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Heart Rate Effects of Longboard Skateboarding

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Abstract

The longboard skateboard has a longer, and usually wider, deck than the standard skateboard to provide greater support of the rider during the higher speeds attained on this version of the skateboard. Fourteen volunteer subjects participated in downhill and uphill longboarding trials. Heart rates were monitored during both trials, and the downhill and uphill average heart rates were compared with resting heart rates and then compared with accepted intensity recommendations for health and fitness benefits. The study questions were: Does longboarding have an acute effect on heart rates? If so, will longboarding uphill and/or downhill cause heart rate changes to levels recommended to improve cardiorespiratory health and fitness? With these questions as guidance we developed four hypotheses. With an average resting heart rate of 59.9 beats/minute, average downhill heart rate of 131.4 beats/minute and average uphill heart rate of 167.8 beats/minute statistical analysis showed statistically significant p values $< .0001$ and each null hypothesis was rejected in favor of their respective research hypotheses. Based on average age and average resting heart rate, average age-predicted maximum heart rate was 193.2 beats/minute and heart rate reserve was 133.2 beats/minute. The average percentages of heart rate reserve for the downhill section (131.4 beats/minute) and the uphill section (167.8 beats/minute) were 54% and 81%, respectively. Downhill heart rates are within moderate intensity levels, 40% to 60% of heart rate reserve, and uphill heart rates are within vigorous intensity levels, greater than 60 % of heart rate reserve. These results indicate that longboarding can increase heart rate to suggested levels suggested by the American College of Sports Medicine for improving cardiovascular health and fitness.

Key words: skateboarding, longboarding, heart rate, effects

Introduction

We examined the heart rate responses to longboard skateboarding uphill and downhill on a two mile section of a walking trail in uptown Butte, Montana with a two percent grade. According to Josh Friedberg of the International Association of Skateboard Companies, skateboarding first originated in California in the 1950s; surfers made their own skateboards out of wood and metal rollerskating wheels. These early skateboards were used for surfing the streets. In the 1970s, the invention of polyurethane wheels revolutionized the skateboarding scene. These wheels were much smoother, faster and safer, and they made skateboarding more fun. Since the 60s and 70s, skateboarding has taken on a different look altogether. The tricks that are done today were unfathomable in the early 70s. Usually measuring between 90 and 150 centimeters in length, the longboard skateboard has a longer, and usually wider, deck than the standard skateboard to provide better support of the rider during the higher speeds attained on this version of the skateboard. It was created for cruising and carving as opposed to the tricks that

are common to the standard skateboard (personal interview, 2012).

Studies show that American children are becoming increasingly overweight, which may lead to chronic lifestyle related diseases at an accelerated pace (Strauss and Pollack 2001, Troiano and Flegal 1998) . In fact obesity in the 6-19 year age category has more than tripled in the last 30 years from 5% to 18%. In 2008, more than 1/3 of children and adolescents were considered overweight or obese (Centers for Disease Control, 2012). Children should be encouraged to participate in a variety of activities that exercise all major muscle groups. Identifying activities, such as longboarding, that may be healthy but are somewhat non-traditional are important because these activities may be a part of the solution for many American adults and children.

Americans are encouraged to exercise at a moderate intensity at least 150 minutes/week (ACSM 2009, United States Department of Health and Human Services 2012). Heart rate reserve (HRR) is the difference between a person's maximum heart rate and resting heart rate, and exercise professionals use a percentage of HRR to prescribe cardiovascular exercise intensity for improving fitness (ACSM 2009). Moderate intensity is defined by the American College of Sports Medicine (ACSM) as 40% to <60% of heart rate reserve and vigorous intensity is defined as > 60% of heart rate reserve (ACSM 2009, Swain & leutholtz 1997). A comprehensive literature review found no studies focusing on the heart rate effects of skateboarding or longboarding. The vast majority of articles in the peer-reviewed literature focused on skateboarding injuries.

Research Questions/Hypotheses

An inverse relationship exists between physical activity and lifestyle related chronic disease such as cardiovascular diseases, hypertension, obesity and type 2 diabetes (ACSM, 2009). Any movement may increase heart rate and, therefore, may have beneficial effects on health. However, some may perceive longboarding downhill as simply going for a ride down a hill with little, if any, physical work done during this activity. Does longboarding have an acute effect on heart rates? Will uphill longboarding have an effect on heart rate? Will downhill longboarding have an effect on heart rate? If so, will it be enough to improve cardiorespiratory fitness? With these questions in mind we developed the following hypotheses:

- **Null Hypothesis 1:** There will be no significant difference between resting heart rate and average heart rate during the downhill portion of the course.
- **Research Hypothesis 1:** There will be a significant difference between resting heart rate and average heart rate during the downhill portion of the course.
- **Null Hypothesis 2:** There will be no significant difference between resting heart rate and average heart rate during the uphill portion of the course.
- **Research Hypothesis 2:** There will be a significant difference between resting heart rate and average heart rate during the downhill portion of the course.
- **Null Hypothesis 3:** The heart rate during the downhill portion of the course will be less than or equal to moderate intensity (40 %) heart rate reserve.
- **Research Hypothesis 3:** The heart rate during the downhill portion of the course will be greater than moderate intensity (40 %) heart rate reserve.
- **Null Hypothesis 4:** The heart rate during the uphill portion of the course will be less than or equal to vigorous intensity (60 % heart rate reserve).
- **Research Hypothesis 4:** The heart rate during the uphill portion of the course will be greater than vigorous intensity (40 % heart rate reserve).

Methods

The study and each subject followed the following steps:

- Resting heart rate measured while seated
- Heart rates monitored and recorded every ½ mile during the descent of a two mile section of the "uptown walking trail" in Butte, Montana, which was the Butte Anaconda Pacific Railway and has a grade of about one to two percent. The longboarders were instructed to ride the descent as they normally would.
- 15 minute rest to pre-trial resting heart rate levels.
- Once the descent was finished, the subjects ascended, or skated, back to the starting point. Again, heart rates were recorded at half-mile intervals.

The subjects wore a Polar FS2 Heart Monitor while riding to record real time heart rates, and were compared with palpated heart rates to ensure accuracy. Trial orders were not randomized; each subject started with the descent to control for previous exertion as a possible cause of heart rate elevation during the downhill portion.

Fourteen volunteer subjects were chosen based on current or previous experience and credentials, and consisted of 12 adults and 2 children (ages twelve years and ten years) with parental supervision and permission. The inclusion criteria were set so only those with previous experience who could demonstrate proficiency were allowed to participate. The demonstration of proficiency involved riding a longboard through a slalom course without falling and coming to a complete stop using a foot-brake. Foot-braking involves dragging one foot, and is a technique used by skateboarders to decelerate and/or stop the skateboard.

The exclusion criteria included any current student of the researcher's and were guided by the American College of Sports Medicine risk stratification process. American College of Sports Medicine (ACSM) guidelines suggests a pre-participation screening that identifies current medical conditions that would exclude those who are at risk for adverse conditions that would cause adverse responses to exercise (ACSM, 2009). The list of conditions that excluded a subject included:

- Pregnancy
- Diabetes
- Hypertension or are taking blood pressure medication
- Asthma
- Concerns about safety of exercise or swimming ability
- Heart surgery
- Chest discomfort with exercise
- Unreasonable breathlessness with exercise
- Unexplained dizziness or fainting
- Musculoskeletal problems that limit functional capacity
- Current smoker

All subjects completed the pre-participation screening to identify anyone who should be eliminated. Additionally, all subjects were under the age of 50 years.

Safety was ensured by direct supervision and monitoring of each subject during the entire process. All subjects gave written, informed consent prior to participating, and an Institutional Review Board approved all procedures.

Results

The average resting heart rate for all subjects was 60 beats/minute with a standard deviation of 3.63. The average heart rate for the downhill portion of the study was 131.4 beats/minute + sd 25.64 and the average for the uphill portion was 167.8 beats/minute + sd 16.02 (Table 1). The complete set of heart rate changes can be seen in Table 1. Examination of a normal quantile plot for the data as well as the results of a Shapiro-Wilk test for normality, verified that an underlying normal distribution was not a reasonable assumption. Therefore, a two-

Table 1. Results of resting, uphill longboarding and downhill longboarding heart rates.

		Subjects													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Miles DH	Resting	59	61	50	58	60	60	58	60	64	64	63	58	60	64
	0.5	168	101	155	135	101	111	137	78	111	134	155	124	167	157
	1	158	89	148	105	113	136	125	80	142	125	145	136	177	159
	1.5	163	124	140	124	93	143	131	88	151	135	169	145	170	160
	2	173	137	134	116	80	140	140	88	137	119	167	122	160	156
Avgerage DH		**165.5**	**112.75**	**144.25**	**120**	**93**	**118**	**136**	**83.5**	**121**	**126**	**162**	**138**	**163**	**157**
DH Time		**10:01**	**12:20**	**11:00**	**13:00**	**13:30**	**13:30**	**14:50**	**14:22**	**14:22**	**14:22**	**12:46**	**12:46**	**9:42**	**10:00**
Miles UH	0.5	157	148	175	170	160	173	181	132	187	197	197	176	171	175
	1	154	166	181	167	167	168	177	132	183	198	196	176	171	176
	1.5	155	160	175	174	168	168	171	120	175	185	197	168	179	180
	2	170	150	202	178	160	148	151	120	176	187	200	180	171	173
Average UH		**159**	**156**	**183.25**	**172.25**	**161**	**165**	**174**	**126**	**163**	**181**	**195**	**170**	**166**	**176**
UH Time		**13:01**	**13:10**	**12:14**	**12:45**	**13:00**	**13:00**	**12:14**	**17:26**	**17:26**	**17:26**	**12:14**	**12:14**	**13:03**	**13:03**
Age		21	20	19	20	20	20	20	43	10	12	20	20	21	21

sample paired t-test was used to compare the average resting heart rate with the average downhill heart rate when longboarding. The resulting t-value was -10.3 ($P< 0.0001$) (Table 2). Thus, our conclusion was to reject null hypothesis 1 in favor of research hypothesis 1. That is, we have strong evidence that the average heart rate when longboarding downhill is significantly higher than the average resting heart rate.

Using a similar process to compare the average uphill and resting heart rates, a two-sample paired t-test produced a t-value of -24.3 ($P < 0.0001$). Based on this we rejected null hypothesis 2 in favor of research hypothesis 2. That is, we have strong evidence that the mean heart rate when longboarding uphill is significantly higher than the mean resting heart rate.

Age Predicted Maximum Heart Rate (APMHR) can be calculated using 206.9 – (0.67 x age) (ACSM, 2009). The sample average APMHR was 193.2 beats/minute. The percentage of HRR for the downhill portion, on average, was 53.5% ± sd 19.3%. Note the percentage per individual is calculated as [(downhill HR – resting HR)÷HRR] ×*100%*. When testing that the average percentage of HRR will be greater than 40%, i.e., research hypothesis 3, we obtain a t-value of 10.30 ($P < 0.0001$) . Thus, we have strong evidence that the downhill portion produces a HR that is classified as moderate intensity.

For the uphill portion, the average percentage of HRR for the sample was 80.8% ± sd 10.5%. When testing research hypothesis 4, that the uphill portion will produce an average percentage of HRR greater than 60%, we obtain a *p-value* < 0.0001(t-value = 28.63). That is, we have strong evidence that the uphill portion engenders a HR that is at the level of vigorous intensity.

Table 2, Statistical Results of Downhill and Uphill Longboarding Heart Rates

	Mean	Standard deviation	t-value	p-value
Resting Heart Rate	59.9	3.63		
Downhill Heart Rate	131.4	25.64	-10.3	p<.0001(0.00000013)
Downhill percentage of HRR	53.5	19.28	10.3	P<.0001(0.000000063)
Uphill Heart Rate	167.8	16.02	-24.3	p<.0001(0.000000000000321)
Uphill percentage of HRR	80.8	10.5	28.63	P<.0001(0.000000000000198)

Limitations/Challenges to the Study

The limitations to this study included the small sample size (N = 14) and our lack of control over each riding style. Each individual was instructed to "ride as they normally would," which had the potential for a wide variety of physiological responses. Some riders would carve actively during the descent and some would do so less actively. Additionally, different people had different boards with different components so some boards were faster than others, which made a difference in the time and effort spent during the ascent.

One challenge that had to be addressed was traffic safety. We designated one person to approach each intersection on a bike and the longboarders were instructed to stop at the major intersections. Another challenge was weather; the data collection for this project took place in April in Butte, Montana. Unfortunately, some of the worst snow storms in Butte occur in April but luckily a window of opportunity opened up between snow storms and we were able to complete the data collection in a timely fashion.

Discussion

We expected an increase in heart rate for the uphill portion of the study, and we were curious as to what the heart rate effects of the downhill portion would be. We were unaware the downhill portion would show such a large increase in heart rate. There may be two causes for the increase during the downhill. One is that the downhill was exciting and this exhilaration may possibly have effected heart rate. The other cause, and one most commonly accepted by longboarders, is the result of the required carving and pumping actions to control the board during the descent. These actions require alternating hip flexion/extension and torso rotation movements that may have some metabolic cost and may cause heart rate to increase to perform these rhythmic actions.

The ACSM recommends a combination of moderate intensity exercise between 40% and >60% of heart rate reserve, and vigorous intensity exercise ≥ 60% heart rate reserve for improving cardiovascular fitness. The intensity ranges are intentionally broad to meet the various needs of all Americans. The heart rate reserve intensity levels of 53% and 81% that we found are considered moderate and vigorous, respectively, and fall within the recommended ranges for improving cardiovascular fitness (ACSM, 2009). The American College of Sports Medicine and the Centers for Disease Control categorize the following activities as moderate intensity: downhill skiing (cruising with light effort), ice skating < 9 miles/hour, surfing (body or board), slowly treading water and flat-water kayaking. The following activities were categorized as vigorous: downhill ski racing or skiing with vigorous effort, fast paced ice-skating or speed-skating, treading water with vigorous effort, and whitewater kayaking (U.S.

Department of Health and Human Services, 2012).

This study indicates that longboarding can increase heart rate to levels suggested for improving cardiovascular health. It is important to note, however, that the trail used during this study was a gentle grade of 1-2%. Longboarding can be dangerous. If speed increases beyond the riders' ability to control the board or come to a stop, serious injuries can be sustained. We do not recommend longboarding, or skateboarding in general, to everyone. We are suggesting that those who do participate in this activity are receiving some cardiovascular benefit.

Future studies should be conducted using different distances and grades, if they can be done so safely. Additionally, it would be interesting to see what the effects of standard park skateboarding would have on heart rate and what the difference in heart rate would be between longboarding and skateboarding.

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