Perceptions of strength training in dance

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Abstract

The aim of this study was to ascertain current perceptions of strength training in dance from the viewpoint of the professional dancer, dance teacher and student dancers across dance genres. A total of 168 responses (149 =F, 19=M) to the modified Training Information Survey (TIS) were analysed for differences in perceptions of strength training between dance students, professional dancers and dance teachers. Some significant differences were found between professionals and teachers ($p>0.05$), and between students and teachers ($p>0.001$). In all instances, dance teachers were less likely to agree with; strength training is essential to my overall development as a dancer, Women should participate in strength training, men should participate in strength training, strength training should be part of every training programme regardless of dance style, strength training is beneficial to women and strength training increases bodyweight. It is evident that perceptions of strength training still vary across the dance sector and it is postulated that further education for dancers on the role strength training

has to play on the development of a dancer would help to break down barriers to participation. From this investigation, it can also be concluded that the perception that dancers have a fear of muscle hypertrophy and a negative impact on aesthetics is no longer widely prevalent, although it still permeates throughout the dance sector.

Introduction

Dancers are often referred to as "aesthetic athletes"[1] due to the physical demands, coupled with the aesthetic artistry required for performance. Historically, dance has focused on aesthetic qualities, with a great emphasis on execution, quality of movement and vocabulary, particularly in modern dance and classical ballet[2], rather than the need to train the physiological systems to meet the demands of choreography. It has also been suggested that dancers often perceive fitness as the absence of injury [2], rather than a requisite part of dance training and that strength is not necessary for a successful dance career[3]. Preconceptions of a dancers' physique required for performance[4], has previously been categorised as exceptionally lean[5], with a low body fat percentage and body weight[6]. This is more prevalent in ballet due to the high focus on aesthetics of the dancers, particularly amongst females. It has also been suggested that the lower body fat percentage has both aesthetic and physiological benefits[7]. Despite this, Liiv et al, [8] noted that modern dancers had a more muscular physique than ballet dancers, although it is unclear if this is as a result of training, selection, or both. It has also been suggested that modern dancers have a higher level of body appreciation than non-dancers[9], and that this may be due to a lower degree of focus on pure aesthetics, but instead a focus on higher athletic demand and strength[9]. However, classical ballet also now demands a more athletic physique than the previous preconception of a lithe, ethereal ballerina[8,10], with new choreographic demands and erosion of sex divides[11] within dancers' roles.

It has previously been assumed that dancers are reluctant to participate in strength training (ST) due to a perception that it will significantly increase muscle size and therefore negatively affect the aforementioned aesthetics of the dancers body[2,3,6,12–14]. However, with the increase in choreographic demands[11], might perceptions towards supplementary training, and the need to improve aspects of physical fitness to meet these demands, be altering?

Perceptions of strength training in sport and dance

Current research into strength training has focused on the lower body, due to the high prevalence of lower body injuries[15,16] and the muscular requirement associated with jumps and landing mechanics[17,18]. However, there is currently little research investigating the impact of this training on the aesthetics of dance, and whether any adaptations in the body are perceived as positive or negative.

In particular, there remains misinformation of the importance of strength training in maximising the performance of female athletes[19,20], with some sports coaches also not recognising the need for strength training to enhance performance in their individual sports[21]. It is probable that these perceptions also exist within dance, across different dance genres, although there is minimal research available on perceptions of strength training in sport or dance. The Training Information Survey (TIS) was created as a tool to ascertain individual perceptions of general sports conditioning and weight training[19]. Responses to this survey demonstrated a similar response across all applications, with male athletes significantly more likely to consider weight training as important to their general and sport-specific training than females [19,21,22]. However, to our knowledge, this survey has to date only been presented to National Collegiate Athletic Association (NCAA) teams who already employ a full-time

strength and conditioning coach which all athletes had access to; a provision not currently afforded to all dance companies.

To date, the perceptions of strength training in dance has not been fully interrogated, with no published research to our knowledge pertaining to this topic. The aim of this study was therefore to ascertain current perceptions of strength training in dance from the viewpoint of the professional dancer, dance teacher and student dancers. It is proposed that a greater understanding of the perceptions of those in the dance sector will enable the successful education and integration of strength training into dance training, rehearsal and performance programmes.

Method

A prospective study design, utilising a self-report survey was conducted. Ethics for this study was granted by Kingston University Ethics Committee. All participants were provided with full research information and gave informed consent prior to commencing the survey. For this study strength training was defined as "any training that requires the muscles to move against an opposing force (usually some form of equipment). This may include free weights (kettlebells, dumbbells, medicine balls), weight training machines, resistance bands or bodyweight training." This statement was included at the beginning of the survey.

The Training Information Survey (TIS)[19] was modified to reflect the dance genres under investigation; replacing wording such as sports training with dance training, and athlete with dancer. The survey consisted of fourteen questions pertaining to participation in strength training followed by twenty-one statements such as Strength training has beneficial effects on

my dance performance and Strength training increases body weight, with a likert scale response of 1-5 (1=Strongly disagree, 5=Strongly agree). A free-text comments box was included at the end of the survey to provide qualitative data as to participants' perceptions of strength training. Basic demographic information was also collated.

The survey was distributed to professional dancers, dance teachers and student dancers and completed online. Professional dancers were deemed as those who had received payment for dance performance for at least three months in the previous twelve. Dance teachers and dance students were classified as those teaching or studying dance at Further Education (FE), Higher Education (HE), vocational training or private classes. Recreational dancers were excluded from this study due to intermittent participation in dance class and not actively pursuing a professional career in dance.

Data was analysed using SPSS Statistics (IBM® SPSS® Statistics, V25.). Differences between the roles of dance student, teacher and professional were assessed by Kruskal Wallis. A Mann-Whitney U was utilised to further investigate any statistically significant results. The p-value was set at $p < 0.05$.

Results

A total of 240 responses were recorded, after removal of incomplete data sets and those that did not comply with the inclusion criteria, 168 responses remained for analysis (149=F, 19=M; age 28.35±10.71 years). Sixty-four participants identified as a dance student, twenty-two as a professional dancer and sixty-three as a dance teacher. Of those who provided a main dance style (N=98), the majority of responses (N=43) were provided by contemporary dancers; classified as incorporating techniques such as Release, Flying low, Cunningham, Limon and

Graham. This was followed by Ballet (N=15) and Jazz (N=9). All recorded dance genre for participants are presented in table 1.

Professional dancers agreed more strongly than dance teachers with the statements Strength training (ST) is essential to my overall development ($U = 661.0$, $z = -2.985$, $p < 0.05$, $r = -0.30$), Women should participate in ST ($U = 697.5$, $z = -2.740$, $p < 0.05$, $r = -0.28$), Men should participate in ST ($U = 772.0$, $z = -2.108$, $p < 0.05$, $r = -0.21$), ST is beneficial to men ($U = 781.0$, $z = -3.510$, $p < 0.05$, $r = -0.21$), and ST is beneficial to women, ($U = 741.5$, $z = -2.380$, $p < 0.05$, $r = 0.24$). (Table 2)

Dance students also agreed more strongly than dance teachers with the statements Strength training (ST) is essential to my overall development as a dancer ($U = 1{,}597$, $z = -3.792$, $p < 0.001$, $r = -0.32$), Women should participate in ST ($U = 1{,}690$, $z = -3.510$, $p < 0.001$, $r = -0.30$), Men should participate in ST ($U = 1{,}724$, $z = -3.418$, $p < 0.001$, $r = -0.29$), ST should be part of every training programme regardless of dance style ($U = 1{,}915$, $z = -2.358$, $p < 0.05$, $r = -0.20$), ST is beneficial to women ($U = 1{,}973$, $z = -2.109$, $p < 0.05$, $r = -0.18$), and ST increases bodyweight, ($U = 1{,}842$, $z = -2.515$, $p < 0.05$, $r = -0.21$) (Table 3). There were no significant differences reported between professional dancers and student dancers for any questions (Table 4).

Thirty-one participants provided further qualitative comments on their experiences and perceptions of strength training. Five participants stated that strength training had a positive impact on their own dancing or that of their students including: “Without Strength Training I would not be the dancer I am today.”, “Starting strength training has had a massively positive affect on my movement quality and also my stamina when teaching.”, and “As a dance teacher,

I can clearly see a difference in my students who do strength training and their peers who don't. Across dance genres!”

However, two responses stated that they did not believe strength training was necessary for dancers or that too much emphasis was placed upon it: “Strength training, as defined in the introduction to the survey, is a very narrow view of preparing the body for dance. It has not been a major part of English Morris dance or folk dance culture and I do not currently use it.”, and “It is only one element to creating a dancer. Often far too much emphasis put on it - fuelled by celebrity/ influencer dancers.”.

Similarly, two participants stated that they do not use strength training, in particular weights, in their training, but rather prefer Pilates, bodyweight training, yoga or via their existing dance practice: “I believe my dance practice has a lot of elements of strength training without the use of props, due to the percussive footwork. I don’t normally use weights or bands but plan to use them to strengthen the upper body.”, and “For me strength training doesn't include the use of weights or extreme techniques. Planks, press up, abdominal exercises and quad, are more than enough to develop strength in your muscles, I don't go to the gym, use machines or weights. I use the weight of my own body.”.

Six participants stated that further education and guidance on strength training for the dance community was important, or felt that a lack of education put them off participation: “I would like more guidance within my dance course relating to strength training.”, “Lack of knowledge about how to find the best advisor in how strength training relates to injury recovery and prevention, and the body's weight, leads me to avoid this practice.”, and “I think that it is

underused within dance - especially for women - due to fear of bulking and reducing flexibility. But educating teachers to educate their students is key.”.

Discussion

It has been suggested that there is a fear amongst dancers that participating in strength training will increase muscle size and therefore have a negative impact on the aesthetics required of a dancers’ body [2,3,6,12–14]. However, it can be argued that these perceptions may be shifting, with dancers recognising the importance of strength training to their overall dance performance. Both dance students and dance professionals stated they strongly agreed that strength training was essential to their overall dance performance, with mean scores of 4.6±0.6 and 4.6±0.5 respectively. They also strongly agreed that strength training had a beneficial impact on their performance and was beneficial to both male and female dancers. These findings appear to contradict prior research demonstrating that dancers do not understand the need for strength training[2,3].

When comparing professional dancers’ responses to those of dance teachers, the professional dancers agreed more strongly with Strength training (ST) is essential to my overall development, Women should participate in ST, Men should participate in ST, ST is beneficial to men, and ST is beneficial to women (Table 2).

Dance students also agreed more strongly than dance teachers with the statements ST is essential to my overall development, Women should participate in ST, Men should participate in ST, and ST is beneficial to women (Table 3).

These results suggest that dancers are aware of the potential benefits of strength to both men and women and believe it is essential to their overall training, whereas teachers are a little more reluctant to agree. The dance teachers' role is predominantly focused on technique, artistry and performance aesthetics, and it has previously been posed that the dance studio should retain this focus, with conditioning taking place in separate classes. Therefore, the results indicate that teachers do not support strength training (ST) to the same degree as dancers and do not view the enhancement of physiological parameters such as strength as imperative to the development of the dancer. However, the dancer, both student and professional, may view their dance training in a more holistic capacity, focusing not only on technique class, but also on their physical and mental fitness. No statistically significant results were found between professional dancers and student dancers, suggesting they share similar perceptions of strength training.

If, as has been proposed[4], education of dancers and the personnel working with them of the benefits of strength and conditioning training for performance enhancement is essential, then it is imperative that dance educators too understand its application. As has been previously noted, any adaptations to dance training must be considered with care before implementation to ensure aesthetic and artistic content is not affected [4,23], and consideration must to be taken not to overload the dancers by simply adding further training to an already busy schedule. High intensity training over prolonged periods can lead to overtraining, increased injury risk and underperformance[24,25,26,27] with overuse accounting for the majority of all injuries in dance[15,25,26,27]. These overuse injuries have been linked with training exposure and spikes in training load during return to dance, or transitional periods between rehearsal and performance[28,29]. Therefore, careful implementation of training can be achieved through periodized training schedules. Periodization utilises a psycho-physiological approach to

training including physiological, psychological, biomechanical and skill based elements[24] and is standard practice within the athletic community but can be overlooked within dance training and education[30]. Careful planning of dancers' training schedule alongside attention to spikes in training exposure and load can address potential risk of fatigue and overuse injuries. Periodized dance training programmes would therefore ensure the inclusion of technique based dance classes, but balanced with supplementary training, rest and psychological skills to reach the dancers' potential, physically and mentally and reduce the risk of fatigue and subsequent injury[24,25,30].

One participant stated that a lack of knowledge leads them to avoid participating in strength training, whilst four others also stated that education on strength training would be beneficial and help to integrate strength training into dance schedules. Therefore, knowledge of strength training amongst dance teachers and surrounding personnel, as well as dedicated strength and conditioning coaches within dance education and company settings, would encourage dancers' participation.

Boyd et al. [21] noted that endurance sports such as cross country running and track and field were more concerned about the implications of weight gain and, as such were more likely to agree to the statement strength training (ST) increases body weight. Similarly, it may be stated that dancers are more aware of their weight in relation to the requirements and aesthetics of their role and therefore an expectation that dancers would be concerned with increased weight or muscle girth. However, the results of the survey imply that dancers were not concerned with increases in weight, with all three groups reporting similar results for ST increases body weight (Students = 3.3±0.9, Professionals = 3.0±1.0, Teachers = 2.9±1.0), and likewise all three groups only slightly agreed with the statement ST increases muscle size (Students = 3.4±1.0,

Professionals = 3.1±1.1, Teachers = 3.2±1.0). One participant did however mention the pressure on females to maintain long lean muscles: “I believe that females should do Pilates and yoga to help lengthen and tone the muscles but not to bulk and get 6-pack.”.

Although strength training will elicit an increase in cross-sectional area of the muscle, concern over increased muscle size does not appear to be as prevalent as previously supposed. In addition, dancers also agreed that strength training helped them to look better, contradicting previous concerns over alterations to the dancers’ aesthetic.

From the cross section of dancers who responded to the survey the perception of strength training being a predominantly male activity and not beneficial for injury prevention or performance enhancement has shifted. With adequate education and coaching in strength training dancers can see the benefits to their dancing. This can be seen in some of the qualitative responses from dancers who suggested that they had only become aware of the benefits of strength training after sustaining an injury, and now wish they had known more prior to their injury. Conversely, other responses cited strength training as surplus to requirements, as they felt their dance training alone ensured they were strong enough. This view, however, conflicts with prior research demonstrating that dance class alone does not elicit enough demand on the physiological systems to see any significant adaptation[3,4]. These views may result from a lack of understanding, as demonstrated in the results (Tables 2 and 3) , by dance teachers as to what constitutes strength training, the need for overload to see adaptations in the physiological systems, and therefore the impact of dance classes on these physiological parameters. Dance teachers are responsible for the education of young dancers, and therefore their perceptions can be absorbed by their students, including perceptions of strength training in dance.

Further comments from responders provided many differing views of strength training, what "strength training" means and its place within dance training, with qualitative comments differing from "It should be part of every dancer's weekly routine in order to physically meet the demands of choreography through safe practice." to "It is only one element to creating a dancer. Often far too much emphasis put on it." and "Strength Training is never going to be a popular option, so must be mandatory and regular in order to achieve results.".

It can also be suggested that there is a misunderstanding as to what constitutes strength training, with some participants stating that; "Planks, press up, abdominal exercises and quad, are more than enough to develop strength in your muscles" and "I believe that females should do Pilates and yoga to help lengthen and tone the muscles but not to bulk and get 6 pack." .

Whilst bodyweight exercises such as planks, press-ups and abdominal exercises will elicit some strength adaptations in those with lower levels of relative strength, the ability to progressively overload the muscles is restricted to approximately 75% of bodyweight [31] and may in turn only allow for further adaptations to muscular endurance through higher repetitions[32]. Pilates, whilst used widely amongst the dance population[33] as yet has little reliable and comparable research that demonstrates significant improvements in muscular strength through participation in Pilates training[33], or relate more specifically to stabilisation of the musculoskeletal system and maintaining alignment[34] rather than specific relative strength parameters.

It is evident that perceptions of strength training still vary across the dance sector and it is postulated that further education for dancers and dance educators on the role strength training has to play on the development of a dancer, would help to break down barriers to participation.

Limitations

As with all self-reported studies results can be misconstrued due to an altered interpretation of the question. Despite the definition of strength prior to the start of the survey, some respondents were still unclear as to the definition of strength training. As participants were able to self-select into the survey it is also possible that those who chose to complete the survey either already have a vested interest in strength and conditioning or are opposed to the inclusion of strength and conditioning within dance training.

Conclusion

Perceptions of strength training in dance are changing and are no longer necessarily confined to the negative impact on dance aesthetics. With the development of more demanding choreography, research into the impact of strength training on both performance outcomes, bodily aesthetics and performance aesthetics must be further investigated. The use of a short questionnaire such as the Training Information Survey (TIS) within schools and companies will aid strength coaches and dance teachers in creating specific training programmes that address these perceptions, thereby enhancing adherence to strength and conditioning programmes.

It can also be concluded that the perception that dancers are afraid of muscle hypertrophy and the impact on aesthetics is no longer highly prevalent, although it still permeates throughout the dance sector. This is particularly apparent in the views of the dancer teachers, and this view may therefore be superseded as dance students and professional dancers, whose views were more accepting to strength training, move into teaching careers.

References

1. Ambegaonkar JP, Caswell S V., Winchester JB, Caswell AA, Andre MJ. Upper-body

muscular endurance in female university-level modern dancers: a pilot study. *J Dance Med Sci*. 2012;16(1):3-7.
2. Koutedakis Y, Hukam H, Metsios G, et al. The effects of three months of aerobic and strength training on selected performanceand fitness-related parameters in modern dance students. *J Strength Cond Res*. 2007;21(3):808-812. doi:10.1519/R-20856.1
3. Koutedakis Y, Stavropoulos-Kalinoglou A, Metsios G. The Significance of Muscular Strength in Dance. *J Danc Med Sci*. 2005;9(1):29-34.
4. Koutedakis Y, Jamurtas A. The dancer as a performing athlete: Physiological considerations. *Sport Med*. 2004;34(10):651-661. doi:10.2165/00007256-200434100-00003
5. Claessens AL, Beunen GP, Nuyts MM, Lefevre JA, Wellens RI. Body structure, somatotype, maturation and motor performance of girls in ballet schooling. *J Sports Med Phys Fitness*. 1987;27(3):310-317.
6. Twitchett EA, Koutedakis Y, Wyon MA. Physiological fitness and professional classical ballet performance: a brief review. *J Strength Cond Res*. 2009;23(9):2732-2740. doi:10.1519/JSC.0b013e3181bc1749
7. Chatfield SJ, Byrnes WC, Lally DA, Rowe SE. Cross-Sectional Physiologic Profiling of Modern Dancers. *Danc Res J*. 1990;22(1):13. doi:10.2307/1477737
8. Liiv H, Wyon MA, Jürimäe T, Saar M, Mäestu J, Jürimäe J. Anthropometry, somatotypes, and aerobic power in ballet, contemporary dance, and DanceSport. *Med Probl Perform Art*. 2013;28(4):207-211.
9. Langdon SW, Petracca G. Tiny dancer: Body image and dancer identity in female modern dancers. *Body Image*. 2010;7(4):360-363. doi:10.1016/j.bodyim.2010.06.005
10. Mišigoj-Duraković M, Matković BR, Ružić L, et al. Body Composition and Functional Abilities in Terms of the Quality of Professional Ballerinas. *Coll Antropol*. 2001;25(2):585-590.
11. Wyon MA, Allen N, Cloak R, Beck S, Davies P, Clarke F. Assessment of maximum aerobic capacity and anaerobic threshold of elite ballet dancers. *Med Probl Perform Art*. 2016;31(3):145-150. doi:10.21091/mppa.2016.3027
12. Wyon M. Testing the aesthetic athlete: contemporary dance and classical ballet dancers.BASES physiological testing guidelines. In: Winter EM, ed. *Sport and Exercise Physiology Testing Guidelines : The British Association of Sport and Exercise Sciences Guide*. Routledge; 2007:249-262.
13. Koutedakis Y, Sharp NCC, Boreham C. *The Fit and Healthy Dancer*. John Wiley; 1999.
14. Koutedakis Y, Cross V, Sharp C. Strength training in male ballet dancers. *Impuls Int J Danc Sci Med Educ*. 1996;4(3):210-219.
15. Bronner S, Ojofeitimi S, Rose D. Injuries in a modern dance company: Effect of comprehensive management on injury incidence and time loss. *Am J Sports Med*. 2003;31(3):365-373. doi:10.1177/03635465030310030701
16. Laws H. Findings on Injuries. In: *Fit to Dance 2*. Newgate Press ©; 2005:16-23.
17. Wyon MA, Twitchett E, Angioi M, Clarke F, Metsios G, Koutedakis Y. Time motion and video analysis of classical ballet and contemporary dance performance. *Int J Sports Med*. 2011;32(11):851-855. doi:10.1055/s-0031-1279718
18. Herman DC, Weinhold PS, Guskiewicz KM, Garrett WE, Yu B, Padua DA. The effects of strength training on the lower extremity biomechanics of female recreational athletes during a stop-jump task. *Am J Sports Med*. 2008;36(4):733-740. doi:10.1177/0363546507311602
19. Poiss CC, Sullivan PA, Paup DC, Westerman BJ. Perceived importance of weight training to selected NCAA division III men and women student-athletes. *J Strength*

Cond Res. 2004;18(1):108-114. doi:10.1519/00124278-200402000-00016
20. Chandler TJ, Brown LE. *Conditioning for Strength and Human Performance*. Wolters Kluwer/Lippincott Williams & Wilkins Health; 2013.
21. Boyd JM, Andrews AM, Wojcik JR, Bowers CJ. Perceptions of NCAA Division I Athletes on Strength Training. *Sport J*. Published online 2017:1. Accessed May 18, 2020. http://web.a.ebscohost.com/ehost/detail/detail?vid=0&sid=d9a9ae02-c4f2-4dd4-b68c-4d333f6d7f87%40sessionmgr4007&bdata=JkF1dGhUeXBlPXNzbyZzaXRlPWVob3N0LWxpdmUmc2NvcGU9c2l0ZQ%3D%3D#AN=123270052&db=ehh
22. Eisner M. Collegiate Athletes' Perceptions on the Importance of Strength and Conditioning Coaches and Their Contribution to Increased Athletic Performance. *J Athl Enhanc*. 2014;03(04). doi:10.4172/2324-9080.1000159
23. Rafferty S. Considerations for integrating fitness into dance training. *J Dance Med Sci*. 2010;14(2):45-49.
24. Wyon M. Preparing to perform: periodization and dance. *J Dance Med Sci*. 2010;14(2):67-72.
25. Murgia, C. Overuse, Tissue Fatigue, and Injuries. *J Dance Med Sci*, 2013;17(3):92–100. doi:10.12678/1089-313X.17.3.92.
26. Dang Y, Koutedakis Y, Wyon M. Fit to Dance Survey: Elements of Lifestyle and Injury Incidence in Chinese Dancers. *Med Probl Perform Art*. 2020;35(1):10-18. doi: 10.21091/mppa.2020.1002. PMID: 32135000.
27 Smith PJ, Gerrie BJ, Varner KE, McCulloch PC, Lintner DM, Harris JD. Incidence and Prevalence of Musculoskeletal Injury in Ballet: A Systematic Review. *Orthop J Sports Med*. 2015:3(7): doi: 10.1177/2325967115592621
28 Lee R. Injury incidence, dance exposure and the use of the movement competency screen (mcs) to identify variables associated with injury in full-time pre-professional dancers. *Int J Sports Phys Ther.* 2017:12(3):352–70.
29 Fuller M. Injuries During Transition Periods Across the Year in Pre-Professional and Professional Ballet and Contemporary Dancers: A Systematic Review and Meta-Analysis. *Phys Ther Sport*. 2020;44:14-23. doi:10.1016/j.ptsp.2020.03.010.
30. DiPasquale S. Dance Exposure Tracking in a Liberal Arts Collegiate Dance Department: A Call for Dancer Health Through Periodization. *J. Dance Educ.* 2018:18(4):154–63. doi:10.1080/15290824.2018.1383610.
31. Ebben WP, Wurm B, Vanderzanden TL, et al. Kinetic analysis of several variations of push-ups. *J Strength Cond Res*. 2011;25(10):2891-2894. doi:10.1519/JSC.0b013e31820c8587
32. Mayhew JL, Ball TE, Arnold MD, Bowen JC. Push-ups as a measure of upper body strength. *J Strength Cond Res*. 1991;5(1):16-21. doi:10.1519/00124278-199102000-00004
33. Bernardo LM, Nagle EF. Does Pilates Training Benefit Dancers? An Appraisal of Pilates Research Literature.
34. Ahearn EL, Greene A, Lasner A. Some Effects of Supplemental Pilates Training on the Posture, Strength, and Flexibility of Dancers 17 to 22 Years of Age. *J Dance Med Sci*. 2018;22(4):192-202. doi:10.12678/1089-313X.22.4.192

Table 1. Self-reported main dance style

Genre	**Percentage %**	**N = 98**
Aerial dance	1.0	1
Ballet	15.3	15
Bharatanatyam	2.0	2
Bollywood	1.0	1
Breaking	1.0	1
Commercial	3.1	3
Contemporary (Limon,Graham,Cunningham, Release,Flying Low)	43.9	43
Contemporary African	1.0	1
Hip hop	5.1	5
Jazz	9.2	9
Kathak	3.1	3
Modern	1.0	1
Musical Theatre	7.1	7
Period	1.0	1
Popping and locking	1.0	1
Street	1.0	1
Tango	1.0	1
Tap	2.0	2

Table 2: Professional dancer against dance Teacher, * = significant difference P<0.05, † = significant difference P<0.001

Question	Professional	Teacher	Sig.
ST is essential to my overall development as a dancer	4.6±0.5 Rank 62.21	4.0±1.0 Rank 44.94	0.003*
Women should participate in ST	4.7±0.5 Rank 60.95	4.3±0.8 Rank 45.46	0.006*
Men should participate in ST	4.7±0.5 Rank 53.38	4.3±0.8 Rank 46.53	0.035*
ST should be part of every training program regardless of dance style	4.6±0.6 Rank 56.88	4.2±0.9 Rank 47.15	0.091*
ST is beneficial to men	4.7±0.5 Rank 58.07	4.4±0.8 Rank 46.66	0.041*
ST is beneficial to women	4.7±0.5 Rank 59.43	4.3±0.8 Rank 46.09	0.017*
ST has beneficial effects on my dance performance	4.6±0.5 Rank 52.67	4.4±0.8 Rank 48.89	0.492
My ST techniques are adequate so that I can avoid injury from ST	4.3±0.8 Rank 55.95	3.9±1.0 Rank 47.54	0.158
My ST techniques are adequate to help me improve my performance	4.4±0.6 Rank 55.16	4.1±0.8 Rank 47.86	0.199
ST increases muscle size	3.1±1.1 Rank 48.97	3.2±1.0 Rank 50.43	0.809
ST increases muscle strength	4.6±0.5 Rank 54.98	4.4±0.6 Rank 47.94	0.206
ST increases body weight	3.0±1.0 Rank 51.66	2.9±1.0 Rank 49.31	0.700
ST helps me feel better – physically	4.5±0.5 Rank 51.97	4.3±0.8 Rank 49.19	0.625
ST helps me feel better – mentally	4.3±0.8 Rank 48.6	4.3±0.9 Rank 50.58	0.734
ST helps me look better	4.1±0.8 Rank 52.48	3.9±0.9 Rank 48.97	0.556
ST is a masculine activity	1.7±0.9 Rank 45.71	1.9±1.0 Rank 51.78	0.300
ST is a feminine activity	1.9±1.0 Rank 47.00	2.1±1.1 Rank 51.24	0.482
ST is fun and enjoyable	3.9±0.8 Rank 55.21	3.6±1.1 Rank 47.84	0.214
ST has significant health benefits	4.4±0.6 Rank 53.95	4.3±0.7 Rank 48.36	0.328
ST enhances body and self-image	4.1±1.0 Rank 53.45	4.0±0.9 Rank 48.57	0.407
ST is only possible with encouragement from others	2.3±1.1 Rank 45.22	2.5±1.1 Rank 51.98	0.258

Table 3: Student dancer against dance Teacher, * = significant difference P<0.05, † = significant difference P<0.001

Question	Student	Teacher	Sig.
ST is essential to my overall development as a dancer	4.6±0.6 Rank 81.86	4.0±1.0 Rank 58.31	0.000†
Women should participate in ST	4.7±0.7 Rank 80.51	4.3±0.8 Rank 59.64	0.000†
Men should participate in ST	4.7±0.6 Rank 80.01	4.3±0.8 Rank 60.13	0.001†
ST should be part of every training program regardless of dance style	4.6±0.6 Rank 77.24	4.2±0.9 Rank 62.86	0.018*
ST is beneficial to men	4.6±0.7 Rank 75.6	4.4±0.8 Rank 64.48	0.064
ST is beneficial to women	4.6±0.7 Rank 76.4	4.3±0.8 Rank 63.69	0.035*
ST has beneficial effects on my dance performance	4.5±0.7 Rank 71.41	4.4±0.8 Rank 68.61	0.638
My ST techniques are adequate so that I can avoid injury from ST	4.2±0.8 Rank 74.9	3.9±1.0 Rank 65.17	0.128
My ST techniques are adequate to help me improve my performance	4.2±0.8 Rank 71.61	4.1±0.8 Rank 68.41	0.606
ST increases muscle size	3.4±1.0 Rank 73.69	3.2±1.0 Rank 66.36	0.261
ST increases muscle strength	4.5±0.6 Rank 73.38	4.4±0.6 Rank 66.67	0.265
ST increases body weight	3.3±0.9 Rank 78.3	2.9±1.0 Rank 61.81	0.012*
ST helps me feel better – physically	4.4±0.6 Rank 71.04	4.3±0.8 Rank 68.98	0.737
ST helps me feel better – mentally	4.4±0.7 Rank 70.41	4.3±0.9 Rank 69.59	0.895
ST helps me look better	3.9±0.8 Rank 68.33	3.9±0.9 Rank 71.65	0.600
ST is a masculine activity	2.0±1.1 Rank 72.6	1.9±1.0 Rank 67.44	0.421
ST is a feminine activity	2.3±1.1 Rank 73.77	2.1±1.1 Rank 66.29	0.254
ST is fun and enjoyable	3.8±0.9 Rank 74.31	3.6±1.1 Rank 65.75	0.175
ST has significant health benefits	4.4±0.6 Rank 71.28	4.3±0.7 Rank 68.74	0.678
ST enhances body and self-image	4.2±0.7 Rank 72.66	4.0±0.9 Rank 67.38	0.397
ST is only possible with encouragement from others	2.6±1.1 Rank 71.62	2.5±1.1 Rank 68.41	0.614

Table 4: Student dancer against Professional dancer, * = significant difference P<0.05, † = significant difference P<0.001

Question	Student	Professional	Sig.
ST is essential to my overall development as a dancer	4.6±0.6 Rank 49.57	4.6±0.5 Rank 49.34	0.967
Women should participate in ST	4.7±0.7 Rank 49.64	4.7±0.5 Rank 49.17	0.923
Men should participate in ST	4.7±0.6 Rank 50.52	4.7±0.5 Rank 47.07	0.464
ST should be part of every training program regardless of dance style	4.6±0.6 Rank 49.58	4.6±0.6 Rank 49.36	0.971
ST is beneficial to men	4.6±0.7 Rank 48.63	4.7±0.5 Rank 51.57	0.573
ST is beneficial to women	4.6±0.7 Rank 48.33	4.7±0.5 Rank 52.28	0.446
ST has beneficial effects on my dance performance	4.5±0.7 Rank 49.01	4.6±0.5 Rank 50.67	0.757
My ST techniques are adequate so that I can avoid injury from ST	4.2±0.8 Rank 49.05	4.3±0.8 Rank 50.57	0.793
My ST techniques are adequate to help me improve my performance	4.2±0.8 Rank 48.13	4.4±0.6 Rank 52.76	0.413
ST increases muscle size	3.4±1.0 Rank 51.54	3.1±1.1 Rank 44.66	0.255
ST increases muscle strength	4.5±0.6 Rank 48.88	4.6±0.5 Rank 50.98	0.701
ST increases body weight	3.3±0.9 Rank 52.54	3.0±1.0 Rank 42.26	0.085
ST helps me feel better – physically	4.4±0.6 Rank 49.11	4.5±0.5 Rank 50.43	0.811
ST helps me feel better – mentally	4.4±0.7 Rank 50.33	4.3±0.8 Rank 47.52	0.622
ST helps me look better	3.9±0.8 Rank 47.74	4.1±0.8 Rank 53.69	0.303
ST is a masculine activity	2.0±1.1 Rank 52.4	1.7±0.9 Rank 42.6	0.095
ST is a feminine activity	2.3±1.1 Rank 52.43	1.9±1.0 Rank 42.53	0.101
ST is fun and enjoyable	3.8±0.9 Rank 49.13	3.9±0.8 Rank 50.38	0.826
ST has significant health benefits	4.4±0.6 Rank 48.36	4.4±0.6 Rank 52.21	0.494
ST enhances body and self-image	4.2±0.7 Rank 49.09	4.1±1.0 Rank 50.48	0.811
ST is only possible with encouragement from others	2.6±1.1 Rank 52.16	2.3±1.1 Rank 43.17	0.125