 127 | 0.07 (0.09) | 0.11 to 0.26 | | | | | |
| Vertigo | | | | | | | | |
| IG | 445 | -0.06 (0.07) | -0.20 to 0.08 | 0.11 | 10.3 | 0.002*‡§ | F = 10.4 *P* < 0.002*‡ | Z = -2.61 *p* =0.009* |
| CG | 127 | 0.63 (0.17) | 0.30 to 0.95 | | | | | |
| Aesthetic | | | | | | | | |
| IG | 444 | -0.25 (0.07) | -0.38 to -0.10 | 0.007 | 0.05 | 0.82‡§ | F = 0.66 *p* = 0.42‡ | F = 0.36 *p* = 0.72 |
| CG | 127 | -0.28 (0.17) | -0.61 to 0.05 | | | | | |
| Ascetic | | | | | | | | |
| IG | 444 | 0.01 (0.08) | -0.14 to 0.17 | 0.008 | 0.05 | 0.82‡§ | F = 0.03 *p* = 0.87‡ | F = 0.03 *p* = 0.97 |
| CG | 127 | -0.01 (0.18) | -0.37 to | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 0.35 | | | | | |

Note: *, significantly different at $p < 0.05$;
‡, baseline variable was a significant covariate at $p < 0.05$;
§, significant nested *class* effect interaction between *treatment group* and *year*
†, significant crossed *class* gender* random effect interaction between *treatment group* and *year*.

*Process data*

Three core themes were constructed following qualitative data analysis: 1) creating a meaningful space, 2) sustaining participation, and 3) student engagement (see Table 5). Under Theme 1, teachers identified the key pedagogical role of external instructor in 'selling' the program in terms of presence, sustaining progression, and motivation (see Cat. A). In terms of content and resources (Cat. B), the novelty value of the program was clearly a factor in stimulating both student and teacher's initial interest. Teachers were cognizant that the success of the intervention was dependent on the quality of the interaction (Cat. C). Initially, instructors supported teachers by delivering some demonstrations and providing resources. This support, however, was not deemed sufficient in developing teacher's autonomous levels of pedagogical content knowledge in PA. Yet beyond the novel experience that generated student excitement and curiosity, the strategy to use teachers to deliver activities post- Phase 1 had a negative effect because teachers lacked the training and self-efficacy to independently deliver the program.

Program aspirations sought to influence sustained participation in PA (Theme 2) beyond the school with PA diaries and community equipment access. For example, the transfer of children's gym equipment to a community setting was designed to facilitate students' engagement in an informal and self-directed way, but only a small proportion of students reported usage (27% of IG reported usage during the last 7 days of the intervention).

Similarly, exercise diaries attempted to bridge the PA space between school and home; however, their application appeared limited because teachers stated many students did not complete the diary (Cat. A). As teachers identified in Cat B., there was a need for greater engagement with parents on the purpose of the intervention to reinforce the messages communicated through school PA. Findings clearly resonate with the research literature where behavioral change is the outcome of both intrinsic motivation and external localized support[4-7].

In regards to student engagement (Theme 3), students responded positively about the program with most stating they would participate in the program again. In particular, students enjoyed smaller group interactions, which provided a more personalized experience in comparison to a traditional PE delivery (Cat. A). Head teachers reported a positive opinion of the program, though this was not always reflected by teachers' comments. Some teachers, for example, stated that the program was a good idea, but found it difficult to engage students to complete the diaries and to continue with the program post intervention.

The interview with the Head of PE at the control school presented a different approach to sport within their school compared to the intervention schools. In this school there was an established and embedded cultural approach to PA which emphasized the importance of '*creating a culture of sport which is embedded into the school philosophy'*. They stated that this is achieved by providing '*high quality PA provision'* by having '*qualified PE teachers deliver PE sessions which allows teacher relief*' for subject specialists, and by '*providing PE staff CPD to improve their range of skills (e.g., gymnastics, swimming)*'. They also stated that '*the focus is not to hire people who are sporty or PA focused, rather the school places a huge emphasis on sport and PA.*' Examples of this included: '*placing a huge emphasis on Sports Day'*, '*embedding Sport Relief (UK national charity) days into the school calendar in which*

*kids do no math or literacy that day*', '*provide lots of sports teams*' for student opportunities, and '*special sport provision for student with special needs with the focus to improve motor skill development'* which has a beneficial impact on class learning.

**Table 5. Staff and student perceptions of the intervention program.**

| Theme | Category | Quotes |
|---|---|---|
| 1. Creating a meaningful space | A. Pedagogical role of the instructor in 'selling' the program | "*There was minimum support given from the company 'running' the project, which resulted in relying on teaching staff, of which, some are new and not confident in this area*" (School Program Coordinator) |
| | | "*Someone needs to organize, run day-to-day and not increase the teaching staff's already heavy workload*" (Year 5 Teacher) |
| | | "*There needs to be more visibility in school by [intervention program] staff to help motivate*" (Year 4 Teacher) |
| | | "*Staff need to come in when they say they will as many students only had one go on the gym equipment*" (Year 4 Teacher) |
| | | "*Staff felt a lot of the work needed to be done to promote and run the project… was left to them, which was extra work they didn't need at the time*" (School Program Coordinator) |
| | B. Novelty value of the program, in terms of intervention content and resources | 96% of the students stated they enjoyed using the children's gym equipment and would like to use the equipment again in the future. (Student Questionnaire) |
| | | "*The circuit equipment was brilliant, the students were very focused as had not experienced anything like this before, we need to purchase for school*!" (Year 4 Teacher) |
| | | "*Yes, the gym equipment was good because I hadn't been on it before. And it was good, because like we did different things that you wouldn't get to do every day because we can't go to the gym, because we're not sixteen yet*" (Student) |
| | | Students' stated that the ski walker (34%) and cycle (32%) were the favorite pieces of equipment; leg extension and bicep/tricep machine (<3%) was their least favorite. (Student Questionnaire) |
| | | "*Phase 2 was over-subscribed in many schools so more sessions have been put on to accommodate*" (Program Administrator) |
| | C. Quality of the interaction | "*Day 1 the children should have been shown a DVD to promote the project, this was not received until Day 3, by which time the project was up and running*" (School Program Coordinator) |
| | | "*Students wanted to go on gym equipment every week but due to staff member not coming in the students only had one session on* |

| | | |
|---|---|---|
| | | *the equipment which was really disappointing for the students*" (Year 3 Teacher) |
| | | "*Overall after talking to the staff in school, the project did have a negative impact which resulted in a lot of staff not wanting to take part in the future*" (School Program Coordinator) |
| 2. Sustaining Participation | A. Bridging PA space between school and community | Only 27% of students reported using the equipment outside of school in the last 7 days at post-intervention. (Student questionnaire) |
| | | *"… me and my friend we went to the park and there was like the exercise things, like the ones that you had but like metal ones. Yes, we used those"* (Student) |
| | | 89% of the teachers said 'yes' it was a challenge to get the children to complete the diaries, only one teacher said 'no' and one was 'unsure'. (Staff questionnaire) |
| | B. Family support | "*Maybe a meeting for parents to explain the program and aims*" (Year 3 Teacher) |
| | | "*A parents meeting to explain their role, how to fill out the PA diaries and what activities they could encourage their child to take part in*" (Year 3 Teacher) |
| | | "*Students have enjoyed participating in the organized event but were not good at carrying it on, though I tried to encourage, they kept losing the diary*" (Year 4 Teacher) |
| 3. Student Engagement | A. Students' responses | "*It was a good program because it keeps you fit and also you get more involved in doing a normal ration of PE. Sometimes PE lessons can be a bit more boring because there's only like one or two teachers and they're teaching one group, while the other groups don't know what they're doing. But this time it's like a smaller group and [the instructor] can speak to all of us at one time*" (Student, Year 3) |
| | | Seven of the eleven students interviewed said the PA program was good exercise, good for your health or mentioned keeping fit. (Student interviews) |
| | | "*I remember that the circuits were quite good because everyone's got something to do at one time. It makes you feel better because you can improve your score each time*" (Student interview) |
| | | *"The machines, because they're more exciting than just doing games and simple PE stuff, so it gets you more involved in what you're doing" (*Student interview) |
| | | Only a third of the students (n=157) received the basic prize (sports bottle), with only 16 students achieving the gold certificate (the top prize). (Student Questionnaire) |
| | B. Staff | *"The program allows children, in a short space of time, to engage with a range of physical activities that challenge them* |

| | |
|---|---|
| perceptions | *and increase their fitness levels. All children of all abilities have approached the project with enthusiasm and confidence" (Head Teacher)*<br>*"Too long, no motivation and children got bored"* (Year 4 Teacher)<br>"*…unfortunately the children had very little enthusiasm for earning the certificates*" (Year 5 Teacher) |

## DISCUSSION

This paper reports findings from the evaluation of a multicomponent PA intervention program delivered to students aged 7-12 years. In examining program mechanisms and processes that facilitate or inhibit PA behavioral change, the authors drew from the fields of education, cultural studies, physical activity and health in developing a more nuanced understanding of behavioral change required to increase levels of PA among school students.

Quantitative analysis identified that the intervention program had no impact on facilitating an increase in PA levels, attitudes towards PA or physical fitness above that of the CG. Qualitative data suggested that the program was received positively by both teachers and students; however the intervention program lacked theoretical underpinning in terms of program design and behavior change. Overall, findings suggest program designers need to move beyond the initial novelty value of an intervention, and consider the impact of PA interventions in the context of school-community collaborations.

### *Physiological and attitudinal outcomes*

Previous research has acknowledged that school-based PA interventions may be effective in increasing duration of PA, and that students exposed to PA intervention programs are more likely to engage in moderate to vigorous PA during the school day compared to those not involved in an intervention[10]. However, despite the limitations of using a self-report

448 questionnaire to assess PA, student's in both groups reported higher levels of PA engagement
449 at post-intervention, suggesting that changes in activity levels were likely due to some other
450 reason such as social desirability bias, seasonal variations (e.g. better weather conditions,
451 increase in daylight hours)[30,37], and not the PA intervention itself. We also observed no
452 positive change in IG attitudinal response towards PA above that of the CG; in fact we
453 observed a slight decline in some attitudinal components in the IG group. However, it did
454 seem that improved attitudes towards catharsis, vertigo, and social continuation had a positive
455 impact on PA levels in some students. The increases in BMI observed in both groups may
456 have been due to a number of reasons including pubertal development, excess food intake,
457 and potentially some positive improvements in physical fitness levels during this time period.
458 The control school, although having some lower physical fitness scores at baseline, seem to
459 have an embedded sports culture within the school, which may have led to the improvement
460 in levels of physical fitness and positive attitudes towards PA observed.
461 Similar findings have been supported by a number of meta-analyses and systematic
462 reviews[11-12, 38-41] which have questioned the causal role of PA levels, compared to the role of
463 dietary change, to tackle rising childhood obesity levels. Our findings show that although
464 there were significant differences in body mass between groups following the intervention,
465 this did not translate into a similar reduction in mean BMI or BMI percentile. Nor were there
466 any positive relationships between PA levels with any anthropometric or physical fitness
467 variable. Physical fitness in the IG was maintained or slightly declined for all outcome
468 measures; in fact, it was the CG that had improvements in aerobic capacity and upper body
469 muscle strength compared to the IG. However as the intervention was delivered at the *class*
470 level, and led by individual teachers, it is worth noting that body mass, stature and BMI
471 percentile were reportedly higher according to the *class mean* analysis in the CG compared to

the IG. Further analysis revealed that this was primarily due to a few classes in the control school having taller and heavier boys in the upper classes. Dobbins' and colleagues[11], for example, highlighted a mixed response to changes in BMI following school based PA interventions in which over 50% of the papers reviewed (n=44) did not report a significant reduction in BMI. This data, in combination with our findings of the sustained BMI percentile observed in both groups, supports the complex nature and variability of BMI during middle childhood and adolescence.

*Factors affecting program implementation and delivery*

The combination of the teacher's responses on the questionnaires, the interviews with the program administrator from the charitable organization, and the responses from the Head Teachers and School Program contacts were utilized to triangulate the data in order to assess the fidelity, delivery and implementation for each Phase and elements of the intervention program. We identified a number of issues concerning program design and implementation that may explain why there was no positive change in attitude, PA levels, or physical fitness above that of the CG. Whilst there was an attempt to draw from a multidisciplinary public health team in the design of the intervention, the program team was not able to identify theories of PA program design or behavioral change, nor was there a mention of pedagogical concepts (e.g., the interdependent relationship between educators, students, knowledge) towards content or program delivery. It was also notable that at the planning stage, there was no direct contact with teaching staff to incorporate and understand the school's interest or culture towards PA. This may have led to a lack of school ownership resulting in inconsistencies in program delivery as it was reliant on external providers to 'sell' the program without understanding local school context. Although, the intended activities of the

program design and expectations identified important mediating variables (i.e., parental and peer support, role modeling, motivational rewards) the mechanisms by which PA engagement would be transitioned *between* school and community was not articulated.

In order to fully understand findings, we drew from a sociocultural learning perspective[21]. From this lens, aspirations to facilitate positive PA behavior were limited because the intervention appeared to characterize student learning in narrow and passive terms (e.g., traditional didactic pedagogies). In contrast, sociocultural learning theories conceive learning as the outcome of individuals' social interactions (inter and intrapersonal processes) within specific cultural spaces, and where knowledge is constructed through sense-making (e.g., where individuals see the relevance of an experience)[42-43]. Put another way, young people see the importance of PA behaviors if it is relevant and authentic to the multiple social spaces they occupy. Hence, while there was an attempt to relocate exercise equipment into the community, and use PA diaries and parental support as linkages between school and home, evidence suggested that unproductive use of these resources resulted in a lack of behavioral change between school and community (an aspiration of the intervention). In this regard, the utility of the Logic Model for program designers can be helpful in the planning phase to illuminate the theory of change in which social programs are intended to have an impact on participants, particularly where aims can be ambiguous and the pathways to behavioral change are opaque.

At an organizational level, it is clear that schools and external communities are rich in culture and context, which in turn act as powerful learning determinants through the interpretive processes of sensemaking[21]. One of the most explicit findings from the evaluation was how the intervention was perceived (by teachers and students) as a curriculum 'novelty' and 'bolt on'. A wealth of research has argued that PA interventions that are not

520 embedded in school culture, and supported by the curriculum, are unlikely to have a sustained
521 or generative impact on improving children's metabolic health profile[10-11, 38]. Indeed, a clear
522 finding from the evaluation was the lack of teacher support in terms of sustained engagement.
523 Buchan and colleagues[44] have previously highlighted the importance of strong relationships
524 between teachers and participants in facilitating and managing delivery of the program. This
525 approach was evident within the control school, as the Head of PE described a strong PA
526 school culture, led by enthusiastic and well-trained staff, which created an environment that
527 fostered the importance of PA across the curriculum. It is unsurprising, therefore, that the
528 control school showed higher levels of improvements in PA levels, physical fitness and in
529 some attitudinal components. From a sociocultural perspective, behavioral change towards
530 PA is the product of 'situatedness'[45] and this suggests that school and community culture can
531 be either a mediating variable or a source of resistance to learning and change. Researchers
532 and educators who abbreviate the impact of school-community relationships when delivering
533 an intervention run the risk of limiting individual engagement by neglecting school-
534 community PA variations that young people must navigate.
535 A unique feature of the program was the repositioning of children's gym equipment into
536 community spaces. While students acknowledged their presence, there was limited evidence
537 they engaged with them in any meaningful and sustainable way. Parental evaluation was
538 omitted as the intervention program design team were sensitive to any increased demands
539 that would be required from parents. Thus, the inability to engage with parents or community
540 facilities during or after the evaluation period limited the ability to understand the extent by
541 which culture within the home and community may have played in our findings.
542 Drawing from the work of Morgan et al.[8] and Conn et al.[18], program content indicated
543 community/cultural relevance was only addressed in terms of surface structure (e.g. location

544 of equipment). It has been argued that sustainable change is an outcome of being aware of the
545 cultural relevance when deep structures are addressed (e.g., beliefs, values and norms)[8,18].
546 The implications for PA intervention designers are the construction of relevant pedagogies
547 that specifically address cultural differences in body type preferences, family expectations,
548 and beliefs about PA within school-community collaborations. Hence, in addressing the
549 knowledge-practice gap that is a feature of PA school-community programs[17], there is a need
550 for pedagogical strategies that facilitate student's reflection, introspection, and critique in the
551 construction of PA behavior that might then transition across school-community
552 relationships.
553 *Application of findings*
554 In this paper, the application of a sociocultural perspective of learning offers researchers a
555 new perspective from which to examine the complex interactions between sociocultural
556 factors and individual agency in engendering PA behavioral change. Research is clear that
557 knowledge is always recontextualized when transmitted between different contexts [20-21] and
558 therefore PA interventions need to make explicit how students 'learn' about PA in different
559 social spaces, and the need to equip them with the cognitive skills that allow them to
560 transition behaviors between school and community.
561 Contemporary research in PA and health has argued that PA interventions require a
562 multicomponent approach that draws support from across multiple sectors and
563 environments[15]. In this evaluation, however, a multicomponent and multisector approach was
564 not sufficient to create positive behavior change towards PA. This may be, in part, due to a
565 limited evidence-based rationale for the intervention design and appreciation of behavioral
566 change theory. In any intervention that seeks individual behavior change there is a need to

draw from pedagogical approaches that reflect localized context such as school/community culture, norms and values.

Although a relatively recent endeavor, there is increasing consensus in the health literature to focus on culture as it applies to a shared understanding of beliefs, actions, artifacts and practices[18,46]. The utility of describing culture in this way is to acknowledge that it does not relate solely with a specific ethnic identity, nor does it hold that all members of a group align with the values and practices of the group[46]. Rather, culture is produced and reproduced through the practices, interactions, and communications of specific human activity[20]. Consequently, a central reason for promoting culture in PA research is to acknowledge the significant impact of culture in shaping how we feel, behave and think[47]. For McGannon & Smith[48], ignoring culture in PA interventions can lead to a decrease in PA participation through feelings of distress and alienation. The implications for future PA research is that a cultural perspective addresses how the culture of the individual (e.g., intrapersonal factors, interpersonal processes) interact with the culture of the situation (e.g., school/community norms)[20-21], and offers a conceptual lens from which to understand the variability of success that school-community based intervention programs have reported[49].

## TRANSLATION TO HEALTH EDUCATION PRACTICE

This evaluation provides an examination of the pedagogical underpinning and the situational factors that affected the outcomes of a school-community based intervention. In this context, we argue that sustained PA behavior change requires a sociocultural approach as it considers not only the pedagogical interactions at a school level but also the impact beyond the intervention. In the planning phase, early engagement of teaching staff, parents and students is necessary to increase ‘ownership’ and increases the likelihood of a sustainable

591 program that meets the cultural and socio-economic needs of the students/families. In so
592 doing, learning designers should create culturally relevant program content which takes into
593 account moderating variables (e.g., age, gender, cultural beliefs) that will facilitate greater
594 engagement of family and community interaction.
595 The findings from this evaluation also demonstrate the need for practitioners and
596 researchers in education, pedagogy, physical activity and health to develop more
597 sophisticated understandings of the behavior changes required to increase levels of PA among
598 young people. Stakeholders should make explicit the mechanisms of behavior change and
599 how these outcomes will be assessed (e.g., interpersonal, intrapersonal, organization,
600 community). This requires a coherent strategy, and theory of change between different phases
601 of the intervention (e.g., preparation, implementation, and appropriation) to ensure different
602 components of the program achieve the intended impact on participants. Specifically, how
603 young people engage in PA when moving *in* and *betwee*n different contextual spaces can be
604 used by public health organizations as a tool to understand the pedagogical and situational
605 factors that influence sustainable PA behavior change. This also has implications for
606 practitioners for the on-going professional development and support of teachers charged with
607 engendering positive PA behaviors. In addressing the criticisms of interventions that are
608 characterized by short term, 'bolted on' activities, there is also a need to design school-
609 community interventions that are underpinned by pedagogical and behavioral change theory
610 which can be embedded into school culture and the wider academic curriculum. Finally, we
611 argue that the evaluation model used in this study supports the need to broaden the
612 conceptual lens from which to examine the impact of PA interventions. Research has tended
613 to focus on the agency between the individual and specific intervention activities with less
614 attention given to the wider impact of school/community culture on the development of

615 positive PA behaviors, and it is here that this paper contributes to existing knowledge on PA
616 levels and improving physical fitness.
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619 References


620 1. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and
621 adolescence on morbidity and premature mortality in adulthood: systematic review.
622 *Int J Obesity*. 2011;35:891–898.

623 2. Doolittle S, Rukavina P. Case study of an institutionalized urban comprehensive
624 school physical activity program. *J Teach Phys Educ.* 2014;33(4):528-557.

625 3. Goh T, Hannon J, Webster C, Podlog L, Brusseau T, Newton M. Effects of a
626 classroom-based physical activity program on children's physical activity levels. *J*
627 *Teach Phys Educ*. 2014;33(4):558-572.

628 4. Telama R, Yang X, Viikari J, Valimaki I, Wanne O, Raitakari O. Physical activity
629 from childhood to adulthood: a 21-year tracking study. *Am J Prev Med*.
630 2005;28(3):267-273.

631 5. Heath GW, Parra DC, Sarmiento OL, et al. Lancet Physical Activity Series Working
632 Group. Evidence-based intervention in physical activity: lessons from around the
633 world. *Lancet.* 2012;380:272–281.

634 6. Koh H, Oppenheimer S, Massin-Short S, Emmons K, Geller A, Viswanath K.
635 Translating research evidence into practice to reduce health disparities: a social
636 determinants approach. *Am J Public Health*. 2010;100:S72-S80.

637 7. Golden SD, Earp JL. Social ecological approaches to individuals and their contexts:
638 twenty years of HEB health promotion interventions. *Health Educ Behav*.
639 2012;39(3):364–372.

8. Morgan PJ, Young MD, Smith JJ, Lubans DR. Targeted health behavior interventions promoting physical activity: a conceptual model. *Exer Sport Sci Rev.* 2016;44(2):71-80.

9. Lubans D, Foster C, Biddle S. A review of mediators of behavior in interventions to promote physical activity among children and adolescents. *Prev Med*. 2008;47(5):463-470.

10. Metcalf B, Henley W, Wilkin T. Effectiveness of intervention on physical activity of students: systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird54). *Brit Med J*. 2012;345:e5888.

11. Dobbins M, Husson H, De Corby K, LaRocca R. School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6-18 (Review). *Cochrane Database Syst Rev* (online), 2013;2:CD007651.

12. Centeio E, Erwin H, Castelli D. Comprehensive school physical activity programs: characteristics of trained teachers. *J Teach Phys Educ*. 2014;33(4):492-510.

13. Kriemler S, Meyer U, Martin E, van Sluijs E, Andersen L, Martin B. Effect of school-based interventions on physical activity and fitness in students and adolescents: a review of reviews and systematic update. *Brit J Sport Med.* 2011;45(11):923-930.

14. Pardo BM, Bengoechea E, Lanaspa E, et al. Promising school based strategies and intervention guidelines to increase physical activity of adolescents. *Health Educ Res*. 2013; 28(3):523-538.

15. Adab P, Pallan MJ, Lancashire ER, et al. Effectiveness of a childhood obesity prevention programme delivered through schools, targeting 6 and 7 year olds: cluster randomised controlled trial (WAVES study). *Brit Med J.* 2018;360:k211.

16. Harris KC, Kuramoto LK, Schulzer M, Retallack JE. Effect of a school based physical activity interventions on body mass index in children: a meta-analysis. *Can Med Assoc J*. 2009;180(7):719-726.

17. McLennan N, Thompson J. *Quality Physical Education (QPE): Guidelines for Policy-makers.* Paris, FR: UNESCO Publishing; 2015.

18. Conn VS, Chan K, Banks J, Ruppar T, Scharff J. Cultural relevance of physical activity intervention research with underrepresented populations. *Int Q Community Health Educ*. 2014;34(4):391-414.

19. World Health Organization. *Report of the Commission on Ending Childhood Obesity*. Geneva, CH; World Health Organization; 2016.

20. Hager P, Hodkinson P. Moving beyond the metaphor of transfer of learning. *Brit Educ Res J*. 2009;35(4):619-638.

21. Hodkinson P, Biesta G, James D. Understanding learning culturally: overcoming the dualism between social and individual views of learning. *Vocat Learn.* 2008;1:27-47.

22. Mandigo J, Francis N, Lodewyk K, Lopez, R. *Position Paper: Physical Literacy for Educators*. Ottawa, CA: Physical and Health Education Canada; 2009.

23. HM Revenue & Customs. Personal tax credits: children in low-income families local measure:2012. Gov.UK Website. https://www.gov.uk/government/statistics/personal-

682 tax-credits-children-in-low-income-families-local-measure-2012-snapshot-as-at-31-
683 august-2012
684 24. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health
685 promotion programs. *Health Educ Behav*. 1988;15(4):351-377.
686 25. Armour K, Makopoulou K. Great expectations: teacher learning in a national
687 professional development programme. *Teach Teach Educ*. 2012;28:336-346.
688 26. W.K. Kellogg Foundation. *Logic Model Development Guide: Using Logic Models to*
689 *bring Together Planning, Evaluation, and Action*. Battle Creek, MI: W.K. Kellogg
690 Foundation; 2004.
691 27. Cooper Institute. *Fitnessgram®/Activitygram® Test Administration Manual*.
692 Champaign, IL: Human Kinetics; 2010.
693 28. Cole TJ, Freeman JV, Preece M. Body mass index reference curves for the UK, 1990.
694 *Arch Dis Child.* 1995;73:25-29.
695 29. Kowalski KC, Crocker PRE, Faulkner RA. Validation of the physical activity
696 questionnaire for older children. *Pediatr Exer Sci*. 1997;9:174–186.
697 30. Crocker PR, Bailey DA, Faulkner RA, Kowalski KC, McGrath R. Measuring general
698 levels of physical activity: preliminary evidence for the Physical Activity
699 Questionnaire for Older Children. *Med Sci Sports Exerc.* 1997; 29(10):1344–1349.
700 31. Schutz RW, Smoll FL, Carre FA, Mosher RE. Inventories and norms for children's
701 attitudes toward physical activity. *Res Q Exerc Sport*. 1985;56(3):256-265.
702 32. Schutz RW, Smoll FL, Wood TM. Physical activity and sport: attitudes and
703 perceptions of young Canadian athletes. *Can J Appl Sport Sci*. 1981a;6:32-39.

704 33. Schutz RW, Smoll FL, Wood TM. A psychometric analysis of an inventory for
705 assessing children's attitudes towards physical activity. *J Sport Psych*. 1981b;4:321-
706 344.

707 34. Charmaz K. *Grounded Theory: A Practical Guide through Qualitative Analysis*.
708 London, UK: Sage Publications; 2006.

709 35. Glaser G, Strauss A. *Discovery of Grounded Theory: Strategies for Qualitative*
710 *Research*. Chicago, IL: Aldine Transaction; 1967.

711 36. Eastwood P. *Statistics on Obesity, Physical Activity and Diet.* Leeds, UK: The NHS
712 Information Centre; 2013.

713 37. Tucker P, Gilliland J. The effect of season and weather on physical activity: a
714 systematic review. *Public Health*. 2007;121(12):909-922.

715 38. Harris KC, Kuramoto LK, Schulzer M, Retallack J. Effect of a school based physical
716 activity interventions on body mass index in children: a meta-analysis. *Can Med*
717 *Assoc J*. 2009;180(7):719-726.

718 39. Guerra PH, Nobre MRC, Silveira JAC, Taddei JAAC. The effect of a school-based
719 physical activity interventions on body mass index: a meta-analysis of randomized
720 trials. *Clinics.* 2013;68:1263-1273.

721 40. Friedrich RR, Schuch I, Wagner MB. Effect of interventions on the body mass index
722 of school-age students. *Rev Saude Publica.* 2012;46(3):551–60.

723 41. Kriemler S, Meyer U, Martin E, van Sluijs EM, Andersen LB, Martin BW. Effect of
724 school-based interventions on physical activity and fitness in children and

725 adolescents: a review of reviews and systematic update. *Brit J Sports*
726 *Med.* 2011;45(11):923-930.

727 42. Kemmis S. Research for praxis: knowing doing. *Pedagogy Cult Soc.* 2010;18:9-27.

728 43. Weick KE, Sutcliffe KM, Obstfeld D. Organizing and the process of sensemaking.
729 *Organization Science.* 2005;16(4):409–421.

730 44. Buchan D, Ollis S, Thomas N, Baker J. Physical activity behavior: an overview of
731 current and emergent theoretical practices. *J Obes*. 2012;1-11.

732 45. Lave J, Wenger E. *Situated Learning: Legitimate Peripheral Participation*.
733 Cambridge, UK: Cambridge University Press; 1991.

734 46. Napier AD, Ancarno C, Butler B, et al. Culture and health. *The Lancet*.
735 2014;384(9954):1607-1639.

736 47. Smith, B. Narrative inquiry: ongoing conversations and questions for sport and
737 exercise psychology research. *Int Rev Sport Exerc Psych.* 2010;3(1):87-107.

738 48. McGannon KR, Smith B. Centralizing culture in cultural sport psychology research:
739 the potential of narrative inquiry and discursive psychology. *Psych Sport Exerc.*
740 2015;17:79-87.

741 49. McCuaig L, Hay PJ. Towards an understanding of fidelity within the context of
742 school-based health education. *Crit Public Health*. 2014;24(2):143-158.

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