
CHARACTERIZATION OF HEART RATE RESPONSES, DURATION, AND DISTANCES TRAVELED IN YOUTH PARTICIPATING IN RECREATIONAL SKATEBOARDING AT COMMUNITY SKATEPARKS

HEATHER N. FURR, JEFF A. NESSLER, AND SEAN C. NEWCOMER

Department of Kinesiology, California State University San Marcos, San Marcos, California

ABSTRACT

Furr, HN, Nessler, JA, and Newcomer, SC. Characterization of heart rate responses, duration, and distances traveled in youth participating in recreational skateboarding at community skateparks. *J Strength Cond Res XX(X): 000–000, 2018*—Recreational skateboarding continues to gain popularity in youth within the United States and abroad. Surprisingly, there is a paucity of research regarding the cardiovascular responses of youth participating in recreational skateboarding. Therefore, the purpose of this study was to test the hypothesis that skateboarding would elicit heart rates and durations consistent with the American College of Sports Medicine (ACSM) and Center for Disease Control and Prevention (CDC) recommendations for cardiovascular fitness in youth. Seventy-one recreational skateboarders (boys: 63 and girls: 8) between the ages of 6 and 17 years participated in this study. Data were acquired at 9 skateparks in the local community. After parental consent, participants completed a questionnaire and were instrumented with a heart rate monitor (Polar V800 GPS Sports Watch), which recorded heart rate, duration, and distance traveled. Participants were instructed to engage in typical skateboarding activities, with the duration and intensity of activity determined by the individual. Participants were 10.6 ± 2.9 years old and had participated in skateboarding for 3.1 ± 2.4 years. On average, subjects skateboarded 55.5 ± 28.4 minutes, at an average heart rate of 140.4 ± 16.1 b·min⁻¹, and traveled an average distance of 2.65 ± 1.87 km. Results from this study suggest that youth participating in recreational skateboarding at community skateparks attain exercise intensities and durations that are comparable with the ACSM's and CDC's exercise recommendations for cardiovascular fitness in youth. These findings may hold implications for city planners consid-

ering the impact of community skateparks on physical activity in youth and overall public health.

KEY WORDS action sports, cardiovascular, physical activity

INTRODUCTION

Skateboarding first came to prominence in the 1950s as an alternative for surfing (8,18). Since then, skateboarding has grown in popularity with an estimated 12–20 million individuals participating in skateboarding in the United States (8). Based on skateboard sales tracking information, it has been reported that the majority (~70%) of skateboard participants are younger than 18 years (7). To accommodate these youth skateboarders, communities are actively investing in skateparks as evidenced by the greater than 4,000 skateparks located across the United States and the construction of hundreds of new skateparks annually (20).

However, over the past decade, there has been a decline in youth participation in skateboarding (15). One factor that may contribute to this decline is the parental perception of injury risk associated with youth participation in skateboarding. These concerns are not unfounded given reports of increased injuries, most notably fractures and dislocations, over the past 2 decades in boy and girl youth skateboarders (16,17). This may lead parents, who play a major role in enabling their children to participate in physical activities, to hold a negative view of the activity and avoid encouraging their children to participate (2). In addition, parents may also discourage their children from participating in skateboarding because of the reported negative social stigma associated with the skateboarding culture (18). Finally, the research literature on the benefits of skateboarding is currently sparse, which may in turn lead parents not to appreciate the potential health benefits skateboarding may provide their children (2).

Currently, the American College of Sports Medicine (ACSM) and the Centers for Disease Control and Prevention (CDC) recommend that youth engage in

Address correspondence to Sean C. Newcomer, snewcomer@csusm.edu.

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TABLE 1. Subject characteristics (mean \pm SD).

Sex	Subject number	Age (yrs)	Height (cm)	Body mass (kg)	Experience (yrs)	Skateboarding (d·wk ⁻¹)	Duration (min)	Skatepark (d·wk ⁻¹)
Female	8	8.8 \pm 1.3	129.3 \pm 12.2	32.0 \pm 8.1	1.7 \pm 0.7	2.3 \pm 1.3	90.0 \pm 32.1	2.1 \pm 1.2
Male	63	10.6 \pm 2.8	143.9 \pm 18.6	37.6 \pm 12.7	3.2 \pm 2.4	4.1 \pm 2.2	124.2 \pm 83.1	2.9 \pm 2.0
Total	71	10.4 \pm 2.7	142.2 \pm 18.5	37.0 \pm 12.3	3.0 \pm 2.3	3.9 \pm 2.2	120.3 \pm 79.6	2.8 \pm 1.9

a minimum of 60 minutes of moderate to vigorous physical activity daily to improve health and well-being (1,10,13). There is currently very little research investigating whether youth meet these recommendations while participating in recreational skateboarding. However, 30 minutes of skateboarding has been reported to elicit a cardiovascular response consistent with the ACSM and CDC’s moderate exercise intensity recommendations in adults ($N = 12$) (11). These results in adults are encouraging because they suggest that participation in skateboarding by youth may also satisfy the ACSM and CDC exercise intensity recommendations. Unfortunately, the cited study represents the entirety of all previous research into this question yet provides little insight into the duration that either adults or youth participate in a typical skate session. Therefore, it is unclear whether youth skateboarders meet the 60 minutes of daily physical activity

recommended by the ACSM and CDC. This knowledge may inform decisions being made about skateboarding by coaches, physical educators, athletes, and city council members looking to build community skateparks in their city. For this reason, the purpose of the current investigation was to characterize both the intensity and duration of youth skateboarders at community skateparks. We hypothesized that recreational youth skateboarders would meet the daily ACSM and CDC physical activity and intensity recommendations when skateboarding at community skateparks.

METHODS

Experimental Approach to Problem

No studies have examined the heart rate response and duration of physical activity in youth participating in recreational skateboarding at community skateparks. In this study, children’s heart rate was measured using a Polar V800 heart rate monitor as an index of exercise intensity. In addition, duration and distance traveled were evaluated in youth engaging in recreational skateboarding. These measurements were taken at 9 local community skateparks.

Subjects

One hundred one boy and girl youth skateboarders, ranging in ages between 6 and 17 years, were recruited at community skateparks located in San Diego County. Written parental informed consent and child assent were obtained, and subjects were informed of the benefits and risks of the investigation before participation. All

Percent of Total Duration Moving v. Stationary

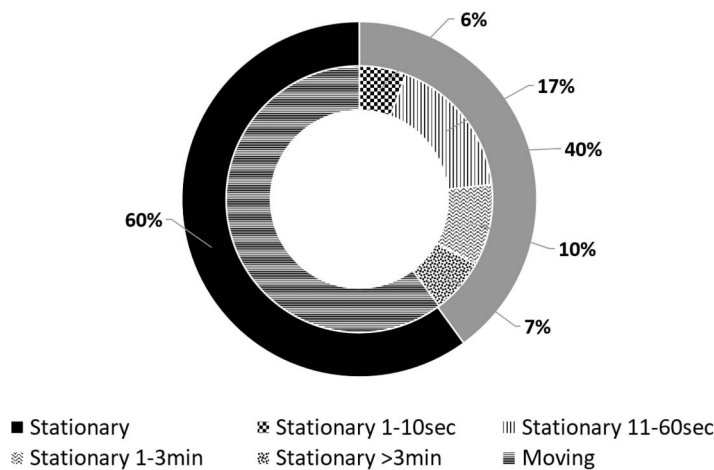


Figure 1. Percentage of the total skateboarding duration (55.5 \pm 28.4 minutes) spent moving, stationary, stationary 1–10 seconds, stationary 11–60 seconds, stationary 1–3 minutes, and stationary greater than 3 minutes.

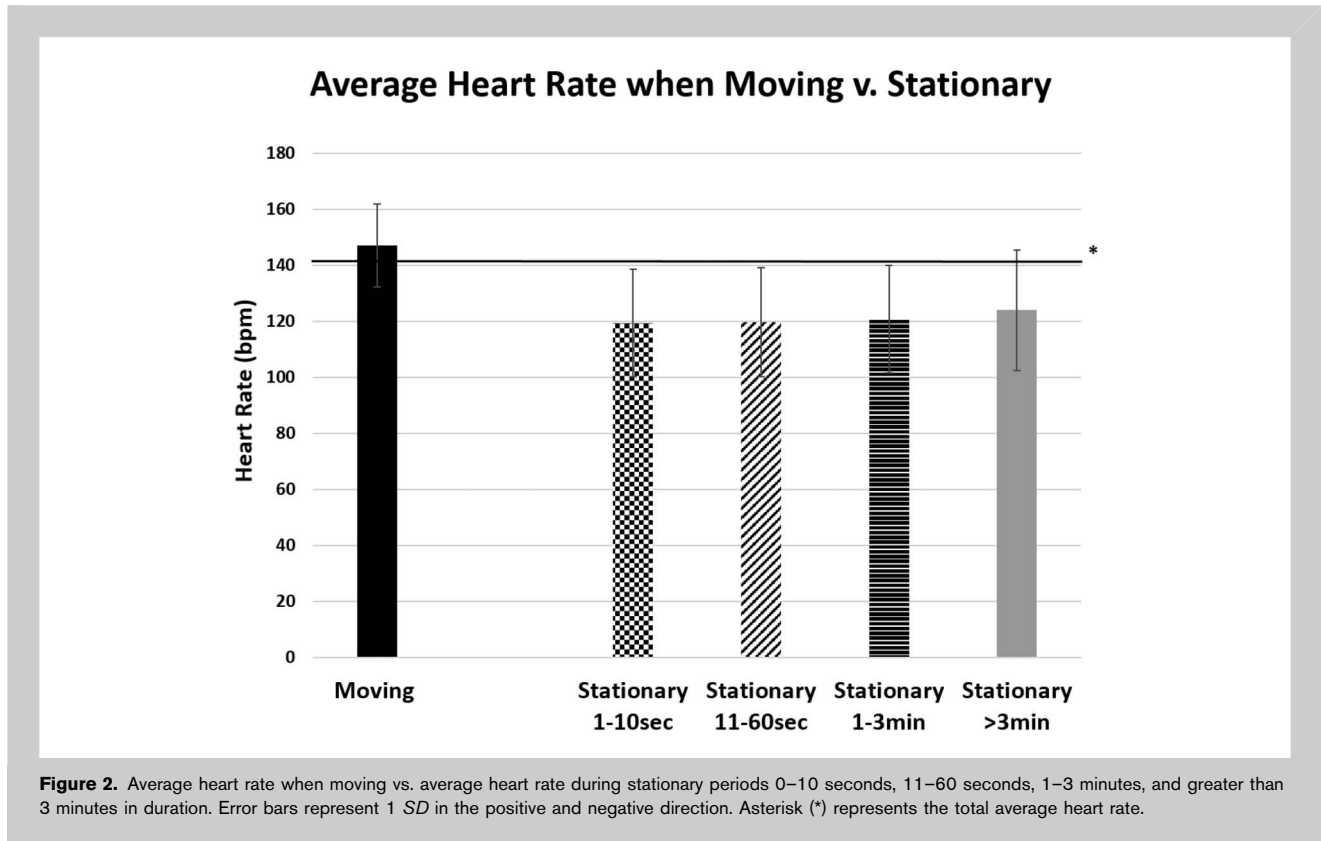


Figure 2. Average heart rate when moving vs. average heart rate during stationary periods 0–10 seconds, 11–60 seconds, 1–3 minutes, and greater than 3 minutes in duration. Error bars represent 1 SD in the positive and negative direction. Asterisk (*) represents the total average heart rate.

procedures were approved by the institutional review board at California State University, San Marcos (IRB#: 863327). Participants completed a 1-page skateboarding history questionnaire, which included questions pertaining to their current skateboarding activity and experience level. In addition, height and body mass were self-reported by parents or participants. Less than 1 year of skateboarding experience was an exclusion criterion for the current study. All subjects were classified as recreational skateboarders and had no history of participating in skateboarding competitions.

Subject Characteristics. Data for 71 of the 101 recruited subjects (63 boys and 8 girls) were included in the final analysis. Subjects with greater than 10% of total heart rate data missing were excluded from the analysis. The average age of participants was 10.4 ± 2.7 years of age (mean \pm SD). On average, subjects were 142.2 ± 18.5 cm tall and weighed 37.0 ± 12.3 kg. Fifty-two of the 71 subjects were younger than 13 years with the remaining 19 subjects ranging between 13 and 17 years of age. As determined through the skateboarding history questionnaire, subjects reported an average 3.0 ± 2.3 years of skateboarding experience, skateboarding 3.9 ± 2.2 days per week for 120.3 ± 79.6 minutes, and spending 2.8 ± 1.9 days per week at a skatepark (Table 1).

Procedures

After completion of written informed consent and assent forms, subjects were instrumented with a Polar V800 GPS sports wristwatch on their left wrist and H7 Bluetooth transmitter, which was located around the chest below the pectoralis major muscles (Polar Electro, Inc., Lake Success, NY, USA). A Gogo Terry cloth wrist band (Needham Heights, MA, USA) was placed over the watch to both blind the subjects of data acquisition and protect the wristwatch from damages during falls. Once fully instrumented, subjects were then instructed to engage in their normal recreational activities for a duration of their choosing. Throughout the skateboarding session, heart rate ($b \cdot \text{min}^{-1}$), duration (seconds), speed ($\text{km} \cdot \text{h}^{-1}$), and distance (km) were acquired at 1-second intervals by the Polar V800 GPS sports watch. On completion of the skateboarding session, data acquisition was terminated and Polar WebSync software was used to download the data from the Polar V800 GPS sports watch to a Microsoft Excel spreadsheet.

Data Analysis. Data reported are mean values \pm SDs. Heart rate and duration were directly compared with the exercise recommendations for cardiovascular fitness and health set by the ACSM and CDC to determine whether the subjects met these recommendations during recreational skateboarding. Heart rate responses were

Percent of Total Duration at High, Moderate, Low and Below Low Exercise Intensity

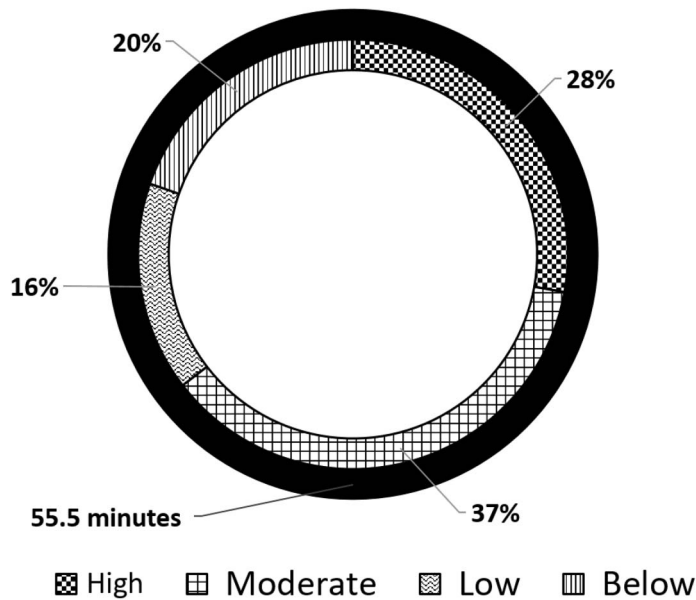


Figure 3. Percentage of the total skateboarding duration (55.5 ± 28.4 minutes) spent at high, moderate, low, and below low exercise intensities based off each subjects' age-predicted maximum heart rate.

age heart rate achieved when moving (147.1 ± 14.8 b·min⁻¹) was higher than the average heart rate when stationary (120.0 ± 19.4 b·min⁻¹). Skateboarders achieved an average heart rate of 119.4 ± 19.1 b·min⁻¹ while stationary 0–10 seconds, 119.6 ± 19.4 b·min⁻¹ while stationary 11–60 seconds, 120.8 ± 19.1 b·min⁻¹ while stationary 1–3 minutes, and 123.9 ± 21.4 b·min⁻¹ while stationary for more than 3 minutes (Figure 2).

Exercise Intensity

Heart rates ≥76% of the age-predicted maximum heart rate (i.e., high intensity) were recorded for 28 ± 26% of the total skate session. In addition, heart rates in the moderate-intensity range (between 64 and 75% of the age predicted maximum) were recorded for 37 ± 17% of the total skate session. Low-intensity exercise (between 57 and 63% of the

age-predicted maximum heart rate) compromised 16 ± 11% of the total session, and the remaining 19 ± 19% of the total duration was spent below low intensity with heart rates <57% of the age-predicted maximum heart rate (Figure 3). Overall, the percentage of time skateboarders spent in high- to moderate-intensity exercise (65%) was greater than the percentage of time spent in low- and below low-intensity exercise (35%).

RESULTS

Heart Rate and Duration

The average total duration of a single skateboarding session was 55.5 ± 28.4 minutes. On average, skateboarders spent 60 ± 18% of the total duration moving and 40 ± 17% of the total duration stationary. Of the time spent stationary, 6 ± 2% was due to breaks of 1–10 seconds in duration, 17 ± 8% was due to breaks of 11–60 seconds in duration, 10 ± 9% was due to breaks between 1 and 3 minutes in duration, and 7 ± 10% was due to breaks greater than 3 minutes in duration (Figure 1). Furthermore, all subjects (100%) were stationary for 0–10 and 10–60 seconds at some point during their session, 76% were stationary for 1–3 minutes, and only 39.4% were stationary for >3 minutes during their skateboarding session.

Skateboarders achieved an average heart rate of 140.4 ± 16.1 b·min⁻¹ throughout the entire skate session. The aver-

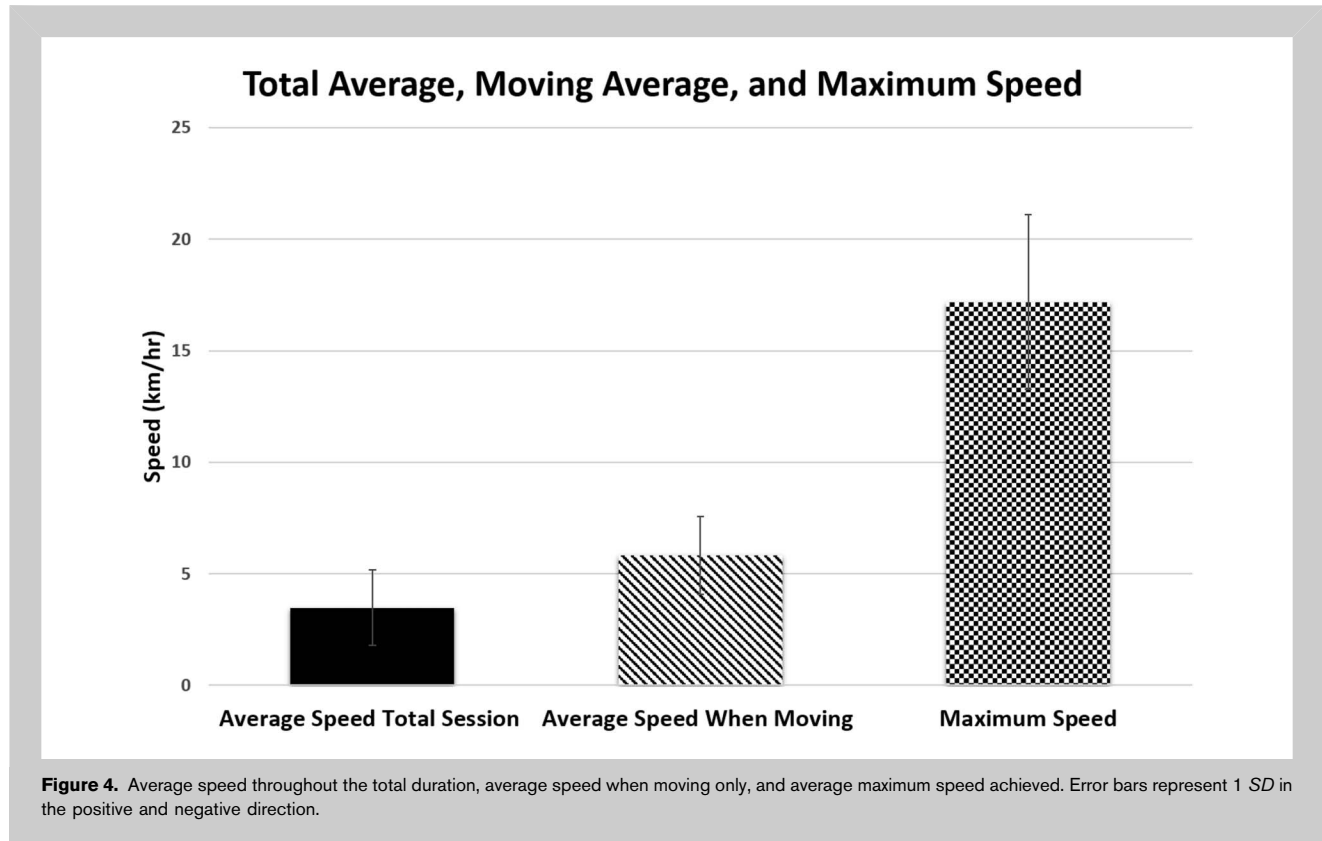
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Distance, Speed, and Elevation

Skateboarders traveled an average distance of 2.65 ± 1.87 km per session with an average elevation change of 0.09 ± 0.05 km. Over the entire skateboarding session (moving + stationary), skateboarders averaged a speed of 3.48 ± 1.70 km·h⁻¹. The average speed of skateboarders when moving was 5.82 ± 1.74 km·h⁻¹, and skateboarders reached an average maximum speed of 17.19 ± 3.92 km·h⁻¹ (Figure 4).

Correlations

An inverse relationship was found between the percentage of time spent stationary and average heart rate ($r = -0.694, p < 0.001$). In addition, average heart rate vs. average speed ($r = 0.643, p < 0.001$) and average speed vs. active heart rate ($r = 0.584, p < 0.001$) were both moderately correlated.



DISCUSSION

Despite its increased popularity and large percentage of youth participants, the exercise intensity and duration of recreational youth skateboarding have yet to be characterized. To investigate the intensity and duration of a single skateboarding session, we conducted a field study at 9 community skateparks located in San Diego County and recorded the heart rate ($\text{b} \cdot \text{min}^{-1}$), duration (seconds), speed ($\text{km} \cdot \text{h}^{-1}$), and distance (km) of 101 youth skateboarders. Results from this study demonstrate for the first time that youth skateboarders participating in recreational skateboarding at community skateparks have average skate durations of 55.5 ± 28.4 minutes. In addition, heart rate responses from this study suggest that most (65%) of the skateboarding duration was spent at moderate to vigorous exercise intensities. These findings are the first to suggest that youth can meet the daily ACSM and CDC physical activity recommendations when skateboarding at community skateparks.

Current research literature on the benefits of skateboarding is limited, and therefore, the appreciation for the potential health benefits that the activity can provide children are currently lacking (4). One previous investigation reported that 30 minutes of street skateboarding elicited a cardiovascular response consistent with the ACSM and CDC's moderate exercise intensity recommendations in adults (11). The current study is the first to characterize

the cardiovascular response in youth skateboarders, which represents ~70% of the total skateboarding population (7). Similar to the study previously performed in adults, youth skateboarders achieved a heart rate response ($140.4 \pm 16.1 \text{ b} \cdot \text{min}^{-1}$) consistent with exercise intensity recommendations set by the ACSM and CDC. In addition, youth nearly met the daily recommended exercise duration for youth (60 minutes per day) in a single skateboarding session (55 minutes). Interestingly, previous research on youth participating in other action sports, such as surfing, demonstrated heart rate ($131 \pm 0.87 \text{ b} \cdot \text{min}^{-1}$) and duration (61.7 ± 1.6 minutes) responses that were similar to the findings of the current study (9). Together, these results suggest that action sports such as surfing and skateboarding could serve as an alternative mode of exercise for children who choose not to participate in traditional sports. This is an important concept given that participation in action sports continues to increase in popularity among youth in the United States and abroad (12). However, in the past 2 decades, previous studies have primarily focused on the increased risk of injury in youth participating in skateboarding (16). Interestingly, over the 85 hours of data collection in the current study, no injuries were observed in any of the 101 youth skateboarders.

Youth skateboarders spent 60% of their time moving with an average heart rate of $147 \pm 15 \text{ b} \cdot \text{min}^{-1}$ and 40% of their time stationary with an average heart rate of $120 \pm 19 \text{ b} \cdot \text{min}^{-1}$. These data highlight the intermittent nature of this

sport and suggest that it may share similarities with the exercise paradigm known as high-intensity interval training (HIIT). Intermittent activity is more consistent with how adolescents generally engage in physical activity, which consists of short bursts of high-intensity exercise combined with varying intervals of low- to moderate-intensity activity (3). Previous research has established many positive health outcomes in the adolescent age group as a result of HIIT including reduced cardiometabolic risk factors, improvements in aerobic fitness, insulin sensitivity, adiponectin and high-density lipoprotein cholesterol, reductions in body mass index, percentage body fat, systolic blood pressure, waist circumference, fasting plasma glucose and insulin, low-density lipoprotein cholesterol, and triacylglycerides (TAG) (14). In addition to its physiological benefits, interval training has been reported to be more enjoyable than sustained exercise (5). This is significant given the strong influence that enjoyment has on adherence to physical activity in youth (14). In addition, it has been suggested that children have greater enjoyment of sports and physical activities when they are not forced to compete or win (2). Given these factors, one can speculate that recreational skateboarding may result in increased physical activity adherence and long-term health benefits in youth that may not be drawn to traditional forms of physical activity.

A number of factors contributed to the age and sex characteristics of the participant pool at local community skateparks and should be considered when interpreting these data. For example, the current study included a greater number of boys (89%) than girls (11%) participants. Although unbalanced, this ratio reflects the general skateboarding population in which boy participants (90%) outnumber girl participants (10%) (6). In addition, most participants were between the ages of 7 and 12 years, thereby limiting the generalization of these results to older youth (12–17 years old). The reason for this discrepancy was that adolescent skateboarders often use skateparks without parental supervision and were therefore unable to provide parental consent to participate in the current study. Finally, results from this study may have been influenced by skatepark design. To account for this potential limitation, data were collected at 9 skateparks that differed considerably in design.

PRACTICAL APPLICATIONS

There are 3 primary applications for the results of this study. First, skateboarding is scheduled to make its debut at the 2020 Summer Olympics, yet this seems to be the first study to characterize the activity of skateboarding. This information might be useful to athletes and coaches when designing training programs for optimal performance. Specifically, coaches should incorporate training intervals of similar intensities and durations reported in this study to mimic skateboarding activities when using alternative modes of training outside of skatepark. Second, skateparks have been shown to create a safe gathering place within the community

for skateboarders of all ages and community groups such as the Tony Hawk Foundation must often help to advocate for their approval and construction. These data may be helpful in demonstrating the benefits that a skatepark might bring to a community. In addition, a better understanding of the sport itself and the physical responses of its participants can help designers create community skateparks that may provide the greatest amount of cardiovascular health benefits. Specifically, advocates and designers of community skateparks can use this information to lobby for the addition of more community skateparks based on the positive cardiovascular impacts they can have on children in their community. Finally, many public schools in New Jersey, New York, California, and Minnesota, have introduced skateboarding into their physical education curriculum in an attempt to engage students who are not interested in traditional sports. It has been suggested that children who are not interested in traditional competitive sports are more likely to participate in individualized activities such as skateboarding outside of school after being introduced to it in school (19). However, this may leave parents concerned because of the current focus on the risk of injury in the literature (17). Results from the current study can help inform concerned parents and school administrators that the health benefits of skateboarding may outweigh the risk of injury.

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