The Physical Educator Vol. 81 • pp. 477–487 • 2024
https://doi.org/10.18666/TPE-2024-V81-I4-11749

PHYSICAL ACTIVITY

Music's Effects on the Environmental Conditions of Physical Activity During Spike Ball Play

David C. Barney, Katie Gurney, Francis T. Pleban, and Jemal Gishe

Abstract

Physical education (PE) has the potential to educate students to spend a lifetime in physical activity. An up-and-coming activity that has this potential of lifetime activity is spike ball. Generally, spike ball is played with four players with teams of two. The ball is put into play and the players can move anywhere they want. The objective is to hit the ball into the net so that the opposing team cannot return it. Spike ball presents itself to be an activity for students in high school and college/university. One aspect of increasing activity during spike ball is music being played. Research dealing with music in physical activity settings has found it to enhance endurance and color how people interpret fatigue. Thus, the purpose of this study was to examine the effects of music on PA rates (measured via pedometer) of college students as

David Barney, Associate Professor, Department of Teacher Education, McKay School of Education Brigham Young University; Katie Gurney, Brigham Young University, Undergraduate Student; Francis T. Pleban, Department of Public Health, Health Administration, and Health Sciences, Tennessee State University; Jemal Gishe, Department of Public Health, Health Administration, and Health Science, Tennessee State University. Please send author correspondence to david_barney@byu.edu

they play spike ball. Generally, it was learned that music had a positive effect on increased amounts of steps taken and time in activity during spike ball play.

Introduction

Physical education (PE) could help prepare students to lifelong participation in a multitude of activities (Pangrazi, 2003). K-12 PE is divided into three categories, elementary (K-5), middle school/ junior high (6-9), and high school (10-12). The purposes of all three are unique and important for the student. In elementary PE, the program should be filled with a wide variety of basic skills, but important experiences that help students understand what capabilities and limitations in the activities the students participate in. In middle school/junior high PE, a heavy emphasis should be placed on skill development and a review of skills taught in elementary PE. For high school (HS) PE, units of instruction should last longer than eight weeks. This, in turn, helps students master the skills necessary for the activity being taught and helps high school students feel more comfortable in adult settings like health clubs, tennis, golf clubs, and other public settings. This helps strengthen these students' lifetime activity skills (Pangrazi, 2003).

In HS PE, many activities are geared toward lifetime activities. For example, tennis, golf, badminton, bowling, weight training, and pickle ball are all considered lifetime activities, which are taught in HS PE. Another lifetime activity that is becoming more popular and common in HS PE is roundnet, or more commonly known as spike ball. Spike ball is a recreational activity that has gained popularity with competitive leagues and tournaments being played in local communities. USA Spikeball® (2016) gave a general overview of the rules:

"Roundnet (Spike Ball) is a team sport played by two teams of two players. Opposing teams line up across from each other with the roundnet (Spike Ball) net in the center. The ball is put in play with a service—a hit by the server from behind the service boundary into the net to an opposing player. Once the ball is served players can move anywhere, they want. The objective of the game is to hit the ball into the net so that the opposing team cannot return it. A team

is allowed up to three touches to return the ball. The rally continues until the ball is not returned properly" (USA Spikeball,® 2016).

From the brief explanation of the rules, spike ball could provide HS PE students with the opportunity to be physically active during gameplay. Equipment for spike ball is one net, which is 36 inches in diameter, and one spike ball, which is 12 inches in circumference (Spikeball.com, 2019).

The possibility of spike ball being implemented in HS PE creates many opportunities for students to be physically active. One tool HS physical educators can use to increase students' physical activity is using music during spike ball activities. Research conducted with music in a physical activity setting has found it to be a positive tool in physical activity settings. For example, background music has been shown to reduce perceived exertion by 10% (Nethery, 2002), enhances endurance (Rendi et al., 2008), and helps "color" how a person interprets their perceptions of fatigue (Karageorghis & Lee-Priest, 2012). Research has also been conducted on music in the K-12 physical education setting. Examples of research on music in the PE setting found that third, fourth, and fifth graders were more active in walking and Frisbee activities when music was played (Barney & Prusak, 2015). A similar research study found that junior high school students were more active when music was played during basketball and volleyball activities (Brewer et. al., 2016).

In research studies dealing with the music's effect on physical activity, a conceptual framework has been established to provide support to the research. Karageorghis et. al. (2006) proposed a conceptual framework of four factors for how music in a physical activity setting can affect a person: a) rhythm response, b) musicality, c) cultural impact, and d) association. Rhythm response refers to the musical rhythm, most notably tempo, or music speed, as measured in beats per minute. Musicality refers to the response to pitch-related elements, such as harmony and melody. The cultural impact refers to the pervasiveness of the music within society. Association pertains to the extramusical association a piece may evoke. The factors exhibit a hierarchical structure (i.e., rhythm response is the most important contributor to the motivational quotient of a piece of music). As mentioned previously, research has been conducted in K-12 physical education. Other music research has been conducted

with college-aged students in a physical activity setting. Barney et al. (2012) investigated the effects of college students listening to their personal music players (PMP) as they worked out at their college fitness facility on campus. The results from this study were that college students preferred to listen to hip hop, pop, and country music as they worked out. College students also felt that, as they listened to music during their workout, they were working out for a longer duration of time and that they were working out at a higher intensity. These results can be beneficial for physical educators at all grade levels and ages of students.

A second study dealing with the effects of music on college students' activity investigated the effects of music being played in a college physical activity basketball class (Barney et. al., 2020). For this study, students played two basketball games with music on during gameplay, and then played two games with no music during gameplay. The researchers had the college students wear pedometers during gameplay to measure their activity. The results from the study revealed that, when music was playing, the college students took an average of 360 more steps compared to when there was no music playing. Also, when music was playing during game play, the college students were, on average, active for 30 minutes compared to 27 minutes with no music playing during game play. (($F(1,94) = 22.132.p < .001$), ($F(1,94) = 23.007$, $p < .001$), respectively.

The literature has and continues to support music as a tool PE teachers can implement in their lessons and class activities. Also, because of the relatively new beginnings of spike ball, this presents an opportunity to investigate the game's physical activity (PA) potential for HS PE students and college students. Thus, the purpose of this study was to examine the effects of music on PA rates (measured via pedometer) of college students as they play spike ball.

Methods

Participants and Setting

Participants for this study were 35 college-aged students (20 males and 15 females) 18 to 27 years old, from a private university located in the western United States. Seventy percent of the male and 80% of the female participants were between the ages of 18 and 22, 75% of the males and 86.7% of females were Caucasian, 65% of

Table 1
Student Demographic Characteristics by Gender

Characteristics	Male [1]	Female [2]	P-Value [2]
Age			
18-22	14 (70.0)	12 (80.0)	0.5029
23-27	6 (30.0)	3 (20.0)	
Ethnicity			
Caucasian	15 (75.0)	13 (86.7)	0.3932
Others	5 (25.0)	2 (13.3)	
Students level of skill of Playing Spike Ball			
2	2 (10.0)	4 (26.7)	
3	13 (65.0)	7 (46.7)	0.3863
4 or 5	5 (25.0)	4 26.7)	
Enjoyment with no music			
Very much	1 (5.0)	0 (0.0)	
Enjoyed	6 (30.0)	2 (13.3)	
Neutral	5 (25.0)	4 (26.7)	0.3838
Fairly enjoyable	6 (30.0)	4 (26.7)	
Not enjoyable	2 (10.0)	5 (33.3)	
Enjoyment with music			
Very Much	19 (95.0)	15 (100.0)	
Neutral	1 (5.0)	0 (0.0)	

[1] Mean (Standard Error)
[2] Chi-square test

males and 46.7% of females had an average level of skill of playing spike ball, and 95% of the males and 100% of the females responded to enjoyment with music as "very much." (Table 1).

Pedometer Instrument

One method of measuring the effects of music during PA, specifically spike ball play is with pedometers (Vincent-Graser et. al., 2009). Pedometers are practical, easy to use, and cost effective (Barfield et. al., 2004; Beighle et. al., 2001) and have been found to be reliable and valid instruments for measuring PA. The Yamaz Digi-Walker LS 2525 was the pedometer used to collect student step counts and time in activity (LeMasurier et al., 2005).

Music Selection

The music selection used for this study consisted of popular, upbeat fast-tempo (120 to 160 beats per minute) songs. The researchers

compiled a list of 40 songs, listened to them, and then narrowed the list down to 25 songs they felt were appropriate to play during gameplay. The songs that fit the requirements were made into a playlist and played over a loudspeaker sound system in the gymnasium.

Procedures and Data Collection

Students participated in three 20-minute spike ball games. During the first of the preceding three spike ball games, students were introduced to the pedometer, shown how to wear the pedometers (Vincent & Pangrazi, 2002), and shown how to reset the pedometer to '0.' When the participants came to play, they would play a 10-minute warm-up game. After the 10-minute warm-up game, the participants would reset their pedometers to '0' and start the 20-minute game. On the days of data collection, one of the researchers attended the games to pass out the pedometers and help the participants record the pedometer data and other data on the spike ball record sheet. On the spike ball record sheet, the students would record how many steps they took, and how much time they were active. Also, on the record sheet, the participants would record their level of spike ball experience, their enjoyment playing spike ball when music was playing and when there was no music, and demographic information.

Data Analysis

Summary statistics, Chi-square test for categorical variables, and CMH for ordinal variables were used for comparison by demographic characteristics and paired t-test and one-way ANOVA for continuous variables were used to assess the effect of music/no music on pedometer step counts and time in activity during three spike ball games. All data analyses were conducted using SAS software, Version 9.4 of the SAS System for Windows (SAS Institute Inc.).

Results

From the pedometer measures, during all the three games, on average, the participants had a higher number of steps and time in activity and less for the rate of perceived exertion. The participants had, on average, 253.7 more steps, 1.5 more minutes, and 0.33 lower rate of exertion with music compared to no music. The one-way ANOVA analysis indicated that for number of steps (P-value < 0.0001), time

in activity (P-Value <0.0001), and rate of perceived exertion (P-value = 0.0273) the differences were statistically significant. Also, from the pairwise t-test analysis, it was observed that the average pedometer measures during all three games for the participants is more for the number of steps and time in activity and less for the rate of perceived exertion. While the difference in average rate of exertion for paired t-test was not statistically significant, during game 2 (P-value = 0.0001) and game 3 (P-value < 0.0001), the difference in average number of steps with music compared to no music was statistically significant, during all the three games the difference in average time in activity with music compared to no music was statistically significant; game 1 (P-value = 0.0334), game 2 (P-value = 0.0005) and game 3 (P-value = 0.0135), Table 2 and Figure 1.

Table 2
Average Pedometer Measures Comparing with and Without Music

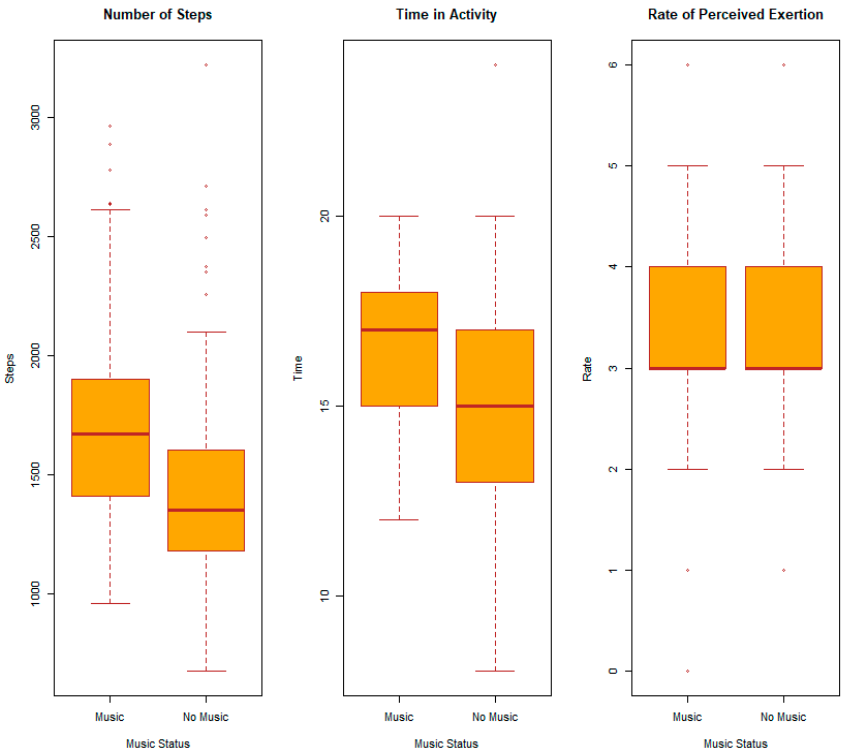
Pedometer Measures	With Music [2]	With No Music [2]	Mean Difference [2]	P-Value [3]
Number of Steps [1]				<0.000
During game 1	1560.9 (78.97)	1519.0 (83.98)	41.9 (89.84)	0.6443
During game 2	1806 (66.90)	1457.8 (75.66)	348.5 (80.77)	0.0001
During game 3	1732.5 (62.67)	1361.9 (54.51)	370.7 (80.02)	<0001
Time in Activity [1]				<0.000
During game 1	16.9 (0.35)	15.5 (0.61)	1.4 (0.63)	0.0334
During game 2	16.7 (0.30)	14.9 (0.50)	1.7 (0.45)	0.0005
During game 3	16.3 (0.33)	14.8 (0.47)	1.5 (0.59)	0.0135
Rate of Perceived Exertion [1]				0.0273
During game 1	3.4 (0.18)	3.6 (0.18)	-0.2 (0.23)	0.3855
During game 2	3.4 (0.19)	3.6 (0.17)	-0.3 (0.25)	0.3055
During game 3	3.0 (0.19)	3.5 (0.19)	-0.5 (0.27)	0.0682

[1] P-Value from ANOVA after adjustment gender and experience.
[2] Mean (Standard Error)
[3] P-Value from ANOVA for the group and from paired sample t-test for the pairs

Discussion

The purpose of this study was to examine the effects of using music on PA rates (measured via pedometer) of college students as they play spike ball. Findings indicate when music is being played during spike ball, the participants took more steps and have slightly

Figure 1
Range of Step Counts, Time in Activity, and RPE With and Without Music



more time in activity. The results from this study coincide with previous research dealing with music in gameplay in an activity, and in general physical activity when there is no music. These results are similar to Barney et. al. (2020) findings for step counts and time in activity of college students in a basketball activity class. Results revealed that those college students who played basketball games with music playing had over 300 more steps and were in activity for three more minutes than their counterparts that played basketball games with no music played.

Additional research that concurs with the results of this study investigated the effects of music on elementary-aged students on two different physical education activities (Frisbee and walking) (Barney & Prusak, 2015). For this study, elementary-aged students wore a

pedometer while they participated in two lessons for each activity. For both activities, one lesson had no music and the other lesson had music playing during the activity. The results from this study showed that the students took more steps in the two lessons that had music playing compared to the lessons when there was no music playing. For this study, steps were the only thing measured. Karageoghis et. al. (2006) had similar results with college-aged students when walking on a treadmill at three levels of intensity. These researchers discovered that fast-tempo music was preferred, and when students picked fast-tempo music, their workout intensity increased. The results from this study, along with the other studies mentioned, confirm the value and effect music can have on participants while playing spike ball games for the purpose of increasing step counts and time in activity.

Implications of the Study

Results from this study help to highlight the impact music can have on students' physical activity. A secondary finding from this study that illustrates music's impact while participating in gameplay: When the music was not played during the spike ball game, the participants would say to the researchers, "Please play the music," "Why can't we have the music playing?," and "We want the music on." These types of comments reinforce the idea that students want music playing during activity (Barney et. al., 2016). As students make these types of comments regarding music being played, K-12 PE teachers and college physical activity instructors may want to ask themselves, is music a beneficial part of their class during activities? In this case, spike ball.

Another implication of this study is the implementation of spike ball into a HS PE and college physical activity class curriculum. For HS PE teachers and college PA instructors, spike ball aligns nicely with the National Association of Sports and Physical Education (NASPE) national standards (NASPE, 2014). Spike ball has the potential for students to demonstrate competency in a variety of motor skills and movement patterns (Standard 1), to demonstrate the knowledge and skills to achieve and maintain a healthy level of physical activity and fitness (Standard 3), and recognize the value of physical activity for health, enjoyment, challenge, self-expression and/or social interaction (Standard 5). Because spike ball aligns with the national standards, spike ball is a viable curricular option in HS

PE and college PA activity classes. As stated earlier, spike ball is a fairly new game that is gaining in popularity (Witt, 2016). Thus, now is the time to capitalize on its popularity. When students are exposed to and participate in spike ball in their HS PE class and/or college physical activity class, there is a greater likelihood that they will participate in spike ball for many years, likely resulting in lifelong physical activity.

Study Limitations

The researchers have noted limitations to this study. First, the participants came from one university, which may not allow for a representative sampling of participants from other colleges and universities. Second, the study was conducted at a private university, which may further limit the generalizability of the findings. Thus, the conclusions and implications are mostly applicable to those participants' demographics.

References

Barfield, J. P., Rowe, D. A., & Michael, T. J. (2004). Interinstrument consistency of the yamax digi walker pedometer in elementary school-aged children. *Measurement in Physical Education and Exercise Science, 8,* 109–116.

Barney, D., Gust, A., & Liguori, G. (2012). College students' usage of personal music players (pmp) during exercise. *ICHPER*SD Journal of Research, 7,* 23–26.

Barney, D., Pleban, F. T., & Gishe, J. (2016). The effects of music in enhancing the elementary physical education environment. *International Journal of Physical Education, 53,* 23–32.

Barney, D., & Prusak, K. A. (2015). The effects of music on physical activity rates on elementary physical education students. *The Physical Educator, 72*(2), 236–244.

Barney, D., Prusak, K. A., & Brewer, L. (2020). The effects of music on student step count and time in activity in college basketball activity classes. *Asian Journal of Physical Education & Recreation, 25*(1), 39–44.

Beighle, A., Pangrazi, R. P., & Vincent, S. (2001). Pedometers physical activity and accountability. *Journal of Physical Education, Recreation and Dance, 72,* 16–19, 36.

Brewer, L., Barney, D., Prusak, K. A., & Pennington, T. (2016). Effects of music on physical activity rates of junior high school physical education student. *The Physical Educator, 73,* 689–703.
Karageorghis, C. I., Jones, L., & Low, D. C. (2006). Relationship between exercise heart rate and music tempo preference. *Research Quarterly for Exercise and Sport, 77,* 240–250.
Karageorghis, C. I., & Lee-Priest, D. (2012). Music in the exercise domain: A review and synthesis (Part 1). *International Review of Sport and Exercise Psychology, 5*(1), 44–66.
LeMasurier, G. C., Beighle, A., Corbin, C. B., Darst, P. W., Morgan, C., Pangrazi, R. P., Vincent, S. D. (2005). Pedometer-determined physical activity levels of youth. *Journal of Physical Activity and Health, 2,* 159–168.
Nethery, V. M. (2002). Competition between internal and external sources of information during exercise: Influence on rpe and the impact of the exercise load. *Journal of Sports Medicine & Physical Fitness, 42,* 172–178.
Pangrazi, R.P. (2003). Physical education K-12: "All for one and one for all." *Quest, 55,* 105–117.
Rendi, M., Szabo, A., & Szabo, T. (2008). Performance enhancement with music in rowing sprint. *The Sport Psychology, 75,* 175–182.
Society of Health and Physical Education. (2014). *National standards & grade-level outcomes for K-12 physical education.* Human Kinetics.
Spikeball.com. (2020). https://spikeball.com/pages/how-to-play-1
USA Spikeball. (2016). *People*. http://usaspikeball.com/u
Vincent, S. D., & Pangrazi, R. P. (2002). Does reactivity exist in children measuring activity levels with pedometers? *Pediatric Exercise Science, 14*(1), 56–63.
Vincent-Graser, S., Pangrazi, R. P., & Vincent, W. J. (2009). Step it up: Activity intensity using pedometers. *Journal of Physical Education, Recreation, & Dance, 80,* 22–24.
Whitt, T. M. (2016). *A descriptive study of roundnet* (Unpublished master's thesis). California State University, Chico.