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Exploring The Psychological And Physiological Outcomes Of Recreational Pole Dancing: A Feasibility Study

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In qualitative and cross-sectional studies, participation in recreational pole dancing classes has been shown to align with improvements in body image, physical fitness, satisfaction of basic psychological needs and group identity. The purpose of this feasibility study was to quantify retention and adherence rates, along with physiological and psychological changes, across eight weeks of pole dancing classes. Of the 76 participants recruited, 68 females (age range nineteen to 60 years) attended baseline testing, a typical term of pole dancing classes at eight local studios (i.e., two 60-minute classes a week for eight weeks) and a post-program testing session

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resulting in an 89.5% retention rate. The adherence rate was 93.8% (mean attendance of fifteen out of sixteen classes). Significant over-time improvements with small to large effect sizes were observed in body image (body appreciation r = 0.45, figure rating r = 0.38), physical self-concept (sport r = 0.30, coordination r = 0.41, strength r = 0.50, endurance r = 0.28, global esteem r = 0.38, flexibility r = 0.18), physical fitness (flexed arm hang r = 0.49, step up test d = 0.26, sit and reach d = 0.23) and visceral fat mass (r = -0.16). No significant changes were observed in bone mineral density, leg lean mass or leg fat mass. Analyses also revealed important correlations between in-class experiences and psychological and physiological outcomes, which may provide insight into potential design elements within future intervention studies. The results from this study inform the design of future larger trials by (a) highlighting retention and adherence rates in an eight-week pole dancing program, (b) identifying effect sizes for key outcomes of pole dancing, and (c) providing insight into the potentially modifiable factors that might be suitable targets for intervention should researchers and practitioners seek to maximize outcomes from this form of training.

Keywords: dance for health, self-determination, group identification, body image, dance science

Des études qualitatives et transversales ont montré que la participation à des ateliers non professionnels de pole dance concorde avec diverses améliorations en termes de perception du corps, de condition physique, de réponse à des besoins psychologiques de base et d'identité de groupe. Cette étude de faisabilité visait à quantifier les taux d'adhésion et de rétention, ainsi que les évolutions physiologiques et psychologiques durant huit semaines de pratique de la pole dance. Sur les 76 participant·e·s recruté·e·s, 68 femmes (âgées entre 19 et 60 ans) ont suivi une initiation de base (en anglais, baseline testing, terme généralement employé pour les cours de pole dance) dans huit studios du pays, soit deux ateliers d'une heure par semaine pendant huit semaines, et une session test après le programme. Il en résulte un taux de rétention de 89,5 %. Le taux d'adhésion s'élève à 93,8 % (soit une participation à 15 cours sur un total de 16). Au fil du temps, des améliorations significatives avec des effets plus ou moins importants ont pu être observées sur la perception du corps (appréciation du corps r = 0,45, évaluation des formes r = 0,38), le concept de soi physique (sport r = 0,30, coordination r = 0,41, force r = 0,50, endurance r = 0,28, estime générale r = 0,38, souplesse r = 0,18), la condition physique (traction r = 0,49, test de la marche d = 0,26, souplesse en position assise d = 0,23) et la masse de graisse viscérale (r = -0,16). L'étude ne montre aucun changement notoire sur la densité minérale osseuse, sur la masse maigre au niveau des jambes ou sur la masse grasse. Les analyses ont également révélé d'importantes corrélations entre des expériences vécues en atelier d'un côté, et des conséquences psychologiques et physiologiques de l'autre. Ces découvertes pourraient être très utiles pour d'éventuels éléments de modélisation dans le cadre de futures études expérimentales. Les conclusions de cette étude façonnent la conception de futurs essais à plus grande échelle grâce (a) à la mise en lumière des taux d'adhésion et de rétention durant un programme de pole dance sur huit semaines, (b) à l'identification de l'ampleur des effets en lien avec la pratique de la pole dance et ses principales conséquences, et (c) à des informations utiles sur les facteurs potentiellement modifiables qui pourraient s'appliquer au domaine expérimental si chercheur·euse·s et spécialistes souhaitent optimiser les résultats pour cette pratique.

Mots clés: autodétermination, identification au groupe, perception du corps, science de la danse

Since the early 2000s, there has been a documented rise in the popularity of recreational pole dancing classes,[1–4] particularly among women.[3] Although still in its early stages, pole dance is emerging as a circus discipline,[5,6] and the literature base for pole dancing research is growing. Classified as an aerial discipline with ground elements[5,6] and sharing similarities to gymnastics and dance,[2] pole dancing is characterized by performing manoeuvres requiring elements of strength, flexibility, and coordination.[7,8]

Participation in pole dancing comes with an element of physical risk. Nicholas et al.[7] report injury rates among pole dancers to be high (8.95 new injuries per 1,000 exposure hours), with the greatest number of injuries occurring at the shoulder and thigh. Naczk et al.[9] report 36.7% of pole dancers sustaining an injury within the last two years and greater menstrual disturbances among pole dancers compared to a control group. Despite these reported injury rates and participation risks, several studies reveal the potential health benefits of pole dancing. Nicholas et al.[10] report pole dancing classes being classified as a moderate-intensity cardiorespiratory activity that, if completed for an adequate frequency and duration (i.e., >150 min per week), may result in health and cardiorespiratory benefits. In qualitative studies, pole dancers have reported perceived physical changes associated with participation in the activity, such as improved strength, flexibility, and body composition.[3,11,12] In cross-sectional studies, competitive female pole dancers are reported to have greater grip strength, upper body muscle mass and flexibility, as well as lower body fat compared to untrained females.[9,13]

Given that a majority of adults, particularly women,[14] are not sufficiently active,[15] and with the rise in popularity of female-predominant pole dancing classes, Nicholas et al.[12] sought to understand the motives for ongoing participation in pole dancing as a form of physical activity. Using a qualitative approach, Nicholas et al.[12] found that participation in pole dancing was associated with participants' sense of accomplishment, experience of variety and enjoyment, improved body acceptance and self-confidence, physical fitness benefits and in-group assimilation (i.e., a sense of community or "sisterhood"). Other qualitative and cross-sectional studies also report psychological benefits associated with participation in pole dancing, including developing and maintaining a positive body image,[12,16,17] improved self-confidence, and stress alleviation.[12]

Despite the aforementioned cross-sectional and qualitative work suggesting the holistic (both psychological and physiological) benefits of pole dancing, researchers have yet to quantify the longitudinal outcomes that may be associated with participation in recreational pole dancing. Additionally, a majority of quantitative studies have focused on experienced pole dancers[9,10,13] rather than novices. Before conducting larger trials and randomized controlled trials to test outcomes associated with an intervention such as a pole dancing program among novices, it is recommended that researchers first (a) determine participant retention and adherence in such programs, (b) quantify potential outcomes and obtain effect sizes for such programs (so as to adequately power any future trials), and (c) understand the potentially modifiable factors that might be suitable targets for future intervention studies.[18]

In line with recommendations for the development of complex interventions,[18] the aim of this study was to undertake a preliminary longitudinal evaluation of psychological and physiological outcomes of participation in pole dancing classes. Our first aim was to determine participant retention and adherence in a term of pole dancing classes. Our second aim was to investigate pre-to-post differences and effect sizes in psychological and physiological outcomes following eight weeks of pole dancing. Our third aim was to explore relationships between in-class experiences (motivation-related factors) and post-training outcomes, thereby identifying modifiable factors to target to maximize outcomes from pole dancing in future studies.

Methods

Study design

The aims of this study were examined using a feasibility design, which is effective in informing the design of larger trials[19] and has been used to determine the feasibility of recruitment, retention and adherence of participants, as well as to identify and quantify outcomes from various forms of physical activity, e.g., Zumba Gold,[20] tai chi,[21] and virtual rehabilitation.[22] As the purpose of the present study was to provide a foundation for future studies and trials, we adopted a feasibility study approach. In addition, formal hypothesis testing to determine the efficacy of an intervention has been omitted, as it is not recommended in feasibility studies.[23,24]

Participants and procedures

Following ethical approval to conduct the study from the Human Research Ethics Committee at the University of Western Australia (reference number RA/4/1/7781), pole dancing studios within the Perth Metropolitan Area were contacted and informed about the study. Studio owners who were interested in allowing research participants to enroll as students in classes provided beginner course dates and class times, which were then distributed to potential participants. The sample was recruited via promotions on social media (e.g., Facebook posts and news stories), flyers in public areas such as cafes and community notice boards, and flyers displayed at pole dancing studios. Potential participants were given an information sheet outlining the details of the study, along with their rights, before providing informed consent. Those informed about the study via a public forum contacted the lead author, who subsequently provided details about participating studios (e.g., where they were located or how participants could enroll in classes). Inclusion criteria were females over eighteen years old with no major health conditions or injury (participants completed a Pre-Exercise Screening, PAR-Q), with no prior or recent (in the last three years) participation in regular pole dancing (defined as weekly classes for eight or more weeks) who were willing to pay for a term of beginner pole dancing classes at a local studio (participating in two classes a week for eight weeks).

Beginner pole dancing classes were conducted and delivered by instructors at local studios rather than in a controlled laboratory environment, as we were interested in investigating psychological measures that have previously been reported as occurring in "realistic" class contexts, e.g., sense of community within the studio.[12] Classes were delivered by 30 instructors across eight local studios. Although instructors across studios did not deliver a specific standardized program, the structure of beginner classes usually involves a fifteen-minute warm-up, about twenty minutes of learning skills including spins, climbing and sitting on the pole,[25] and approximately twenty minutes of learning a routine (including combining pole skills learnt along with dance elements), finalized by a five-minute cool-down.[10] Participants selected a studio based on location, time and/or cost of classes, and were asked to attend two 60-minute beginner pole dancing classes per week for eight weeks. Although 150 minutes of pole dancing per week is the suggested dose for potential health and cardiorespiratory benefits,[10] two 60-minute classes per week (for a total of 120 minutes) was the selected dose for the current study, as pole dancing courses are usually purchased as one 60-minute class for eight weeks[11] with local studios reporting most beginner students enrolling for one to two classes per week. Further, cost for participation in two classes per week varied between 300–360 AUD versus 400–480 AUD for three classes per week. Two classes per week was selected to reduce financial cost being a barrier to participation. The sample was recruited over a twelve-month period (six pole dancing terms). Retention was calculated by dividing the number of participants that completed the study by the number that were recruited and completed baseline measures. Adherence was calculated via class attendance recorded by each studio and expressed as a percentage of the total number of enrolled sessions (i.e., sixteen classes).

Psychological and physiological outcomes

Prior to and following the eight-week pole dancing term, participants attended a testing session at the University of Western Australia. Participants completed dual-energy x-ray absorptiometry (iDXA) body composition scans (GE Lunar iDXA, Encore v16), physical fitness tests, and an online questionnaire containing a range of psychological scales (detailed below) using online survey software (Qualtrics, Provo, UT). Whole-body iDXA scans were performed following methods outlined by Staynor et al.[26] Following the scan, the Regions of Interest function was used to allow for the calculation of body composition in each region (i.e., trunk, right and left arm, right and left leg). This involved placing[1] a horizontal vector at the top of the iliac crest,[2] a horizontal vector along the inferior border of the mandible, and[3] bisecting lines through the shoulder and hip joint centres. Body composition outcomes included body mass, lean mass percentage, fat percentage total body, trunk, right and left arm, right and left leg, and visceral fat mass. Bone densitometry outcomes included total bone mineral density (BMD; g/cm^3), T-score (comparison to healthy young adult population), and Z-score (comparison to age-matched norms).[48]

The following fitness tests were conducted using the methods outlined in the American College of Sports Medicine's *Health-Related Fitness Assessment Manual*.[27] Cardiorespiratory fitness (maximum oxygen consumption; VO_{2max}) was calculated indirectly using the Queens College Step Test. Participants stepped up and down on a step (height 41.25 cm) for three minutes at a cadence of 88 beats per minute (bpm). Following the test, pulse rate was taken at radial or carotid sites for fifteen seconds and multiplied by four to determine heart rate in bpm. Muscular strength was measured using the flexed arm hang. An overhand grip position was used, and participants were timed for the duration they could keep their chin above, but not resting on, a fixed overhead bar. The score from a single test was recorded. A familiarization trial was not conducted to prevent the effect of muscular fatigue on test performance; however, testers provided a demonstration prior. Flexibility was assessed using the sit and reach test. Participants removed their shoes, and the zero point was positioned at the foot/box interface. The best of two trials was recorded.

Participants were instructed to maintain their pre-program physical activity levels throughout the eight weeks of pole dancing classes. All training was reported in a daily training diary; however, due to low completion and compliance, these data were not analyzed. Measures of body image and physical self-concept were obtained before and after the pole dancing term to allow for repeated-measure comparisons, while motivation-related variables were assessed only following the pole dancing term.

Body image

The Body Appreciation Scale-2 (BAS-2)[28] was used to measure the extent to which participants appreciated, accepted, and respected their bodies. The BAS-2 consists of ten items (e.g., "I respect my body," "I appreciate the different and unique characteristics of my body"). For each item, participants were asked to report their agreement using a five-point Likert scale ranging from one ("never") to five ("always"). Scores were averaged, with a higher score indicating greater positive body image. Cronbach's α values for BAS-2 pre-training and post-training scores were 0.95 and 0.94, respectively.

The Figure Rating Scale (FRS)[29] was used to assess body size satisfaction. The FRS consists of nine silhouette figures that increase gradually in size from very thin (value of one) to very obese (value of nine). Participants were asked to indicate both the number of the drawing (from one to nine) that they considered to most closely represent their "current" appearance and the number that they considered to most represent their "ideal" appearance. Body size satisfaction was defined as the difference between one's perceived current appearance and ideal appearance, consistent with Markland[30] and Markland & Ingledew.[31] A positive body size satisfaction score indicated that a participant felt larger than their ideal body size, while a negative score indicated that they felt smaller than their ideal body size. A small difference between current and ideal appearance indicated a greater level of body satisfaction, while a larger difference between appearances indicated a lower level of body satisfaction.

Physical self-concept

Marsh's Physical Self-Description Questionnaire-Short Form (PSDQ-S)[32] was used to assess physical self-concept. Six subscales were selected, totalling 22 items; subscales included coordination (e.g., "I am good at coordinated movements"), sport (e.g., "I have good sports skills"), strength (e.g., "I am a physically strong person"), flexibility (e.g., "my body is flexible"), endurance (e.g., "I can be physically active for a long period of time without getting tired"), and global esteem (e.g., "Overall, I have a lot to be proud of"). For each item, participants were asked to report their agreement on a six-point Likert scale ranging from one ("false") to six ("true"). Cronbach's α values for pre-training and post-training subscale scores were for coordination 0.95 and 0.94, sport 0.96 and 0.93, strength 0.93 and 0.91, flexibility 0.94 and 0.90, endurance 0.91 and 0.89, and global esteem 0.89 and 0.88, respectively.

Motivation-related outcomes

The selection of motivation-related outcomes was guided by findings reported in Nicholas et al.[12] and included measures of autonomy, competence, relatedness, need satisfaction, intrinsic motivation, group identification, and variety. The scales used to measure these outcomes are listed below. Cronbach's α values for each subscale are presented in Table 3.

The Basic Needs Satisfaction in Sport Scale (BNSSS)[33] was used to assess the degree to which participants' needs for autonomy, competence and relatedness were satisfied throughout the pole dancing term. The BNSSS comprises 32 items (ten items for each of the subscales for autonomy and competence, and twelve items for the subscale of relatedness). Participants were asked to respond to the items with regard to their "feelings and experiences in pole dancing over the last term." All items were modified from specifying "in my sport" to "in pole dancing" and included autonomy (e.g., "In pole dancing, I get opportunities to make decisions"), competence (e.g., "I get opportunities to feel that I am good at pole dancing"), and relatedness (e.g., "In pole dancing, I feel welcomed"). Participants were asked to report their agreement with the 32 items on a seven-point Likert scale ranging from one ("not true at all") to seven ("very true").

The Intrinsic Motivation Inventory (IMI)[34] was used to measure participants' enjoyment of the pole dancing term. The seven-item interest/enjoyment subscale was used to assess intrinsic motivation. Each item was modified from specifying "the activity" to "pole dancing" (e.g., "I enjoyed doing pole dancing," "Pole dancing was fun to do"). For each statement, participants were asked to report their agreement on a seven-point Likert scale ranging from one ("not true at all") to seven ("very true").

Participants' perceptions of variety were assessed using the Perceived Variety in Exercise instrument (PVE),[35] which was framed to provide assessments of perceived variety over the term of pole dancing classes. The five-item instrument (e.g., "I engaged in a variety of exercises") was scored on a six-point Likert scale with responses ranging from one ("false") to six ("true").

The Group Identification Scale (GIS)[36] was used to assess group identity associated with membership in the pole dancing classes. The instrument includes four items, all of which were modified to include "pole dancing class" as the reference group (e.g., "I feel a tight bond with members in my pole dancing class"). Participants were asked to report their agreement with the four items on a seven-point Likert scale ranging from one ("I strongly disagree") to seven ("I strongly agree").

Data analysis

Data were screened for outliers, normality and homogeneity of variance using IBM SPSS (Version 22.0). Descriptive statistics (means, standard deviations, medians, interquartile ranges [IQR], and reliability coefficients for psychological variables) and Pearson correlations between study variables were calculated ($\alpha = 0.05$). Intention-to-treat principles were used to provide an indication of effects that are likely to occur for an entire sample, regardless of whether they completed the training or post-testing (i.e., all participants were included in the analyses with missing values substituted with the last score carried forward). This conservative approach is recommended to inform future randomized controlled trials of likely outcomes regardless of training (i.e., treatment) dose.[37] In addition, we conducted per-protocol analyses to examine outcomes that occurred among participants who completed the term of classes and returned for follow-up testing.

Psychological and physiological changes

To examine psychological and physiological changes that occurred over eight weeks of pole dancing classes, a one-way Repeated Measures Multivariate Analysis of Variance (MANOVA) was used to compare pre-program and post-program scores for the variables under categories of body image, physical self-concept, physical fitness, and body composition. Multivariate effects over time were followed up at the univariate level using a Bonferroni-adjusted alpha criterion in light of multiple comparisons (i.e., 0.05/number variables). Effect sizes for step up test, sit and reach, body composition, and bone densitometry were calculated using Cohen's d and interpreted as small ($d = 0.20$), medium ($d = 0.50$), and large ($d = 0.80$).[38] Non-parametric tests were used for psychological measures (ordinal data) as well as flexed arm hang and visceral fat mass data, as violations of normality were observed using the Kolmogrov-Smirnov statistic. A Wilcoxon Signed Rank Test was used to compare pre-to-post visceral fat mass scores ($\alpha < 0.05$). Effect sizes were calculated using Cohen's r and interpreted as small ($r = 0.10$), medium ($r = 0.30$), and large ($r = 0.50$).[39,40]

Relationships between motivation-related variables and post-training outcomes

To explore relationships between motivation-related variables (i.e., competence, relatedness, autonomy, intrinsic motivation, variety, and group identification) and post-training outcomes (i.e., body image, physical self-concept, physical fitness and body composition), partial correlations were computed for each psychological and physiological outcome variable while controlling for age and each pre-training score ($\alpha < 0.05$). Specifically, these analyses were performed to demonstrate the association between motivation-related variables and post-training outcomes while partialling out the shared variance attributed to pre-program scores on the outcome in question. Pearson correlations were also computed to explore relationships between motivation-related variables (i.e., competence, relatedness, autonomy, intrinsic motivation, variety, and group identification) ($\alpha < 0.05$). Coefficients were interpreted as a measure of the strength of the relationship between variables from negligible ($r < 0.1$) to very strong ($r > 0.9$).[41]

Results

Retention and adherence outcomes

The recruited sample included 76 adult females enrolled in beginner pole dancing classes across eight local pole dancing studios. Five participants had participated in pole dancing previously (reporting no regular participation for over three years). In total, 68 females aged nineteen to 60 years (M_{age} = 28.74, SD = 9.72) completed the study (i.e., attended baseline testing, attended a term of pole dancing classes, and returned for post-testing), resulting in a retention rate of 89.5%. The adherence rate was 93.8% ($M_{sessions}$ = 15.01, SD = 2.37). Of the eight participants who dropped out, one cited time concerns, one reported illness, one reported injury, and five did not report reasons for failing to complete the term of classes or attend follow-up tests.

Psychological and physiological changes

Intention-to-treat results are presented in Table 1, while per-protocol results are presented as supplementary material (Table S1). As we were interested in the observed effects of pole dancing, the below results focus on effect sizes; however, all results are presented in Table 1.

Table 1. Descriptive statistics and pre-to-post differences (intention-to-treat analysis, $N = 76$).

Variable	Pre-training Median (IQR)	Post-training Median (IQR)	*Z*	*p*	–	Effect size Cohen's *r*
Body Image					–	
Body appreciation	**3.30 (0.95)**	**3.80 (0.70)**	**5.60**	**<.001****		0.45
Body size satisfaction	**1.00 (1.00)**	**1.00 (1.00)**	**−4.67**	**<.001****		−0.38
Physical Self-Concept					–	
Sport	**3.00 (2.00)**	**3.66 (1.83)**	**3.71**	**<.001****		0.30
Coordination	**4.00 (1.60)**	**4.20 (1.30)**	**5.07**	**<.001****		0.41
Strength	**3.33 (2.00)**	**4.33 (1.67)**	**6.23**	**<.001****		0.50
Flexibility	**4.00 (2.00)**	**4.00 (2.17)**	**2.24**	**.025****		0.18
Endurance	**3.00 (2.17)**	**3.33 (2.00)**	**3.48**	**<.001****		0.28
Global esteem	**4.60 (1.50)**	**5.00 (1.10)**	**4.67**	**<.001****		0.38
Physical Fitness						
Flexed arm hang (sec)	**0.00 (3.95)**	**3.20 (7.99)**	**6.10**	**<.001****		0.49
Regional Fat Tissue						
Visceral fat mass (g)	**156.00 (213.00)**	**148.00 (225.00)**	**-2.02**	**.043****	–	−0.16

Variable	**Pre-training Mean ± SD**	**Post-training Mean ± SD**	***F* (df)**	***p***	**Bonferroni-adjusted *α***	**Effect size Cohen's *d***
Physical Fitness			19.29 (2,70)	**<.001†**	.025	
Step test VO_{2max} ($ml{\cdot}kg^{-1}{\cdot}min^{-1}$)	**37.44 ± 3.72**	**38.36 ± 3.38**	**12.39 (1,71)**	**.001***		0.26
Sit and reach (cm)	**8.27 ± 9.38**	**10.32 ± 8.63**	**25.38 (1,71)**	**<.001***		0.23
Total Body Composition			**6.11 (3,72)**	**.001†**	.017	
Total body mass (kg)	65.79 ± 12.31	65.84 ± 12.27	0.06 (1,74)	.801		0.00
Total lean tissue (%)	**63.16 ± 6.07**	**63.69 ± 5.93**	**14.67 (1,74)**	**<.001***		0.08
Total body fat (%)	**32.93 ± 6.44**	**32.42 ± 6.25**	**13.15 (1,74)**	**.001***		0.08
Regional Lean Tissue			**5.69 (5,70)**	**<.001†**	.010	
Trunk lean tissue (%)	**65.77 ± 7.95**	**66.33 ± 7.84**	**8.01 (1,74)**	**.006***		0.07
Right arm lean tissue (%)	**60.80 ± 5.82**	**61.65 ± 5.46**	**23.14 (1,74)**	**<.001***		0.15
Left arm lean tissue (%)	**60.71 ± 5.96**	**61.37 ± 5.58**	**14.59 (1,74)**	**<.001***		0.11
Right leg lean tissue (%)	60.04 ± 5.84	60.43 ± 5.51	1.86 (1,74)	.174		0.07
Left leg lean tissue (%)	60.21 ± 5.90	60.54 ± 5.48	1.30 (1,74)	.257		0.05

(*Continued*)

Table 1. (Continued)

Variable	**Pre-training Median (IQR)**	**Post-training Median (IQR)**	***Z***	***p***	**–**	**Effect size Cohen's *r***
Regional Fat Tissue			**4.34 (5,70)**	**.002†**	.010	
Trunk fat tissue (%)	**31.71 ± 8.19**	**31.16 ± 7.86**	**7.67 (1,74)**	**.007***		0.07
Right arm fat tissue (%)	**34.66 ± 6.26**	**33.90 ± 5.77**	**18.78 (1,74)**	**<.001***		0.12
Left arm fat tissue (%)	**34.95 ± 5.99**	**34.29 ± 5.77**	**14.87 (1,74)**	**<.001***		0.11
Right leg fat tissue (%)	**36.39 ± 6.04**	**35.92 ± 5.60**	**9.23 (1,74**	**.003***		0.08
Left leg fat tissue (%)	**36.29 ± 6.07**	**35.84 ± 5.74**	**8.45 (1,74)**	**.005***		0.08
Bone Densitometry			0.16 (3,67)	.922	.017	
Total bone mineral density (g/cm³)	1.21 ± 0.11	1.21 ± 0.11	0.47 (1,69)	.486		0.00
T-score	1.37 ± 1.13	1.36 ± 1.09	0.29 (1,69)	.285		0.01
Z-score	1.38 ± 0.98	1.37 ± 0.95	0.30 (1,69)	.296		0.01

Statistically significant results are bolded

† Significant pre-to-post differences at multivariate level ($\alpha < 0.05$)

*** Significant pre-to-post differences based on Bonferroni-adjusted α value**

**** Significant pre-to-post differences based on Wilcoxon Signed Rank Test**

Body image

Moderate-sized effects were observed for change in both body appreciation and body satisfaction following eight weeks of pole dancing classes. Body appreciation (BAS) increased from a median score of 3.30 to 3.80 (r = 0.45). Although a negative moderate effect size (r = -0.38) was observed for the figure rating scale, indicating that the difference between ideal and current figure rating scores decreased (and therefore showing greater body satisfaction following the classes), no differences were observed in pre-median and post-median scores.

Physical self-concept

Moderate-to-large-sized effects were observed for change over time in the majority of physical self-concept domains measured in this study. Increases were reported in perceptions of sporting competence (r = 0.30), coordination (r = 0.41), strength (r = 0.53), and global esteem (r = 0.38). A small effect size was observed for perceptions of endurance (r = 0.28), and flexibility (r = 0.18).

Physical fitness

Improvements occurred over time across all three physical fitness tests. A large-sized effect was observed for change in strength (r = 0.49), with median flexed arm hang time increasing from 0.00 to 3.25 sec. Small effects were observed for change in cardiorespiratory fitness, with mean VO_{2max} increasing from 37.44 to 38.36 $ml \cdot kg^{-1} \cdot min^{-1}$ (d = 0.26), and flexibility with mean sit and reach increasing from 8.27 to 10.32 cm (d = 0.23).

Body composition

Mean baseline height and body mass were 1.67 m (range 1.53 to 1.87) and 65.13 kg (range 45.18 to 118.30 kg), respectively. Total body mass remained consistent following eight weeks of pole dancing (d = 0.00). Less-than-small-sized effects (d < 0.20) were observed for several body composition outcomes, including slight increases in lean tissue percentages for total body (↑0.53%, d = 0.08), trunk (↑0.57%, d = 0.07), left arm (↑0.61%, d = 0.11), and right arm (↑0.85%, d = 0.15), as well as a slight decrease in total fat percentage (↓0.51%, d = 0.08). Small yet significant changes were observed for visceral fat mass (↓13g, r = -0.16). No significant

Table 2. Partial correlations between motivation-related variables and post-training outcomes (controlling for age and each outcome variable's pre-training score).

Outcome variable	**Post group identification**	**Perceived competence**	**Perceived autonomy**	**Perceived relatedness**	**Perceived variety**	**Intrinsic motivation**
Body size satisfaction	.08	−.02	.04	.20	.22	.02
Body appreciation	**.40**	**.49**	**.36**	**.36**	**.35**	**.29**
Self-concept coordination	.13	**.36**	.23	.21	.11	.09
Self-concept sport	.02	.17	.04	.00	.13	−.04
Self-concept strength	.04	**.42**	.21	.09	**.25**	.12
Self-concept flexibility	.22	**.38**	**.32**	**.28**	**.31**	**.26**
Self-concept endurance	**.26**	.18	**.31**	.21	**.24**	**.28**
Self-concept global esteem	**.38**	**.53**	**.45**	**.41**	**.24**	**.44**
Flexed arm hang	−.04	.16	−.02	−.05	−.02	−.01
Step test VO_{2max}	.05	.12	.01	.04	.10	.07
Sit and reach	.14	.20	.18	**.25**	.04	.14
Total body mass	.19	.23	.09	.14	**.41**	.06
Total body fat (%)	.03	.10	.02	.08	.20	−.03
Total lean tissue (%)	−.02	−.08	−.00	−.07	−.18	.03
Total bone mineral density	.04	−.01	.03	.07	.14	−.03

Statistically significant results are bolded: $r \geq .24 = p < .05$ | $r \geq .31 = p < .01$ | $r \geq .39 = p < .001$

changes occurred for lean tissue percentage in the legs or bone densitometry measures (Table 1).

Relationships between motivation-related variables and post-training outcomes

Group identification ($r = 0.40$), relatedness ($r = 0.36$) and competence ($r = 0.49$) were positively correlated with body appreciation ($p < 0.01$). Competence was also positively correlated with psychological outcomes of global esteem ($r = 0.53$), perceived coordination ($r = 0.36$), and perceived strength ($r = 0.42$, $p < 0.001$) (Table 2).

There was a moderate to strong relationship between relatedness and group identification ($r = 0.75$, $p < 0.001$). In addition, competence ($r = 0.46$), relatedness ($r = 0.64$), autonomy ($r = 0.63$), variety ($r = 0.57$), and group identification ($r = 0.68$) were positively associated with intrinsic motivation ($p < 0.01$). These results, along with internal consistencies and descriptive statistics, are presented in Table 3.

Table 3. Correlations, internal consistencies, means and standard deviations for motivation-related variables.

Outcome variable	1	2	3	4	5	6
1 Group identification	**0.92**	.37	.65	.75	.48	.68
2 Perceived competence		**0.93**	.73	.57	.31	.46
3 Perceived autonomy			**0.93**	.85	.40	.63
4 Perceived relatedness				**0.96**	.46	.64
5 Perceived variety					**0.88**	.57
6 Intrinsic motivation						**0.90**
Possible range	1–7	1–7	1–7	1–7	1–6	1–7
Median (IQR)	6.00 (1.25)	5.60 (1.10)	5.80 (1.30)	6.08 (1.17)	5.40 (1.00)	6.85 (0.43)

Cronbach α reliability coefficients are in bold along the diagonal
All correlations are statistically significant p <0.01

Discussion

Despite recreational pole dancing being an increasingly popular form of physical activity, researchers have yet to examine the feasibility of or quantify the longitudinal outcomes associated with participation in recreational pole dancing. The first aim of this study was to determine retention and adherence in pole dancing classes at local studios. A total of 76 females were recruited over a twelve-month period (six pole dancing terms). Retention (89.5%) and adherence (93.1%) were high, aligning with rates reported previously in dance studies.[42] These results give an indication of the number of participants willing to commit and pay for a pole dancing term (two classes a week for eight weeks) at a local studio. Because participants paid standard commercial rates to attend pole dancing classes at a studio, it is possible that financial investment may have increased motivation to attend classes over freely available programs. Our results provide insight into retention and adherence rates of realistic community-based programs compared to those that are cost-free and conducted in controlled environments (e.g., university facilities). Further, our results provide insight into sample size inflation in future larger trials based on reaching a necessary sample size while accounting for likely attrition.

The second aim of the study was to quantify the pre-to-post effects (and the magnitude of those effects) of pole dancing classes on psychological and physiological outcomes. Following eight weeks of classes, noteworthy improvements were observed in psychological (body image and physical self-concept) and physical fitness (muscular strength, cardiorespiratory fitness and flexibility). These results support findings from previous qualitative and cross-sectional studies on pole dancing,[3,4,16,17] indicating that body image may improve following participation in pole dancing classes. Our findings also indicate that recreational pole dancing classes may offer improvements in aspects of self-concept that are similar to those observed in other forms of physical activity (e.g., Pilates [43] and dance genres [44,45]). Although effect sizes for body composition changes were less-than-small in magnitude, slight increases in lean mass were observed in the upper body (arms and trunk), whereas no changes were observed in the lower body. These results align with findings reported in a study comparing pole dancers to a sedentary control group, whereby upper limb muscle (impedance ratio and phase angle) was greater in pole dancers than in the control group and no differences were reported in lower limb scores.[13] Along with reported strength gains (i.e., flexed arm hang time), these results indicate that pole dancing may be beneficial for those seeking to develop upper body musculature and strength.[9,13]

A novel integration in this study was the ability to report visceral fat mass using iDXA. Visceral adipose fat (fat deposited within the abdominal cavity) is a predictor of cardiovascular disease, cancer, type II diabetes, and mortality.[46,47]

The median visceral fat mass for participants in this study (pre 168 g, post 155 g) is comparable to the normative mean score (170 g) among female adults of a similar age range.[26] However, high end-range visceral fat scores reported among females in the current study (pre 1,825 g and post 1,716 g) were much higher than reported in female norms (360 g).[26] These findings suggest that some females participating in the study may be at greater risk of compromised health. Over the eight-week period, visceral fat mass decreased slightly, indicating that participation in pole dancing may contribute to reductions in visceral adipose tissue. Conversely, no significant changes were observed in bone health measures. According to the World Health Organization,[48] mean reported BMD, T-scores (comparison to healthy young adults) and Z-scores (age-matched norm) were classified within healthy ranges, signifying that the participant sample was not an at-risk group for osteoporosis. The few studies reporting dance interventions to be successful in improving bone mineral density have targeted adolescents or older adults and have focused on lower-body weight-bearing dance styles rather than classes incorporating upper-body weight-bearing activity (e.g., ballet [49], dance aerobics [50], or exergaming [51]). As upper-body resistance training has been shown to increase upper-body BMD in women,[52] it is suggested that bone health measures, including upper-body BMD, should be investigated in future pole dancing studies and across women of all ages. Importantly, an increased intervention duration and/or dosage may be required to observe significant improvements in bone health measures (e.g., three days per week for twenty weeks [52]).

Our third aim was to explore relationships between in-class experiences (motivation-related factors) and program outcomes. To do this, we examined the extent to which perceptions of competence, relatedness, autonomy, variety, intrinsic motivation, and group identification were associated with psychological and physiological outcomes. Several interesting associations emerged that may be worth exploring in future studies. First, group identification, relatedness, and competence were positively correlated with body appreciation. Second, competence (i.e., a sense of accomplishment and achievement) was also positively correlated with psychological outcomes of global esteem and perceived strength. These results provide insight into in-class factors, and therefore potentially modifiable targets for consideration in future studies should researchers seek to maximize outcomes such as body appreciation and physical self-concept—for example, investigating the effectiveness of fostering an environment (e.g., training instructors in need-supportive instruction [53,54]) that promotes the satisfaction of psychological needs (i.e., competence, relatedness, and autonomy) on body appreciation and physical self-concept.

We also explored relationships between motivation-related variables of competence, relatedness, autonomy, variety, intrinsic motivation, and group identification. Interestingly, there was a moderate to strong relationship between relatedness and group identification, supporting the notion that relatedness and group identification are somewhat aligned with one another.[12,55] Results also revealed that perceptions of competence, relatedness, autonomy, variety, and group identification were positively associated with intrinsic motivation. In support of self-determination theory,[53,56] our results demonstrate that the satisfaction of basic psychological needs is associated with internalized forms of motivation.[57,58] Further, our results align with the adapted physical literacy and self-determination theory cycle proposed by Stuckey et al.[59] in the context of circus arts. The physical literacy cycle consists of a positive feedback process between active participation, movement competence, confidence, and motivation,[60,61] and is proposed to offer a unique holistic approach to well-being.[60] The integration of self-determination theory into the cycle points to the influence of the satisfaction of basic psychological needs (i.e., self-competence, autonomy, and relatedness) on self-motivation in a social context.[59] Interestingly, group identification was also strongly associated with interest/enjoyment, indicating that feeling part of and identifying strongly with an in-group may contribute to promoting intrinsic motivation in the context of pole dancing. Results from previous studies have demonstrated that intrinsic motivation predicts long-term adherence[58,62] and that group identification is associated with positive health behaviours such as engagement in exercise.[36] As such, it is recommended that in future studies, researchers investigate the extent to which intrinsic motivation and group identification predict engagement and long-term adherence in pole dancing.

Limitations

It must be acknowledged that this study was exploratory in nature, and findings are intended to inform the design of larger studies and trials. Although psychological and physiological changes occurred following a term of pole dancing classes, the lack of a control group limits any inferences of causality, as we were unable to control for threats to internal validity. The following factors may have introduced bias—therefore, results must be interpreted with some caution, and the direct application of results to randomized controlled trial design may be hindered: (1) participants were required to pay for classes at a studio, and therefore the adherence rate may be specific only to situations where participants have made a financial commitment; (2) the sample included participants recruited via community-focused promotion (e.g., social media and news stories) by the research institution and via promotion by pole dancing studios, and therefore results represent those with varying levels of intention to commence pole dancing (for example, some participants had no prior interest in pole dancing prior to seeing the news stories, whereas some already intended to sign up for classes at a studio prior to hearing about the research study); (3) although instructors were not purposefully made aware of research participants in their classes, it is possible that participants discussed study participation in class, and as such, delivery and motivation bias from instructors may have occurred; (4) the beginner class programs delivered at participating studios (i.e., specific skills taught, duration spent on each skill, conditioning exercises and dance style) were not recorded or collected—as course curriculum can vary between studios and instructors, it is recommended that standardized class plans be developed and followed in future studies to understand specific skills and elements of training that may contribute to improving different physiological outcomes; and (5) classes were delivered by 30 different instructors. Collecting information on teaching experience, competency, communication, and leadership style of instructors may be beneficial in future studies to provide insight into characteristics that may influence psychological and physiological outcomes.

Several other limitations must be acknowledged. First, less-than-small and small effect sizes were reported for body composition outcomes, indicating that two pole dancing classes a week for eight weeks may not be an adequate dose of training to observe substantive changes in body composition. Additionally, no changes were observed in bone mineral densitometry. As such, it is recommended that researchers consider increasing the length of the training intervention in future studies (e.g., four or five months of pole dancing classes). Second, the muscular strength and flexibility tests selected provide an indication of improvements to a specific movement pattern or bodily region (i.e., sit and reach measures forward flexion or hamstring and lower back flexibility; flexed arm hang measures vertical pull strength). To understand the effects of pole dancing on overall muscular strength and flexibility, it is recommended that future investigations include a battery of tests that cover a range of movement patterns and/or bodily regions. Finally, the sample was limited to females from the Perth Metropolitan Area, and findings may differ among other groups such as males or those from other regions or countries.

Conclusion

This is the first empirical longitudinal study to document the potential psychological and physiological outcomes of participation in pole dancing classes.

As improvements were observed in body appreciation, physical self-concept, physical fitness, and body composition (although minimal), it is recommended that these outcomes be considered in future studies and trials designed to investigate the effects of pole dancing on health and fitness. In addition, this feasibility study provides estimates of anticipated effect sizes for these outcomes, as well as an indication of retention and adherence rates that can be used for sample calculations in future trials. Conceptually, this work provides insight into potential motivation-related factors (i.e., needs satisfaction, variety, and group identification) that may contribute to psychological outcomes (such as body appreciation, perceived competence, and global esteem) associated with participation in pole dancing, thus guiding the development of future investigations of potentially modifiable factors to target to maximize outcomes from pole dancing training.

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Conflict of interest

None declared.

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References

1. Andreasson J, Johansson T. The new fitness geography: the globalisation of Japanese gym and fitness culture. Leis Stud. 2015;(November):1–12.
2. Dale JP. The future of pole dance. Australas J Pop Cult. 2013;2(3):381–96.
3. Holland S. Pole Dancing, Empowerment and Embodiment. London: Palgrave McMillan; 2010. 222 p.

4. Whitehead K, Kurz T. 'Empowerment' and the Pole: A Discursive Investigation of the Reinvention of Pole Dancing as a Recreational Activity. Fem Psychol. 2009;19(2):224–44.
5. Greenspan S. Injury Frequency and Characteristics in Adolescent and Adult Circus Artists: A Pilot Prospective Cohort Study. Med Probl Perform Art. 2021 Jun;36(2):103–7.
6. Greenspan S, Munro D, Nicholas J, Stubbe J, Stuckey MI, Van Rijn RM. Circus-specific extension of the International Olympic Committee 2020 consensus statement: methods for recording and reporting of epidemiological data on injury and illness in sport. BMJ Open Sport Exerc Med. 2022;8(e001394).
7. Nicholas J, Weir G, Alderson JA, Stubbe J., Van Rijn RM, Dimmock JA, et al. Incidence, Mechanisms, and Characteristics of Injuries in Pole Dancers: A Prospective Cohort Study. Med Probl Perform Art. 2022;37(3):151–64.
8. Ruscello B, Esposito M, Pantanella L, Partipilo F, Lunetta L, Ottavio SD. Biomechanics and Physiology in top level Pole Dancers: A case study. J Phys Health Sport Med. 2018 Dec;1(1):1–15.
9. Naczk M, Kowalewska A, Naczk A. The risk of injuries and physiological benefits of pole dancing. J Sports Med Phys Fitness. 2020 Jun;60(6):883–8.
10. Nicholas JC, McDonald KA, Peeling P, Jackson B, Dimmock JA, Alderson JA, et al. Pole Dancing for Fitness: The Physiological and Metabolic Demand of a 60-Minute Class. J Strength Cond Res. 2019 Oct;33(10):2704–10.
11. Griffiths K. Femininity, Feminism and Recreational Pole Dancing. London: Routledge; 2015. 154 p.
12. Nicholas JC, Dimmock JA, Donnelly CJ, Alderson JA, Jackson B. "It's our little secret . . . an in-group, where *everyone's* in": Females' motives for participation in a stigmatized form of physical activity. Psychol Sport Exerc. 2018 May;36:104–113.
13. Ballarin G, Scalfi L, Monfrecola F, Alicante P, Bianco A, Marra M, et al. Body Composition and Bioelectrical-Impedance-Analysis-Derived Raw Variables in Pole Dancers. Int J Environ Res Public Health. 2021 Nov 30;18(23).
14. Australian Bureau of Statistics. Australian Health Survey: Physical Activity, 2011–12. 2013.
15. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin B, et al. Physical Activity and Public Health: Updated Recommendation for Adults From the American College of Sports Medicine and the American Heart Association. Circulation. 2007;116(9):1081–93.
16. Dimler AJ, McFadden K, McHugh TLF. "I Kinda Feel Like Wonder Woman": An Interpretative Phenomenological Analysis of Pole Fitness and Positive Body Image. J Sport Exerc Psychol. 2017 Oct 1;39(5):339–51.
17. Pellizzer M, Tiggemann M, Clark L. Enjoyment of Sexualisation and Positive Body Image in Recreational Pole Dancers and University Students. Sex Roles. 2016 Jan;74:35–45.
18. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. BMJ. 2008 Sept 29;337:a1655. https://doi.org/10.1136/bmj.a1655
19. Eldridge SM, Lancaster GA, Campbell MJ, Thabane L, Hopewell S, Coleman CL, et al. Defining Feasibility and Pilot Studies in Preparation for Randomised Controlled Trials: Development of a Conceptual Framework. PLoS One [Internet]. 2016 Mar 15;11(3):1–22. Available from: https://dx.doi.org/10.1371/journal.pone.0150205

20. Delextrat A, Bateman J, Esser P, Targen N, Dawes H. The potential benefits of Zumba Gold ® in people with mild-to-moderate Parkinson's: Feasibility and effects of dance styles and number of sessions. Complement Ther Med [Internet]. 2016 Aug;27:68–73. Available from: https://dx.doi.org/10.1016/j.ctim.2016.05.009
21. Galantino M L, Callens ML, Cardena GJ, Piela NL, Mao JJ. Tai Chi for Well-being of Breast Cancer Survivors With Aromatase Inhibitor-associated Arthralgias: A Feasibility Study. Altern Ther Health Med. 2013 Nov;19(6):38–44.
22. Pompeu JE, Arduini LA, Botelho AR, Fonseca MBF, Pompeu SMAA, Torriani-Pasin C, et al. Feasibility, safety and outcomes of playing Kinect Adventures!™ for people with Parkinson's disease: a pilot study. Physiotherapy [Internet]. 2014 Jun;100(2):162–8. Available from: https://dx.doi.org/10.1016/j.physio.2013.10.003
23. Eldridge SM, Chan CL, Campbell MJ, Bond CM, Hopewell S, Thabane L, et al. CONSORT 2010 statement: Extension to randomised pilot and feasibility trials. BMJ [Internet]. 2016 Oct 24;355:1–32. Available from: https://dx.doi.org/10.1186/s40814-016-0105-8
24. Ganderton C, Henry M, Walker A, McGinley P, Verhagen E. Implementation of Calf Endurance Training in a Touring Group of Professional Circus Performers: A Feasibility Study. Med Probl Perform Art. 2021;36(1):54–60.
25. Edwards K. The Ultimate Pole Bible. 5th ed. Spin City; 2018.
26. Staynor JMD, Smith MK, Donnelly CJ, El Sallam A, Ackland TR. DXA reference values and anthropometric screening for visceral obesity in Western Australian adults. Sci Rep [Internet]. 2020 Oct 30;10(1):1–11. Available from: https://doi.org/10.1038/s41598-020-73631-x
27. Kaminsky LA. ACSM's Health-Related Physical Fitness Assessment Manual. 4th ed. Pescatello LS, Arena R, Riebe D, Thompson MD, editors. Philadelphia: Lippincott Williams & Wilkins; 2014. 114.
28. Tylka TL, Wood-Barcalow NL. The Body Appreciation Scale-2: Item refinement and psychometric evaluation. Body Image [Internet]. 2015 Jan;12:53–67. Available from: https://dx.doi.org/10.1016/j.bodyim.2014.09.006
29. Stunkard AJ, Sorensen TIA, Schulsinger F. Use of the Danish Adoption Register for the study of obesity and thinness. In: Kely SS, Rowland LP, Sidman RL, Matthysse SW, editors. Genetics of neurological and psychiatric disorders. New York: Raven Press; 1983. 115–20.
30. Markland D. The mediating role of behavioural regulations in the relationship between perceived body size discrepancies and physical activity among adult women. Hell J Psychol. 2009;6(2):169–82.
31. Markland D, Ingledew DK. The relationships between body mass and body image and relative autonomy for exercise among adolescent males and females. Psychol Sport Exerc. 2007 Sept;8(5):836–53.
32. Marsh HW, Martin AJ, Jackson S. Introducing a Short Version of the Physical Self Description Questionnaire: New Strategies, Short-Form Evaluative Criteria, and Applications of Factor Analyses. J Sport Exerc Psychol. 2010 Aug;32(4):438–82.
33. Ng JY, Lonsdale C, Hodge K. The Basic Needs Satisfaction in Sport Scale (BNSSS): Instrument development and initial validity evidence. Psychol Health. 2011 June 1;12(3):257–64.
34. McAuley E, Duncan T, Tammen VV. Intrinsic Motivation Inventory [Internet]. 1987. Available from: selfdeterminationtheory.org/intrinsic-motivation-inventory/

35. Sylvester BD, Standage M, Dowd AJ, Martin LJ, Sweet SN, Beauchamp MR. Perceived variety, psychological needs satisfaction and exercise-related well-being. Psychol Health. 2014 Apr 22;29(9):1044–61.
36. Sani F, Madhok V, Norbury M, Dugard P, Wakefield JRH. Greater number of group identifications is associated with healthier behaviour: Evidence from a Scottish community sample. Br J Health Psychol. 2015 Sep 20;20(3):466–81.
37. Gupta SK. Intention-to-treat concept: A review. Perspect Clin Res. 2011 Jul-Sep;2(3):109–12.
38. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
39. Coolican H. Research Methods and Statistics in Psychology. 5th ed. Abingdon: Routledge; 2013.
40. Fritz CO, Morris PE, Richler JJ. Effect size estimates: Current Use, Calculations, and Interpretation. J Exp Psychol Gen. 2012 Feb;141(1):2–18.
41. Schober P, Boer C, Schwarte LA. Correlation Coefficients: Appropriate Use and Interpretation. Anesth Analg. 2018 May;126(5):1763–8.
42. Yan AF, Cobley S, Chan C, Pappas E, Nicholson LL, Ward RE, et al. The Effectiveness of Dance Interventions on Physical Health Outcomes Compared to Other Forms of Physical Activity: A Systematic Review and Meta-Analysis. Sports Med [Internet]. 2018. Available from: link.springer.com/10.1007/s40279-017-0853-5
43. Cruz-Ferreira A, Fernandes J, Gomes D, Bernardo LM, Kirkcaldy BD, Barbosa TM, et al. Effects of Pilates-Based Exercise on Life Satisfaction, Physical Self-Concept and Health Status in Adult Women. Women Health. 2011 May;51(3):240–55.
44. Burkhardt J, Brennan C. The effects of recreational dance interventions on the health and well-being of children and young people: A systematic review. Arts Health. 2012;4(2):148–61.
45. Schwender TM, Spengler S, Oedl C, Mess F. Effects of Dance Interventions on Aspects of the Participants' Self: A Systematic Review. Front Psychol [Internet]. 2018 Jul 17;9(1130):1–25. Available from: frontiersin.org/article/10.3389/fpsyg.2018.01130/full
46. Bray GA, Jablonski KA, Fujimoto WY, Barrett-Connor E, Haffner S, Hanson RL, et al. Relation of central adiposity and body mass index to the development of diabetes in the Diabetes Prevention Program. Am J Clin Nutr. 2008 May;87(5):1212–8.
47. Britton KA, Massaro JM, Murabito JM, Kreger BE, Hoffmann U, Fox CS. Body fat distribution, incident cardiovascular disease, cancer, and all-cause mortality. J Am Coll Cardiol. 2013 Sep 3;62(10):921–5.
48. World Health Organization. Prevention and Management of Osteoporosis [Internet]. WHO Technical Report Series. 2004;921. Available from: apps.who.int/iris/bitstream/handle/10665/42841/WHO_TRS_921.pdf?sequence=1
49. Matthews BL, Bennell KL, McKay HA, Khan KM, Baxter-Jones ADG, Mirwald RL, et al. Dancing for bone health: A 3-year longitudinal study of bone mineral accrual across puberty in female non-elite dancers and controls. Osteoporos Int. 2006;17(7):1043–54.
50. Yu PA, Hsu WH, Hsu WB, Kuo LT, Lin ZR, Shen WJ, et al. The effects of high impact exercise intervention on bone mineral density, physical fitness, and quality of life in postmenopausal women with osteopenia. Medicine (United States). 2019 Mar;98(11):1–5.
51. Staiano AE, Marker AM, Beyl RA, Hsia DS, Katzmarzyk PT, Newton RL. A randomized controlled trial of dance exergaming for exercise training in overweight and obese adolescent girls. Pedriatr Obes. 2017 Apr;12(2):120–8.

52. Nickols-Richardson SM, Miller LE, Wootten DF, Ramp WK, Herbert WG. Concentric and eccentric isokinetic resistance training similarly increases muscular strength, fat-free soft tissue mass, and specific bone mineral measurements in young women. Osteoporos Int. 2007 Jun;18(6):789–96.
53. Deci EL, Ryan RM. The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behaviour. Psychol Inq. 2000;11(4):227–68.
54. Ntoumanis N, Quested E, Reeve J. Need supportive communication: Implications for motivation in sport, exercise, and physical activity. In: Jackson B, Dimmock JA, Compton J, editors. Persuasion and Communication in Sport, Exercise, and Physical Activity. Abingdon: Routledge; 2018. 155–69.
55. Sheldon KM, Bettencourt BA. Psychological need-satisfaction and subjective well-being within social groups. Br J Soc Psychol. 2002 Mar;41(Pt 1):25–38.
56. Ryan RM, Deci EL. Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness. New York: Guildford Publications; 2017. 756 p.
57. Davies MJ, Coleman L, Stellino MB. The relationship between basic psychological need satisfaction, behavioural regulation, and participation in CrossFit. J Sport Behav. 2016;39(3):239–55.
58. Silva MN, Vieira PN, Coutinho SR, Minderico CS, Matos MG, Sardinha LB, et al. Using self-determination theory to promote physical activity and weight control: a randomized controlled trial in women. J Behav Med. 2010 Apr;33(2):110–22.
59. Stuckey M, Richard V, Decker A, Aubertin P, Kriellaars D. Supporting Holistic Well-being for Performing Artists During the COVID-19 Pandemic and Recovery: Study Protocol. Front Psychol. 2021 Feb;12(577882):1–8.
60. Cairney J, Dudley D, Kwan M, Bulten R, Kriellaars D. Physical Literacy, Physical Activity and Health: Toward an Evidence-Informed Conceptual Model. Sport Med [Internet]. 2019 Feb 11;49(3):371–83. Available from: https://doi.org/10.1007/s40279-019-01063-3
61. Jefferies P, Ungar M, Aubertin P, Kriellaars D. Physical Literacy and Resilience in Children and Youth. Front Public Heal. 2019 Nov 19;7:346.
62. Silva MN, Markland D, Carraça E V, Vieira PN, Coutinho SR, Minderico CS, et al. Exercise autonomous motivation predicts 3-yr weight loss in women. Med Sci Sports Exerc. 2011 Apr;43(4):728–37.
63. Nicholas, J. C. (2019). *The psychological, physiological, and injury-related characteristics of recreational pole dancing* [University of Western Australia]. https://doi.org/10.26182/5e7d60d09e2cd

Table S1. Descriptive statistics and pre-to-post differences (per-protocol analysis, $n = 68$).

Variable	**Pre-training Median (IQR)**	**Post-training Median (IQR)**	***Z***	***p***	**–**	**Effect size Cohen's *r***
Body Image					.–	
Body appreciation	**3.30 (0.95)**	**3.80 (0.70)**	**5.60**	**<.001****		0.48
Body size satisfaction	**1.00 (1.00)**	**1.00 (1.00)**	**–4.67**	**<.001****		-0.40
Physical Self-Concept					–	
Sport	**3.00 (2.00)**	**3.66 (2.00)**	**3.69**	**<.001****		0.32
Coordination	**4.00 (1.60)**	**4.20 (1.30)**	**5.07**	**<.001****		0.43
Strength	**3.33 (2.00)**	**4.33 (1.67)**	**6.15**	**<.001****		0.53
Flexibility	**4.00 (2.00)**	**4.00 (2.17)**	**2.27**	**.023****		0.19
Endurance	**3.00 (2.17)**	**3.33 (2.00)**	**3.48**	**<.001****		0.30
Global esteem	**4.60 (1.50)**	**5.00 (1.10)**	**4.67**	**<.001****		0.40
Physical Fitness						
Flexed arm hang (sec)	**0.00 (3.95)**	**3.20 (7.99)**	**6.10**	**<.001****		0.52
Regional Fat Tissue						
Visceral fat mass (g)	**156.00 (213.00)**	**148.00 (225.00)**	**–2.02**	**.043****	–	-0.17

(*Continued*)

Table S1. (Continued)

Variable	**Pre-training Mean ± SD**	**Post-training Mean ± SD**	***F* (df)**	***p***	**Bonferroni-adjusted α**	**Effect size Cohen's *d***
Physical Fitness			**20.44 (2,63)**	**<.001†**	.025	
Step test VO_{2max} (ml.kg⁻¹·min⁻¹)	**37.46 ± 3.56**	**38.48 ± 3.13**	**12.61 (1,64)**	**. <.001***		0.30
Sit and reach (cm)	**8.33 ± 9.43**	**10.60 ± 8.54**	**26.36 (1,64)**	**<.001***		0.25
Total Body Composition			**6.27 (3,64)**	**.001†**	.017	
Total body mass (kg)	65.79 ± 12.31	65.13 ± 12.13	0.06 (1,66)	.801		0.00
Total lean tissue (%)	**63.29 ± 5.90**	**63.88 ± 5.72**	**15.00 (1,66)**	**<.001***		0.10
Total body fat (%)	**32.88 ± 6.31**	**32.30 ± 6.08**	**13.42 (1,66)**	**<.001***		0.09
Regional Lean Tissue			**5.92 (5,62)**	**<.001†**	.010	
Trunk lean tissue (%)	**65.77 ± 7.78**	**66.40 ± 7.65**	**8.10 (1,66)**	**.006***		0.08
Right arm lean tissue (%)	**60.74 ± 5.66**	**61.70 ± 5.24**	**24.00 (1,66)**	**<.001***		0.18
Left arm lean tissue (%)	**60.64 ± 5.81**	**61.38 ± 5.38**	**14.92 (1,66)**	**<.001***		0.13
Right leg lean tissue (%)	60.21 ± 5.73	60.65 ± 5.33	1.89 (1,66)	.174		0.08
Left leg lean tissue (%)	60.34 ± 5.95	60.71 ± 5.47	1.30 (1,66)	.258		0.06
Regional Fat Tissue			**4.47 (5,62)**	**. 002†**	.010	
Trunk fat tissue (%)	**31.71 ± 8.00**	**31.09 ± 7.86**	**7.75 (1,66)**	**.007***		0.08

Variable	Pre-training Mean ± SD	Post-training Mean ± SD	*F* (df)	*p*	Bonferroni-adjusted α	Effect size Cohen's *d*
Right arm fat tissue (%)	**34.70 ± 6.09**	**33.86 ± 5.77**	**19.34 (1,66)**	**<.001***		0.14
Left arm fat tissue (%)	**35.03 ± 6.24**	**34.30 ± 5.77**	**15.21 (1,66)**	**<.001***		0.12
Right leg fat tissue (%)	**36.21 ± 5.90**	**35.70 ± 5.60**	**9.35 (1,66)**	**.003***		0.09
Left leg fat tissue (%)	**36.17 ± 6.10**	**35.67 ± 5.74**	**4.67 (1,66)**	**.005***		0.08
Bone Densitometry			0.16 (3,59)	.923	0.017	
Total bone mineral density (g/cm^3)	1.21 ± 0.11	1.21 ± 0.11	0.49 (1,61)	.489		0.00
T-score	1.31 ± 1.13	1.30 ± 1.09	0.29 (1,61)	.595		0.01
Z-score	1.36 ± 1.01	1.35 ± 0.98	0.30 (1,61)	.589		0.01

Statistically significant results are bolded
† Significant pre-to-post differences at multivariate level (α < 0.05)
*** Significant pre-to-post differences based on Bonferroni-adjusted α value**
**** Significant pre-to-post differences based on Wilcoxon Signed Ranks Test**