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ABSTRACT

Little is understood about the acute physiological or metabolic demand of pole dancing classes. As such, the aims of this study were to quantify the demands of a standardized recreational pole dancing class, classifying outcomes according to American College of Sports Medicine (ACSM) exercise intensity guidelines, and to explore differences in physiological and metabolic measures between skill- and routine-based class components. Fourteen advanced-level amateur female pole dancers completed three 60-min standardized pole dancing classes. In one class, participants were fitted with a portable metabolic analysis unit. Overall, classes were performed at a mean VO_2 of 16.0 $ml·kg^{-1}·min^{-1}$, total energy cost of 281.6 kcal (4.7 $kcal·min^{-1}$), metabolic equivalent of 4.6 METs, HR of 131 $b·min^{-1}$, RPE of 6.3/10, and blood lactate of 3.1 mM. When comparing skills- and routine-based components of the class, energy cost per min (4.4 vs. 5.3 $kcal·min^{-1}$), peak VO_2 (21.5 vs. 29.6 $ml·kg^{-1}·min^{-1}$), METs (4.3 vs. 5.2), and RPE (7.2 vs. 8.4) were all greater in the routine-based component ($p < 0.01$), indicating that classes with an increased focus on routine-based training, as compared to skills-based training, may benefit those seeking to exercise at a higher intensity level, resulting in greater caloric expenditure. In accordance with ASCM guidelines, an advanced-level 60-min pole dancing class can be classified as a moderate-intensity cardiorespiratory exercise; when completed for ≥30 min, ≥5 days per week (total ≥150 min) satisfies the recommended level of exercise for improved health and cardiorespiratory fitness.

Keywords: energy expenditure; heart rate; intensity; group exercise; pole fitness; fitness class

The physiological and metabolic demand of a standardized 60-minute pole dancing class

INTRODUCTION

Formalized pole dancing exercise classes began in the early 2000s (23), with classes continuing to grow in popularity across North America, the United Kingdom, Europe, and Australasia (8, 14, 16, 23). Although pole dancing has become a popular form of physical activity, the majority of pole dancing research to date has been focused on understanding the sociological (i.e., feminism and sexuality), cultural (11, 14, 23) and psychological aspects (e.g., participation motives and body image) of participation (10, 20). In contrast, limited work has been devoted to investigating the physical demands of pole dancing as a form of physical activity, and how those demands compare with other exercise modalities.

The physiological and metabolic demands of group exercise classes and other fitness-based activities are well documented (15, 21, 22, 24), allowing activities to be categorized according to exercise intensity; an example being the American College of Sport Medicine (ACSM) guidelines (3) that enables health professionals to prescribe a diverse range of exercise options based on an individual's exercise needs and preferences. Despite the fact that no quantitative scientific studies examining the physiological or metabolic demand and/or related physical benefits of pole dancing have been conducted, anecdotal claims regarding such benefits are abundant. For example, following a discursive analysis of 15 Australian pole dancing studio websites, Donaghue et al (11) reported that, of the websites examined, all made claims of improved fitness benefits from pole dancing on their opening pages. Despite its growth as a form of physical activity, the anecdotal evidence for its benefits, and the importance of understanding the activity's demands (as shown by the extent of this kind of work in other areas), limited attention had been devoted to understanding the physiological and metabolic demands of recreational pole dancing classes.

In an attempt to improve the understanding of acute responses to exercises and types of training within other group fitness classes, thereby facilitating safe and effective exercise prescription, researchers have investigated the physiological and metabolic differences between class components based on elements such as music tracks in Bodypump™ (13, 22) and Bodycombat™ (13), and movement styles in aerobic dance (9). Pole dancing classes also consist of discrete components; with the structure of a typical class generally including a warm-up, followed by a skills-based component (i.e., performing individual manoeuvres on the pole), and/or a routine-based component (i.e., performing sequences of manoeuvres on the pole along with standing or floor-based dance moves to music), followed by a cool-down. Investigating differences between these class components, and more specifically, the differences between skills-based and routine-based activities, will assist in understanding the demands of a different types of training within a pole dancing class.

Understanding the acute physiological and metabolic demands of pole dancing, in particular, heart rate (HR), rate of perceived exertion (RPE), energy cost (EC), oxygen consumption (VO_2), and blood lactate (BLa) responses, will allow this form of physical activity to be categorized alongside other exercise genres, enabling health professionals to prescribe pole dancing as an exercise option based on individuals' lifestyle and health-related goals. Such knowledge will also enable studio owners to accurately promote the potential benefits of pole dancing classes to the community. Hence, the aim of the study was to quantify the physiological and metabolic demands of a standardized recreational pole dancing class, and to classify the class according to the ACSM exercise intensity guidelines. The secondary aim was to investigate physiological and metabolic differences between the discrete components (skills- vs. routine-based training) of a standardized pole dancing class.

METHODS

Experimental Approach to the Problem

A within-groups repeated-measures study design was employed to examine the physiological and metabolic demand of a typical 60-min pole dancing class. Participants attended a familiarization session, and three standardized pole dancing classes.

Subjects

Fourteen advanced-level female pole dancers with no previous history of major injury were recruited from a range of local pole dancing studios (M_{age} = 33.3 ± 6.1 years, M_{height} = 163.4 ± 7.3 cm, M_{mass} = 59.2 ± 9.6 kg). Participants were eligible to participate if they were training at an advanced-level at a studio, and could perform manoeuvres such as Static V and Extended Butterfly. Advanced-level participants were selected to ensure competence in skills when conducting manoeuvres on the pole whilst wearing a portable metabolic analysis unit. The Human Research Ethics Committee of the host institution approved all procedures ([redacted]), conforming to the Declaration of Helsinki. All participants were informed of the benefits and risks of participation, and provided written informed consent before the study commenced. Participants were instructed to refrain from any exercise and consumption of caffeine the day of testing, and to refrain from eating for 2 h prior to testing sessions.

Procedures

Familiarization and testing sessions were conducted at a private pole dancing studio fitted with permanent 38.1 mm brass Pussycat poles (Super B38, The Pussycat Pole®, Queensland, Australia). Testing sessions involved three standardized advanced-level 60 min pole dancing class led by a qualified group fitness and certified pole dancing instructor. The same class was delivered across all three sessions, each comprising of a warm-up, skills-based manoeuvres on both sides of the body (Figure 1), routine-based training, and cool-down (Table 1). A total class duration of 60-min was chosen as this is a standard class time (14). Class structure and duration of class components were defined following field-based research and industry consultation. The warm-up consisted of general aerobic activity followed by dynamic stretches, and several pole-specific drills. The skills-based component involved training four different pole manoeuvres, each for five minutes. For each manoeuvre, participants watched the instructor demonstrate and break down the movement, before executing the manoeuvre for several repetitions on each side of the body. Participants transitioned into each manoeuvre, holding the final isometric position for several seconds before transitioning out and resting until recovered, or until the instructor was available for spotting (if required). During the routine-based component, the instructor taught sections of a set routine involving jazz-style dance moves and pole manoeuvres, before leading participants through the full routine to music. The cool-down involved a set sequence of upper and lower body static stretches. As advanced-level participants were recruited, an advanced-level class was conducted to ensure that participants were working at a realistic intensity based on their skill-level (i.e., manoeuvres within the class were suitable for advanced-level pole dancers). A combination of static (locked) and spinning (unlocked) poles were used throughout the standardized class (Table 1).

(Insert Table 1 about here)

(Insert Figure 1 about here)

For each of the three sessions, HR ($b \cdot min^{-1}$), BLa (mM), and RPE responses were collected. HR (Polar Team[2], Kempele, Finland) was recorded continuously throughout each session, whilst BLa (mM) samples were taken at five time points; (1) prior to the start of the class, (2) following a 15 min warm-up, (3) following skills-based manoeuvres, (4) following routine-based work, and (5) following the cool-down (Lactate Pro 2, Arkray, Japan). Prior research shows acceptable instrument reliability (Coefficients of Variation [CV%]) for BLa across the ranges 1.00-1.99 = 5.1%; 2.00-4.99 = 3.0%; 5.00-9.99 = 2.7% (4). Lactate samples were taken from the earlobe immediately following each class component; this site was chosen (over a finger) to eliminate discomfort when using fingers to grip the pole, and avoid contamination from grip products applied to hands. Subsequent to each class component, RPE was recorded using the Borg CR-10 scale (5, 6), participants were presented a hardcopy of the scale and instructed to rate their perception of exertion (6, pp51).

Oxygen consumption (VO_2, $L·min^{-1}$) was assessed in one of the three sessions in a randomized order using a portable metabolic system (CosMed K5, Roma, Italy) in mixed chamber mode. Before each session, the K5 system was calibrated according to manufacturer's instructions. Notwithstanding, VO_2 and, VCO_2 ($L.min^{-1}$) were recorded continuously throughout the entire session. The same portable metabolic unit, HR system, and BLa equipment were used across all sessions.

Energy cost (EC) was calculated for the warm-up, skills-based component, routine-based component, cool-down, and entire class. The EC was defined as kJ equivalent * VO_2 ($L.min^{-1}$), with kJ equivalent determined by a corresponding respiratory exchange ratio (RER) (19). Metabolic Equivalent of Task (MET) was defined as 1 MET = 3.5 $ml·kg^{-1}·min^{-1}$ (19).

Statistical Analyses

Descriptive statistics were calculated for all physiological and metabolic variables. Repeated-measures analyses of variance were used to determine whether there were significant differences between class components (i.e., warm-up, skills-based training, routine-based training, and cool-down) for mean and peak VO_2, $kcal·min^{-1}$·, and METs during the session fitted with the metabolic unit; as well as mean and peak HR, RPE, and BLa over the three sessions ($\alpha < 0.05$). If significantly different, a Bonferroni post-hoc test was used to determine where the differences existed.

RESULTS

For the one class where participants were fitted with the metabolic unit, the 60-min pole dancing class was completed at a mean VO_2 of 16.0 $ml \cdot kg^{-1} \cdot min^{-1}$. Mean caloric expenditure (total energy cost) for the entire workout was 281.6 kcal (4.7 $kcal \cdot min^{-1}$), whilst mean metabolic equivalent was 4.6 METs (Table 2).

Across the three classes, participants elicited a mean HR of 131 $b \cdot min^{-1}$ over the entire session, reaching a mean of 136 $b \cdot min^{-1}$ in the routine-based component of the class. Analyses of variance determined that RPE was significantly different for each component of the class (F (1.88, 24.42) = 66.08, $p < 0.01$), being greatest in the routine-based component of the class (8.4/10), followed by the skills-based component (7.2/10), whilst the mean score over the entire class was 6.4/10. Mean BLa was 3.1 mM, and remained fairly consistent throughout the class, with the greatest value recorded in the warm-up (3.7 mM) (Table 2).

When comparing the routine- and skills-based components of the class, $kcal \cdot min^{-1}$ (F (3, 36) = 81.35, $p < 0.01$), METs (F (3, 36) = 103.16, $p < 0.01$), mean VO_2 (F (3, 36) = 103.16, $p < 0.01$), peak VO_2 (F (3, 36) = 74.99, $p < 0.01$), and RPE (F (3, 36) = 66.08, $p < 0.01$) were all greater in the routine-based component (Table 2).

(Insert Table 2 about here)

DISCUSSION

To our knowledge, this is the first study to investigate the physiological and metabolic demand of a 60-min standardized pole dancing class. This study measured VO_2, HR, EC, blood lactate, and RPE during a typical pole dancing class, with the aim of classifying the class according to ACSM exercise intensity guidelines, as well as identifying differences in physiological and metabolic measures between class components.

According to ACSM (3), moderate-intensity cardiorespiratory endurance exercise is defined as having an absolute intensity of 3.0 to 5.9 METs. As such, the 60-min pole dancing class performed would be classified as a moderate-intensity cardiorespiratory endurance exercise. Similarly, BLa throughout each class component, and overall, was between 2-8 mM, giving the class an aerobic metabolic profile (15).

The ACSM (3) recommends that to improve health and cardiorespiratory fitness, adults should engage in moderate-intensity cardiorespiratory exercise for ≥30 min a day, on ≥5 days of the week (total ≥150 min a week); or vigorous intensity exercise for ≥20 min a day on ≥3 days a week (total ≥75 min a week); or a combination of moderate- and vigorous-intensity exercise that expends ≥500-1000 MET-min a week. As such, if performed for ≥150 min a week, pole dancing may be an appropriate form of exercise training that fulfils the criteria set out by ACSM for improving health and cardiorespiratory fitness.

In regard to class components, although METs increased during the routine-based component of the class, this value remained within the moderate-intensity exercise classification. However, mean and peak HR increased, indicating that the continuous combination of dance and pole combinations, involving larger postural changes and greater frequency of arm movements above heart level, resulted in a higher (although not significant) HR response (1, 9). Importantly, METs, energy cost per min ($kcal \cdot min^{-1}$), mean and peak VO_2 and RPE were greatest during the routine-based component of the class, as compared to the skills-based component, signifying a greater physical demand of this class component. As such, classes that have a greater focus (i.e., duration spent) on routine-based training, as compared to skills-based training, may be recommended for those seeking an elevated intensity of training and greater expenditure of energy.

The lower physical demand in the skills-based components of the class is likely due to manoeuvres being executed in a non-continuous manner, with longer rest periods. The focus of skills-based training is the execution of manoeuvres, particularly holding the final position; as a result, a longer duration was spent under isometric muscular contraction which may explain lower oxygen consumption levels during this component of the class (12). Though categorically, the MET value of the skills-based component fell within the ranges for moderate-intensity cardiorespiratory exercise (3), this component of the class appeared to be somewhat characteristic of resistance-style training, whereby sets of repetitions were executed for each exercise (or manoeuvres in this case) (2, 3). Similarly, class elements appeared to challenge balance (e.g., balancing upside down in Handspring), agility (e.g., dance and transition elements) and coordination (e.g., elements of manoeuvres, transitions, and dance), thus appearing to satisfy some elements of neuromuscular training (2, 3). Although elements appeared to be characteristic of resistance and neuromuscular type training, studies examining these elements specifically are needed to confirm such classifications.

The metabolic equivalent for the standardized class (4.6 METs) was comparable to exercise pursuits such as ballet or modern dance (4.8 METs), gymnastics (4.0 METs), and low impact aerobic dance (5.0 METs) (15). However, pole dancing provided a lower energy expenditure than circuit training (8.0 METs) and stationary cycling at a moderate intensity (7.0 METs) (15), indicating that compared with these activities, the pole dancing class analyzed was of a lower exercise intensity (i.e., less physically demanding), and would need to be performed for a longer duration to achieve the equivalent energy expenditure of such activities.

There were several limitations of the present study. First, as the mask of the metabolic unit restricted vision (i.e., looking down) and as the unit backpack was not able to contact the floor or pole, advanced skill-level participants were recruited to ensure competence when performing manoeuvres. As such, participants may have exerted less energy compared with lesser experienced pole dancers (i.e., intermediate skill-level). However, the level of task difficulty was tailored to the advanced level athlete, and therefore, it is likely that the relative intensity may have been similar across skill-levels.

Second, the results from this study were specific to the advanced-level standardized class, and as such, classes with different manoeuvres (including those of a different skill level) or where a greater proportion of time is spent on skill-based or routine-based components, may elicit different overall results. It is therefore recommended that future investigations consider physiological and metabolic responses in classes containing different manoeuvres and of varying class components (e.g., routine-based only class).

Finally, the current study focused on the acute response to a 60-min standardized pole dancing class; and, though improvements in cardiorespiratory fitness may occur if the recommended volume of activity set out by ACSM (3) is met, longitudinal research (i.e., randomized control trials) is required to explore such long-term benefits.

In conclusion, results from the pole dancing activity analyzed here indicate that an advanced-level pole dancing class can be classified as a moderate-intensity cardiorespiratory exercise, and if completed for ≥30 min on ≥5 days per week (total ≥150 min), could satisfy ACSM guidelines for recommended level of cardiorespiratory exercise for improved health and cardiorespiratory fitness. Additionally, classes with a greater focus on routine-based training, whereby participants are working at a greater intensity, may provide greater expenditure of energy, as compared to skill-based classes.

PRACTICAL APPLICATIONS

From an applied perspective, studio owners can promote pole dancing as a cardiorespiratory exercise that, if performed for an adequate frequency and duration, may result in health benefits and improved cardiorespiratory fitness (3). Similarly, knowledge that exercise intensity and energy expenditure are greater during routine-based training, as compared with skills-based training, can be used by instructors to develop safe and effective classes based on needs or goals of participants, such as the prescription of an increased duration on routine-based training, as opposed to skills-based training, for participants seeking benefits from training at an increased intensity.

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FIGURE LEGEND

Figure 1. Manoeuvres conducted during the skills component of the class: (from left) a) Cupid, b) Handspring, c) Front split down pole, d) Cradle spin to e) Extended butterfly. All manoeuvres (with the exception of Front split down pole) are International Pole Sports Federation (IPSF) coded moves (18), these images have been reproduced with IPSF approval.

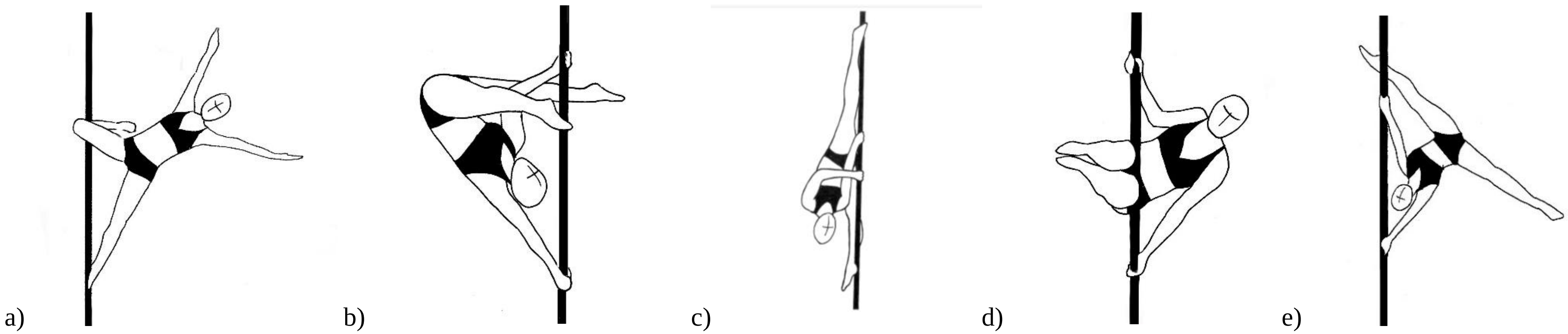

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Table 1. Description of the 60-minute standardized pole dancing class

Class component	Time (min)	Primary exercises	Work to rest ratio	Pole condition
Warm-up	10	General aerobic activity followed by dynamic stretches	Continuous	Static
	5	Pole-specific drills: 2–4 repetitions of each drill (1–2 each side)	10–30 sec : 10–20 sec	
		Outside leg hang climb (2–3 leg hangs per climb)		Static
		Pole crunches (3–5 knee tucks)		Static
		Pencil spin (elbows 90°)		Spinning
Skills-based training		4–6 repetitions of each manoeuvre (2–3 each side)	15–40 sec : 20–45 sec	
	5	Cupid		Static
	5	Handspring		Static
	5	Front split down pole		Spinning
	5	Cradle spin to extended butterfly		Spinning
Routine-based training		Routine to song ‘Queen of the Night’ by Whitney Houston		Static
	14	Learning sections and combinations of routine	20–90 sec : 10–30 sec	
	6	2 x run throughs with music	105 sec : 60–90 sec	
Cool-down	5	Static stretches using the pole	30 sec stretch : 10 sec transition	Static
		Standing chest and hip flexor stretch (unilateral)		

	Standing shoulder / oblique stretch (unilateral side bend)
	Standing shoulder / back / gluteal stretch (unilateral opposing leg crossed over knee)
	Standing mid and upper back (bilateral scapula protraction and thoracic flexion)

Table 2. Metabolic measures for the pole dancing class fitted with the metabolic unit (*n*=13), and average physiological and metabolic measures over the three pole dancing classes (*N*=14).*†

Class component	RER	VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)	Peak VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)	EC ($kcal \cdot min^{-1}$)	TEC (kcal)	MET	HR ($b \cdot min^{-1}$)	Peak HR ($b \cdot min^{-1}$)	RPE	BLa (mM)
Warm-up	0.95 ± 0.04	16.6 ± 2.5 ^{ac}	24.6 ± 4.0 ^{abc}	4.9 ± 0.9 ^{ac}	78.3 ± 12.9	4.8 ± 0.7 ^{ac}	123 ± 16 ^{b}	172 ± 18 ^{c}	6.3 ± 1.3 ^{abc}	3.7 ± 1.1
Skills-based training	0.91 ± 0.04	15.2 ± 1.9 ^{de}	21.5 ± 4.9 ^{de}	4.4 ± 0.8 ^{de}	87.3 ± 14.6	4.3 ± 0.5 ^{de}	127 ± 14	170 ± 14 ^{e}	7.2 ± 1.0 ^{de}	2.8 ± 0.8
Routine-based training	0.91 ± 0.05	18.0 ± 1.9 ^{f}	29.6 ± 4.7 ^{f}	5.3 ± 1.1 ^{f}	104.0 ± 20.6	5.2 ± 0.5 ^{f}	136 ± 17	183 ± 21 ^{f}	8.4 ± 0.9 ^{f}	3.1 ± 1.1
Cool-down	0.98 ± 0.06	8.5 ± 1.1	12.3 ± 2.5	2.5 ± 0.5	9.9 ± 3.2	2.4 ± 0.3	125 ± 28	143 ± 24	4.0 ± 1.9	2.6 ± 1.1
Over entire class	0.93 ± 0.03	16.0 ± 1.6	29.6 ± 4.7	4.7 ± 0.8	281.6 ± 46.9	4.6 ± 0.5	131 ± 13	188 ± 18	6.4 ± 1.1	3.1 ± 0.9

* RER, respiratory exchange ratio; VO_2, mean oxygen consumption; Peak VO_2, peak oxygen consumption; EC, energy cost; TEC, total energy cost; MET, metabolic equivalent of task; HR, mean heart rate; RPE, rate of perceived exertion; BLa, blood lactate.

† all data are presented as mean ± SD

a statistical difference ($p < 0.05$) between warm-up and skills-based components

b statistical difference ($p < 0.05$) between warm-up and routine-based components

c statistical difference ($p < 0.05$) between warm-up and cool-down components

d statistical difference ($p < 0.05$) between skills-based and routine-based components

e statistical difference ($p < 0.05$) between skills-based and cool-down components

f statistical difference ($p < 0.05$) between routine-based and cool-down components