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Original Research

Characterization of Adult Heart Rate Responses During Recreational Skateboarding at Community Skateparks

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ABSTRACT

International Journal of Exercise Science 13(2): 501-510, 2020. Youth participating in recreational skating at community skate parks attain exercise intensities and durations that are comparable with the CDC's exercise recommendations for cardiovascular fitness for their age group. However, it is currently unclear if adults who skateboard in the same environment also achieve the recommended intensities and durations for cardiovascular fitness. Therefore, the purpose of this study was to test the hypothesis that skateboarding would elicit heart rates and durations consistent with the CDC's recommendations for cardiovascular fitness in adults. Fifty-five subjects between ages 18-55 were recruited from six community skateparks for this study. Subjects completed a questionnaire and were instrumented with a Polar V800 heart rate receiver on the left wrist and an H7 Bluetooth heart rate transmitter around the chest below the pectoralis major. Participants were instructed to engage in a typical skateboarding session on their own board with the duration and intensity of activity to be determined by the participant. The mean age of the participants was 27.4 ± 8.5 years, and participants reported skateboarding at a community skate park a mean of 3.1 ± 1.8 days/week. Participants had a mean heart rate of 138.2 ± 21.9 beats per minute (71.7% of age predicted maximum), skated for 65.5 ± 36.2 minutes, and traveled 4.56 ± 4.5 kilometers. Subjects spent 70% of their total duration at moderate-intensity or above and 30% within the low, and below low-intensity range. Results from this study suggest that adults participating in recreational skateboarding in community skateparks achieve the CDC's exercise recommendations for cardiovascular fitness. These findings may have implications for community skatepark design and professional training programs for adult skateboarding athletes.

KEY WORDS: Skating, exercise, action sports.

INTRODUCTION

Action sports, sometimes referred to as extreme sports, are recreational activities that usually involve a higher inherent risk, require specialized equipment, and offer additional creativity compared to traditional sports (11, 17, 19). One of these action sports, skateboarding, is the act of riding a short oblong piece of wood, plastic, or aluminum mounted on four wheels to perform stunts, tricks, or leisurely cruise (6). Skateboarding can occur where there is an asphalt or concrete surface, but community skate parks provide an environment most conducive to this sport (16). There is an estimated 3,199 community skateparks nationwide and 9,702 worldwide

(5). The ease of accessibility to community skateparks may be one factor contributing to the fact that in 2017, 1.8% of the U.S. population reported to participating in skateboarding at least once that year (13). Interestingly, data suggest that skateboarding is growing in popularity in adults, with 29% of skateboarding participants between 18 and 55 years old (20). Given the participation rate of adults in this sport, it is important to understand the potential health benefits that long-term participation in skateboarding may elicit.

The Centers for Disease Control and Prevention (CDC) currently recommends that adults participate in moderate-intensity aerobic physical activity for a minimum of 30 minutes 5 days a week or vigorous-intensity aerobic physical activity for a minimum of 20 minutes 3 days a week to obtain positive health benefits (15). Based on these guidelines, it has recently been reported that skateboarding can be characterized as an aerobic activity that may have positive effects on both weight management and cardiovascular health in adults (4,9). However, it is unclear if these findings are generalizable to adults participating in recreational skateboarding at community skateparks since the data from these aforementioned studies were collected in laboratory settings where participants skateboarded on flat surfaces. Community skateparks, unlike the flat experimental conditions of the laboratory, provide participants the ability to interact with a concrete environment that is comprised of features that are conducive for generating speed and performing tricks. For this reason, it is likely that the interactions of features within recreational skateparks increases engagement, which in turn leads to greater skateboarding speeds, distances, durations, and heart rate responses than those previously reported in laboratory settings. This is supported by the fact that we have recently reported that children participating in skateboarding at community skateparks achieve mean heart rates and durations that are consistent with CDC physical activity recommendations for children (8). However, it is still unclear if the speeds and distances traveled by adults participating in recreational skateboarding at community skateparks can elicit exercise intensities and durations consistent with the CDC's physical activity recommendations for cardiovascular health. Therefore, the purpose of this study was to test the hypothesis that skateboarding at community skateparks would elicit heart rates and durations consistent with the CDC's recommendations for cardiovascular fitness in adults.

METHODS

Participants

Fifty-five subjects between ages 18 to 55 were recruited for this study at six different recreational community skateparks in the North San Diego County Area. These parks range from 22,000 - 33,000 square feet with street, bowl, and flow elements including but not limited to bowls, rails, stairs, and banks. Written consent and liability waiver forms were completed by each subject prior to participating in the study. Experimental procedures were approved by the California State University San Marcos Institutional Review Board (IRB#1156648). Subjects also completed a one-page questionnaire, which included questions pertaining to the subject's height, weight, and general skateboarding habits. Less than one year of skateboarding experience was an exclusion criterion for this study. In addition, all subjects were classified as recreational skateboarders and had no history of competing in professional skateboarding events. Data for 45 out of the 55 recruited subjects were included in the final analysis (44 males and 1 female).

Ten subjects were excluded from the analysis because greater than 10% of the total heart rate data, or all of the GPS data for the skateboard session were missing.

Protocol

The procedures for this investigation are similar to those we have previously reported in youth skateboarders (8). Briefly, subjects were instrumented with a Polar V800 heart rate receiver on the left wrist and an H7 Bluetooth heart rate transmitter around the chest below the pectoralis major (Polar Electro, Inc., LakeSuccess, NY, USA). A Gogo Terry cloth wristband (Needham Heights, MA, USA) was placed over the Polar V800 receiver to both blind the subjects of heart rate response and protect the receiver from damage during falls. Following instrumentation, subjects were instructed to engage in their normal activities on their own skateboard within the skatepark for a duration of their choice. During each session the Polar V800 receiver recorded heart rate (bpm), duration (seconds), speed (km·hr^{-1}), and distance (km) at one second intervals. Data collection ceased when the subjects reported completion of their activities. Data relating to the amount of features within each skatepark, the subject's interactions with these elements, or the dimensions of each subject's skateboard were not recorded. Polar WebSync software was used to download the data, which was transferred to a Microsoft Excel sheet and SPSS program for data analysis.

Statistical Analysis

Data are reported as mean ± calculated standard deviation (SD). The CDC recommendations for cardiovascular fitness and health were used as a comparison for heart rate and duration to determine if the recommendations were met during recreational skateboarding. Heart rate responses were represented as a percentage of subjects' age-predicted maximum heart rate and classified as high (≥ 76%), moderate (64–75%), low (57–63%), and below low (≤ 57%) exercise intensities, consistent with a previous study in youth skateboarders (8). Age-predicted maximum heart rate was calculated as 220 minus the subjects' age (12). The relationship between heart rate and kinematic data such as speed, distance, and time spent stationary were examined using correlational analyses. Time spent stationary was considered resting at 0.0 km·hr-1 while time spent active was considered ≥ 0.1 km·hr^{-1}. For statistical analysis, all instances of time spent stationary were grouped into durations of 1-10 seconds, 11-60 seconds, 1-3 minutes, or greater than 3-minutes. Mean heart rates achieved while active were then compared with mean heart rates achieved during each of the four classifications of time spent stationary using paired (dependent) t-test. Pearson's product moment correlation was used to evaluate the relationship between mean heart rate and both percentage of time spent stationary and mean speed, as well as the relationship between mean active heart rate and mean speed.

This research was carried out in full accordance with the ethical standards of the International Journal of Exercise Science (14).

RESULTS

Self-reported subject characteristics are presented in Table 1. The mean total duration of a single skateboarding session was 65.47 ± 36.17 minutes. Skateboarders spent a mean of 64.24 ± 15.94% of the total duration active and 35.1 ± 15.9% of the total duration stationary. Skateboarders were

stationary for a mean of 4.14 ± 1.89% for 1-10 seconds in duration, 16.03 ± 6.7% for 11-60 seconds in duration, 9.41 ± 7.41% for 1-3 minutes in duration, and 5.52 ± 9.73% for over 3 minutes in duration (Figure 1). In addition, all subjects (n = 45) were stationary for 0-10 seconds, 97.78% (n = 44) were stationary for 11-60 seconds, 86.67% (n = 39) were stationary for 1-3 minutes, and only 44.44% (n = 18) were stationary for over 3-minutes during their skateboarding sessions.

Table 1. Self-reported subject characteristics collected at the beginning of protocol. n = 45.

Age (years)	Height (cm)	Weight (kg)	Days per Week Skateboarding	Days per Week Skateboarding at a Skatepark	Mean Session Duration (min)
27.4 ± 8.5	175.2 ± 6.8	72.2 ± 10.0	3.5 ± 2.0	3.1 ± 1.8	134.8 ± 76.5

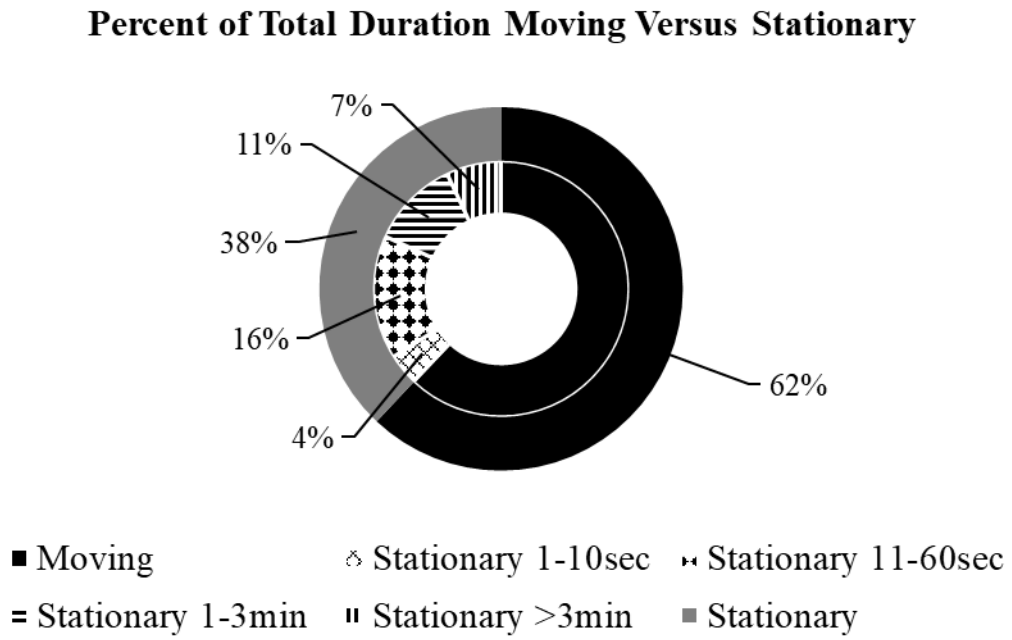

Figure 1. Percentage of the total skateboarding duration (65.47 ± 36.17 min) spent moving, stationary, stationary 1-10 seconds, stationary 11-60 seconds, stationary 1-3 minutes, stationary over 3 minutes. n = 45.

Skateboarders achieved a mean heart rate of 138.24 ± 21.88 beats per minute (bpm) during their skateboarding session. The mean heart rate achieved when the skateboarders were active (144.47 ± 20.29 bpm) was higher, and significantly different ($p < 0.05$) than the mean heart rate when the skateboarders were stationary for 1-10 seconds (Mean difference = 32.67, $p < 0.001$) and 11-60 seconds (Mean difference = 31.51, $p < 0.001$). Mean active heart rate and heart rates during 1-3 minutes (n = 38), and over 3-minutes (n = 18) were not compared due to a lack of subjects resting for that period of time. Subjects achieved a mean heart rate of 111.8 ± 21.87 bpm when stationary for 1-10 seconds, 112.97 ± 23.11 bpm when stationary for 11-60 seconds, 116.47 ± 24.95 bpm when stationary for 1-3 minutes, and 112.16 ± 30.53 bpm when stationary for over 3-minutes during their skateboarding session. (Figure 2).

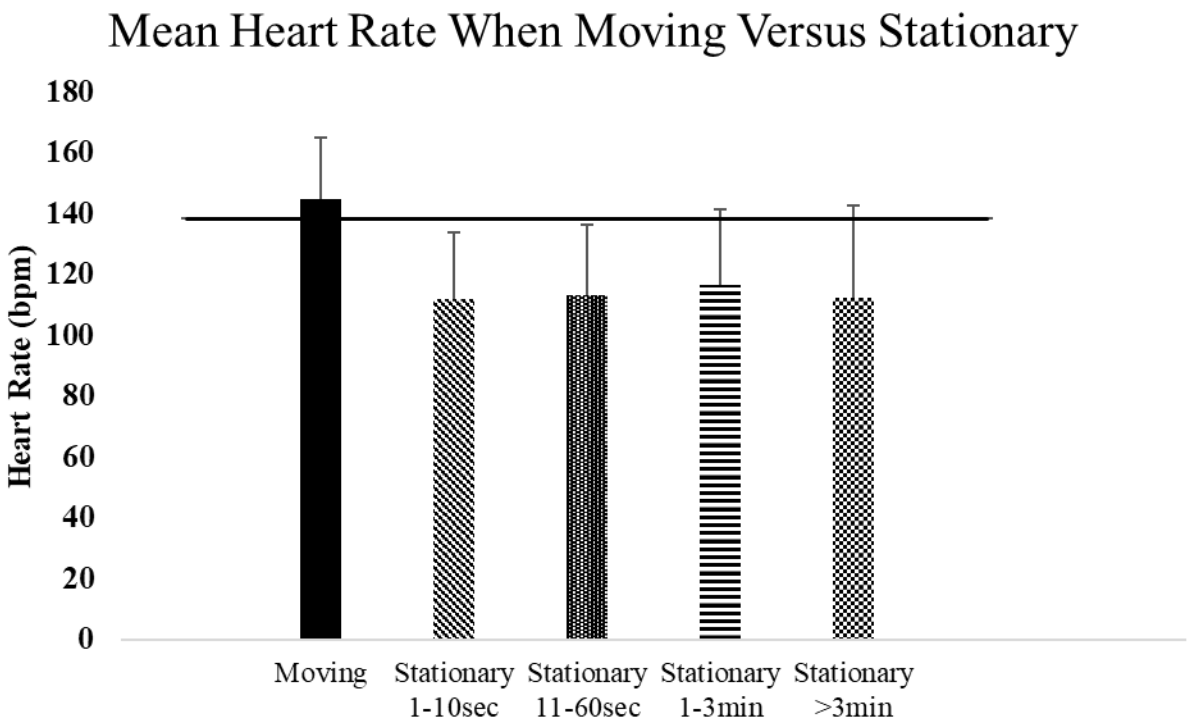

Figure 2. Mean heart rate when moving vs. mean heart rate during stationary periods of 0-10 seconds (n = 45), 11-60 seconds (n = 44), 1-3 minutes (n = 38), and over 3 minutes (n = 18) in duration. Error bars represent the calculated SD for each category. The black horizontal line represents the total mean heart rate. n = 45.

Heart rates were recorded over the entirety of each session and categorized into exercise intensity ranges of high (≥ 76%), moderate (64–75%), low (57–63%), and below low (≤ 57%) based on each subject's age predicted maximum heart rate. Subjects spent 43.32 ± 33.03% of their total session within the high-intensity range, and 28.8 ± 18.86% within the moderate-intensity range. 11.1 ± 9.25% of the sessions were spent in the low-intensity range, and finally 16.78 ± 21.09% of total session duration was within the below low-intensity category. In total the subject's exercise intensities were at a moderate-intensity or above for 70% of their total duration, compared to only 30% within the low, and below low-intensity range during the mean session (Figure 3).

Skateboarders traveled a mean distance of 4.58 ± 4.5 kilometers (km) per session with a mean elevation change of 0.16 ± 0.12 km. The mean speed during the entirety of the skateboarding duration was 4.24 ± 2.03 km $\cdot hr^{-1}$. The mean speed the skateboarders obtained when moving was 6.48 ± 1.94 km $\cdot hr^{-1}$, and the skateboarders produced a maximum speed of 19.26 ± 3.44 km $\cdot hr^{-1}$ (Figure 4).

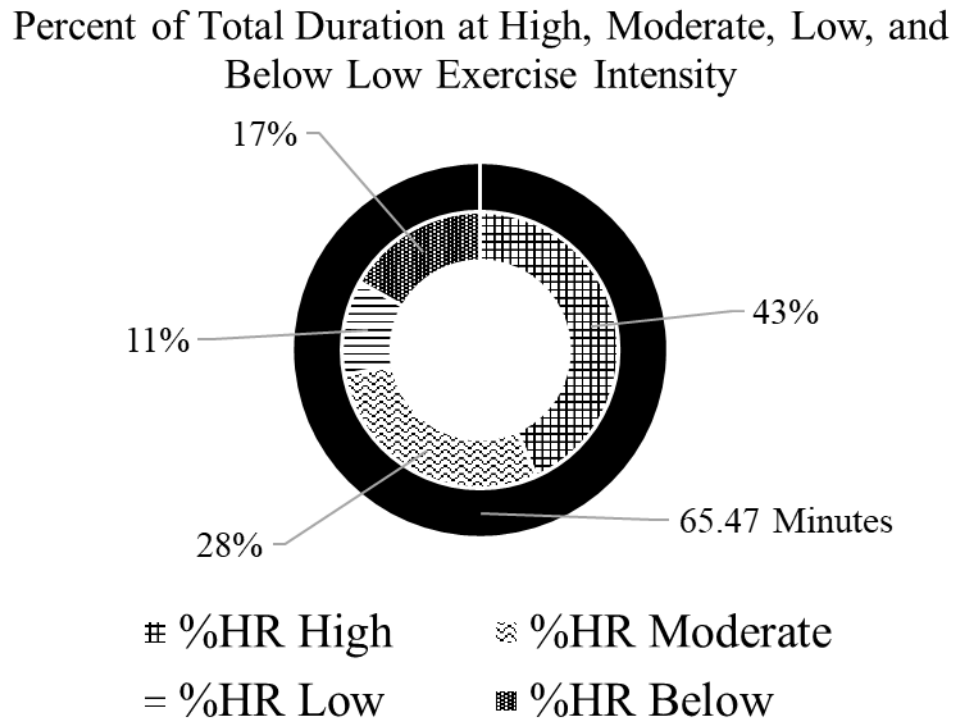

Figure 3. Percentage of the total skateboarding duration (65.47 ± 36.17 min) spent at high, moderate, low, and below low exercise intensities based off of each subjects' age-predicted maximum heart rate. *n* = 45.

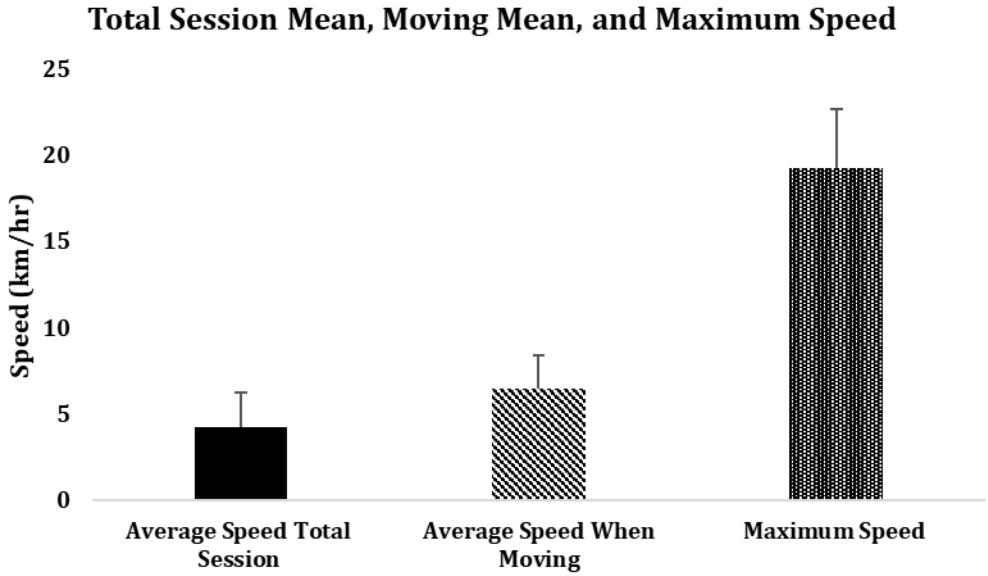

Figure 4. Mean speed throughout the total duration of skateboarding, mean speed of skateboarders when moving only, and maximum speed achieved while skateboarding. Error bars represent the calculated SD for each category. *n* = 45.

Moderate correlations were found between mean heart rate and percentage of time while stationary (r = -0.4908, $p < 0.001$), mean heart rate vs. mean speed (r = 0.4409, $p < 0.002$), and mean speed vs. mean active heart rate (r = 0.3276, $p < 0.028$).

DISCUSSION

The CDC recommends that adults receive 30 minutes of moderate-intensity aerobic exercise for 5 days a week (15). While previous research has found that skateboarding meets these recommendations in laboratory settings, the intensity and duration of recreational skateboarding in the field has yet to be characterized in adults (1,8). This study demonstrated for the first time that adults participating in recreational skateboarding at community skateparks achieved mean heart rates (138.2 ± 21.9 beats per minute) and durations (65.5 ± 36.2 minutes) that are consistent with those suggested by the CDC for daily physical activity. This information, combined with the subjects self-reporting that they skateboarded at community skateparks with a mean of 3.1 ± 1.8 days/week, suggests that recreational adult skateboarders accumulate over 180 minutes of moderate intensity aerobic exercise a week through their participation in skateboarding at community skateparks. Therefore, results from the current study support the hypothesis that skateboarding at community skateparks elicits heart rates and durations consistent with the CDC's weekly physical activity recommendations for cardiovascular fitness in adults.

While current research investigating the potential benefits of adult skateboarding is still limited, results from the current study are consistent with previous investigations suggesting that adult skateboarders may satisfy the CDC's physical activity requirements for cardiovascular health through their participation in recreational skateboarding (1,4,9,10). For example, previous research has demonstrated that skateboarders achieve a mean heart rate of 142.00 ± 15.7 bpm when skateboarding at a self-selected pace on a level concrete surface for 30 minutes (10). Further, longboarders were reported to achieve a mean heart rate of 131.40 ± 25.64 bpm when longboarding on a declined surface for 30 minutes and a mean heart rate of 167.80 ± 16.02 bpm on an inclined surface for the same duration (1). These findings demonstrate that skateboarding on a level or sloped surface for 30 minutes for 3-5 days per week may allow for skateboarders to meet the CDC's exercise requirements (1,4,9,10). This study is unique in that it is the first to report that adults participating in recreational skateboarding at community skateparks engage in the activity for a mean self-selected duration of 65.47 ± 36.17 minutes. Interestingly, over half the time (64.24 ± 15.94%) of the total skateboarding session at community skateparks is actively spent skateboarding. It remains unclear how self-selected skateboarding durations in recreational skatepark settings compare to skateboarding in previously described laboratory settings that are flat and provide no concrete features to generate speed or perform tricks (4,9,10). One can speculate that participant engagement while skateboarding in community skateparks is high and likely leads to greater self-selected skateboarding durations when compared to skateboarding on concrete that is flat and featureless.

Several of the findings from this current study are also consistent with the results of a similar study characterizing the cardiovascular responses of youth recreational skateboarders at community skateparks. Youth skateboarders achieved a mean heart rate of 140.40 ± 16.1 bpm and mean active heart rate of 147.1 ± 14.8 bpm when skateboarding at a mean self-selected duration of 55.5 ± 28.4 minutes (8). However, despite the similarities in both the mean heart rates and duration between adults and youth, adults skateboard at a high-intensity for 43.32 ± 33.03% of their total session while youth skateboard at a high intensity for only 28.00 ± 26.00% of their

total session (8). Additionally, adult skateboarders almost doubled the distance skated than their youth counterparts (4.58 ± 4.5 km vs. 2.65 ± 1.87km) and had a higher total elevation change (0.16 ± 0.12 km vs. 0.09 ± 0.05km) (8). These findings demonstrate that adult skateboarders choose to skate at higher intensities, over greater distances, and for longer durations when compared to youth skateboarding at community skateparks. Unfortunately, results from the current study do not provide insight into the underlying reasons for these reported differences in variables associated with adults and youth skateboarding at community skateparks. However, one can speculate that adults likely have less free time to participate in recreational skateboarding at community skateparks, which may result in a more focused and deliberate skateboarding session when compared to youth. In addition, differences in how adults and youth choose to interact with the built environment of community skatepark may also contribute to these reported differences. Future research will need to characterize community skatepark utilization by both adults and youth to determine underlying cause for these differences in skateboarding intensities, distances and durations across age groups.

Increases in heart rates during recreational skateboarding that are reported in this study and others are likely a result of multiple factors associated with skateboarding (1,4,9,10). Specifically, previous research has reported that oxygen consumption is increased as a result of the repetitive dynamic kicking motion of the lower extremities that is used for propulsion during skateboarding (9,10). In addition, increases in lower limb muscle activity utilized for stabilization and force development during common tricks such as an ollie also likely contribute to increased heart rates during recreational skateboarding (7,18). Lastly, enhanced sympathetic outflow due to the perceived risk associated with this sport may also play a significant role in the heart rate response associated with skateboarding. In direct evidence to support this can be derived from data demonstrating that heart rate during downhill skateboarding is increased significantly above resting values in the absence of lower extremity engagement associated with propulsion (kicking) and performing tricks (1). However, future more well controlled studies are needed to determine the full impact that perceived risk has on the heart response during recreational skateboarding.

Skateboarding is scheduled to make its Olympic debut in Tokyo in 2020. To further advance the sport on a worldwide stage, skateboarding research can be utilized to develop a skateboarding program that leads to advances in professional training for national teams. These programs should have an emphasis on endurance, agility, and balance of the professional skateboarder. Athletes may incorporate various training methodologies such as high-velocity resistance training, plyometrics, stimulus-response exercises, sport-specific multisensory integration exercises, and movement stability exercises (2). Endurance periodization programs should also be incorporated into a skateboarding athlete's training in order to reach peak performance when competing (2). In addition to training programs, advances in skatepark development may aide the athlete in reaching peak performance during competition. The potential for physiological responses within different skateparks would allow training facilities to develop their skateparks with specific goals for the athlete. These newly developed facilities could be created to produce intensity specific responses for skate, vert, or bowl parks in preparation for Olympic competitions.

The physiological benefits of skateboarding in both adults and youth may also support advocacy for accessible recreational skate parks in local communities. Future investment in skatepark development may help to expand the skating community, support an active lifestyle, and improve social skills within the skateboarding population (16). In addition, educators might consider implementing skateboarding in school physical education programs to encourage youth to participate in the sport throughout their lifetime.

The findings in the current study support the hypothesis that adults participating in recreational skateboarding at community skateparks are meeting the CDC recommendations for exercise. These data are also consistent with results from earlier studies conducted in both youth and adults. Future studies should focus on understanding the effects of skatepark design on cardiovascular response in skateboarders, since the differences in skateboarding technique within street, bowl, and flow parks can vary greatly. In addition, the characterization of potential difference in cardiovascular responses between males and females during skateboarding should be investigated given the fact that a growing number of females are participating in the sport (3).

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