



CHARACTERISTICS OF COMPETITIVE BATON TWIRLING ATHLETES

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ABSTRACT

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Competitive baton twirling is a sport that combines elements of gymnastics, dance and ballet while necessitating cardiovascular endurance, muscular endurance and power, hand-eye coordination, spatial awareness, kinesthetic awareness, timing and choreography. Approximately one million baton twirlers participating in the sport in the United States. Despite considerable participation in competitive baton twirling, little is known about the characteristics of the athletes. This work documents demographic and behavioral characteristics of competitive baton twirlers. Questionnaires were completed by 169 female twirlers from across the United States and Canada. Respondents reported a mean (\pm SD) age of 18.07 yrs. (\pm 6.08) and height of 63.89 in (\pm 6.24), weight 133.56 lbs. (\pm 32.49), BMI (22.92), GPA 3.73 (\pm 0.31), years of competing 8.02 yrs. (\pm 1.81). All (100%) qualified respondents reported experiencing injury due to competing in or training for baton. The extent of the injuries reported varied greatly. A diversity of training, recovery, hydration, and nutrition habits were also reported. These findings indicate that the competitive baton twirlers that participated in this research are adolescent females, diverse in physical profile, of normal BMI, high academic achievers, dedicated athletes, consistently overcome injuries and train by diverse means. Future research may consider the long-term physical effects and an association with mental health competitive baton twirling has on the athletes.

Contribution/Originality: This study contributes to the existing literature as it is the first attempt to profile competitive baton twirlers as athletes.

1. INTRODUCTION

Sport (or sports) is all forms of usually competitive physical activity which, through casual or organized participation, aim to use, maintain or improve physical ability and skills while providing entertainment to participants, and in some cases, spectators (Science Daily, 2021). Incorporated into the definition of 'sport' are all forms of physical activity that contribute to physical fitness, mental well-being and social interaction. These include: play; recreation; organized, casual or competitive sport; and indigenous sports or games (United Nations, 2021). Sport is generally recognized as activities which are based in physical athleticism or physical dexterity, with the largest major competitions such as the Olympic Games admitting only sports meeting this definition, and other organizations such as the Council of Europe using definitions precluding activities without a physical element from classification as sports (Science Daily, 2021).

Competition—defined as contexts where an individual can attain his or her ends only at the expense of others not attaining theirs—is pervasive in everyday life. Competition has important implications for motivation. Goals

drive people to achieve; in competitive goal-pursuit contexts, the goal is to win, and contestants invest effort throughout the competition to achieve this goal. Competition has been linked to both positive and negative goal-related outcomes. On one hand, compared with noncompetitive contexts, competition can engender a sense of challenge and excitement, and increase contestants' desire to do well. On the other hand, competition can create anxiety, reduced concentration, and heightened distractibility, which can undermine intrinsic motivation (Huang, Etkin, & Jin, 2017).

A method of developing a better understanding of an athlete or a population of athletes' tactics toward their respective sport and competition is to develop a profile of that athlete or population. Over the past three decades, sport has become much more scientific. Our understanding of biomechanics, technique and technology has seen previous performance barriers broken time and time again. While our advanced physiological and technical knowledge has produced huge progressions and previously unattainable physical performances, there is a significant 'knowledge gap' developing in another area that is also critical to creating results. Profiling bridges the gap between 'potential' and 'great' sports performances through the development of a better understanding of an athlete's experience, achievement, training behavior and other information.

Sport Baton Twirling is a relatively new discipline that has evolved through many dimensions. The baton is an instrument constructed of steel with rubber ends similar in consistency to a vehicle tire (Fern, Kyle, & Allan, 1987). It weighs approximately ½ pound and is sized to the length of the athlete's arm from the shoulder to the tip of the fingers. The baton is weighted and balanced for air dynamic flow. For an athlete to be a successful baton twirler they must handle the baton with maneuvers to create visual images, pictures and patterns, executed with intricacy, dexterity, smoothness, fluidity, and speed, both close in and around the body and by release the baton into the air. Throwing the baton with velocity and revolution to propel the apparatus forty to fifty feet into the air while spinning, leaping and jumping across the floor to arrive at the precise point and time to catch it is a common element in baton performance. Utilizing fine motor skills and precise timing to execute the strategic placement of the baton in a scrolling, continuous rolling motion around the neck, shoulders and arms without using the hands to guide or control its path, all in synchronization with the movement of the body adds a dimension to the routine. Athletes are also expected to express artistry and emotion of the body through movement that creates a demonstration of strength, flexibility, physical fitness, beauty, aesthetics, and harmony in coordination with the manipulation of the baton. The blend of baton and body together create elements of risk, physical stamina, agility and excitement all set to music, utilizing time and space to display both technical merit and artistic expression in creating a successful performance (World Baton Twirling Federation, 2021).

To date, there has not been an assessment of the behavior associated with competitive baton twirling. Therefore, the purpose of this research was to develop a profile of competitive baton twirlers based on anthropomorphic data, baton experience, injury history, training activity and other information.

2. METHODS

A questionnaire was developed through consultation with experienced competitive baton twirling coaches and athletes. An initial series of questions were constructed, then vetted through expert review to most efficiently collect information that was meaningful to the athletes and to the researchers. Forty-one questions were used for the final questionnaire.

Questions regarding anthropomorphic, academic, competition, training and lifestyle topics constructed in an electronic document that made it easier and more convenient to complete. A link to the questionnaire was broadcast via social media to the competitive baton twirling community. The distribution of the questionnaire followed guidelines established by Dillman, Smyth, and Christian (2014).

Descriptive statistics were calculated along with parametric statistics to determine the relationships that exist between the variables of interest. Pearson correlations were used to determine the strength of the relationship

between variables. Linear regression was then used to test the relationship between multiple predictor variables and a continuous outcome variable. All statistics were calculated using SPSS 27.

3. RESULTS

One hundred seventy-eight competitive baton twirlers responded to the survey that was broadcast via social media over a two-week period. Respondents provided meaningful information representing twenty-six different states of the United States of America and one province of Canada.

Descriptive statistics of the overall study participants are offered in Table 1. The mean age of participants was 18.07 years ($SD \pm 6.08$, Min = 7, Max = 58). The mean height of participants was 163.25 cm ($SD \pm 10.57$, Min = 121.92, Max = 198.12). The mean weight of the participants was 60.33 kg ($SD \pm 14.74$, Min = 27.22, Max = 113.39). The mean Body Mass Index score (BMI) for the group was 22.8 ($SD \pm 2.48$, Min = 18.3, Max = 28.9). The mean GPA of participants was 3.74 ($SD \pm 0.31$, Min = 2.7, Max = 4.6).

Table-1. Overall Descriptive Information.

	Mean	SD	Min	Max
Age	18.07	± 6.08	7	58
Height (cm)	163.25	± 10.57	121.92	198.12
Weight (kg)	60.33	± 14.74	27.22	113.39
BMI	22.8	± 2.48	18.3	28.9
GPA	3.74	± 0.31	2.7	4.6

As a competitive sport, baton twirling is constructed in a system of levels. These levels include novice (little experience/lower skillset), beginner, intermediate, advanced and elite (greater experience/higher skillset). Tables 2 – 6 provide information for these respective groups.

Table-2. Mean Age Across Groups (yrs.).

	Mean	SD	Min	Max
Overall	18.07	± 6.08	7	58
Novice	10.11	± 1.96	7	13
Beginner	14.67	± 3.56	8	22
Intermediate	17.92	± 3.56	9	29
Advanced	19.16	± 5.84	10	50
Elite	20.37	± 7.57	13	58

The overall mean age of the participants in this research study was 18.07 years ($SD \pm 6.08$, Min = 7, Max = 58). Participants reporting competing at the Novice level the mean age was 10.11 years ($SD \pm 1.96$, Min = 7, Max = 13). Beginners reported a mean age of 14.67 years ($SD \pm 3.56$, Min = 8, Max = 22). Intermediate athletes reported a mean age of 17.92 years ($SD \pm 3.56$, Min = 9, Max = 29). Advanced athletes reported a mean age of 19.16 years ($SD \pm 5.84$, Min = 13, Max = 50). Elite athletes reported a mean age of 20.37 years ($SD \pm 7.57$, Min = 13, Max = 58).

Table-3. Mean height across groups (cm).

	Mean	SD	Min	Max
Overall	163.25	± 10.57	121.92	198.12
Novice	167.66	± 3.58	165.1	170.18
Beginner	147.02	± 14.33	121.92	162.56
Intermediate	163.88	± 13.94	152.00	198.12
Advanced	162.58	± 9.78	132.08	182.88
Elite	163.93	± 8.99	154.94	182.88

The overall mean height of the participants in this research study was 163.25 cm (SD±10.57, Min = 121.92, Max = 198.12). Participants reporting competing at the Novice level the mean height was 167.66 cm (SD±3.58, Min = 165.1, Max = 170.18). Beginners reported a mean height of 147.02 cm (SD±14.33, Min = 121.92, Max = 162.56). Intermediate athletes reported a mean height of 163.88 cm (SD±13.94, Min = 152.00, Max = 198.12). Advanced athletes reported a mean height of 162.58 cm (SD±9.78, Min = 132.08, Max = 182.88). Elite athletes reported a mean height of 163.93 cm (SD±8.99, Min = 154.94, Max = 182.88).

Table-4. Mean Weight across Groups (kg).

	Mean	SD	Min	Max
Overall	60.33	±14.74	27.22	113.39
Novice	39.91	±13.44	27.67	72.57
Beginner	57.28	±17.89	27.22	107.05
Intermediate	59.80	±12.42	30.39	86.18
Advanced	63.82	±15.04	30.84	113.39
Elite	62.47	±10.17	41.73	83.91

The overall mean weight of the participants in this research study was 60.33 kg (SD±14.74, Min = 27.22, Max = 113.39). Participants reporting competing at the Novice level the mean weight was 39.91 kg (SD±13.44, Min = 27.67, Max = 72.57). Beginners reported a mean weight of 57.28 kg (SD±17.89, Min = 27.22, Max = 107.05). Intermediate athletes reported a mean weight of 59.80 kg (SD±12.42, Min = 30.39, Max = 86.18). Advanced athletes reported a mean weight of 63.82 kg (SD±15.04, Min = 30.84, Max = 113.39). Elite athletes reported a mean weight of 62.47 kg (SD±10.17, Min = 41.73, Max = 83.91).

Table-5. Body Mass Index (BMI) Across Groups.

	Mean	SD	Min	Max
Overall	22.8	±2.48	18.3	28.9
Novice	14.1	±3.82	10.2	25.1
Beginner	26.5	±4.67	18.3	40.5
Intermediate	22.3	±2.14	13.2	27.4
Advanced	24.1	±2.64	17.7	33.9
Elite	23.2	±1.78	17.4	31.2

The overall mean BMI of the participants in this research study was 22.8 (SD±2.48, Min = 18.3, Max = 28.9). Participants reporting competing at the Novice level the mean BMI was 14.1 (SD±3.82, Min = 10.2, Max = 25.1). Beginners reported a mean BMI of 26.5 (SD±4.67, Min = 18.3, Max = 40.5). Intermediate athletes reported a mean BMI of 22.3 (SD±2.14, Min = 13.2, Max = 27.4). Advanced athletes reported a mean BMI of 24.1 (SD±2.64, Min = 17.7, Max = 22.9). Elite athletes reported a mean BMI of 23.2 (SD±1.78, Min = 17.4, Max = 31.2).

Table-6. Academic Achievement across Groups.

	Mean	SD	Min	Max
Overall	3.74	±0.31	2.7	4.6
Novice	3.74	±0.21	3.5	4.0
Beginner	3.67	±0.36	2.8	4.23
Intermediate	3.71	±0.29	3.0	4.0
Advanced	3.75	±0.33	2.7	4.6
Elite	3.76	±0.27	3.1	4.0

The overall mean GPA of the participants in this research study was 3.74 (SD±0.31, Min = 2.7, Max = 4.6). Participants reporting competing at the Novice level the mean GPA was 3.74 (SD±0.21, Min = 3.5, Max = 4.0). Beginners reported a mean GPA of 3.67 (SD±0.36, Min = 2.8, Max = 4.23). Intermediate athletes reported a mean

GPA of 3.71 (SD±0.29, Min = 3.00, Max = 4.0). Advanced athletes reported a mean GPA of 3.75 (SD±0.33, Min = 2.7, Max = 4.6). Elite athletes reported a mean GPA of 3.76 (SD±0.27, Min = 3.1, Max = 4.0).

Table-7. Training Behaviors.

Training Behavior	Percentage
Employ stretching or mobility each training session	95.1
Structure targeted practices	90.3
Practice 4 or more days a week	72.0
Train outside of baton	85.4
Daily	5.60
6x/week	4.00
5x/week	11.4
4x/week	11.4
3x/week	26.2
2x/week	27.8
Do not	15.7
Train baton and other on same day	67.9

Table 7 offers information regarding the training behaviors of competitive baton twirlers. The percentage of respondents that employ stretching or mobility exercises at each training session was 95.1. Those reporting structuring training sessions to address specific targets was 90.3 percent. Seventy-two percent of respondents report training four or more days per week. When asked how often they train outside of baton 5.60 percent reported daily, 4.00 percent reported six times per week, 11.4 percent reported five times per week, 11.4 reported four times per week, 26.2 percent reported three times per week, 27.8 percent reported two times per weekend 15.7 percent reported no training outside of baton. Approximately sixty-eight (67.9) percent of respondents reported training baton and another method on the same day.

Table-8. Training Session Profile.

Included in baton training sessions	Percentage
Pre-stretch/mobility	94.9
Structured Warm-up	75.1
Skill progression	84.2
Targeted attention	89.8
Cool down	37.3
Post-stretching/mobility	34.5

The results gathered from the questions that inquired about the structure of training sessions, as displayed in Table 8, 94.9% of respondents indicated the inclusion of pre-training stretching or mobility exercises. A structured warm-up was employed by 75.1 percent of the respondents. Athletes (84.2%) reported using a specific progression in skill development. Most athletes (89.8) use training sessions to target a specific area. Only 37.3 percent of respondents employ a cool down with training sessions. Similarly, 34.5 percent of athletes reported stretching or mobilizing post- training.

Table-9. Related Performance Behaviors.

Performance Behavior	Percentage
Consider nutrition when training and competing	65.7
Consider hydration when training and competing	92.0
Sleep 7 or more hours a night on average	53.3
Use a chiropractor regularly	63.6
Use a massage therapist	20.8
Use a physiotherapist regularly	10.1

Table 9 reports results from athletes being asked if the athlete considers nutrition when training and competing, 65.7 percent responded affirmatively. Ninety-two percent of respondents consider hydration when training and competing. Only 53.3 percent of athletes responded that they sleep seven or more hours a night on average. Using a chiropractor regularly (63.6%), a massage therapist (20.8%) and a physiotherapist (10.1) were reported by respondents.

Table-10. Additional Training.

Activity	Percentage
Dance	74.1
Fitness	61.4
Gymnastics	38.6
Yoga	23.4
Weightlifting	19.6
Swimming	7.0

Athletes reported using dance (74.1%), fitness (61.4%), gymnastics (38.6%), yoga (23.4), weightlifting (19.6%) and swimming (7%) as methods of additional training to enhance their baton twirling performance, as seen in Table 10.

Table-11. Reported Injury History Associated with Competitive Baton Twirling.

Injury	Percentage
Bumps and bruises	96.0
Sprained or strained fingers	54.4
Sprained or strained ankle	46.7
Sprained or strained hip	45.2
Sprained or strained knee	36.9
Sprained or strained back	35.4
Concussion	28.6
Broken bone	28.5
Sprained or strained wrist	25.9
Sprained or strained neck	15.2

Table 11 reports injuries associated with competitive baton twirling included: bumps and bruises (96.0%), sprained or strained fingers (54.4%), sprained or strained ankle(s) (46.7%), sprained or strained hips (45.2%), sprained or strained knee(s) (36.9%), sprained or strained back (35.4%), concussion (28.6%), broken bone(s) (28.5%), sprained or strained wrist(s) (25.9%) and sprained or strained neck (15.2%).

4. DISCUSSION

The present analysis is based on survey data from 178 baton twirlers, all of which had competed in at least one baton twirling competition with one year of completing the questionnaire. As there is not a clear understanding of how many competitive baton twirlers there are in the United States of America and Canada it is unclear what percentage the responding population represents. Additionally, this is the first attempt to develop a profile of any sort of these athletes.

As a group, the survey participants were experienced competitors, in which 85.26% having been competing for at least four years and 52.85% competing for nine plus years. These athletes ranged in age from 7 to 58 years with an average age of 18.07 years, suggesting that participation in competitive baton twirling can be a long-term sport. Further confirming that competitive baton twirling can be a sport in which competitors can have a long twirling career is that the average age of respondents in this survey was greater than those that participate in more mainstream sports such as basketball, baseball, softball, soccer and football (United States Bureau of Labor

Statistics, 2017). When considering the age of the athletes and their advancement in skill level the results of this research indicate the maturation rate of both are consistent. The ages of the athlete's progress as does the skill level of the athletes accordingly.

Participants reported a mean Body Mass Index (BMI) of 22.8, which places them in the Healthy Weight category according to the Government of Canada (2019). When comparing this group to the average BMI in the United States of 26.5 and Canada of 26.8, which is considered overweight, baton twirlers on average are least likely to experience health related issues. When examining the BMI scores across groups only one group reported an average BMI that was not considered healthy (Beginner: 26.5). However, there is an indication that if athletes continue in the sport of baton twirling it is likely a healthy BMI can be achieved as evidenced by the subsequent three groups reporting health BMI scores and a higher average age.

Baton twirling is a dynamic sport demands considerable effort and preparation. Therefore, dedicating time to learn, refine and become proficient at the skills required to be successful is paramount. In addition to baton many athletes engage in various training activities outside of baton. In this survey athletes were asked about their training behaviors. A significant amount (95%) of respondents reported employing stretching or mobility exercises at each baton training session. Rather than taking time to randomly practice twirling, 90% of respondents reported structuring their practices to target specific movements, tricks or skills. Results from our survey also indicated that 72% of respondents practice baton at least four days per week along with a high percentage training outside of multiple times per week with 67% reporting practicing baton and an outside activity on the same day. These results that baton athletes are dedicated to their sport and work diligently to build a skillset outside of baton to enhance their performance.

Common among modern athletes is the recognition that other behaviors can support or deter their performance. Attending to aspects such as nutrition, hydration and sleep are fundamental to athletic performance. While 92% of respondents consider hydration when they train or compete only approximately 66% consider nutrition when they are training and/or competing. Just as a limited number of respondents consider nutrition a behavior that can impact their performance only 53.3% report sleeping 7 or more hours a night on average. These two pieces of information indicate competitive baton twirlers could benefit from a greater realization that nutrition factors significantly in athletic performance. Insufficient sleep duration can have an impact on metabolism, endocrine function, and athletic and cognitive outcomes, and, furthermore, increase perceived effort during exercise. Recently, the International Olympic Committee (IOC), has addressed, for the first time, sleep as a major contributor to athletic performance and as a fundamental feature of athlete mental health. In addition, the National Collegiate Athletics Association (NCAA) included sleep health as part of their published mental health best practices as well as their more recently published official position statement on the importance of sleep health for student athletes. The IOC mental health document considers sleep health in terms of sufficiency (ie, at least 7 hours for adults), proper circadian alignment, good overall perceived sleep quality, and absence of sleep disorders, including insomnia disorder and sleep apnea. The document recommends that these dimensions of sleep be considered important for mental health as well as physical health and functioning. Charest and Grandner (2020) based on the information gathered in this survey competitive baton twirlers are on the cusp of healthy and unhealthy sleep behavior (Charest & Grandner, 2020).

Interestingly, 94.5% of respondents reported employing forms of sports medicine (chiropractic, massage, physio) as means to recover from practice or competition. This information parallels the evolution of sports medicine over the past decade. The composition of sport medicine has varied across settings, and over time. Historically, the most common practitioners have been physicians, who are the primary healthcare providers, and physiotherapists, who provide rehabilitation. In the United States and some Canadian provinces, a third profession, athletic therapy, has also been prominent, with primary responsibility for on-site care during training and competition. (In settings where athletic therapists are not common, these services are typically provided by

physiotherapists.) In recent years, sport medicine has seen the re-composition of some professions and the addition of others. Physiotherapy has expanded its scope of practice by establishing a sport physiotherapy specialization, with advanced training in manipulation, which historically has been the domain of chiropractors. The expansion of sport medicine has included the establishment of sport specializations in chiropractic and massage (Theberge, 2008). With such a large percentage of athletes reporting the use of sports medicine professionals and the evolution of the sports medicine profession as a whole it is logical the two have a working relationship.

When considering the number of respondents that reported employing forms of therapy to recover from practice or competition the information gleaned from the reporting of injury history correlates. A significant number of athletes have reported a variety of injuries experienced because of baton. Ninety-six percent of respondents reported suffering bumps or bruises, 28.6% reported suffering concussions and 28.5% reported experiencing a broken bone due to baton. A recently published study reported 18% of the participants answered that they had experienced a concussion which significantly differed depending on the sport practiced (soccer 25%, handball 24%, volleyball 13%, basketball 15%). Helmich (2018) Certainly, these percentages are significant for athletes in one sport to experience on a regular basis. With such a large amount and variety of injuries encountered by baton athletes the need to seek professional assistance to recover from either practice or competition is warranted.

5. CONCLUSION

Competitive baton twirling is a sport that spans the not only the United states and Canada, but the World. Competitive baton twirling careers can begin at an early age and continue through adulthood. The athletes that compete in the sport of baton twirling maintain healthy Body Mass Index, perform well academically and work diligently to improve their performance in the sport. Most competitive baton twirlers participate in other sports, often using these other sports to support their baton twirling progression. The great majority respondents reported some degree of injury due to baton twirling training or competition. These injuries warrant the need to seek assistance in recovering from the variety of injuries experienced. Being the first known attempt to develop a profile of competitive baton twirlers these results offer interesting insight into these athletes.

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