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PHYSICAL ACTIVITY

Exploring Secondary Science Teachers' Use of Classroom Physical Activity

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Abstract

This study explored the use of classroom physical activity (PA) in secondary science classrooms. To accomplish this, semistructured interviews were conducted with secondary science teachers (n = 11). Interviews were based on the constructs of the social-ecological model. Most teachers reported using classroom PA in some form—in-class breaks, outdoor activities, and curriculum support. Teachers used classroom PA to improve academic and behavioral outcomes of students. They had varied perceptions regarding collegial support of classroom PA, but mostly felt supported by administrators. Teachers reported being unaware of their district's and the state department of education's beliefs about classroom PA. Overall, factors that negatively influenced classroom PA use tended to be within the interpersonal, organization, and policy levels of the social-ecological model, while factors that positively influenced classroom PA use tended to be within the individual level.

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Participation in physical activity (PA) offers several benefits for adolescents. Regular PA helps build and maintain healthy bones and muscles, reduces the risk of obesity and several chronic diseases (e.g., diabetes, cardiovascular disease), and promotes psychological well-being (Centers for Disease Control and Prevention [CDC], 2010; U.S. Department of Health and Human Services [USDHHS], 2008). Further, adolescents who participate in higher levels of PA tend to do better in a number of school-related metrics, such as homework completion, class attendance, self-reported grades, positive academic attitudes, higher academic aspirations, and school completion rates (Darling, 2005; Darling, Caldwell, & Smith, 2005; Fredricks & Eccles, 2006; Harrison & Narayan, 2003). Despite these benefits, PA levels appear to decline as children become adolescents (CDC, 2014). For example, children aged 6 to 11 in the United States average 88 min/day of moderate to vigorous PA compared to only 33.3 and 25.5 min/day for youth aged 12 to 15 and 16 to 19, respectively (Belcher et al., 2010). Efforts are needed to lessen this decline and to ensure that adolescents attain sufficient levels of PA.

The school environment offers a potential opportunity for increasing PA in this age group, as adolescents in the United States spend, on average, 6.64 hr/day for 180 days/year in school (National Center for Education Statistics, 2008). In elementary schools (kindergarten to sixth grade) in the United States, students have opportunities to be active during physical education and recess. However, these opportunities typically decrease or are eliminated as students progress into secondary school (i.e., middle school, high school; Pellegrini, Huberty, & Jones, 1995). For instance, only 3% of high schools provide physical education 3 days/week compared to 13.7% of elementary schools (CDC, 2007b). Further, only 17% of students (ninth to 12th grade) report to be physically active 60 min/day and 30% report to attend daily physical education class (CDC, 2007b). Clearly, efforts for improving PA in adolescents during school are needed.

Although a strong body of observational research supports the need for PA in adolescents, limited data exist on how to increase PA in secondary schools (Belcher et al., 2010; Darling, 2005; Darling et al., 2005; Harrison & Narayan, 2003; Whitt-Glover et al., 2009). Few interventions involving high school students have successfully

increased PA (Felton et al., 2005; Knox et al., 2012). Felton et al. (2005) found that a comprehensive school PA intervention targeting high school females led to significant improvements in moderate to vigorous and vigorous PA levels 1 year postintervention. Additionally, Knox et al. (2012) implemented PA into seventh to ninth grade mathematics and English classrooms, finding improvements in waist circumference, systolic blood pressure, triglycerides, and high density lipoprotein cholesterol in the intervention group after 18 weeks of intervention. These success stories lay the groundwork within the literature; however, more research needs to explore how PA can be increased in schools.

The Comprehensive School Physical Activity Program [CSPAP]—a framework designed by the Society of Health and Physical Educators (SHAPE America) to increase PA in schools (CDC, 2013)—outlines methods of increasing PA in kindergarten to 12th grade students. The CSPAP is “a multi-component approach by which school districts and schools use all opportunities for students to be physically active, meet the nationally-recommended 60 minutes of PA each day, and develop the knowledge, skills, and confidence to be physically active for a lifetime” (CDC, 2013, p. 12). The CSPAP framework is not limited to change at the individual level, but was created to change the entire school culture through a systematic format. Classroom PA is one method for increasing adolescents’ PA suggested by the CSPAP framework (CDC, 2013). Classroom PA involves integrating PA into the content of lessons and/or classroom breaks through provision of activities as a break within a lesson or during a transition between subjects (CDC, 2013). Classroom PA can be easily adapted to various styles of teaching and allows for flexibility in implementation. Activities can be unplanned or strategically integrated into specific areas within a curriculum.

Classroom PA may be a beneficial addition to classrooms for several reasons. First, classroom PA has been linked to improvements in cognitive function (e.g., attention, memory), academic behaviors (e.g., homework completion, time on task), and academic achievement (e.g., standardized test scores, grades), as well as increased overall PA (Donnelly & Lambourne, 2011; Mahar et al., 2006; Rasberry et al., 2011). Second, PA accumulated in short bouts throughout a day improves health-related outcomes (e.g., body

composition, blood pressure) as much or more than a single continuous PA bout (Ando et al., 2013; Padilla, Wallace, & Park, 2005; Stone, Rowlands, Middlebrooke, Jawis, & Eston, 2009). Third, PA is a relatively simple teaching strategy that does not require a plethora of resources or extensive training to be successfully implemented. For example, in a study examining the impact of classroom PA on BMI, teachers were able to be trained at one 6-hr in-service session prior to the school year (Donnelly et al., 2009). Yet most research on classroom PA has been completed in elementary school settings. For instance, a recent review of PE integration into classrooms—a form of classroom PA—found that 19 of 21 studies targeted elementary school settings (Marttinen, McLoughlin, Fredrick & Novak, 2017).

While classroom PA has been found to be an effective method for increasing PA, research of classroom PA in secondary classrooms is limited (Knox et al., 2012). Primarily, efforts have focused on teachers' perceptions of classroom PA in secondary classrooms and these studies were conducted in schools that serve Native American or Indigenous populations in the United States (Cothran, Kulinna, & Garn, 2010; McMullen, Kulinna, & Cothran, 2014). For example, Cothran et al. (2010) conducted a study in which 11 of the 23 participants were secondary school teachers and concluded that teachers were more likely to use classroom PA if they were concerned with the wellness of their students and if they had a history of a high level of wellness themselves. Teachers in the same study encountered barriers to classroom PA related to challenges with scheduling and emphasis on academic assessments. McMullen et al. (2014) explored teachers' perceptions of classroom PA breaks and determined features of preferred activity breaks. Eight of the 11 participants in this study were secondary school teachers. Teachers reported classroom control was an important aspect of classroom PA implementation and preferred activities that were related to class content, easy to implement, and enjoyed by the students. The focus on schools that serve Native American and Indigenous populations in these studies creates challenges with generalizing the results to other secondary schools. Thus, research should continue to explore classroom PA in secondary schools with differing populations to improve understanding in this area.

For an increase in classroom PA opportunities in secondary schools, best practices from teachers who use classroom PA strategies must be understood. Several studies have explored the use of classroom PA by elementary and middle school teachers to hone classroom PA strategies (Dinkel, Schaffer, Snyder, & Lee, 2017; Kibbe et al., 2011; Mahar et al., 2006). However, some differences in secondary classrooms may influence classroom PA. For instance, secondary teachers typically teach in discipline-specific subject areas, meaning they may have fewer opportunities to use PA in transitions between subjects or they may teach a subject that is not as conducive with PA as others. Similarly, secondary teachers may feel they do not have time to implement classroom PA, because they only see a group of students for a portion of the day (e.g., 45 min, 1 hr), whereas elementary teachers spend the majority of the day with the same group of students. Because of this, the nuances of classroom PA within secondary classrooms and specific subject areas must be understood.

Science classrooms may be an ideal setting for increasing understanding of PA in secondary classrooms, yet research in this area has been limited and conflicting. One study found middle school science teachers and students reported positive effects on enjoyment, learning, and behavior after implementing a PA-specific science curriculum, citing an ideal overlap between science curriculum and PA (Finn & McInnis, 2014). However, another study found elementary and middle school teachers reported being the least comfortable integrating classroom PA into science in comparison to other subjects (Dinkel, Lee, & Schaffer, 2017). Because of conflicting results and the lack of high school teachers involved in these studies, additional examination of classroom PA in secondary science classrooms is needed.

This study explored the use of classroom PA in secondary science classrooms. To accomplish this, it examined science teachers' use of classroom PA and barriers to implementing classroom PA. Because of the lack of research on classroom PA in secondary settings, the researchers used a qualitative approach to explore the topic thoroughly and develop an understanding that guides subsequent research efforts.

Theoretical Framework

The study design was based on the constructs of the social-ecological model (Stokols, 1996). The social-ecological model provides a framework for understanding the influence of several social and environmental factors on the utilization of classroom PA by secondary science teachers. The model comprises five levels (individual, interpersonal, organization, community, policy) that contain several factors that may influence the use of classroom PA (American College Health Association, 2016). The individual level includes personal knowledge, self-efficacy, and beliefs. The interpersonal level includes relationships with friends, peers, and coworkers. The organization level includes place of employment and involvement in groups. The community level includes local recreation facilities and interactions with community organizations. The policy level includes school/district policies and state legislation (Stokols, 1996).

Method

Researchers conducted semistructured interviews with secondary science teachers to explore the use of PA in their classrooms. Interviews focused on teachers' use of classroom PA and/or their willingness to incorporate classroom PA. This was approved by a university institutional review board.

Eleven secondary science teachers from a Midwestern metropolitan area in the United States participated in this study. The majority of participants ($n = 8$) were high school teachers (ninth to 12th grade), female ($n = 9$), and Caucasian ($n = 10$). The average age of the teachers was 35.63 years (range: 22–55 years). Teachers had on average over 7 years (range: 1–19 years) of teaching experience and almost all held a master's degree ($n = 10$). When asked about their typical PA levels, most teachers reported attaining at least 30 min of PA on 6 of the past 7 days. Teachers represented seven schools and two school districts.

Participants

A purposive sample of participants was initially recruited through (1) a partnership program that connects researchers and local pre-kindergarten (PK) to 12th-grade teachers, or (2) a teacher education meeting for local secondary science teachers. During recruitment

efforts, research personnel provided a brief description of the study and teachers were asked to provide their e-mail address if interested in participating. An e-mail was sent to potential participants with a brief description of the procedures. Teachers were encouraged to respond to verify their interest, ask for clarification or further information, and schedule an interview. After the initial interviews, snowball sampling was used and participants were asked to provide the e-mail addresses of colleagues they thought might be interested in participating. A similar e-mail to the aforementioned recruitment e-mail was sent to the suggested colleagues, and the same protocol was followed for scheduling interviews.

Instrument

An interview based on constructs of the social-ecological model sought to determine the use of classroom PA. For participants to have the same concept of classroom PA, interviews were initiated with the definition that classroom PA includes integrating any type of PA, at any level of intensity within general education classrooms during normal classroom time (Webster et al., 2013). The researcher posed dichotomous yes/no questions to guide the interviewee to a corresponding set of follow-up probes. Table 1 provides examples of interview questions. The interview guide was a modified version of an interview guide for examining the use (e.g., teachers' perceptions, factors influencing implementation) of classroom PA in elementary school teachers (Dinkel, Lee, & Schaffer, 2017).

Data Collection

A semistructured interview was conducted with each of the 11 participants. Interviews lasted 30 to 75 min and occurred either in-person or over the telephone. Interviews took place in a quiet, private environment and were recorded with an audio recorder. At the completion of the interview, participants were given or mailed a \$10 gift card.

Two research personnel were involved in data collection. Research personnel were trained in qualitative data collection methods and had previously gathered qualitative data (e.g., focus groups, semistructured interviews). Half of interviews were conducted by one of the research personnel, and the other half were conducted by the other research personnel.

Table 1*The Social-Ecological Model and Example Interview Questions*

Level	Example interview questions
Individual	Do you currently integrate PA into your classes? Why/why not? How confident do you feel using PA in your classroom? Please explain. How do you typically use PA in your classroom?
Interpersonal	Thinking about other teachers within your grade level at your school, how do you think their opinions on classroom PA compare to yours? Why? How often would you ideally like to collaborate with other teachers to discuss classroom PA? Why?
Organization	Please tell me about the wellness environment at your school. What are your district's beliefs about utilizing PA in the classroom and promoting PA in general?
Community	How could community organizations support the use of classroom PA?
Policy	Does your school/district have a wellness policy about classroom PA? Please explain. What guidelines or policies are you aware of for providing classroom PA?

Data Analysis

After the interviews were completed, research personnel transcribed the interviews verbatim using an Olympus AS-2000 transcription kit (Center Valley, PA). Interviews were uploaded in NVivo 10 (QSR International, 2012) and analyzed through a directed content analysis approach (Baxter, 1991; Hsieh & Shannon, 2005). First, the themes for the codebook were designed based on the social-ecological model's framework (Bradley, Curry, & Devers, 2007; Crabtree & Miller, 1999). Next, two trained researchers read the transcripts and independently developed codes within each theme to create an initial draft of the codebook. The drafts were compared and discrepancies were discussed (Borkan, 1999). Consistencies

were then synthesized and codes formed (Moustakas, 1994). Data were validated through the process of peer debriefing—discussion of discrepancies in coding with a third researcher until consensus is reached (Lincoln & Guba, 1985). The third researcher reviewed the codebook and any major discrepancies to form the final codebook. Once the final codebook was completed, the first two researchers revisited the transcriptions and coded the content. Coded content was compared and discrepancies were discussed. Major discrepancies were discussed with a third researcher until consensus was reached. Data were further validated via member checking (Creswell, 1998).

Results

Results are presented within the constructs of the social-ecological model—individual, interpersonal, organization, community, and policy. Trends in responses illustrate key findings and are followed by one or more quotes that support these findings.

Individual

All but one participant ($n = 10$) reported utilizing classroom PA. Participants primarily utilized classroom PA in the form of in-class PA breaks ($n = 5$), outdoor activities ($n = 6$), and curriculum support ($n = 8$). Several participants reported implementing classroom PA daily ($n = 4$), while other participants typically implemented between 1 and 3 days/week ($n = 4$), or reported infrequent implementation ($n = 2$). Those implementing PA daily cited behavioral improvements as their primary reason ($n = 3$) for doing so. For example, a middle school teacher mentioned, “It keeps boredom down, um, it keeps participation up . . . makes them look forward to what they’re doing next.” Participants who implemented 1 to 3 days said it depended on their curriculum ($n = 4$). A middle school teacher explained the frequency of her use, “Just because . . . it doesn’t always fit in the schedule. Um, sometimes I can’t always tie it in every single class period.”

Mondays ($n = 5$) and/or Fridays ($n = 4$) were seen as the most effective days for implementing classroom PA. Mondays were seen as ideal because of student fatigue ($n = 3$). A middle school teacher mentioned, “Mondays are usually really good because [students are] really sleepy so it helps them wake up.” Fridays were cited as ideal for behavioral reasons ($n = 3$). A high school horticulture teacher stated,

“Fridays are very important because they get really anxious to be out by that point.”

Several participants ($n = 5$) reported classroom PA was most effective at the beginning of the day. A high school biology teacher said, “First period, um, you know I’m working with teenagers and they’re still groggy and, you know, uh, the non-morning people and it does sort of help to get them going.” However, a number of participants also saw value in utilizing PA at the end of the day ($n = 5$) or after lunch ($n = 4$).

Some participants noted their students responded positively to classroom PA ($n = 5$). As a high school teacher stated, “They’re pretty good. They appreciate it. Um, most of them are pretty engaged when we get up and do something.” Participants also reported improvements in their students’ academic performance ($n = 6$) and/or behavior ($n = 6$). A high school horticulture teacher stated,

It just helps with behavioral management. For one, ya know, the students get really antsy after having to sit throughout the entire day. Um, it’s good for engagement, ya know, and it’s just more fun to learn that way. I feel like it’s just, ya know, sometimes it’s easier to retain things when you have physical activities associated with it.

When discussing how classroom PA was implemented, participants most frequently reported integrating PA into the curriculum ($n = 8$). For example, a high school biology teacher mentioned, “Just part of teaching science, the lab, the activities.” Other common implementation methods included outdoor activities ($n = 6$) and/or taking in-class breaks for PA ($n = 4$). As far as outdoor activities, a middle school teacher said,

We’ll go outside and look at the different parts of the environment and that helps them with, “Oh this is living and nonliving.” It’s not necessarily like purposeful movement but its general movement. Um, I do measurement outside, because you need space to measure things. So they’re moving around measuring things.

Referring to in-class PA breaks, a high school biology teacher noted, “I occasionally do brain break stuff . . . that is completely

unrelated to the content if I need to wake them up or if we have a really long section of notes.”

Participants utilizing classroom PA reported learning about the strategy while in college ($n = 6$). One of the high school teachers stated, “From day one, like even in undergrad, like my teaching science topics class focused on activity in the classroom.” Participants also reported learning about classroom PA during professional development ($n = 4$). For example, a middle school teacher mentioned, “I went to a conference, like a professional development workshop, where we had to get up and move around, we had to interact.”

Over half of participants reported that they were very confident in implementing classroom PA ($n = 7$), while others reported that their confidence could be improved ($n = 5$). A high school biology teacher stated, “Very confident. Don’t have a problem with it.” Conversely, another high school teacher said,

You know, when it comes to my anatomy classes it’s a little bit different story; it’s harder because that is just—it’s such a different type of curriculum, um, and it’s a lot of memorization of content, which it makes it a little bit more uncomfortable trying to incorporate PA into a class like that.

Although utilization of classroom PA was common, almost all participants felt they could incorporate more PA into their classroom ($n = 9$). Several participants noted this could be done through more curriculum integration ($n = 8$). For example, a middle school teacher mentioned, “We talk about bones and muscles and how they work together. So that’s another way we could incorporate movement.” Additionally, a high school biology teacher said, “I think [in] the calorie lab you could insert physical [activity], . . . when they talk about nutrition and calories we can insert more PA specific curriculum related there.”

Many participants identified at least one barrier that limited the amount of PA they used ($n = 8$). One of the more frequent barriers noted was large class sizes/lack of space ($n = 5$). A high school biology teacher noted, “Definitely space. There’s 32 students in most of my classes, in a room that should probably hold 24, so, it’s an issue.” Half of participants mentioned changing the classroom environment ($n = 6$) to overcome structural limitations in the classroom environment. A high school biology teacher stated:

I can move my tables around so, um, different table arrangements can help with stuff like that. Um, whether ya know we put them together in like a 4, like prearranged in a group or rows makes a difference so I think that the arrangement of tables can over—you can do things to overcome large classes.

Resistance from students ($n = 3$) was also found to be a significant barrier. One participant noted, “They don’t want to do it. Some of them don’t want to do it. Um, that’s [being active] doing too much. We hear that a lot—anything is doing too much for some kids.” Additionally, participants ($n = 3$) mentioned challenges with classroom management as a barrier. A middle school teacher commented,

Even if you go over expectations beforehand, there’s always somebody who’s going to cross that line and being able to pull them back without, um, shutting the whole thing down can be really difficult at times. Um, if the classroom management is not strong, getting kids up and moving around and learn while they’re doing it is really hard to do.

To overcome barriers, some teachers identified the need to increase their knowledge of classroom PA ($n = 3$). A high school biology teacher mentioned, “Well more literature, obviously would always be good. Um, I know that, uh, we need more stuff [research on classroom PA research] for science.” When asked what more they would like to learn about classroom PA, participants most frequently reported that they would like to learn new or specific ideas for implementing classroom PA ($n = 8$). A high school teacher was interested in learning “ways to get students engaged physically in the morning.” Similarly, participants ($n = 8$) reported they would attend professional development about classroom PA to gain more classroom PA knowledge ($n = 8$). For example, a middle school teacher stated, “I’ve always done everything that I could to learn more, so yeah [I would attend].”

Interpersonal

When discussing other teachers within their subject area and grade level, most participants reported their colleagues’ use of classroom PA varied or none of their colleagues used classroom PA

($n = 9$). A high school chemistry teacher stated, “Um, within my specific subject [colleagues] are set in their ways a little bit, but I think they value, um, work completion and things that they can track, over getting the kids really actively involved.” All but one participant saw years of teaching experience as an indicator of classroom PA use ($n = 10$), with more experienced teachers being less likely to implement. A high school teacher stated,

I feel like, and I don't know if its necessarily that years of teaching experience, they just get apathetic about these things, I think that it's just nowadays, you know, how they teach us in college is just so different. And what I learned is probably much different than someone who's been there for 20 years and I, ya know, when I was in college they really stressed things like that. So I think that's why it's a lot easier for me to incorporate it or think about it when I'm trying to teach.

Some participants reported that they discuss classroom PA with their colleagues ($n = 5$). Typically, these discussions were infrequent and as part of a broader conversation regarding curricular topics. For example, describing these discussions, a high school biology teacher said, “Um, only when we are talking about human anatomy labs or labs that relate to PA.”

In regard to other teachers at their schools, participants were asked how the physical educators promote PA. Several participants reported they were unaware of any efforts or their efforts were minimal ($n = 5$). For example, a middle school teacher responded, “Um, recently not much. They used to do walking clubs and then of course sports, um, but in the recent years nothing really other than what they do in their own physical education classes.” Additionally, a high school chemistry teacher mentioned, “Um, I'm not really that sure. I mean they really don't. But I also—we are on complete different sides of the building.”

Organization

Several participants reported, on a scale from 1 to 5 (1 = *low*, 5 = *high*), that their school was rated as a 4 or 5 in terms of readiness to increase classroom PA ($n = 5$). Each participant attributed that

score to having an open-minded and supportive administration. For instance, a middle school teacher replied, “I would say around a four. I think our administration is very open minded about these newer, not even newer, but you know the revamping of classroom strategies and things.”

When describing their school’s wellness environment, participants most commonly mentioned activities related to staff wellness ($n = 7$). A high school biology teacher remarked,

So for staff wellness it is very much promoted, like they promote, um, they do like quarterly little giveaway things where they’ll focus on [a] wellness topic and then they’ll give you a water bottle or a whatever—if you take a health survey at the end of every school year you get a \$25 gift card . . . so I think as a staff, um, the opportunity is there to participate in some wellness stuff, um, I don’t know how much it filters down to kids.

Five participants reported having a wellness team that provided leadership for school wellness activities. A high school teacher stated, “We have a committee for health and wellness and . . . they send out ideas. Like on Wednesdays wear tennis shoes to promote a healthy back and taking care of our feet because teachers stand on their feet all the time.” The wellness priorities of the schools were most frequently related to healthy nutrition and PA promotion ($n = 5$) or the priorities were unknown ($n = 5$). Among the participants recognizing wellness priorities in their schools, a high school biology teacher mentioned, “PA and nutrition—I mean like from the emails I get like the programs are always either nutrition based or like record how much you walk a day.” Conversely, a high school teacher stated, “I don’t think there are any. I don’t think there is a wellness team. There’s definitely not a wellness team. There’s a school nurse and she sometimes agrees to weigh everybody in, like that’s what we have.”

The majority of participants reported that the administration at their school is supportive of classroom PA ($n = 8$). For instance, a high school horticulture teacher said,

I would say that they’re really supportive of it. Our assistant principal actually used to be a physical education teacher so I’m sure she’s really supportive of it. Um, they’re always really

big into finding, like, the new research out there and what can best serve students and then, you know, teaching us right at the beginning of the year; how can we incorporate this into our classroom styles.

In contrast, most participants did not know their district's ($n = 6$) and/or the state department of education's ($n = 10$) stance on classroom PA. When discussing the district, a high school teacher stated, "I don't know that they have any beliefs. If they do, they haven't conveyed those to me." All of the participants that thought they knew their district's beliefs ($n = 5$) reported they were similar to their schools' beliefs and supportive of classroom PA. A middle school teacher mentioned, "I think the district is also for promoting it, as well. I think they can see the benefits behind it." In terms of the state department of education, a middle school teacher remarked, "The only thing I really know about state is the state's standards and state testing. I don't really hear much about PA and different kinesthetic activities at the state level."

Community

Almost all participants reported that it would be helpful to receive support from a community organization ($n = 10$). Participants often discussed how community organizations could collaborate with or support schools by providing partnerships and resources ($n = 7$) and/or lead activities at schools ($n = 4$). In reference to providing resources, a high school biology teacher stated,

I really like the idea of those exercise balls as the chair for students, um, what I have heard at conferences is that once the initial kind of bouncing . . . [ends], it seems to be well-received by the students as well. But there's a huge cost there that, ya know, most school districts aren't gonna be able to do that on top of their normal budget.

Policy

All but one participant ($n = 10$) reported their school did not have a wellness policy that included classroom PA or they were not aware of one. When asked how they would create a wellness policy for their school, most participants mentioned mandating frequency

of PA in class ($n = 10$). A middle school teacher mentioned, “That the kids get up out of their seat at least once a lesson. Moving around; move their entire body somewhere.” Participants felt a policy like this would be most effective if it came from the school or teachers within the school ($n = 7$) rather than the district ($n = 3$) or the state department of education ($n = 1$). A high school chemistry teacher noted, “. . . teacher driven would get more teachers on board. Starting from the bottom up is a lot better. Coming from the top down you’re going to get a lot of resistance from teachers.” Additionally, a high school chemistry teacher said,

Other teachers. Teachers hate being dictated to. We really do. But if you’ve got a teacher that is willing to, you know, um, kind of humble themselves and learn from administrators and learn from other people and then say “Hey, this is what I’m doing in my classroom, please come and watch.” Um, teachers are really, they are, they’re much better at, you know, at picking up on stuff that their colleagues are doing rather than being dictated [to].

Discussion

This study explored secondary science teachers’ use of classroom PA. Secondary science teachers primarily utilized classroom PA in the form of in-class PA breaks, outdoor activities, and curriculum support. Factors that negatively influenced classroom PA use tended to be within the interpersonal, organization, and policy levels of the social-ecological model, while factors that positively influenced classroom PA use tended to be within the individual level. These findings suggest that understanding factors within specific social-ecological model levels may be important for reducing barriers and building on positive influences of classroom PA.

Throughout the interviews, several factors were discussed that may be detrimental to the implementation of classroom PA. These factors were within the interpersonal, organization (e.g., school characteristics, formal rules and regulations), and policy (e.g., local policy, state policy) levels of the social-ecological model. Within the interpersonal level, teachers had mixed perceptions of support for classroom PA from their colleagues (e.g., mixed use in colleagues,

lack of collaboration). This was especially prevalent when they discussed more experienced teachers. Colleagues' attitudes toward classroom PA have been shown to influence teachers' willingness to implement classroom PA in their own classrooms (Goh et al., 2013). Consistent with previous research, within the organization level teachers reported large classes/lack of space as an environmental barrier to implementing classroom PA (Cothran et al., 2010; Dinkel, Lee, & Schaffer, 2017; Evenson, Ballard, Lee, & Ammerman, 2009; McMullen et al., 2014). Within the policy level, most teachers were unaware of any wellness policy related to classroom PA at their schools. Teachers were also unaware of their district's and the state department of education's beliefs about PA. When teachers are unaware of policies and beliefs about classroom PA, this could be viewed as lack of support and, consequently, limit the implementation of classroom PA (Dinkel, Schaffer, et al., 2017; Webster et al., 2013).

Conversely, several factors were discussed that may positively influence the use of classroom PA. Four of these factors were within the individual level of the social-ecological model (e.g., knowledge, attitudes, beliefs), while one was within the interpersonal level (e.g., social networks, family, friends). First, all teachers were able to identify benefits of classroom PA. The ability to identify and understand the benefits of classroom PA has been shown to increase teachers' likelihood of implementing classroom PA (Cothran et al., 2010; Martin & Murtagh, 2015). For instance, Martin and Murtagh (2015) concluded that teachers' perceptions of classroom PA were associated with levels of PA in their students, in that positive perceptions equated to higher levels of PA. Second, most teachers mentioned they were confident in their ability to implement classroom PA. Confidence in implementing classroom PA is likely a result of positive attitudes and past experiences with classroom PA (Cothran et al., 2010; Faulkner & Reeves, 2000; McKenzie, LaMaster, Sallis, & Marshalls, 1999). Third, the majority of teachers reported being physically active on most of the previous 7 days. Teachers' perceptions of personal wellness and history of PA have been associated with attitudes toward classroom PA (Faulkner, Reeves, & Chedzoy, 2004). Faulkner and Reeves (2000) found that teachers with positive perceptions of their own sport competence also had the most

positive attitudes toward implementing classroom PA. Fourth, within the interpersonal level of the social-ecological model, support from administration appeared to influence classroom PA implementation positively. Administrative support has been associated with increased use of classroom PA (Centeio, Erwin, & Castelli, 2014; Goudeau, Baker, & Garn, 2014; Howie, Newman-Norlund, & Pate, 2014; Naylor, Macdonald, Zebedee, Reed, & McKay, 2006; Stylianou, Kulinna, & Naiman, 2015). Centeio et al. (2014) concluded that “having a supportive administration gave teachers the efficacy and backing they needed to carry out implementation and provide more opportunities for students to be physically active” (p. 503).

Implications

Findings from this study have research and practical implications. From a research perspective, future efforts need to explore the utilization of PA in secondary science classrooms using larger, more diverse samples—including teachers who do not utilize classroom PA—to gain broader knowledge of the use of classroom PA. Additionally, it may be helpful for research to target specific grades and subjects. For instance, a teacher in this study was very confident implementing PA into a horticulture class, but lacked confidence with anatomy and physiology. Future research efforts could also include a PA measure (e.g., pedometer, accelerometer) to examine the relationship between teachers’ perceptions of classroom PA and the amount of classroom PA students obtain.

Future research efforts may also aim to reduce barriers and/or assist teachers in overcoming barriers to implementing classroom PA. Based on this study, the interpersonal, organization, and policy levels of the social-ecological model may serve as good target areas for this. For instance, increasing support from colleagues (e.g., mentoring, collaborating), schools/districts (e.g., providing equipment, offering professional development opportunities), and policy makers (e.g., developing standards, providing resources for classroom PA) have been shown to increase implementation of classroom PA in elementary classrooms (Cothran et al., 2010; Webster et al., 2013). Similar strategies need to be tested in secondary classrooms so that their efficacy can be determined.

It is noteworthy that findings of this study largely align with research involving elementary school teachers (Dinkel, Lee, &

Schaffer, 2017; Evenson et al., 2009; Goh et al., 2013; Martin & Murtagh, 2015). Thus, it may be that research findings from elementary classrooms can inform efforts and research in secondary classrooms.

One promising route forward is the integration of PE into classrooms. A review by Marttinen et al. (2017) suggests the utilization of PE teachers to integrate PA into the curriculum of other disciplines. Although most studies examined integration with mathematics, science classrooms might be ideal because of the overlap with PA and physiology (Marttinen et al., 2017). Further, O'Hara et al. (2011) suggest that wearable activity trackers allow students to be active, measure activity, and interact with the data outputs. It is important to note that the above studies included a combination of elementary and secondary school settings. Differences between elementary and secondary classrooms, such as longer class times, focus on individual disciplines, and teachers should consider overlap between content and PA responses (e.g., biology and cardiovascular response, physiology and cellular respiration) when beginning to integrate PA into classrooms. Future research may explore these factors in more depth.

As far as practical implications, these findings may be applicable to the future practices of teachers, administrators, and policy makers. A notable trend in teachers' responses involved willingness of teachers to learn more about classroom PA. Thus, classroom PA professional development workshops may improve classroom PA utilization in teachers. Participants in this study mentioned they would like to learn from other teachers, see classroom PA modeled, and hear success stories from other teachers, thus teacher-led workshops may be beneficial. Further, collaborative efforts with PE teachers could be another effective way of providing education within these parameters. From an administrative perspective, administrators can continue to make efforts to increase and/or clarify support of classroom PA such as communicating with teachers to emphasize the use of classroom PA and/or fostering discussions of classroom PA among teachers to increase their sense of social support. Per the findings relating teachers' own wellness to increased classroom PA implementation, efforts that promote teacher PA participation are recommended (Dinkel, Schaffer, et al., 2017; Faulkner & Reeves, 2000).

All of the aforementioned factors are similar to recommendations provided by CSPAP (CDC, 2013). Considering most participants felt their schools were ready to increase classroom PA implementation, it may be beneficial for these schools to initiate the CSPAP training program. In the case of schools that are not as ready, SHAPE America (n.d.) offers a Physical Activity Leader professional development that develops and supports teachers who serve as PA champions within their school. This may allow teachers who use classroom PA to catalyze school-wide implementation. It is also essential that schools create and effectively communicate wellness policies related to classroom PA. Policy makers within the school, district, and state department of education could create wellness policies that include classroom PA, to increase teachers' perception of support from the policy level (Webster et al., 2013).

Limitations and Strengths

This study was not without limitations. The generalizability may be limited by the small sample size and use of a single data collection method. Future studies may include a larger sample and a multifaceted approach to data collection that might include direct observation of PA or document analysis. The use of snowball sampling in recruitment may have limited this study. Snowball sampling increased the efficiency of recruiting participants; however, it may have homogenized the sample as participants might have referred like-minded coworkers. To limit this, the researchers recruited teachers from various grade levels to increase diversity of the sample. Another limitation might have been responses that were influenced by participants' social desirability. It is possible that teachers provided their perceptions of a desirable response rather than an accurate response to appease the interviewer. To limit this, the researchers encouraged teachers to respond genuinely and instructed interviewers to remain as unbiased as possible.

Most of the findings from this study are consistent with findings from similar studies. This study substantiates previous research and expands the knowledge base, particularly related to secondary students. For this study, alignment with previous research helps address methodological issues that might limit generalizability, such as a

small sample size. Additionally, these findings support research that was conducted within specific populations (i.e., Native American, Indigenous populations). This adds weight and relevance to the present findings that expand beyond what was previously known. In terms of previous research, the consistency found with these findings increases the validity of previous findings of studies conducted in different populations.

Conclusions

The findings from this study increase understanding of secondary science teachers' use of classroom PA. Although teachers identified several barriers to implementing classroom PA, it appears that teachers use classroom PA when they understand the benefits of classroom PA, are confident in implementing classroom PA, participate in PA themselves, and feel their administration supports classroom PA. In contrast, teachers may limit use of classroom PA when they feel unsupported by colleagues in their use of classroom PA, have large classes/limited space, and lack awareness on policies related to classroom PA. Future efforts may consider these factors when aiming to improve secondary teachers' use of classroom PA.

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