

Longboard skate poling: Physiological and perceptual responses as an emerging recreational activity

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Abstract

Longboard skate poling is an emerging recreational activity that incorporates upper-body propulsion while riders maintain balance on a longboard, yet its ability to provide vigorous whole-body exercise has not been well described. This exploratory study quantified the acute physiological responses of fifteen healthy young adults to a standardized twenty-minute skate poling session. Participants rode a longboard while propelling themselves forward using a handheld pole at a predetermined stroke rate while oxygen uptake and carbon dioxide production were measured breath by breath using a portable gas analysis system. Heart rate was recorded continuously by a chest-strap monitor. From these recordings, metabolic equivalents and energy expenditure were calculated. Immediately after completing the session, participants reported perceived exertion, Borg's Rating of Perceived Exertion, and enjoyment, Physical Activity Enjoyment Scale. On average, participants expended a total of 309.5 ± 27.8 kilocalories, 14.1 ± 1.2 kilocalories per minute, and achieved 12.0 ± 1.6 metabolic equivalents, with the lower bound of the 95 percent confidence interval remaining well above the threshold used to classify vigorous intensity exercise. Mean heart rate was reported as 163 ± 6 beats per minute, corresponding to 94 ± 4 percent of age-predicted maximal heart rate. Peak heart rate reached 187 ± 7 beats per minute. Participant perceptual responses reflected experiencing high effort and positive affect; the average perceived exertion rating was 16 ± 1 on the 6 to 20 scale and an enjoyment score of 4.6 ± 0.2 on a 5-point scale. These findings are suggestive that, as an exercise medium, longboard skate poling can produce vigorous physiological responses while remaining highly enjoyable for riders. This suggests that skate poling may offer a physically demanding and engaging alternative to traditional exercise. Larger and longer-term studies are needed to determine whether these acute observations are sustainable and whether this modality can be integrated into accessible, structured exercise programs.

Keywords: Skate poling, Exercise intensity, Physical activity, Metabolic equivalents (MET), Perceived exertion

Introduction

The cardiovascular and metabolic health benefits of consistent physical activity and exercise have been well established, yet estimates predict a substantial portion of adults fail to meet their recommended activity levels (Strain et al., 2024). Insufficient physical inactivity remains a major modifiable contributor to global disease burden. This reflects a widespread, multifactorial difficulty in maintaining consistent engagement with exercise modalities (Bauman et al., 2012; Piercy et al., 2018). Population-level surveillance data in the United States has found fewer than one-quarter of adults consistently achieve the recommended levels of aerobic and muscle-strengthening exercise with many viewing their routine daily activities as sufficient, considering structured exercise and gym based workouts as unappealing or unnecessary (Boulton et al., 2019; Hurst et al., 2023; Lachman et al., 2018). Limited time, low motivation, and poor enjoyment of classic exercise modalities are just some of the many frequently cited barriers central to the lack of exercise adherence globally (Rhodes & Kates, 2015; Trost et al., 2002).

Enjoyment specifically has emerged as an important determinant to engagement with regular physical activity. Higher reported levels of perceived enjoyment are associated with greater adherence, increased voluntary participation, and improved long-term engagements in both recreational and structured exercise modalities (Teixeira et al., 2022; Yan et al., 2023). Recent work by Cavallini and Dyck suggests a mismatch between traditionally structured, repetitive exercise media and what many adults actually enjoy (Cavallini & Dyck, 2020). Physical activity that can be integrated into daily life and that can be seen as purposeful and engaging are more often viewed as enjoyable and sustainable forms of exercise (Cavallini & Dyck, 2020; Gothe

& Kendall, 2016). These findings have contributed to a growing interest in alternative ways to exercise that combine physical exertion with skill acquisition, novelty, and intrinsic engagement.

Beyond enjoyment for a type of exercise, the physiological stimulus the activity provides is strongly influenced by the amount of active muscle recruited during the activity (Travers et al., 2022). Activities that recruit a greater proportion of musculature generally impose higher cardiovascular and metabolic demands, resulting from increased oxygen requirements and elevated energy costs throughout the body (Smith et al., 2023; Travers et al., 2022). Whole-body exercise modalities that incorporate coordinated upper and lower extremity involvement exemplify this principle. Activities such as Nordic walking and cross-country skiing deliberately engage the arms, trunk, and lower limbs during locomotion and have consistently been shown to elicit higher oxygen consumption and cardiovascular demands than lower body-dominant activities performed under comparable conditions (Hansen & Smith, 2009; Holmberg, 2015; Pellegrini et al., 2017). These modalities illustrate how purposeful upper-body contributions during movement can substantially increase the physiological load of an exercise.

Skate poling with a longboard is an emerging form of wheeled exercise in which forward propulsion is activated by a handheld pole or paddle while both feet remain on the longboard, a full-body activity for which physiological characterization is currently limited. Unlike traditional skateboarding or longboarding, which primarily relies on intermittent lower extremity use for propulsion, skate paddling requires continuous coordination of the arms, trunk, and lower limbs to generate forward movement by pushing off with the pole or paddle while maintaining balance and postural control. This movement pattern requires the engagement of upper and lower body musculature during movement and introduces sustained neuromuscular and postural demands to maintain balance that collectively may influence cardiovascular and metabolic responses.

Exercise intensity is commonly quantified using metabolic equivalents of task (MET) on a 1 to 10 scale, allowing for standardized comparisons across activities and populations (Leal-Martín et al., 2024). Exercise modalities and physical activities that exceed 6 MET are classified as vigorously intense and are associated with greater cardiometabolic stimulus when performed for a sufficient duration (Ainsworth et al., 2011; Piercy et al., 2018). Prior work examining the physiological cost of traditional skateboarding and longboarding has demonstrated that wheeled board activities can elicit moderate to vigorous metabolic demands depending on the speed, terrain, movement strategy, and activities performed while riding (Board & Browning, 2014; Diewald et al., 2024). However, the physiological demands of skate poling, which deliberately incorporates upper body propulsion into the activity, have not yet been systematically characterized.

This study aimed to characterize the cardiovascular and metabolic responses associated with skate poling during a standardized riding session in healthy collegiate-aged adults. Oxygen consumption, heart rate, estimated energy expenditure, perceived exertion, MET, and enjoyment were quantified during a single 20-minute session of skate paddling. The physiological profile will ultimately help characterize this novel form of skating in terms of exercise intensity.

Materials & Methods

Participants

Fifteen healthy college-aged adults (male, $n=12$; female, $n=3$) aged 18-23 years were recruited from the greater Los Angeles area to participate in this exploratory study. Inclusion criteria required participants to be recreationally active and capable of performing moderate-to-vigorous physical activity without medical restriction. Prior experience with skateboarding or similar board-based activities was required from all participants to ensure safety during performance of the skate poling task. Exclusion criteria included known cardiovascular or pulmonary disease, neurological or musculoskeletal conditions that could limit exercise participation, balance impairments, or any injury that could interfere with safe completion of the protocol. All participants completed a pre-participation Physical Activity Readiness Questionnaire and an exercise history questionnaire before enrollment. Written informed consent was obtained from all participants, ethical approval was obtained from the University of California, Los Angeles (UCLA) (IRB: 11-003190) and single IRB approval for off-site participants (sIRB: BRANY, NY, USA) in accordance with the Declaration of Helsinki. Given the exploratory, single-session nature of this investigation, a formal a priori power analysis was not performed. The sample size was selected to provide stable descriptive estimates of physiological responses and to align with prior descriptive exercise physiology studies utilizing novel or alternative exercise modalities.

Longboard Testing Procedure

In this descriptive study, both physiological and perceptual data were gathered during a single 20-minute skate poling session on a flat, cement-paved outdoor area. Participants completed four left turns each lap, covering an average distance of 2.5 to 3.0 miles. Participants were instructed to maintain a consistent, predetermined pace of 12 strokes per minute on a single side throughout the entire session. Skate poling involves riding a longboard while using a handheld pole (SupSkate, Hamboards Inc, Newport, DE) to propel forward, with both feet balancing on the board as shown in Figure 1. The board was constructed from birch wood coated with polyurethane, measured 60 inches by 11 inches, and weighed approximately 19 pounds. The poles were adjustable in length from 57 to 81 inches and weighed around 625 grams, depending on their size. In the week

prior to testing, each individual underwent thorough familiarization with SupSkate, which encompassed a standardized safety briefing, pole fitting, as well as a demonstration of proper skate poling technique, including mounting procedures, propulsion mechanics, and optimal riding posture. A one-hour familiarization period was allotted to each participant to ensure mastery of the requisite movement patterns and to reliably uphold the specified stroke rate of 12 strokes per minute.



Figure 1. Complete testing setup featuring the research participant positioned on a Longboard, equipped with a handheld pole and a portable indirect calorimetry system attached to her face.

Physiological Measurements

Oxygen consumption and carbon dioxide production were measured continuously throughout the skate poling session using a portable metabolic analysis system worn as headgear (Calibre, Wellesley, MA). The Calibre system has been previously validated for indirect calorimetry and portable exercise assessment demonstrating high measurement accuracy relative to multiple established portable and laboratory-based cardiopulmonary exercise testing systems (Alcantara et al., 2022; Van Hooren et al., 2024). The lightweight unit (0.05 kg) was secured to the participant's head using adjustable straps, with the metabolic sensor positioned within a face mask covering the nose and mouth to allow breath-by-breath gas exchange measurement. Calibration was performed prior to each testing session according to manufacturer guidelines. Heart rate was recorded continuously using a chest-strap heart rate monitor (Polar Electro, Kempele, Finland) positioned at the sternum and synchronized with the metabolic system. Energy expenditure was derived from gas exchange data using standard metabolic equations, and metabolic equivalents were calculated relative to body mass using conventional methods. Physiological data were averaged across the full 20-minute session and reported as mean values.

Perceptual Measures

Following the session, participants completed the Physical Activity Enjoyment Scale (PACES) and Borg's Rating of Perceived Exertion (RPE). Enjoyment was assessed using the PACES method, which evaluates affective responses to physical activity using a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"), with higher mean scores indicating greater enjoyment (Chen et al., 2021; Kendzierski & DeCarlo, 1991). The PACES method has been shown to demonstrate strong reliability and validity across adolescent, young adult, and clinical populations, and higher scores are predictive of long-term exercise adherence (Raedeke, 2007). Although short-form versions have also been validated, the full scale remains the standard for capturing the multidimensional nature of exercise enjoyment. Perceived exertion during the protocol was assessed using Borg's RPE scale, a widely validated psychophysiological marker of exercise intensity that demonstrates a near-linear relationship with heart rate across aerobic and high-intensity exercise modalities (Scherr et al., 2013; Williams, 2017). On this scale, values range from 6, corresponding to "no exertion," to 20, indicating "maximal exertion," with RPE multiplied by a factor of 10 providing an approximate estimate of heart rate in beats per minute.

Statistical Analysis

All analyses were exploratory and descriptive in nature. Energy expenditure ($\text{kcal}\cdot\text{min}^{-1}$; total kcal), metabolic equivalents ($\text{kcal}\cdot\text{kg}^{-1}\cdot\text{h}^{-1}$), heart rate ($\text{beats}\cdot\text{min}^{-1}$; % predicted HR_{max}), perceived exertion (Borg 6–20 scale), and enjoyment (PACES; 1–5 scale) are reported as mean $\pm$ standard deviation and 95% confidence intervals (95% CI). Subject demographic and anthropometric variables, age (y), height (cm), body mass (kg), and body composition (BMI) were summarized as mean $\pm$ standard deviation. No inferential statistical tests were performed. This study was designed to characterize physiological and perceptual responses within a single

cohort at a single moment in time rather than to evaluate between-group or between-condition differences. The inclusion of 95% confidence intervals was intended to quantify the precision of descriptive estimates and to enhance transparency and interpretability, given the exploratory design. All statistical analyses were performed using Microsoft Excel (Microsoft Corporation, Redmond, WA).

Results

Fifteen healthy young adults completed the skate poling protocol and were included in final analysis. All participants completed a single session without injury or adverse events. Participants had a mean age of 20.4 ± 1.3 years (95% CI: 19.68–21.12), height of 179.4 ± 9.8 cm (95% CI: 173.97–184.83), and body mass of 78.3 ± 6.9 kg (95% CI: 74.48–82.12). Mean heart rate during the session was 163 ± 6 bpm (95% CI: 159.68–166.32), corresponding to $94 \pm 4\%$ of predicted maximal heart rate (95% CI: 91.78–96.22), and a mean peak heart rate of 187 ± 7 bpm (95% CI: 183.12–190.88). Mean energy expenditure during the session was 14.1 ± 1.2 kcal·min⁻¹ (95% CI: 13.44–14.76), resulting in a total energy expenditure of 309.5 ± 27.8 kcal (95% CI: 294.10–324.90). Mean metabolic equivalents were 12.0 ± 1.6 kcal·kg⁻¹·h⁻¹ (95% CI: 11.11–12.89). Perceived exertion assessed immediately following the session yielded a mean Borg's RPE score of 16 ± 1 (95% CI: 15.45–16.55), and reported a mean PACES of 4.6 ± 0.2 (95% CI: 4.49–4.71). All physiological and perceptual outcome data are summarized in Table I.

Table I. Participant Characteristics, Cardiovascular, metabolic, and perceptual responses during a standardized 20-Minute Skate Poling Session (n = 15).

Parameter		Mean $\pm$ SD	95% CI
Anthropometric	Age	20.4 ± 1.3	(19.68, 21.12)
	Height (cm)	179.4 ± 9.8	(173.97, 184.84)
	Weight (kg)	78.3 ± 6.9	(74.48, 82.12)
Energy Expenditure	kcal/min	14.1 ± 1.2	(13.44, 14.76)
	Total kcal	309.5 ± 27.8	(294.10, 324.90)
METS	kcal/kg/hr	12.0 ± 1.6	(11.11, 12.89)
Heart Rate	Average bpm	163 ± 6	(159.68, 166.32)
	Max bpm	187 ± 7	(183.12, 190.88)
	% HR max	94 ± 4	(91.78, 96.22)
RPE	6-20 scale	16 ± 1	(15.45, 16.55)
PACES	1-5 scale	4.6 ± 0.2	(4.49, 4.71)

Note: Figures present descriptive data mean, standard deviation (SD), and 95% confidence intervals (95% CI). No inferential statistical tests were applied, given the exploratory design.

Discussion

The present study evaluated the acute physiological and perceptual responses to skate poling exercises during a standardized 20-minute session in a population of healthy young adults. Skate poling requires riders to generate movement by repetitively propelling themselves with a handheld paddle while simultaneously maintaining balance and stabilization through sustained lower body control, ensuring both feet remain firmly positioned on the longboard. This movement style results in sustained whole-body engagement throughout the riding session, providing a plausible explanation for the elevated cardiovascular and metabolic demands observed.

Physiological Demand: METs, Energy Expenditure, and Heart Rate

The average metabolic intensity observed during the skate poling session well exceeded established thresholds for classification as a vigorous intensity physical activity, with a mean MET of 12.0 ± 1.6 and the lower bounds of the 95% CI remaining well above the ≥ 6 MET criterion used to classify vigorous exercise (Ainsworth et al., 2011; Piercy et al., 2018). The sustained nature of this classification across the confidence interval indicates that the observed intensity is not attributable to a small group of high responders. The reported range demonstrates a consistent metabolic demand among participants and corroborates previous research, which shows that exercise modalities involving a greater proportion of active muscle mass generally produce higher metabolic costs compared to those focused primarily on the lower body (Smith et al., 2023; Travers et al., 2022).

The energy expenditure rates reported during the skate poling session further support this interpretation. Participants expended approximately 14 kcal·min⁻¹, a rate comparable to those reported for other whole-body or high-demand recreational activities classified as vigorous in the Compendium of Physical Activities (Ainsworth et al., 2011). Similarly high energetic costs have been reported in trials examining Nordic walking, where the addition of upper body propulsion has been found to substantially increase energy expenditure relative to

conventional walking (Hansen & Smith, 2009; Pellegrini et al., 2017). Although skate poling by nature differs mechanically from these modalities, the present findings suggest that incorporating sustained upper body propulsion into locomotion may similarly elevate metabolic demand.

Heart rate responses from the riding session provide additional complementary evidence of the exercise medium eliciting substantial cardiovascular load. Mean heart rate during the skate poling session corresponded to approximately 94% of age-predicted maximal heart rate, with peak values approaching near maximal levels in several participants. Responses within this range are deemed characteristic of intense exercises and are commonly reported in other whole-body exercise modalities (Achten & Jeukendrup, 2003; Swain & Leutholtz, 1997). The concordance between elevated heart rate, high MET values, and substantial energy expenditure throughout the 20-minute riding session collectively strengthens the interpretation that skate poling can elicit a robust cardiovascular workout.

As seen in Figure II, the physiological responses to longboard skate poling closely overlap with published physiological ranges for Nordic skiing, a well-established high-intensity, whole-body endurance activity (Ainsworth et al., 2011; Sandbakk & Holmberg, 2014). Jogging at moderate speeds demonstrated lower metabolic and cardiovascular demands, while traditional skateboarding exhibited substantially lower MET values, heart rates, and perceived exertion due to its intermittent propulsion and reduced active muscle mass. These comparisons indicate that sustained upper- and lower-body propulsion is a primary determinant of cardiovascular load, positioning longboard skate poling as a high-intensity, low-impact locomotor modality comparable to Nordic skiing and exceeding the physiological demands of jogging and conventional skateboarding.

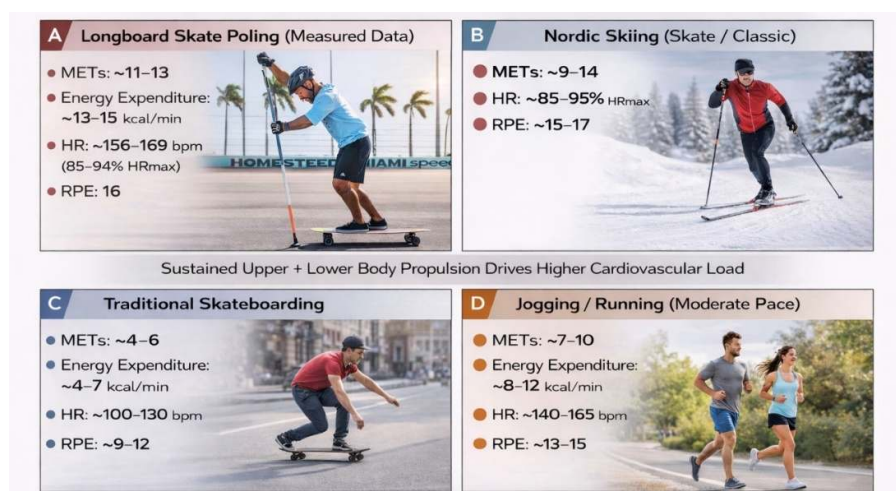


Figure II. Composite comparison of the physiological demands of longboard skate poling relative to Nordic skiing, jogging, and traditional skateboarding.

Perceptual Demands: Perceived Exertion and Enjoyment

Reported perceived exertion ratings from the riding session were consistent with the physiological demands from skate poling. Mean Borg's RPE values corresponded to "hard" workloads and closely aligned with what would be expected from the elevated heart rate and metabolic responses measured during the session. The "hard" classification taken in tandem with the physiological responses reflects a well-established relationship between perceived exertion and cardiovascular workload (Scherr et al., 2013; Williams, 2017). This agreement supports an internal consistency of physiological and perceptual measures and is suggestive of participants accurately perceiving the demanding nature of the activity.

Despite the high exertional demand, enjoyment ratings were uniformly high. Mean PACES scores exceeded 4.5 on a 5 point scale, indicating a stable positive effect across the participants. A high enjoyment level is especially important to an exercise modality given the well-established association with long-term exercise adherence (Raedeke, 2007; Teixeira et al., 2022). Prior works have shown that activities that incorporate skill, novelty, and purposeful movement are often perceived as more enjoyable and easier to stay consistent with than traditional, repetitive exercise formats for many adults, especially as they age (Cavallini & Dyck, 2020; Gothe & Kendall, 2016). While adherence was not assessed within the acute study, the combinations of vigorous physiological demand and high levels of enjoyment observed during skate poling aligns with many common characteristics associated with sustained voluntary participation in a physical activity.

It is also possible that the novelty of skate poling contributed to the perceptual responses recorded from the session. Novel and skill-based exercise modalities have been shown to alter attentional focus and may reduce perceived exertion relative to physiological load through increasing cognitive engagement and external focus

(Chen et al., 2021; Lohse & Sherwood, 2011). The present study cannot disentangle novelty effects from mechanical demands, though the combination of high physiological strain and favorable perceptual responses is consistent with prior work demonstrating that engaging or unfamiliar exercise formats may attenuate perceived effort despite substantial cardiovascular load (Raedeke, 2007).

Limitations

There are several limitations that should be considered when interpreting the present findings. The small sample population consisted of exclusively young, healthy adults with prior experience in board-based activities, which may limit generalizability to older individuals and those with no previous experience with skateboard-based activities. The study was limited to a single, acute session, which cannot directly predict long-term adherence and health benefits. Additionally, the absence of a comparison condition precludes any direct physiological comparison between skate poling and other whole-body or lower-body dominant exercise modalities. Environmental factors inherent to outdoor testing, including surface characteristics and self-selected pacing strategies, may also have contributed to inter-individual variability in physiological responses. While this approach enhances ecological validity, it limits strict standardization of exercise intensity. Finally, although the portable indirect calorimetry system used in this study has been validated for dynamic exercise, outdoor movement may introduce minor measurement variability that cannot be entirely eliminated (Alcantara et al., 2022).

Conclusion

This exploratory study demonstrates that exercising with skate poling can elicit intense cardiovascular and metabolic responses while maintaining high enjoyment among riders. Participants exceeded established thresholds for vigorous physical activity across multiple markers, including MET, energy expenditure, Heart rate, and perceived exertion, consistent with demanding workloads. These findings indicate that a wheeled, whole-body exercise modality that incorporates sustained upper-body propulsion can produce physiologically demanding exercise that aligns with those observed in other vigorous recreational activities. High PACES scores further suggest that skate poling supports a positive effect important to determining the potential for long term participation. The present findings provide initial physiological characterization of skate poling as an emerging modality for full-body recreational exercise. Although the small sample size and single-session design limit generalizability and preclude conclusions regarding training adaptations or long-term adherence, these results support further investigation using repeated sessions, more diverse populations, and direct comparisons with established exercise modalities to clarify the role of skate poling within structured exercise and intervention-based programs.

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