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# Teacher-Level Factors, Classroom Physical Activity Opportunities, and Children's Physical Activity Levels

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**Background**: Classroom-based physical activity (CBPA) breaks are a cost-effective strategy to promote physical activity (PA) at school. Despite teachers' critical roles in sustained implementation of CBPA breaks, few studies examined the association of teacher-level factors with student PA levels, and none focused on rural schools. **Methods**: We monitored children's PA levels over 4 consecutive school days at 6 rural Oregon elementary schools with Walk4Life pedometers. During the same week, teachers recorded all student PA opportunities (recess, PE, and CBPA breaks) and answered a 26-item questionnaire about factors influencing their use of CBPA breaks. Mixed-effects models were used to associate teacher-level factors and PA opportunities with children's moderate to vigorous PA (MVPA; in minutes per day), controlling for child-level covariates. **Results**: When teachers valued PA, students accumulated more MVPA (1.07 min/d; $P < .01$) than students of teachers reporting low PA value. Students did more MVPA (1 min/d; $P < .001$) when teachers agreed the school operating conditions posed barriers to providing PA than when teachers disagreed that barriers existed. PE classes contributed significantly to student's PA levels. **Conclusion**: Provision of PE, increasing teacher value for PA, and further investigation of how teacher-level factors relate to students' MVPA levels during CBPA breaks at rural elementary schools are warranted.

**Keywords**: survey research, teaching, youth, intervention study, pedometry

Few elementary school-aged children (6–11 y old) accumulate the daily recommended levels of physical activity (PA).[1] The Physical Activity Guidelines for Americans recommend that children and adolescents aged 6–17 years do at least 60 minutes of mostly moderate to vigorous PA (MVPA) daily.[2] The most recent available population-level data show that 43% of youth aged 6–11 years are attaining 60 or more minutes of MVPA on at least 5 days per week with PA levels dropping dramatically with age.[3] Recent data show that only 8% of 12- to 15-year-olds and 5% of 16- to 19-year-olds participate in at least 60 minutes of PA on 5 or more days per week.[3]

Many factors contribute to children's abilities to achieve the recommended PA for health, including where they live. Children residing in rural areas are more likely to be living in poverty, less likely to meet PA guidelines, and are at higher risk for obesity compared with children living in nonrural areas.[4–7] The reasons for this are not entirely clear but likely include fewer proximal PA-promoting resources, such as local parks, and transportation challenges to access more distal opportunities, such as after-school sport programs.[8–10] Given the limited access to resources for rural children and their increased risk for low PA and obesity, it is important to implement cost-effective PA programs to improve their health outcomes.[11]

Comprehensive School Physical Activity Programs (CSPAP) are recommended as the most effective intervention to increase children's PA levels.[2,12,13] CSPAP interventions are multicomponent and include (1) physical education (PE), (2) PA before and after school, (3) PA during school [eg, recess, classroom-based PA (CBPA) breaks], (4) family and community engagement, and (5) school staff involvement.[14] It is expected that using all components of CSPAP for PA promotion will be most beneficial[15]; however, this may not be as feasible for schools with limited resources, such as those located in low-income, rural areas. Recent data suggest that rural schools hire fewer PE teachers and have fewer resources to provide PA opportunities outside of PE.[10] As such, rural schools with insufficient resources to hire full-time PE teachers may find training existing staff to implement PA during school hours using CBPA breaks a cost-effective alternative.[16,17]

CBPA tools are typically used in academic lessons, in transitions, as mind breaks, and as intentional active time.[18] Several studies highlight the effectiveness of CBPA breaks on increasing children's PA levels, improving children's health indicators (eg, body mass index), and maintaining or improving children's academic performance.[19–21] However, to achieve these outcomes, teachers must adopt and sustain implementation of CBPA breaks, and children must participate. Teachers play a critical role in sustained CBPA breaks implementation.[21] The available research suggests several teacher-level factors that influence teacher's implementation of CBPA breaks.[21] Factors found to influence CBPA implementation included (1) access to CBPA tools,[22] (2) implementation self-efficacy,[22–24] (3) participation in professional development,[22–24] (4) teaching experience,[25] (5) school operating conditions (eg, academic expectations and schedule),[22,24,26–29] (6) school situational support (eg, administrative support, classroom space),[24,29–31] and (7) value placed for PA.[26,30] None of these studies examined the direct association of teacher-level factors with children's MVPA levels. This is a very important association to investigate because it is possible that despite increased teacher provision of CBPA breaks, children could continue to have low PA levels. For example, in a study that promoted the implementation of CSPAP components, despite an increased provision of PA opportunities, children decreased

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their MVPA levels and increased their sedentary time.[15] This is a critical gap, and research is needed to confirm a positive relationship between increased teacher-level factors and children's PA levels.

Efforts to elucidate the association of teacher-level factors with children's PA levels are limited.[21–23] Existing research has focused on urban schools and has shown through direct observation that teacher's participation in CBPA breaks was associated with higher levels of children's PA among a sample of 14 elementary schools (n = 2505)[24] and among a sample of 72 classrooms from New York City. This literature showed larger class sizes resulted in students engaging in fewer minutes of PA during CBPA breaks.[32] It is less clear from this literature what other factors were associated with children's PA levels. Addressing this gap could provide valuable data about how to optimize CBPA breaks to promote PA in these underresourced rural settings where obesity is high and school-day PA is low.[4,7,33] Therefore, we evaluated the relationship of teacher-level factors with children's PA levels, while adjusting for other school-day PA opportunities, across 6 rural Oregon elementary schools.

# Methods

## Study Setting

This study was nested in a larger childhood obesity project. Generating Rural Options for Weight Healthy Kids and Communities was a multicomponent, 5-year intervention implemented in 6 rural communities in Oregon. One of Generating Rural Options for Weight Healthy Kids and Communities' goals was to facilitate increases in children's school-based PA. One strategy adopted to meet this goal was using the Balanced Energy Physical Activity (BEPA) Toolkit, a CBPA tool. The BEPA Toolkit includes 61 activity cards, a music and dance DVD, and a variety of portable play items. Each activity card in the BEPA Toolkit is paired with a nutrition message to provide a multicomponent learning and activity resource. One school from each community was randomized into control (n = 3) and intervention (n = 3) groups. Eight months prior to data collection, intervention school teachers received a BEPA Toolkit for their classrooms and CBPA training. In control schools, each *grade level* received 1 BEPA Toolkit. Teachers in control schools did not receive CBPA training. For intervention group teachers, trainings were conducted onsite in 1 or 2 sessions, lasting 60–90 minutes. Presentations followed a scripted format that was divided into 3 parts: (1) information on school-day PA, (2) teachers' roles in promoting schools' PA, and (3) implementing CBPA breaks using the BEPA Toolkit. Teachers at intervention and control schools were encouraged to use the BEPA Toolkit and any other CBPA tools that they preferred or were familiar with.

## Participants

In fall 2015, all children (n = 1739) enrolled in grades 1–6 were invited to participate in 4 days of PA assessment. Two weeks prior to data collection, parents received forms explaining PA assessment procedures. Parents were given the choice to opt their children out of the assessment. A small proportion (6.3%) of parents opted out, and an additional 1.3% of children opted out during data collection. Parents were also given the option of having their children participate in assessments without providing data for the study (1.3%). In all, 1584 children consented to participate. During PA data collection, teachers (n = 76) were invited to complete a questionnaire and report their daily classroom schedule. Data collection methods and tools were approved by the institutional review board of Oregon State University.

## Instruments

Walk4Life pedometers (model MVP 3D; Walk4Life Inc, Oswego, IL) were used to measure children's PA levels at school. These pedometers are validated to assess daily step counts, measure children's total activity time, and estimate time spent in MVPA based on a prespecified threshold of ≥120 steps per minute.[34,35] Pedometers were attached on elastic belts, organized by device numbers, and packed inside classroom-specific kits. Each child wore a specific pedometer for the entire 4-day data collection.

Questions on the 26-item BEPA-Toolkit teacher questionnaire were adapted from previous publications,[24,31,36] guided by social cognitive theory (eg, self-efficacy in delivering CBPA) and value theory to capture whether factors such as teachers' personal value for PA and self-efficacy in providing CBPA opportunities may directly influence children's PA levels.[37,38] The survey was reviewed by experts in survey measurement and cognitively tested by a group of childhood educators. Content experts reviewed and edited questions to improve measurement of teacher-level factors. Items measured included value for PA (n = 2 items), self-efficacy associated with using the BEPA Toolkit (n = 4), BEPA Toolkit access, use, and training (n = 6 items), school operating conditions (eg, academic expectations and schedule; n = 2 items), school situational support (eg, administrative support, classroom space; n = 4 items), and teacher demographics. In addition, teachers were asked to share their class schedules and report the frequency and duration of all PA opportunities that occurred throughout each day of assessment (eg, recess, CBPA, PE).

## Procedure

The research team spent 4 days at each school. On the first day, teachers were trained on data collection processes. Then, teachers were given pedometer kits corresponding to their classroom. Pedometer kits included pedometers and classroom rosters with pedometer numbers assigned to each child. A control pedometer was placed in each kit to measure data accrued from transporting kits to and from classrooms. Rosters were used by teachers to (1) guide pedometer distribution; (2) note absenteeism, early departure, or late arrivals; (3) list wear time; and (4) write any additional information that could explain children's PA data.

Children were given pedometer belts every morning of data collection and instructed to wear them around their waist with pedometers placed above their right hip. At the end of each school day, children dropped off pedometer belts in classroom-specific bags, and teachers placed classroom rosters and schedules in the bag. At the end of each day, bags were collected by the research team. The settings for each pedometer were examined to assure accuracy of data collection settings (eg, pedometers were measuring MVPA at a rate of 120 steps per minute) and repacked into classroom pedometer kits. Repacked pedometer kits were dropped off at classrooms with new forms for the next day's data collection.

Questionnaire distribution occurred on the second day of data collection. Teachers were invited to complete the questionnaire and reminded up to 2 times during the onsite data collection. A third reminder was sent via e-mail if no hard copies were returned by the last day of data collection. Teachers consented to participate in the study by returning completed questionnaires. At the end of data collection, all teachers received additional CBPA tools as compensation for study participation.

## Data Collection

Data collection started at the end of September 2015 and ended in mid-November 2015. The research team spent 1 week at each school. Pedometer data were downloaded on the last day of data collection (day 4).

## Data Analysis

***Children's PA Data.*** First, pedometer data were cleaned by subtracting PA accrued from transportation. Daily participation in PA assessment was used to generate average PA variables (steps per day, minutes of total PA per day, and minutes of MVPA per day) for each child. Average PA variables were included in analysis if children wore their pedometers for at least 80% of mean daily wear time[39] and accrued on average of 500–15,000 steps per day.[40]

Descriptive statistics were used to examine sample distributions for all PA outcomes (steps per day, total PA per day, and MVPA per day), and all PA exposure variables (in minutes per day) by child sex, grade, and intervention condition. PA outcomes were standardized for average pedometer wear time. Independent samples *t* tests were conducted to compare means for PA outcomes and PA opportunities by child sex and by intervention condition. In addition, analysis of variance was used to compare mean PA values and PA opportunities by grade level. Multiple comparisons were adjusted using Tukey's honest significant difference test.

***Teacher-Level Factors.*** Spearman's rank correlation was computed for variables measuring PA importance, self-efficacy, and support of CBPA breaks implementation. Teacher-level factors were aggregated by domain based on Spearman's rank correlation. Items measuring the same teacher-level factor were aggregated if they were correlated at ≥.5 and were correlated at <.5 with items measuring other teacher-level factors. Variables that did not meet these 2 criteria were excluded from associative analyses. With variables that met the criteria, reliability assessments were conducted via quantification of Cronbach's alpha.

***Associative Models.*** A mixed-effects model was used to examine the primary aim of this study. The model included a random effect for school and fixed effects for associated teacher-level factors and PA opportunities with children's MVPA time in minutes per day. In addition, the following covariates were examined: child sex, grade, intervention condition, wear time average, and number of students in class. The Kenward–Roger correction method was used for the computation of denominator degrees of freedom to account for the small sample of schools (n = 6).[41] Statistical significance was defined as $P < .05$, and all data management and data analysis processes were completed in Stata IC/14.1.[42]

# Results

Of our eligible sample of students, 94.8% (n = 1468) had usable PA data. Sixteen children were removed from analysis due to average step values outside the recommended inclusion criteria.[40] Data were not available for children who lost their pedometers (n = 35), returned pedometers with inaccurate settings (n = 16), and returned pedometers with dead batteries (n = 13). The sample was further reduced due to pedometer wear <80% of mean daily wear time, and teachers who did not participate in the study (n = 211). In addition, special education classrooms (n = 3) were excluded from analysis because of small class sizes (10 students in the 3 classrooms combined), grade misclassification, and low participation rates. The data from 1247 children (boys: n = 640 and girls: n = 607; 78.7% of eligible sample) were included in the final analyses.

## Children's PA Data

Table 1 presents standardized 4-day average steps, total PA, and MVPA by child sex, grade, and intervention condition. Boys accrued significantly more PA per day than girls ($P < .001$).

**Table 1 Standardized PA Averages by Sex, Grade, and Intervention Condition**

| Variables | Steps per day, mean (SD) | Total activity per day, mean (SD) | MVPA per day, mean (SD) |
|---|---|---|---|
| Overall (N = 1247) | 4767 (1386) | 47.4 (13.6) | 17.1 (6.2) |
| Child sex | | | |
| Boys (n = 640) | 5206 (1485)[a] | 51.6 (14.7)[a] | 18.2 (6.5)[a] |
| Girls (n = 607) | 4305 (1100)[a] | 42.9 (10.8)[a] | 15.9 (5.5)[a] |
| Child grade level | | | |
| 1 (n = 200) | 4510 (1178)[23] | 44.7 (11.6)[234] | 17.1 (5.1)[256] |
| 2 (n = 221) | 5308 (1462)[156] | 51.8 (14.2)[15] | 20.7 (6.7)[13456] |
| 3 (n = 232) | 4978 (1250)[15] | 49.0 (12.3)[15] | 18.8 (5.3)[2456] |
| 4 (n = 251) | 4911 (1556)[5] | 49.0 (15.7)[15] | 16.8 (6.2)[2356] |
| 5 (n = 260) | 4215 (1220)[2346] | 42.3 (12.0)[2346] | 13.9 (5.1)[1234] |
| 6 (n = 83) | 4659 (1225)[25] | 48.5 (12.5)[5] | 12.9 (4.9)[1234] |
| Intervention (n = 684) | 4922 (1456)[a] | 48.5 (14.2)[a] | 17.9 (6.8)[a] |
| Control (n = 563) | 4579 (1273)[a] | 46.0 (12.8)[a] | 16.1 (5.1)[a] |

*Note*. Grade level statistical significance was denoted with numbered superscripts. The superscripts indicate the grade level that significantly differed from the grade level that received the superscripts. Tukey's honest significant difference test was used to adjust for multiple comparisons.

Abbreviations: MVPA, moderate to vigorous PA; PA, physical activity.

[a]Statistically significant differences for PA outcomes by child sex and condition.

Children from the intervention schools accumulated significantly more PA in all PA categories than children in control schools ($P < .001$). In addition, PA outcomes varied significantly by grade level ($P < .05$). Children in higher grades were significantly less active than children in lower grades.

On average, children received 12 (7.5) minutes of PE per day, 32 (4.1) minutes of recess per day, and 3 (6.1) minutes of CBPA per day. Independent samples *t* test indicated that boys and girls did not differ significantly on the amounts of PA opportunities (data not shown). Children in the intervention group were exposed to significantly more minutes of PE (12.8 vs 11.2 min/d) and recess (34.0 vs 30.6 min/d) than children in the control group ($P < .05$), but CBPA breaks were not significantly different by intervention condition. In addition, opportunities for PA varied significantly by grade level [eg, children in grade 6 received significantly more time for PE compared with all other grades (data not shown)].

## Teacher-Level Factors

Among teachers (N = 68; control: n = 33 and intervention: n = 35) who participated in the study, 57.3% (control: 36.3%; intervention: 77.1%) reported ever using the BEPA Toolkit. Despite this large percentage, only 7.3% (control: n = 3; intervention: n = 2) of teachers used the BEPA Toolkit during data collection. As such, we had limited ability to use any teacher-level variables that referenced the BEPA Toolkit specifically (n = 12) and excluded them from subsequent analysis. Nevertheless, 24 teachers (35.2%; control: n = 16 and intervention: n = 8) used other CBPA methods (eg, GoNoodle, Deskercise, Music accompanied with specific movements, Adventure to Fitness, extra walking or running time) to promote PA during classroom time, enabling the use of all other teacher-level variables (n = 13). Spearman's rank correlation was used with 2 PA importance variables, and 8 statements related to support of CBPA implementation. The PA importance variables had a correlation of .51 and were combined to represent the PA value domain. Three variables measuring classroom space had correlations ranging from .58 to .81 were used to characterize situational support. Cronbach's alpha on these 3 variables was good (.86).[43] In addition, 2 variables measuring academic expectations and school schedule, which had a moderate correlation ($r = .63$), were used to indicate school operating conditions. No other variables met inclusion criteria.

## Associative Model

Unstandardized averages for MVPA were used as the outcome in the mixed-effects model (Table 2). Among teacher-level factors, PA values and school operating conditions had statistically significant ($P < .01$) associations with children's MVPA levels. Specifically, after adjustment, a 1-unit increase in PA values was associated with 1.07 more minutes per day of school-based daily MVPA time ($P < .01$). However, a 1-unit increase in school operating conditions was associated with a decrease of 1 minute in daily MVPA time ($P < .01$). Among PA opportunities, the association of PE time remained significant ($P < .01$) after adjustment, indicating the provision of more PE opportunities was associated with more MVPA. In addition, compared with children from classrooms of 15–20 students, children from larger classrooms accumulated significantly more MVPA time per day ($P < .01$). Children from intervention schools accrued 2.37 more minutes of MVPA per day compared with children from control schools, but this was not statistically significant ($P = .14$).

**Table 2 Summary of Mixed-Effects Model for Variables Associated With Children's MVPA Levels**

| Predictors | Coefficient | 95% confidence interval |
|---|---|---|
| PA values | 1.07** | 0.38 to 1.74 |
| Situational support | 0.14 | −0.52 to 0.79 |
| School support | −1.00** | −1.61 to −0.39 |
| Experience | −0.00 | −0.04 to 0.02 |
| CBPA time per day | −0.00 | −0.06 to 0.06 |
| PE time per day | 0.08** | 0.02 to 0.15 |
| Recess time per day | −0.07 | −0.22 to 0.08 |
| Girls | −2.47*** | −3.07 to −1.87 |
| No. of students per class (15–20[a]) | | |
| 21–25 | 2.66*** | 1.57 to 3.74 |
| 26–30 | 2.99*** | 1.75 to 4.22 |
| 31–35 | 2.91** | 0.70 to 5.11 |
| Intervention | 2.37 | −1.26 to 6.01 |
| Wear time per day | 0.04** | 0.01 to 0.06 |
| Grade level (1[a]) | | |
| 2 | 3.06*** | 1.91 to 4.21 |
| 3 | 1.38* | 0.84 to 2.67 |
| 4 | −0.49 | −1.58 to 0.60 |
| 5 | −3.77*** | −4.90 to −2.64 |
| 6 | −4.31*** | −5.86 to −2.76 |
| Intercept | 3.67 | −5.64 to 12.99 |
| Random effects | | |
| Within-school variance | 1.74 | 0.30 to 10.06 |
| Between-school variance | 28.51 | 26.34 to 30.86 |

Abbreviations: CBPA, classroom-based PA; MVPA, moderate to vigorous PA; PA, physical activity; PE, physical education.
[a]Reference category for comparison of categorical variables. The model was adjusted for child sex, child grade level, number of children per classroom, intervention condition, and pedometer wear time.
$^{*}P < .5$. $^{**}P < .01$. $^{***}P < .001$.

# Discussion

Teachers play an important role in the promotion of their student's PA.[21] Therefore, it is critical to ensure adequate teacher support for the implementation of CBPA breaks. Previous research has identified several teacher-level factors that may be associated with teacher implementation of CBPA. However, information regarding how teacher-level factors were associated with children's PA outcomes was lacking. In addition, no studies were conducted among schools in rural communities, despite the awareness that rural schools hire fewer PE teachers, struggle with a higher obesity rate and lower PA participation, and have fewer resources.[4,7,10,33] Finally, none of the published literature examined the relationship between the provision of CBPA breaks and children's PA levels, while adjusting for other PA opportunities. Understanding how CBPA breaks contribute to children's PA while considering other school-based PA offerings may provide useful insight for the improvement of school-based PA promotion activities. This can help administrators in underresourced rural schools make strategic decisions about how best to support student PA at school.

This study addressed the current gaps by examining the association of teacher-level factors and PA opportunities with children's PA levels at school. Our findings indicate that the value teachers held for PA and time provisioned for PE were associated with more time spent in MVPA, whereas school operating conditions was associated with lower levels of MVPA. Moreover, children from intervention schools and from larger classrooms accumulated more MVPA. Consistent with the existing literature, we observed boys amassed more MVPA per day than girls, and older children were less active than younger children.

Our results confirmed a positive association between a teacher's personal value for PA and children's MVPA levels. These results suggest that teachers who cared about a child's PA level may enact certain behaviors or have specific characteristics that promote more child PA during their class time. Post hoc analyses revealed that teachers who provided CBPA opportunities expressed higher PA value compared with teachers who did not provide CBPA (59% of CBPA implementers reported high value for PA, vs 43% of non-CBPA implementers; Pearson's $\chi^2_3 = 6.38$, $P = .09$). This is consistent with the existing literature showing teachers who report they cared about their students' PA levels were more willing to implement CBPA breaks.[26,30]

Previous studies examined teachers' personal PA *behaviors* and found that a teacher's PA participation was not associated with CBPA implementation.[30,44] Others found that a teacher's own PA participation was predictive of PA competence, which, in turn, led to greater frequency of PA promotion.[45] Our results and others appear to suggest that increasing teacher PA self-efficacy and promoting value for PA are important contributors to teachers' implementation of CBPA breaks.

Results from other studies conveyed that academic demands and time constraints were reported by teachers as the primary barriers to implementation of CBPA breaks.[22,24,26–28] Our approach was to evaluate if these barriers were associated directly with children's PA levels. Interestingly, we observed that teachers reporting the lowest concern regarding academic demands and time constraints had students that accrued fewer daily minutes of MVPA. In comparison, teachers who reported academic demands and time constraints were barriers to providing PA opportunities, had students who accumulated more MVPA per day. There are several possible explanations. First, this may be an outcome specific to rural schools. Data suggest teachers who are recruited to rural schools tend to be more internally motivated to make a difference in the life of their pupils, and because rural schools have fewer resources, their teachers tend to take on a lot more tasks or responsibilities.[46] Therefore, it is possible that when rural teachers report challenges to providing PA opportunities, it is because that they are motivated to deliver those opportunities despite the constraints. If teachers are not delivering CBPA breaks (and are not motivated to do so), they may not perceive the barriers. Furthermore, it is possible that resources are most constrained (including PE resources) in schools where teachers report the highest concern. In addition, teacher-level factors that were not analyzed due to poor implementation of the BEPA Toolkit may also have helped explain this association. For example, it would have been helpful to measure teachers' access or implementation self-efficacy relative to all CBPA strategies (not just BEPA Toolkit use) and the association of self-efficacy on CBPA implementation in general with children's PA.

Based on previous research, we expected teaching experience and classroom support would be associated with children's PA levels.[24,25,30,31] However, we did not observe this. Our finding that larger classroom size was associated with higher MVPA levels of students was in contrast to one other published study that found larger classrooms resulted in less PA.[32] Although our results were drawn from a sample of 6 rural schools, it is important to note that Dunn et al[32] conducted their study among urban schools (New York City elementary schools). The difference in results could be due to the fact that we did not measure PA separately for each segment of the day; therefore, children from larger classrooms may have accumulated more PA during recess or PE because a greater number of classmates were available to participate in unstructured PA opportunities. Dunn et al did not report whether larger classes had more activity outside of the classroom as data were derived from observations of the classroom setting only.

In regard to the provision of PA opportunities across all settings, on average, children received a total of 48.2 minutes per day to engage in PA. Previous research shows that using CBPA breaks significantly increases the time children spend in MVPA.[19–21] Our results showed that time provided for PE, which represented 25% of total PA opportunities, was the only PA opportunity significantly associated with children's MVPA levels. Furthermore, PA patterns seen in this study are consistent with the literature reporting PA by child sex and age, with boys accruing more PA than girls and younger students accruing more PA than their older counterparts.[47] Finally, we observed that students in intervention schools accumulated 2.37 minutes per day of more MVPA compared with students in control schools. This difference in the amount of MVPA was not statistically significant, but in a previous study, we found a 3-minute difference in MVPA levels was associated with lower body mass index $z$ scores.[33] Thus, 2.37 minutes per day may have practical significance. This difference may be explained by the fact that intervention school teachers received CBPA training (specifically for BEPA Toolkit) and therefore were better equipped to promote MVPA.

## Limitations

Although the results of this study are informative, they must be considered in the context of study limitations. Our aim was to assess the association of 9 teacher-level factors with children's PA levels. This study was embedded in a community-based participatory project where teachers in 2 different intervention conditions were provisioned with BEPA Toolkits differently, but not required to use the BEPA Toolkits. As a result, the proportion of teachers who used the kit during the data collection week was too low to permit examination of specific BEPA Toolkit variables. As such, we were only able to examine 5 factors in association with children's PA levels. That said, 24 teachers used other CBPA approaches during the measurement period enabling the examination of the potential influence of teacher-level factors not specific to the BEPA Toolkit. Furthermore, this is a snapshot of what occurred during a single week, and as such causal relationships cannot be implied. In addition, since we conducted this study, new research has been published highlighting other teacher-level factors that may have informed results meaningfully (eg, teacher's perception of student enjoyment during CBPA break).[21,48,49] Finally, although the survey was created based on other validated surveys, cognitively tested, and examined by experts in the field, we were unable to formally validate the survey due to lack of resources and time.

# Conclusion

This was the first study to evaluate the association of teacher-level factors and provision of school-based PA opportunities with children's MVPA levels at school, in a rural elementary school setting. The results of this study show that teachers who value PA have students who engage in more daily MVPA. In addition, after adjustment for all covariates, only time provided for PE had a statistically significant association with children's MVPA levels. These results affirm that teachers play a key role in promoting children's PA levels in rural schools and that PE is an important component of the rural school curriculum to support PA among elementary-aged children. Future research would benefit from monitoring more closely how teachers implement CBPA breaks interventions to improve their effectiveness.

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