Original Article

Afterschool jump rope program: time and intensity of physical activity

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Abstract:

Problem Statement: As inactivity and obesity rates increase among youth populations, it is crucial to implement activity programs that provide adequate time and intensity and keep youth interested in the exercise. Jump rope programs for youth combine the vigorous exercise of rope jumping with learning and social components which help students jump for longer periods of time. **Purpose:** The purpose of this study was to assess the time and intensity of physical activity for youth participating in a jump rope afterschool program. **Approach:** Fourth and 5th grade students (n=28), average age of 9.2 ($\pm$ 1.2) years, participated in an 11-week afterschool program where they learned skills in footwork, rope tricks, partner skills, and a group routine. Accelerometers were used at weeks three, six, and nine, to assess time and intensity of physical activity during the sessions. **Results:** In the 90-minute session, on average, participants spent 17.3 minutes (19.2%) in vigorous activity, 28.0 minutes (31.2%) in moderate activity, 8.0 minutes (8.9%) in light activity, and 36.7 minutes (40.7%) in sedentary behavior. Boys spent less time in sedentary and more in vigorous activity than girls. Caucasian participants spent more time in sedentary and less time in light, moderate, and vigorous activity than non-Caucasian participants. **Conclusions:** Jumping rope is an intense activity and programs maintain a high MVPA while students learn skills and routines. Participants in the afterschool jump rope program obtained more MVPA minutes than reported data on traditional afterschool programs.

Key Words: jump rope, afterschool program, physical activity

Introduction

For children and young adults in the United States ages two to nineteen, 31.8% are considered overweight or obese with 16.9% in the obese classification (Ogden, Carroll, Kit, & Flegal, 2014). The U.S. Department of Health and Human Services recommends that children participate in 60 minutes of moderate to vigorous physical activity (MVPA) per day, every day of the week. This should include aerobic, muscle building, and bone strengthening activities (*Physical Activity Guidelines for Americans 2nd edition*, 2018). In the U.S., 47% of children ages 2-15 years old exceed two hours per day of sedentary time (Sisson et al., 2009) and another 30% (ages 6-11 years old) do not meet the national physical activity (PA) recommendations (Fakhouri, Hughes, Brody, Kit, & Ogden, 2013). Regarding vigorous intensity physical activity (VPA) specifically, children who participate in more than five minutes of VPA per day are 5.2 times less likely to be classified as overweight than children who obtain less than five minutes of VPA (Wittmeier, Mollard, & Kriellaars, 2008).

Girls participate in less MVPA and more sedentary activity than boys in physical education (PE) classes (Matthews-Ewald, Moore, Harris, Bradlyn, & Frost, 2013), recess (Nettlefold et al., 2011), afterschool programs (Taverno Ross, Dowda, Colabianchi, Saunders, & Pate, 2012), and total daily activity (Verloigne et al., 2012). From ages 8-18 years, PA levels decrease by an average of 7% per year with the greatest decline found in girls ages 9-12 years old (Dumith, Gigante, Domingues, & Kohl, 2011). Additionally, non-Hispanic black and Hispanic children have higher obesity prevalence than non-Hispanic white children (Ogden et al., 2014).

For school aged children, a majority of their day is spent in sedentary activities (Bailey et al., 2012). Schools are viewed as a good setting for PA programs due to the access to large populations as well as a societal expectation that PA minutes be accumulated during PE and recess (Pate et al., 2006). Afterschool programs provide an ideal opportunity to increase MVPA. In 2014, 18% of students participated in afterschool programs, increasing from 2004 and 2009 (Alliance, 2014). Additionally, students who regularly attend afterschool programs accumulate fewer minutes of sedentary time and more minutes of MVPA than students who go home after school (Taverno Ross et al., 2012).

In youth, jumping rope has been found to be an effective mode of exercise while positively impacting fitness, body composition (Kim et al., 2007), one leg balance, agility, vertical jump (Jahromi & Gholami, 2015),

bone strength (oscalcis stiffness)(Arnett & Lutz, 2002). Jumping rope in repetition is commonly used as a fitness exercise and in circuit training for adults but this may be too monotonous and physically intense for children. The sport involves learning single, partner, and large group tricks involving footwork, rope movement, and coordination. The integration of learning these skills with the activity of jumping rope may increase enjoyment, social interactions, and sport variation, which can increase PA participation in youth populations.

The activity of jumping rope is an intense form of exercise but the time and intensity of activity while learning jump rope skills and routines has not previously been assessed. The purpose of this study was to assess the time and intensity of PA for youth participating in a jump rope afterschool program. Energy expenditure during the program and differences in PA between gender and minority status populations were examined.

Material & Methods

Participants

Participants were 4th and 5th grade students, average age of 9.2 (± 1.2) years, who self-enrolled into afterschool jump rope programs at two elementary schools. All students who enrolled in the program were asked to participate in the study and consent and assent forms were obtained from guardians and participants in accordance with IRB approval. Out of the 36 students who enrolled in jump rope program, 28 participated in the study.

Procedure

To objectively assess PA during the sessions, accelerometers (ActiGraph GTM1) were used. To calculate the amount of sedentary, light, moderate, and vigorous intensity PA during the jump rope program, a calibration equation was used to convert the counts from the accelerometers to PA minutes. The cut points used for this study were developed for children and adolescents ages six to eighteen (Freedson, Sirard, & Debold, 1997) and are detailed in Table 1.

Table 1. Accelerometer Physical Activity Intensity Cut Points

	Sedentary	Light	Moderate	Vigorous	Very Vigorous
Counts per minute	0-149	150-499	500-3999	4000-7599	>7600

Energy expenditure via metabolic equivalents (METs) was calculated using counts per minute (cpm) and age (Freedson, Pober, & Janz, 2005).

$$METs = 2.275 + (0.0015 \times cpm) - (0.08957 \times age) - (0.000038 \times cpm \times age)$$

The afterschool jump rope program was held twice a week over 11 weeks with sessions lasting 90 minutes. During the sessions, participants worked through skills that were separated into six progressive levels. The levels were color-coded and when the participants mastered a skill, they put a star sticker (color matched to the skill level) on their individual skills sheet. The skill sheets had a print out of their school's mascot and their name, and were displayed in the gym (School One) or the hallway (School Two). While learning these skills, the participants practiced partner skills and memorized a group routine. The participants also received take home practice logs to encourage PA outside of the sessions. These sessions were run by two facilitators during the first ten weeks and culminated with a showcase performance of their group routine at a local high school during week eleven.

Accelerometers were worn at three timepoints (at weeks three, six, and ten) and were coded with the participant number so they could be linked to their demographic information. The accelerometers were worn around the hips using the ActiGraph waistbands with the monitor located at the front on their right hip. They were worn for the entire 90-minute session, and collected before they left the gym.

Data Analysis

To examine PA time and intensity, counts per minute recorded by the accelerometers were converted into time spent in the different intensity levels and MET ranges (Freedson et al., 1997; Patty Freedson et al., 2005). A repeated measures ANOVA was used to assess differences between the three accelerometer time points. Between group ANOVAs were used to examine the effect of gender, race, and ethnicity (minority status) on the accelerometer data. SPSS (v21.0) was used to complete analysis.

Results

Twenty-eight participants from both schools completed the measurements for this study. The participants' average age was 9.2 (± 1.22) years, there were 21 females and seven males, 21 non-minority and seven minority participants. There were no differences between School One and School Two on age or gender of participants but School Two had a significantly higher minority population ($t(26) = -4.019$, $p < .05$). Demographic information is presented in Table 2.

Table 2. Participant Demographic Information

	School 1 (n=21)	School 2 (n=7)	Total (n=28)
Gender	n (%)	n (%)	n (%)
Male	5 (24)	2 (29)	7 (25)
Female	16 (76)	5 (71)	21 (75)
Race			
White	20 (95)	3 (43)	23 (82)
Black	0 (0)	2 (29)	2 (7)
American Indian	0 (0)	2 (29)	2 (7)
Asian	1 (5)	0 (0)	1 (4)
Ethnicity			
Hispanic	1 (5)	3 (43)	4 (14)
Non-Hispanic	20 (95)	4 (57)	24 (86)
Age			
Years Avg (sd)	9.6 (1.08)	8.0 (0.82)	9.2 (1.22)

There was no significant difference between the three time points on percentage of time at each intensity therefore the three time points were averaged to obtain an overall view of activity during the jump rope sessions.

Moderate to vigorous physical activity (MVPA) was defined as the cumulative time that was spent at or above 500 counts per minute (Freedson et al., 1997). On average, participants in the afterschool jump rope program spent 45.3 minutes (50.3% of the 90-minute session) in MVPA with 17.3 minutes (19.2%) of that time in vigorous activity. The time spent in the PA intensities and significant differences within gender and minority status are presented in Table 3.

Table 3. Time Spent in Physical Activity Intensities

	Gender						Minority			
	Total (n= 28)		Male (n= 7)		Female (n= 21)		Yes (n= 7)		No (n=21)	
	min	%	min	%	min	%	min	%	min	%
Sedentary	36.7	40.7	29.8*	33.1	39.0*	43.3	27.5*	30.6	39.7*	44.1
Light	8	8.9	8.7	9.7	7.8	8.7	9.2*	10.2	7.6*	8.4
Moderate	28	31.2	31.2	34.6	27	30	35.4*	39.3	25.6*	28.4
Vigorous	17.3	19.2	20.3*	22.6	16.2*	18	17.9	19.9	17.1	19
^aMVPA	45.3	50.3	51.5	57.2	43.2	48	53.3	59.2	42.7	47.4
^bVery Vigorous	9.7	10.8	10.8	12	9.3	10.3	8.7	9.7	10	11.1

Notes. Time (%) of 90 minute sessions. ^a MVPA = Moderate + Vigorous. ^b Calculated subgroup of Vigorous

* $p < .05$, between groups

Females spent more time in sedentary activity than males $F(1, 27) = 4.287, p < .05$. Males spent more time in overall vigorous activity than females, $F(1, 26) = 8.154, p < .01$. Non-minority participants spent more time in sedentary activity than minority participants, $F(1, 27) = 8.724, p < .05$. Furthermore, minority participants spent significantly more time in light activity, $F(1, 27) = 5.276, p < .05$, moderate activity, $F(1, 27) = 24.129, p < .001$, and vigorous activity $F(1, 26) = 5.356, p < .05$ than non-minority participants.

METs were calculated to examine energy expenditure during the sessions using counts per minute and average age. During the 17.3 minutes of vigorous activity, they were exercising at a minimum of 6.1 METs. Vigorous exercise can be further categorized into the very vigorous intensity, showing that while participating in the afterschool jump rope program, participants spent 9.7 minutes exercising at above 10.2 METs. In examining this very vigorous cut point, participants spent significantly more time in very vigorous activity (>10.2 METs) than vigorous activity (6.1-10.2 METs), $t(26) = 3.174, p < .01$.

Discussion

On average, participants obtained 76% of the recommended daily MVPA minutes during the afterschool jump rope sessions. The number and percent time of PA minutes in this program is higher than what has been found in previous studies using accelerometers to assess time and intensity of activity in children during afterschool programs (Ajja et al., 2014; Bailey et al., 2012; Taverno Ross et al., 2012; Trost, Rosekranz, & Dziewaltowski, 2008). For comparison, the highest MVPA was found in 10-14 year old participants of the Health and Physical Activity Promotion in Youth (HAPPY) study, which assessed three different PA interventions (Bailey et al., 2012). Boys and girls in the jump rope program received 23.7 and 14.0 more minutes, respectively, of MVPA than boys and girls in the HAPPY programs.

In comparison to a study which examined twenty traditional afterschool programs in South Carolina, boys and girls, ages 5-12 years old, obtained 35.3% of the recommended daily MVPA minutes compared to 76% for participants in the jump rope program (Ajja et al., 2014). Looking specifically at VPA, boys in jump rope engaged in an average of 20.3 minutes per jump rope session compared to boys in the HAPPY study who engaged in an average of 6.6 minutes per session (Bailey et al., 2012) and boys in common Midwest afterschool programs who engaged in an average of 6.8 minutes (Trost et al., 2008). Girls in jump rope engaged in an average of 18.1 minutes of VPA compared to girls in the HAPPY study who engaged in an average of 7.2 minutes (Verloigne et al., 2012) and girls in a regular afterschool programs at 4.1 minutes of VPA (Trost et al., 2008). In reference to additional outcomes, children in jump rope engaged in an average of 17.3 minutes of vigorous activity per session, which is above five minutes associated with a lower likelihood of being obese (Wittmeier et al., 2008).

Consistent with other studies, male participants spent less time in sedentary activity, and more time in vigorous activity than females. Even though girls spent more time in sedentary activity than boys, it is important to note that girls in this program spent more time in activity than found in previous studies examining afterschool programs. Physical activity declines with age for both boys and girls, but the decline has been found to be more drastic in girls (Wichstrøm, von Soest, & Kvaem, 2012). This jump rope program provided an opportunity for girls to participate in high levels of moderate, vigorous, and very vigorous activity, which could potentially play a role in increasing PA in adulthood.

Additionally, participants who identified as Black, American Indian, Asian, or Hispanic engaged in more light and moderate intensity activity and less sedentary activity than the non-minority participants. This is an important finding knowing that children in these minority groups have higher rates of obesity (Ogden et al., 2012).

In examining the energy expenditure accumulated during the sessions, the 17.3 minutes spent at 6.5 METs is at a higher energy expenditure than climbing stairs (5.5 METs). The 9.7 minutes spent at above 10.6 METs represented the participants exercising 2.6 METs above what is expended while running at 8kph/5mph (Harrell et al., 2005).

Limitations

The study is limited by the sample size of participants in the program. The study could only be conducted at two schools, which limited the generalizability of the study. Second, a control group was not used to compare the jump rope program to other afterschool programs occurring at the same time. Participants could self-enroll into concurrent afterschool programs however this would not impact the amount or intensity of PA during the jump rope sessions.

Conclusions

Overall, this study reaffirms past studies which indicate that jumping rope is aerobically challenging. Anyone who has jumped rope for even five minutes can attest to this! The issue is that with youth populations, strictly jumping rope for exercise is not fun or sustainable. Learning jump rope skills within a team provides a setting for youth to participate in meaningful amount of time in moderate and vigorous intensity activity.

Although studies have directly measured the metabolic cost, heart rate, and oxygen consumptions of individuals jumping rope, it has been while jumping at a set cadence for shorter periods of time. Individuals practicing jump rope skills and routines incorporate muscle strengthening moves, flexibility exercise, and high heart rate intervals for long periods of time. This may lead to even more positive cardiovascular changes than previously found in rhythmic jump rope studies. Consistent exercise in the moderate to vigorous intensity range has been found to improve students' behavior, cognition, and academic achievement (Lees & Hopkins, 2013) all of which would positively impact physiological, psychological, and social school health. There are no federal policies mandating the duration and days per week of physical education or recess and legislation focusing on achievement in core curriculum has led to decreased opportunities for physical activity during the school day (Cooper et al., 2016). This, along with the fact that afterschool program participation continues to increase with 10.2 million students involved in 2014 (Alliance, 2014), demonstrates the opportunity for afterschool physical activity programs to positively impact school health.

Like any PA program, afterschool PA programs need to be effective in engaging elementary school aged children in enough MVPA to meet recommendations and experience outcomes. It is evident that jumping rope engages children in high intensity PA and that programs which integrate learning skills, partner work, and

group routine development keep children engaged and accumulating MVPA time. Additionally, jump ropes are long lasting and cost-effective exercise equipment that are often a standard component of physical education equipment. Afterschool jump rope programs may be an excellent way to create opportunities for children to reach the recommended daily amount of PA.

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