

# Evaluation of a school–community linked physical activity intervention targeting 7- to 12-year-olds

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

3

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15

16

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

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

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

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

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

87 interventions need to develop not only physical fitness but also the physical literacy of young  
88 people<sup>22</sup>.

89

## 90 Purpose

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

96

## 97 Methods

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

101

### 102 *Physical Activity Intervention*

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

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

116

### 117 *Intervention Delivery*

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

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

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

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

144

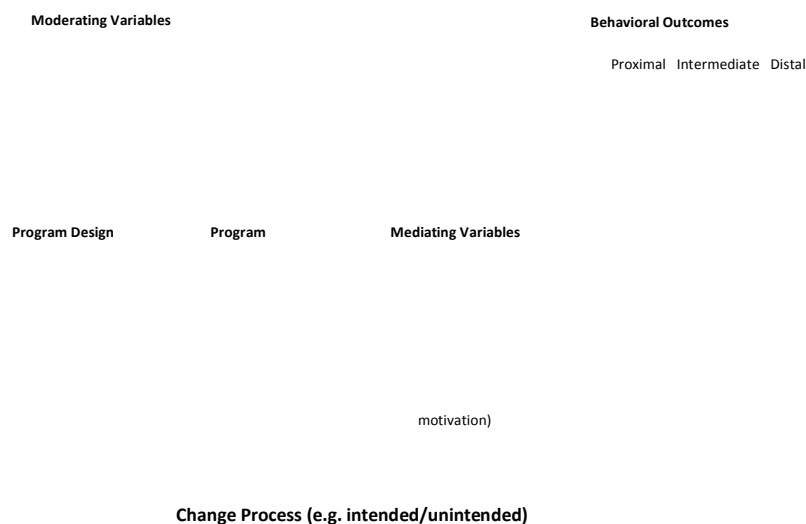
#### 145 *Evaluation Design*

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

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



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



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

161  
162 At the start of the evaluation, the team sought to clarify program expectations and  
163 underpinning assumptions. Following recommendations by Armour and Makopoulou<sup>25</sup>, a  
164 Logic Model<sup>26</sup> (see Table 1) was co-constructed between researchers and key stakeholders  
165 (i.e., program designers, program administrators, fitness instructor) to establish the following  
166 areas of the program: 1) identify theory of change that underpinned the intervention, 2)  
167 resources and activities used to facilitate change, and 3) perceived outputs, outcomes, and  
168 impact. The utility of the Logic Model offered evaluators the opportunity to identify implicit  
169 and explicit assumptions that shaped, mediated, and delivered program aims and allowed for  
170 examination of the theory of change that underpinned the intervention. Interviews with the

171 Head of PE at the control school, supported by outcome data, allowed us to address a  
 172 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  Educating students about the benefits of PA will increase activity levels  Schools provide a facility to engage students in PA  Change is positive	<input type="checkbox"/> 1 Fitness Instructor <input type="checkbox"/> Local sporting role models and team mascot to motivate students <input type="checkbox"/> Specialist students' gym equipment <input type="checkbox"/> Program funding administered by local charitable organization <input type="checkbox"/> Parental support	<input type="checkbox"/> Resource materials, DVD and score cards <input type="checkbox"/> Deliver circuit training sessions <input type="checkbox"/> School and community based access to specialized kids gym equipment <input type="checkbox"/> Rewards program <input type="checkbox"/> Independent evaluation research commissioned	<input type="checkbox"/> Increasing PA levels in students <input type="checkbox"/> Improving students' awareness of the importance of PA, exercise intensity and the health benefits <input type="checkbox"/> Increase students' overall fitness levels	<input type="checkbox"/> Decrease BMI <input type="checkbox"/> Increase positive attitudes towards PA <input type="checkbox"/> Increase metabolic health <input type="checkbox"/> Reduce obesity levels in young people	<input type="checkbox"/> Engendering positive health behaviors in young people <input type="checkbox"/> Formalizing the linkages between school-community linked interventions

173

174 *Participants*

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

181

182

183

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<sup>24</sup>. 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<sup>27</sup> (FitnessGram<sup>®</sup>, The Cooper Institute<sup>®</sup>) 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<sup>28</sup>. 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<sup>28</sup>. 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

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

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

231 *Process Evaluation*

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

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

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

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

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**Table 2. Overview of evaluation methods**

Measure	Variable	Evaluation method
<b>Outcome Data</b>		
	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)
<b>Context Data</b>		
	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 Ethnicity data for each evaluation school HMRC data for socio-economic status and ethnicity data for the city
<b>Process Data</b>		
	Fidelity	Questionnaires: teaching staff Interview with Program Administrator/Logic Model Final intervention program report (including Head Teacher comments) Letters from School Program Coordinators
	Implementation	Questionnaires: teaching staff, students Interviews: teaching staff, students, program administrator Final intervention program report (including Head Teacher and School Program Coordinators comments) Letter from Evaluation School Program Coordinator

280

281 *Data Analyses*

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

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

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

312



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<sup>th</sup> percentile) which is consistent  
317 with the England national average of ~34%<sup>36</sup>. The majority of students (64%) were in the  
318 normal BMI (5<sup>th</sup> -85<sup>th</sup> percentile), 14% were classified as obese (>95<sup>th</sup> percentile), and only  
319 3% were classified as underweight (>5<sup>th</sup> 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)
<i>Anthropometric Characteristics</i>			
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·m <sup>-2</sup> )			
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)
<i>Physical Fitness</i>			
VO <sub>2</sub> max (ml.kg.min <sup>-1</sup> )			
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)
<i>Physical Activity Questionnaire (excludes data from 7 year olds)</i>			
PAQ-C Composite Score			
IG	378	2.6 (0.8)	3.0 (0.7)
CG	110	2.5 (0.7)	3.0 (0.6)

<i>Children's Attitude Toward Physical Activity</i>			
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)

324

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

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

338 Drawing from assumptions identified in the Logic Model, it was expected that the PA  
339 intervention would improve attitudes towards PA leading to increases in PA levels. At  
340 baseline, the CATPA inventory showed that students exhibited relatively positive attitudes  
341 towards PA (scores of  $> 3.1$  for all variables), however 45% of students self-reported low  
342 levels of PA (PAQ-C score of 1 or 2 at baseline). By post-intervention, students in both  
343 groups had similar increases in their mean PAQ-C composite score showing higher levels of  
344 PA levels compared to baseline ( $p > 0.05$ ). However, the control students showed small  
345 improvements in the CATPA inventory with improved attitudes toward PA for health and  
346 fitness ( $p = 0.01$ ) and vertigo ( $p = 0.002$ ). Gender comparisons showed that girls generally  
347 had more positive attitudes towards catharsis ( $p = 0.023$ ), and aesthetics ( $p < 0.001$ )  
348 compared to boys, whereas boys had a higher mean attitude towards vertigo compared to the  
349 girls ( $p < 0.001$ ). Bivariate correlations were performed to determine if there was an  
350 association between changes in attitudes towards PA and increasing PA levels. Both groups  
351 showed a positive relationship between attitudes toward PA and PA levels, in which  
352 increasing PA levels were associated with attitudes towards catharsis ( $\rho = 0.17$ ;  $p = 0.001$ )  
353 and vertigo ( $\rho = 0.15$ ;  $p = 0.005$ ) in the IG and towards social continuation ( $\rho = 0.35$ ;  $p >$   
354  $0.001$ ) in the CG.

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

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

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

372

373

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	<i>Least Square Means Difference (SE)</i>	95% CI	$\eta_p^2$	F	<i>p</i>	<i>Class Means</i>	<i>Mann-Whitney (adjusted)</i>
<i>Anthropometric Characteristics</i>								
Body Mass								
IG	468	1.72 (0.09)	1.53 to 1.90	0.02	8.15	0.005*‡	F = 12.0 <i>p</i> < 0.001*	Z = -3.13 <i>p</i> = 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 <i>p</i> < 0.006*	Z = -3.38 <i>p</i> < 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 <i>p</i> = 0.11	Z = -1.42 <i>p</i> = 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 <i>p</i> = 0.02	Z = -1.63 <i>p</i> = 0.10
CG	121	2.61 (0.99)	0.66 to 4.57					
<i>Physical Fitness</i>								
VO <sub>2</sub> max								
IG	447	-0.52 (0.15)	-0.81 to -0.23	0.06	14.71	>0.001*‡§	F = 28.9 <i>p</i> < 0.001*	Z = -6.40 <i>p</i> < 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					
<i>Physical Activity Questionnaire (excludes data from 7 year olds)</i>								
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					
<i>Children's Attitude Toward Physical Activity</i>								
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					
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374

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

380

381 *Process data*

382 Three core themes were constructed following qualitative data analysis: 1) creating a  
383 meaningful space, 2) sustaining participation, and 3) student engagement (see Table 5).  
384 Under Theme 1, teachers identified the key pedagogical role of external instructor in ‘selling’  
385 the program in terms of presence, sustaining progression, and motivation (see Cat. A). In  
386 terms of content and resources (Cat. B), the novelty value of the program was clearly a factor  
387 in stimulating both student and teacher’s initial interest. Teachers were cognizant that the  
388 success of the intervention was dependent on the quality of the interaction (Cat. C). Initially,  
389 instructors supported teachers by delivering some demonstrations and providing resources.  
390 This support, however, was not deemed sufficient in developing teacher’s autonomous levels  
391 of pedagogical content knowledge in PA. Yet beyond the novel experience that generated  
392 student excitement and curiosity, the strategy to use teachers to deliver activities post- Phase  
393 1 had a negative effect because teachers lacked the training and self-efficacy to independently  
394 deliver the program.

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

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

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

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

424 *kids do no math or literacy that day*, *'provide lots of sports teams'* for student opportunities,  
 425 and *'special sport provision for student with special needs with the focus to improve motor*  
 426 *skill development'* which has a beneficial impact on class learning.  
 427

**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	<i>"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"</i> (School Program Coordinator)
		<i>"Someone needs to organize, run day-to-day and not increase the teaching staff's already heavy workload"</i> (Year 5 Teacher)
		<i>"There needs to be more visibility in school by [intervention program] staff to help motivate"</i> (Year 4 Teacher)
		<i>"Staff need to come in when they say they will as many students only had one go on the gym equipment"</i> (Year 4 Teacher)
		<i>"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"</i> (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)
		<i>"The circuit equipment was brilliant, the students were very focused as had not experienced anything like this before, we need to purchase for school!"</i> (Year 4 Teacher)
		<i>"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"</i> (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)
		<i>"Phase 2 was over-subscribed in many schools so more sessions have been put on to accommodate"</i> (Program Administrator)
C. Quality of the interaction	<i>"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"</i> (School Program Coordinator)	
	<i>"Students wanted to go on gym equipment every week but due to staff member not coming in the students only had one session on</i>	

		<i>the equipment which was really disappointing for the students”</i> (Year 3 Teacher)
		<i>“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”</i> (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)  <i>“... 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”</i> (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	<i>“Maybe a meeting for parents to explain the program and aims”</i> (Year 3 Teacher)  <i>“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”</i> (Year 3 Teacher)  <i>“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”</i> (Year 4 Teacher)
3. Student Engagement	A. Students’ responses	<i>“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”</i> (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>“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”</i> (Student interview)  <i>“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”</i> (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	<i>“The program allows children, in a short space of time, to engage with a range of physical activities that challenge them</i>

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

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428

## 429 DISCUSSION

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

435 Quantitative analysis identified that the intervention program had no impact on facilitating  
436 an increase in PA levels, attitudes towards PA or physical fitness above that of the CG.

437 Qualitative data suggested that the program was received positively by both teachers and  
438 students; however the intervention program lacked theoretical underpinning in terms of  
439 program design and behavior change. Overall, findings suggest program designers need to  
440 move beyond the initial novelty value of an intervention, and consider the impact of PA  
441 interventions in the context of school-community collaborations.

442

### 443 *Physiological and attitudinal outcomes*

444 Previous research has acknowledged that school-based PA interventions may be effective  
445 in increasing duration of PA, and that students exposed to PA intervention programs are more  
446 likely to engage in moderate to vigorous PA during the school day compared to those not  
447 involved in an intervention<sup>10</sup>. 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)<sup>30,37</sup>, 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<sup>11-12, 38-41</sup> 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

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

479

#### 480 *Factors affecting program implementation and delivery*

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

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

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

515 At an organizational level, it is clear that schools and external communities are rich in  
516 culture and context, which in turn act as powerful learning determinants through the  
517 interpretive processes of sensemaking<sup>21</sup>. One of the most explicit findings from the  
518 evaluation was how the intervention was perceived (by teachers and students) as a curriculum  
519 '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<sup>10-11, 38</sup>. Indeed, a clear  
522 finding from the evaluation was the lack of teacher support in terms of sustained engagement.  
523 Buchan and colleagues<sup>44</sup> 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'<sup>45</sup> 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.<sup>8</sup> and Conn et al.<sup>18</sup>, 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)<sup>8,18</sup>.  
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<sup>17</sup>, 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<sup>20-21</sup> 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<sup>15</sup>. 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

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

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

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#### 584 TRANSLATION TO HEALTH EDUCATION PRACTICE

585 This evaluation provides an examination of the pedagogical underpinning and the  
586 situational factors that affected the outcomes of a school-community based intervention. In  
587 this context, we argue that sustained PA behavior change requires a sociocultural approach as  
588 it considers not only the pedagogical interactions at a school level but also the impact beyond  
589 the intervention. In the planning phase, early engagement of teaching staff, parents and  
590 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 *between* 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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