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Use of a 'pose rate' to quantify yoga

Bethany Forseth[a,*], Caitlyn Hauff[b]

[a] University of Milwaukee, College of Nursing, 1921 E Hartford Ave, Milwaukee, WI, 53211, USA
[b] University of South Alabama, Department of Health, Kinesiology and Sport, 171 Jaguar Drive, Mobile, AL, 36688-0002, USA

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ABSTRACT

Objective: To develop a method that describes the physical activity completed during yoga, and to use this method to compare three different yoga video categories: weight loss, beginner, and stress relief/meditation.

Design: This study conducted content analysis of commercially available yoga videos in which pre-determined characteristics of yoga routines were recorded. Outcome measures included the yoga routine characteristics of: duration of each yoga routine, number of completed poses, body position of each pose, and pose rate.

Results: Twenty-two routines from yoga videos were analyzed. Duration of routine between the three different categories was not significantly different. There were significant differences between the video categories based on the characteristics of total number of poses and the pose rate, with weight loss routines having the highest values compare to beginner routines and stress relief/meditation (total number of poses: 74.1, 34.3, 25.6 poses, $p < 0.05$; Pose rate: 2.5m 1.5, 1.1 poses/min, $p < 0.05$, respectively). Additionally, differences were observed between body postures in poses with weight loss videos including more standing poses (38.8, 17.0, 5.7 poses, $p < 0.05$, respectively) and a lower percentage of seated (9.9%, 15.8%, 39.0%, $p < 0.05$, respectively) and supine poses (10.9%, 18.5%, 28.8%, $p < 0.05$, respectively) compared to the beginner and stress/meditation videos.

Conclusions: The characteristics of total poses, pose rate, and total standing poses showed significant differences between different styles of yoga. Further research should be conducted to validate these characteristics as an intensity measures and to assess if these characteristics have variations between different yoga styles.

1. Introduction

Assessment of physical activity is important because it allows for the understanding of the dose-response relationship between physical activity and health outcomes. [1] Physical activity is commonly assessed through a description of the frequency of engagement in an activity, the intensity of an activity, the time (duration) of each bout, and finally the type of activity, these traits are commonly referred to as the FITT principle. [2] If these components of physical activity cannot be assessed, research regarding the activity cannot be compared between studies and recommendations cannot be created for engagement in the activity for promotion of optimal health outcomes.

Yoga is an activity that presents a unique challenge to the assessment of intensity. Yoga classes can vary based on the style of yoga that is being performed, the duration of the class, asanas (poses) completed during the class. Assessing the intensity of yoga class is further complicated by the poses performed in the class, not only due to varying body positions and duration they are held for, but each pose performed incorporates muscular strength, muscular endurance, aerobic, flexibility, and balance components. The multiple components of each yoga pose create difficulty in assessing the intensity because the intensity of these components are assessed by different methods (i.e. one cannot examine the intensity of muscular strength through oxygen consumption, an aerobic measurement method).

Previous research has assessed the intensity of yoga through oxygen consumption, heart rate, percent of maximal voluntary contraction, and perceived effort. [3–8] Looking specifically at hatha yoga, three separate studies examined the average oxygen consumption during hatha yoga in healthy adults. Oxygen consumption results from these studies ranged from 7.6 to 13.5 $mL \cdot kg^{-1} \cdot min^{-1}$, relating to 9.9–26.5% of maximal oxygen consumption and ultimately placing hatha yoga into a 'light' intensity category. [3,9–10] Additional studies examined the heart rate responses during hatha yoga and found an intensity level between 45–57% of maximal heart rate, indicating a light to moderate intensity based on heart rate [6,10] in healthy men and women. Finally, Miles et al. conducted a study that assessed the rate of perceived exertion (RPE) to

* Corresponding author.
E-mail address: bforseth@uwm.edu (B. Forseth).

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hatha yoga in advanced and novice yoga users. Rate of perceived exertion was taken every eight-minutes during the class and ranged between 9 (very light)-15 (hard) on the scale, with no difference observed in between advanced and novice participants. [11] While the measurement methods used in these studies provide information on the intensity of one aspect of a yoga (i.e. oxygen consumption, heart rate, or RPE), none of these measurement methods incorporate more than one fitness component of yoga poses.

The variability between classes and inability to assess the intensity of yoga does not allow researchers to easily compare research studies that employ yoga in their study methods. It is vital that comparisons are able to be made because studies that compare multiple styles of yoga have found that there are differences in intensity based on the style. Potiaumpai et al. compared hatha and power yoga via oxygen consumption and found hatha yoga to have an average VO_2 of 13.5 $mL \cdot kg^{-1} \cdot min^{-1}$, categorizing it into a light intensity. The power yoga, in contrast, required an average VO_2 of 21.5 $mL \cdot kg^{-1} \cdot min^{-1}$, and was classified as a moderate intensity. [9] In another study the intensities of hatha, ashtanga and gentle yoga were compared by heart rate measurements. The study found that hatha, ashtanga and gentle yoga averaged an intensity of 45%, 54% and 42% of maximal heart rate, respectively. [6] Additionally, the metabolic equivalents (METs) for yoga, listed in the physical activity compendium, range between 2.0–4.0 METs for four different styles of yoga. [12] Indications that different styles of yoga are of different intensities have encouraged researchers in the field of yoga to call for and find a standard way of reporting yoga. Current recommendations for reporting have been to detail the full routine performed or measuring multiple intensity-related variables. [13,14]

To the author's knowledge, there is no published study that has considered examining characteristics of yoga routines (i.e. number of poses completed, duration of each pose, body position of poses) to provide an indication of intensity and as standard method of reporting the activity performed during yoga. Therefore, the primary purpose of this paper is to develop a method that describes the physical activity completed during yoga by conducting a content analysis of commercially available yoga videos. The first objective of this paper is to quantify characteristics of yoga (the number of total poses completed and body posture) and calculate the pose rate (number of poses completed per minute of the routine). The second objective is to then compare characteristics (total number of poses completed, body postures of each pose, and pose rate) between yoga routines performed for different purposes (weight loss, beginners, and stress relief/meditation) to assess if the measures can differentiate between different yoga practices. These three yoga routine categories are representative of the marketed purpose for the most popular commercially available yoga videos.

2. Methods

2.1. Design

A content analysis was conducted to examine the research objectives. Historically, content analyses were performed for quantitative analyses and are now commonly used as qualitative method to examine various forms of communication. [15] Content analysis has a purpose of describing, summarizing, and categorizing the data in simplified ways and is valuable for exploratory research. [15–17] This research project used the content analysis with the quantitative perspective to describe yoga routines and assess if pose characteristics could be a way to categorize yoga.

2.2. Yoga video selection

Yoga videos were selected for the content analysis based on their bestselling and/or most watched status from common consumer websites. Beyond their popular status, inclusion criteria for the yoga routines was: the use of traditional yoga poses (using either their English or Sanskrit names), and ability to be categorized according to purpose by weight loss, beginner, or stress relief/meditation. Whole videos, or some routines on videos were excluded from the study if they used non-traditional yoga props (i.e. dumbbell weights) and/or if non-traditional yoga poses were included (i.e. pilates movements or calisthenics). Many yoga videos included multiple yoga routines on a single disc; therefore, if multiple yoga routines on the video met the inclusion criteria then multiple routines from a single video were included in the study.

2.3. Procedures and data analysis

Prior to data collection and analysis, researchers reviewed yoga literature and yoga classes to develop meaningful units of analysis to guide the creation of the code book. [15,17] During this review process, researchers considered ways to categorize and express the physical activity performed during a yoga routine, similarities between class layouts (starting with breathing, practicing poses, and then meditating), and commonly incorporated poses. B.K.S. Iyengar, the founder of iyengar yoga, described the poses in his yoga routine through groups of body positions: standing, sitting, forwards bends, twists, inversions, backbends, and reclining asanas. [18] Additionally, two previous research studies had described their yoga programs and findings by using body position groups. Blank and colleagues (2006), examined physiological responses to yoga and presented results based on body positions using four different groups: supine or seated, standing, back arch, and inversions. [19] Cramer, et al (2013), while developing and describing their yoga program, had also mentioned three posture groupings, specifically in the body positions of standing, sitting, and supine. [20] The researchers utilized these resources to create meaningful units of analysis [15,17] and it was decided that the body position of poses could be a recorded characteristic of each yoga routine. Therefore, each pose was categorized into one of the following body position categories: supine, seated, standing, and other. Upon reviewing the yoga videos and further research into physiological responses in different body positions, the standing category was further split into standing-head-up and standing-head-down (See Fig. 1 for code book).

Along with body position, two other characteristics were agreed upon to be recorded from the yoga routines: duration of each yoga routine and total number of completed poses. *Duration of the yoga routine* began when the instructor started to lead the class through breathing and/or poses and ended once the final relaxation pose was completed, as stated by the instructor or end of the video. The *total number of poses completed* included individual poses and excluded any additional body movement cues by the instructor to transition to a new pose.

Prior to watching the videos, researchers came to an agreement on the video characteristics being coded and what defined each component (i.e. the start of the routine or the start/end of a pose). [15,17] Researchers then watched each video, using a code sheet to record characteristics of each yoga routine (Fig. 1). One researcher watched all yoga videos. To strengthen the validity of the findings and to establish trustworthiness in the coding and analysis process, a second researcher watched and recorded yoga characteristics from 20% of the yoga routines. [15,21–24] Researchers watched the videos together but recorded the characteristics independently and did not discuss the video or their codes while watching the videos. [25–29] After the videos were completed and all yoga routines had been coded, the two researchers discussed the coded characteristics to find a consensus regarding what was observed. [29] In this process researchers also established if any changes needed to be made to the coding process and/or categories. After deliberation, no modifications were made to the coding sheet. It was not necessary to obtain IRB approval for this project as the researchers were examining commercially available yoga videos, not human subjects or biological/

Yoga Video Title:
Yoga Category (& style if stated)
Total Length of Video:

		Pose Duration		Body Position					
						Stand			
Pose #	Pose Performed	Start Time	End Time	Lying	Sit	Head up	Head Down	Other Postures	Notes
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									

Fig. 1. Code Book.

living material.

2.4. Data statistical analysis

Once the videos were analyzed, a pose rate was calculated for each yoga routine. The pose rate considers the number of poses completed per minute of routine by dividing the total number of poses completed by duration of the class. Means and standard errors of yoga routine characteristics were analyzed for each video category. Each of the body position categories was statistically analyzed as a total number of poses in the routine. The number of poses in each body position category was also assessed as a percentage of the total number of poses in that routine. This accounted for differences in total number of poses being completed between routines and categories. An analysis of variance was used to compare differences in characteristics (routine duration, total poses, body position of poses, and pose rate) between the video categories. Bonferroni Post Hoc tests were used to follow up on any significant differences from the analysis of variance. Inter-rater reliability was used to examine the agreement between the coding of the two researchers. [24] Statistical analyses were performed using SPSS Version 21 for Windows (IBM Corp, Armonk, New York), with the significance level set at $\alpha = 0.05$.

3. Results

A total of 22 routines from 18 different yoga videos were included in the analysis. Inter-rater reliability between the primary and secondary researcher was 95%. Table 1 compares the characteristics of: routine duration, total number of poses, and pose rate between the categories. While duration of the classes was not significantly different between categories, the total number of poses completed was different ($p < 0.05$), which also resulted in the pose rate being significantly different between the categories ($p < 0.05$). For total number of poses, the weight loss category had significantly more poses completed compared to the other two categories, but the beginner routine and stress relief/meditation routines were not significantly different from each other. Similarly, the pose rate was significantly higher in the weight loss category, but there was no difference between the beginner and stress relief/meditation routines.

The poses completed were then further examined by body position in the pose, both by total number of poses performed and, in a percentage, relative to the total number of all poses completed (Table 2). When examining the total number of poses completed in each body position, all standing poses, standing head up poses, and other poses were significantly different between the groups ($p < 0.05$). In all of these analyses, the weight loss routine was significantly higher than all other categories, but the beginner and stress/meditation routines were not significantly different in total number of body poses completed.

Data on poses performed in each body position, examined by percentage, relative to the total number of poses completed in the routines is displayed on Table 2 and Fig. 2. The seated and other poses were significantly higher in both the beginner and stress relief/meditation routines compared to the weight loss routine ($p < 0.05$), but the beginner and stress relief/meditation routines were not significantly different in their percentages for seated and other poses. Finally, the total standing poses was significantly higher in both the weight loss and the beginner routines compared to the stress relief/mediation routines ($p < 0.05$).

4. Discussion

Quantification methods for yoga are essential to examine relationships between yoga and health, provide ways to compare yoga research, and create recommendations for health benefits. This study

Table 1
Yoga Routine Characteristics by Yoga Routine Category.

Routine Characteristic	Weight Loss Routines n = 8	Beginner Routines n = 7	Stress Relief/ Meditation Routines n = 7
Routine Duration (minutes)	29.4 (7.4)	22.9 (5.3)	21.7 (9.2)
Total Poses (poses/routine) *	74.1 (22.7)	34.3 (13.7)	25.6 (11.7)
Pose Rate (poses/minute) *	2.5 (0.8)	1.5 (0.6)	1.1 (0.5)

Means (SE). * $p < 0.05$.

Table 2
Body Position Characteristics by Yoga Routine Category.

Routine Characteristic	Weight Loss Routines n = 8	Beginner Routines n = 7	Stress Relief/ Meditation Routines n = 7
Supine Poses (number of poses)	6.1 (5.0)	5.9 (7.3)	8.3 (7.7)
Supine poses (% of total poses)	10.9% (11.3)	18.5% (25.4)	28.8% (28.6)
Seated Poses (number of poses)	6.5 (7.1)	5.3 (3.1)	7.43 (3.3)
Seated poses (% of total poses) *	9.9% (8.5)	15.8% (9.7)	39.0 % (28.3)
Total Number of Standing Poses (number of poses) *	38.8 (11.5)	17.0 (8.3)	5.7 (5.1)
Total Standing Poses (% of total poses) *	59.9% (17.0%)	51.1 (26.4)	18.6% (15.0)
Standing-Head-Up Poses (number of poses) *	32.5 (10.9)	12.9 (5.1)	4.0 (3.2)
Standing-Head-Up Poses (%of total poses) *	50.2% (14.2)	41.3% (25.4)	13.5% (10.6)
Inversion Poses (number of poses)	3.4 (3.2)	4.3 (5.0)	1.7 (2.8)
Inversion Poses (%of total poses)	9.6% (4.9)	10.7% (8.2)	5.1% (7.9)
Other Poses (number of poses) *	22.6 (10.1)	5.86 (8.6)	4.1 (4.4)
Other Poses (% of total poses) *	34.8% (17.5)	13.5% (15.4)	13.6% (13.2)

Means (SE). * $p < 0.05$.

demonstrated that examining the characteristics of yoga may be a method to not only quantify yoga, but also to differentiate characteristics of routines between different yoga styles. Significant differences were observed between yoga categories for the characteristics of the pose rate, total number of yoga poses completed, and the volume of poses completed in some body postures (i.e. standing, seated, and other).

There has been an outcry in the yoga community for a universal method to report yoga, which would allow researchers to compare study findings. More recently there has been some indication that different styles of yoga may elicit different benefits and experiences. [20,30] Therefore, having a method, such as the pose rate, that can differentiate between different types of yoga by taking the routine characteristics/ intensities into account is essential. The concept of the pose rate was developed in this study to account for differences in routine duration that could impact the number of poses able to be performed. Within traditional yoga classes, the total number of poses completed are different between styles and classes. The pose rate provides information on the average speed in which the poses are completed, which may relate to eliciting different physiologic responses and therefore provide information on the intensity of the yoga routine. Previous research indicates that different styles of yoga have different intensities and are more physically demanding. [6–9,12] Findings from this study show that the pose rate can differentiate between different types of yoga, making it a simple and effective means to compare yoga research.

Additionally, findings support that the number of poses completed in specific body positions may be another method assess yoga. The weight loss category included significantly more standing poses. The beginner routines included a high percentage of standing poses, but not as many total standing poses as the weight loss routines. Previous research shows that poses completed the body position of standing compared to seated postures have a higher physiological demand. [31–32] While this research project did not examine intensity by physiological responses a rough indication of intensity can be assessed through the pose rate and body position categories. This estimate would equate a higher physiological demand and therefore higher intensity during the weight loss routines. In contrast, the stress relief/meditation, which was comprised of more seated postures, would be a lower physiological demand and therefore a lower intensity.

As discussed, a limitation of this study was that the routines analyzed did not follow traditional styles of yoga, therefore, limiting the generalizability of the results. However, while the categories in this study did not follow traditional yoga styles, they were distinctively and significantly different and tended to follow patterns of certain yoga styles. Weight loss routines moved at a faster pace and involved more transitions and poses, similar to a vinyasa style class. Beginner routines tended to focus more on alignment and appeared to hold poses for longer, comparable to an iyengar class. Finally, the stress relief/meditation appeared to involve a minimal number of yoga poses and focused more on other aspects of yoga (e.g. mindfulness or breathing) relating to a yin or restorative yoga class. Another limitation is that the yoga videos analyzed were a convenience sample, rather than a random sample, as the videos were selectively chosen based on their popularity and ability to fit into one of the three defined categories. Lastly, while yoga impacts all aspects of a human experience (i.e. physical, cognitive, emotional, behavioral and social) [20] this study solely focused on the

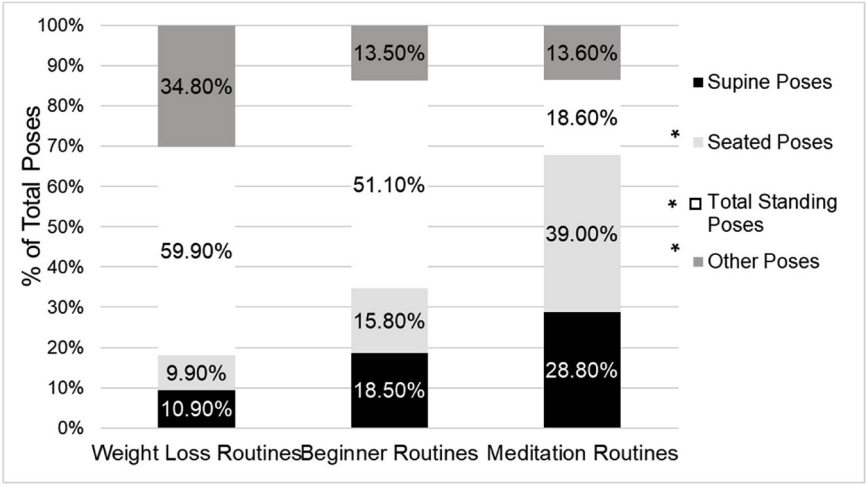

Fig. 2. Percentage of Pose Body Position by Yoga Routine Category.

physical experience. Further research should be conducted to assess if differences are observed between traditional yoga styles. Research should also be conducted to examine if the number of poses completed corresponds to larger physiological and metabolic responses, to validate this concept. Despite limitations, strengths of this study include the development of the concept to quantify yoga through simple means and that this method can distinguish between different yoga categories. Additionally, to the author's knowledge this is the first study to examine quantifying yoga through pose characteristics.

5. Conclusion

Currently, there is no universal way to report yoga practices for research purposes, thus, this study is a step towards creating a common method to report yoga. The use of yoga routine characteristics, such as total number of poses completed or a pose rate, to quantify yoga is a novel idea. Previous research has indicated that different styles of yoga have different physiological demands, and because different poses elicit different physiological responses, it is reasonable to believe that different styles of yoga would also have different class characteristics (e.g. number of poses, pose rates). This study demonstrates that the characteristics of total poses, pose rate, and total standing poses have significant differences between different types of yoga. Additionally, this concept would allow researchers a simple, cost-effective, and consistent means of reporting yoga. Using a standard method to quantify yoga will allow for easy comparisons between published research and will help to further the field of yoga research.

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