Section: Original Research

Article Title: An 8-week Exercise Intervention Based on Zumba® Improves Aerobic Fitness and Psychological Well-Being in Healthy Women

Authors: Anne A. Delextrat[1], Sarah Warner[2], Sarah Graham[1], and Emma Neupert[3]

Affiliations: [1]Department of Sport and Health Sciences, Oxford Brookes University, Oxford, UK. [2]Department of Agriculture, Newcastle University, Newcastle, UK. [3]Department of Sports Studies, Winchester University, Winchester, UK.

Running Head: Physiological and psychological benefits of Zumba®

Journal: *Journal of Physical Activity & Health*

Acceptance Date: May 11, 2015

DOI: http://dx.doi.org/10.1123/jpah.2014-0535

Abstract

Background: Although Zumba® is practiced by millions of people worldwide, there is a paucity of research about its potential benefits. The objective of this study was to investigate the effects of Zumba® on physiological and psychological outcomes in healthy women. ***Methods:*** Cardiovascular fitness, body composition, physical self-perception and psychological well-being were assessed before and immediately after 8 weeks of Zumba® performed three times weekly (Zumba group, n = 22, age: 26.6±5.4 years old; height: 165.8±7.1cm) or no intervention (control group, n = 22, age: 27.9±6.0 years old; height: 164.7±6.2cm). All variables were analyzed by a two-way (group x time) analysis of variance with repeated measures, and a Bonferroni post-hoc test. Pearson correlation coefficient assessed the relationship between changes in anthropometric, physiological and psychological variables. ***Results:*** Zumba® provided significant positive changes in maximal aerobic fitness (+3.6%), self-perception of physical strength (+16.3%) and muscular development (+18.6%), greater autonomy (+8.0%) and purpose in life (+4.4%). No significant changes were observed in the control group. In addition, some psychological changes were significantly correlated to body fat at baseline, and changes in fitness. ***Conclusions:*** These results highlight that Zumba® is beneficial to improve fitness and well-being in healthy women, but does not change body composition.

Key words: maximal oxygen consumption, running economy, body fat, autonomy, strength perception.

Abstract word count: 198

Manuscript word count: 4349

Introduction

The protective role of physical activity on depression and cardiovascular disease has been widely reported in the literature.[1-2] The recommendations of the American College of Sports Medicine[3] to decrease/maintain a healthy body weight and enhance cardiovascular fitness include 75 to 150 min of weekly exercise. However, recent reports on physical activity trends in Europe show a plateau in sport participation in the past few years, especially in women.[4] This slower growth could be linked to various factors such as low income, time constraints or education.[4] Within this context, the development of DVD-based workouts allowing exercising at home seems like an interesting and cost-effective strategy to promote sport participation.

Zumba® is a dance-based fitness class that originated in Colombia in the 1990s and is now extremely popular worldwide (www.zumbafitness.com). Scientific studies about the potential benefits of Zumba in healthy women have shown many positive effects of this type of workout on body composition and physical fitness.[5-7] Donath et al.[7] tested the effects of Zumba® sessions performed twice weekly for eight weeks in physically active young women. They showed that, compared to a control group with no physical activity, women who took part in Zumba® improved their cardiovascular endurance (+21%), trunk strength endurance (+48-71%) and dynamic balance (+11%). Two other recent studies investigated the effects of longer intervention periods (twice to three times weekly for 12 to 40 weeks) in middle-aged female hospital employees.[5-6] Significant improvements were observed in maximal oxygen consumption (VO_{2max}) relative to body mass (+4.7% to 6.9%), total fat mass (-2.5% to -5.5%) and body fat percentage (-3.6%) compared to a control group.[5-6] While these results are very promising, the Zumba® sessions were performed as a class with an instructor, and it would be interesting to investigate if similar benefits could be brought about by Zumba® DVD workouts performed at home.

While the physical and physiological benefits of Zumba® classes seem relatively well established, there is a paucity of data in the literature on the effects of Zumba® on psychological outcomes. Only study reported a significant (+9.8%) improvement of total quality of life score (assessed by a questionnaire) after eight weeks of Zumba® in young women.[7] The psychological benefits of other types of dance are better described. Significant improvements in mood, body image, personal accomplishment, strength and endurance self-perception and self-concept (including physical self, identity and self-satisfaction) were reported after various dance-based group interventions.[8-9] It has also been shown that performing dance workouts alone (dance mat "exer-gaming") could lead to significant psychological improvements, such as a greater autonomy.[10]

Several associations were reported between the different types of benefits brought about by physical exercise. Indeed, a greater level of aerobic fitness has been positively linked to various aspects of quality of life, including decreased mental stress and improved self-control and mental resources.[11-12] Likewise, Carr and Jaffe[13] showed that self-acceptance and self-satisfaction could be related to body composition and body mass changes over time. However, these associations were evidenced with various types of exercise, and it would be interesting to observe if the practice of Zumba® could achieve similar results.

Within this context, the aim of the present study was to investigate the effects of an 8-week intervention based on Zumba® exercise on cardiovascular fitness, body composition, physical self-perception and psychological well-being in healthy women. A secondary objective was to identify if there was any association between the changes in physiological and psychological parameters as a result of the intervention.

Methods

Participants

Forty-four women volunteered to take part in the study. They were recruited from various community centres and amongst university students and staff members. Inclusion criteria included weekly physical exercise lower than 2h and no previous practice of Zumba®. Exclusion criteria were pregnancy, musculoskeletal injuries and metabolic/cardiorespiratory contraindications to physical exercise. Participants were randomly allocated to a Zumba® group (n=22, age: 26.6±5.4 years old; height: 165.8±7.1cm) and a control group (n=22, age: 27.9±6.0 years old; height: 164.7±6.2cm). Each participant was informed in detail about the testing procedures and possible risks of the study before signing an informed consent. In addition the study was approved by the university local ethics committee. Seven participants stopped the study during the 8-week intervention, and therefore final analyses involved only 19 participants in the Zumba® group and 18 in the control group.

Procedures

Each participant took part in one pre-test and one post-test sessions before and immediately after an 8-week period with either a Zumba® intervention (Zumba® group) or no intervention (control group). The pre- and post-tests were performed during one single session in the laboratory, while the Zumba workouts were undertaken at home with a DVD. In addition, participants were advised to keep the same diet as usual during the entire duration of the study, and required to record the content of their meals twice weekly (one week day and one week-end day) in a diary. The diary was based on simple qualitative (name of food) and quantitative (small, medium or large portions) descriptions.

Preliminary assessments

Upon arrival in the laboratory, each participant was given two psychology questionnaires to fill in. The first one was the Physical Self-perception profile (PSPP),[14] consisting in five 6-item subscales: *perceived sport competence, perceived bodily attractiveness, perceived physical strength and muscular development, perceived level of physical conditioning and exercise*, and *physical self-worth*, followed by four 2-item questions about how important these aspects are. Participants answered using a four-choice alternative format. The second questionnaire was the Scales of Psychological Well-being (SPW),[15] based on six 9-item sub-categories including *autonomy, environmental mastery, personal growth, positive relations with others, purpose in life* and *self-acceptance*. The answer format followed a scale from 1 (strongly disagree) to 6 (strongly agree).

Anthropometric measurements included height (cm, Seca, Marsden, UK) and body mass. In addition, body fat percentage (BF%), and estimated muscle mass in the arms, legs and trunk were measured by bioelectrical impedance (Tanita BC 418 MA Segmental Body Composition Analyser, Tokyo, Japan). This analyzer is characterized by very good reliability (Intraclass correlation coefficient of 0.96 or higher),[16] and its validity ranges from very high for leg lean mass to moderate for trunk fat and lean mass compared to dual-energy x-ray absorptiometry (DXA).[17]

Physical fitness was assessed by a running economy test, followed by an incremental test to determine VO_{2max}, both performed on a treadmill (Woodway PPS 55 Sport, Woodway, Weil am Rhein, Germany). After one minute rest to measure resting heart rate (HR_{rest}), the running economy (RE) test consisted in two 4-min running bouts performed at a speed identified as "easy" by participants (RE_{low}, 7.1±1.1 km.h^{-1}), followed by a higher speed (RE_{high} = RE_{low} + 2 km.h^{-1}, 9.1±1.1 km.h^{-1}). The VO_{2max} test followed immediately, was performed at the same speed throughout the test (RE_{high}+ 1 km.h^{-1}, 10.1±1.1 km.h^{-1}) and involved increases in slope of 2% every 2-min until exhaustion.[18] During both tests, pulmonary gas exchange and heart rate (HR) were measured breath-by-breath by a gas analyser (Metalyzer 3B, Cortex, Leipzig, Germany). The criteria for the achievement of VO_{2max} were based on volitional exhaustion, an increase in oxygen consumption (VO_2) values lower than 150 $mL.min^{-1}$ between the last two stages, HR greater than 90% of age-predicted maximal heart rate (HR_{max}) and respiratory exchange ratio ($RER=VCO_2/VO_2$) greater than 1.15.[19]

Running economy (mL of $O_2.kg^{-1}.km^{-1}$) was calculated from VO_2 values averaged from the 3rd to 4th minute of RE_{low} and RE_{high}. Maximal oxygen uptake (VO_{2max}) and HR_{max} were determined as the maximal values averaged over 60 s. In addition, individual linear regressions between VO_2 and HR values obtained during the test were developed for each participant, as previously described.[20-21]

Zumba workouts

Participants were requested to take part in three 60-min Zumba® workouts weekly by following the same DVD at home for the entire duration of the study. Their HR was recorded at 5-s intervals (Polar team system 1, Polar, Finland) during one weekly session, and they were requested to let the research team know if they missed any session. Mean HR (HR_{mean}) was then calculated as the average HR from the start to the end of the 60-min long session (including warm-up and cool-down). It was then expressed relative to HR_{max} obtained during the incremental test, and relative to heart rate reserve ($HRR = HR_{max} – HR_{rest}$). The following five heart rate zones were defined and the time spent in each zone was calculated:[3,22]

-Zone 1: HR<40% of HRR

-Zone 2: 40% of HRR≤HR≤60% of HRR

-Zone 3: 60% of HRR≤HR≤75% of HRR

-Zone 4: 75% of HRR≤HR≤85% of HRR

-Zone 5: HR>85% of HRR

Finally, absolute ($L.min^{-1}$) and relative ($mL.kg^{-1}.min^{-1}$) VO_2 values were extrapolated from HR data recorded during the Zumba® sessions, using the individual regression equations from the incremental test. It was previously shown that HR-VO_2 relationships during Zumba could accurately be reflected by the HR-VO_2 relationships obtained during a treadmill running test.[20] Based on a mean 5 $kcal.L^{-1}$ of O_2 consumed, energy expenditure ($kcal,min^{-1}$) was then calculated from the VO_2 data. Energy expenditure was also expressed as Metabolic Equivalent (MET, 1 MET=3.5 mL of $O_2.kg^{-1}.min^{-1}$). An average value between the eight weeks was then calculated for these variables.

Control group

The control group took part in all the pre- and post-assessments, but did not follow the Zumba® intervention. Instead, they were required to carry on doing their normal daily activities throughout the eight-week period. To encourage such practice, a weekly diary of exercise workouts performed (including classes, gym workouts, sports in clubs), as well as commute time and transport mode (car, bus, bicycle or walk) and sedentary activities (watching TV, time ina seated position) was kept by each participant. For the workouts, participants were requested to log the duration and estimated intensity (high, moderate or low) of the activity performed.

Statistical analyses

All data were expressed as mean ± standard deviation. After checking for normal distribution and equality of variances, an analysis of variance with repeated measures was performed to evaluate the effect of group (Zumba® *vs.* control), time (pre- *vs.* post) and interaction between these factors (group*time) on anthropometric, physiological and psychological parameters. Post-hoc Bonferroni pairwise comparisons were subsequently undertaken when a significant interaction effect was found. Effect sizes were calculated using partial eta squared (η_p^2) and interpreted as no effect if $0 < \eta_p^2 < 0.05$, a minimum effect if $0.05 < \eta_p^2 < 0.26$; a moderate effect if $0.26 < \eta_p^2 < 0.64$, and a strong effect if $\eta_p^2 > 0.64$.[23] In addition, the percentage change between pre- and post-test was calculated for each variable in the Zumba® group, and Pearson correlations were used to assess the relation between the changes in psychological, fitness and anthropometric data (n=19). For all these analyses, significance was set at $p = .05$.

Results

Results of the incremental running test showed that the criteria for the achievement of VO_{2max} were accepted (increase in VO_2 of 118±35 $mL.min^{-1}$ between the last two stages, HR of 96±4% of age-predicted HR_{max}, RER of 1.16±0.08). Adherence to the Zumba® intervention programme for participants who completed pre- and post-tests was 87%. The mean heart rate recorded during the Zumba® workouts averaged over the 8-week intervention was 144±11 $beats.min^{-1}$ (75.2±6.3% of HR_{max}). It corresponded to VO_2 values of 1.35±0.20 $L.min^{-1}$ or 22.1±3.5 $mL.kg^{-1}.min^{-1}$ (59.6±8.3% of VO_{2max}), and caloric expenditures of 5.9±0.9 $Kcal.min^{-1}$ or 6.3±1.0 METs. The time spent in the various heart rate zones is presented in Figure 1.

The changes in anthropometric and physiological variables following the 8-week intervention are displayed in Table 1. Statistical analyses showed a significant interaction effect between group and time on VO_{2max} expressed in relative values ($p = 0.010$), with a significant improvement observed in the Zumba group (+3.6%, $p = 0.008$) between pre- and post-tests, but no significant variation in the control group (-2.4%, $p = 0.063$). This difference was associated with a moderate effect size. No other significant effect of time, group or interaction was shown on any other anthropometric or physiological variable ($p > 0.05$).

Table 2 shows the changes in psychological variables in both groups between pre- and post-intervention. Regarding the PSPP questionnaire, a significant effect of time was shown on the *perceived level of physical conditioning and exercise* ($p = 0.005$), *perceived physical strength and muscular development* ($p = 0.002$) and *importance given to sport competence* ($p = 0.006$), with significantly better scores obtained in the post- compared to pre-test. In addition, a significant interaction effect between group and time was observed on *perceived physical strength and muscular development*, with greater increases between pre- and post-tests in the Zumba® group (+19.4%, $p = 0.003$), compared to control group (+4.8%, $p = 0.153$). The statistical analysis also showed a significant group by time interaction effect on the *importance given to physical strength and muscular development* ($p = 0.048$). Post-hoc analyses revealed a significantly greater score for this item in the post- compared to pre-test in the Zumba® group (+31.1%, $p = 0.003$), while the control group showed no significant pre-post variation (+4.3%, $p = 0.172$). Furthermore, significant interaction effects between group and time were observed for the *autonomy* ($p = 0.028$) and *purpose in life* ($p = 0.021$) items of the SPW questionnaire. Indeed, significant increases between pre-and post-tests were found in the Zumba® group (+9.2% and +4.2%, respectively for *autonomy* and *purpose in life, p* = 0.04 to 0.028), while scores for the control group did not vary significantly between these time points (-0.9%% and -2.2%, respectively for *autonomy* and *purpose in life*, *p* = 0.267 to 0.573). Moderate to large effect sizes were shown for these changes in psychological variables.

Several associations were observed between some pre-test data and the changes observed as a result of the Zumba intervention. Indeed, baseline BF% was significantly related to the change in the *importance given to sport competence* (r = -0.492, $p < 0.05$) and the change in *relations with others* (r = -0.415, $p < 0.05$). In addition, significant relations were found between age and the change in the *importance given to physical strength and muscular development* (r = -0.431, $p < 0.05$) and between the pre-test VO_{2max} levels and the change in *environmental mastery* (r = 0.459, $p < 0.05$). Significant relations were also shown between the changes in physical fitness, anthropometric and psychological parameters that occurred during the 8-week intervention. The variation in RE_{low} was significantly correlated to the variation in the *importance given to physical strength and muscular development* (r = -0.643, $p < 0.05$) and *purpose in life* (r = -0.526), while the variation in RE_{high} was significantly correlated to the variation in *perceived physical strength and muscular development* (r = -0.487, $p < 0.05$). Significant correlations were also observed between the improvements in VO_{2max} and in the *importance given to physical conditioning level and exercise* (r = 0.638, $p < 0.05$), and the changes in BF% and the variation in the *importance given to bodily attractiveness* (r = -0.730, $p < 0.01$).

Discussion

The main results of this study showed that a home-based Zumba® intervention provided positive changes in maximal aerobic fitness as well as psychological benefits, including a higher self-perception of physical strength and muscular development, greater autonomy and purpose in life. These changes were associated with moderate to large effect sizes. In addition, we identified a link between some of the psychological changes and anthropometric or physiological parameters. This is the first study to show the benefits of Zumba® workouts performed as a home-based intervention.

Significant increases in VO_{2max} expressed relative to body mass were observed after eight weeks in the present study, with a large effect size. Previous studies have shown chronic benefits of Zumba® workouts on cardiorespiratory endurance, including increases in the six-mile walk test performance (+21%)[7] and in cycling VO_{2max} (+5%)[5-6]. Interestingly, we did not find any significant effect of the Zumba® intervention on VO_{2max} expressed in absolute values, similarly to a previous investigation[5], which could be due to the concomitant changes in body composition and fitness. These aspects will be discussed later. The improvement in VO_{2max} (+3.6%) observed in the present study is slightly lower than observed in previous studies, which could be partly explained by the shorter length of our intervention (8 weeks *vs*. 12 and 40 weeks in our study and the studies of Barene et al.).[5-6] Indeed, although most authors suggest a minimal duration of 6-8 weeks to increase aerobic fitness,[24] greater improvements are observed with interventions of longer durations (+4.7% vs. +6.9% for 12 *vs.* 40 weeks).[5-6]

The average intensity of the Zumba® workouts in the present study is within the range suggested to improve aerobic fitness.[25] Indeed, we showed a mean HR of 144 beats.min^{-1} (75.2% of HR_{max}), corresponding to a mean VO_2 of 1.35 L.min^{-1} (59.6% of VO_{2max}). The ACSM recommendations to improve aerobic fitness include exercising at 40% to 60% of heart rate reserve (HRR) for a minimum of 150 min weekly.[3] Within this context, our intervention corresponded to 180 min weekly, with 35.6% of exercise time spent at 40-60% of HRR, and 56.8% of the time at higher intensities. It seems that improvements in VO_{2max} are not necessarily proportional to exercise intensity, as Barene et al.[6] reported similar improvements in VO_{2max} after 12 weeks of Zumba® compared to soccer training, despite a greater intensity of the soccer workouts (average HR of 78.3% *vs.* 73.0% of HR_{max}, respectively for soccer and Zumba®). These results suggest that Zumba® could be a suitable physical activity for women to improve their aerobic fitness, without experiencing a high amount of cardiovascular stress.

The present study did not find any improvement in running economy as a result of Zumba® workouts. These results are in accordance with two recent studies that examined the effects of a Zumba® intervention on energy expenditure at submaximal intensities, and did not find any significant effect of Zumba® on HR while cycling at 100 Watts.[5-6] This absence of improvement could be explained by the different movement patterns in Zumba® and running, although information about muscle recruitment in this type of dance is currently lacking. Cross-training benefits of several types of exercise have been previously shown on running economy, including soccer, strength training and plyometrics.[5-6,26-27] However, although Zumba® workouts incorporate strength elements to a small extent, they might not be enough to allow positive adaptations on running economy.

Many women's motivation to exercise is weight loss,[28] and anecdotal evidence suggests that Zumba® should be a good way to achieve this objective. However, our results as well as those from previous studies did not show any significant decrease in total body fat levels following short-term Zumba® interventions in healthy women and adults with components of the metabolic syndrome (8-12 weeks).[5,29] This absence of body fat loss seems specific to Zumba® since a significant decrease in fat mass in the lower limb was observed after a soccer-based but not a Zumba®-based intervention of similar durations in middle-aged sedentary women.[5] The relatively short duration of the interventions could explain this absence of body fat changes, since significant fat losses linked to the practice of Zumba® were only evidenced after 40 weeks.[6] The amount of calories burnt during the Zumba® workouts of the present study was 5.9 $kcal.min^{-1}$ or 354 kcal in a 60-min session, which is comparable to results from another study also using a Zumba® DVD (6.6-7.4 $kcal.min^{-1}$ depending on dance styles).[30] However, although our participants were advised to keep their diet as usual, the possibility of a dietary compensation due to the change in physical activity levels is frequent and cannot be excluded in the present study.[31] Further studies would be necessary to investigate the effects of a Zumba® intervention with or without dietary manipulation on body fat. Estimated muscle mass in specific body parts were also recorded in the present study, showing no significant variation following the 8-week intervention. This is not very surprising since guidelines for muscle hypertrophy include using relatively heavy weights during resistance training workouts,[24] while Zumba® is characterised by a mixture of aerobic and resistance training elements. It would be interesting to investigate the effects of Zumba® Toning classes that incorporate more resistance training elements with the use of light weights on changes in muscle mass.

The psychological benefits of dance-based classes are well documented in the literature.[32-33] However, only one study reported specific benefits linked to the practice of Zumba®.[7] These authors observed a significant improvement in Quality of Life based on a questionnaire involving elements of physical and psychological health, social relations and environment after eight weeks of Zumba® in female college students. However, the Zumba® workouts in this study were performed in class settings, and it is well-known that a significant part of the effects of dance classes reported in the literature is linked to exercising as a group with an instructor.[34] Although these elements are missing in the home-based settings of the present study, we identified several significant improvements in psychological outcomes in the Zumba group compared to the control group. The significantly greater *perceived physical strength and muscular development* and importance given to these aspects observed in the present study are in accordance with improvements in self-perceptions of strength, fitness and endurance reported in women and adolescent girls after various types of dance-based interventions.[9-35] In addition, the significant improvements in the SPW items of *autonomy* and *purpose in life* observed in the present study are supported by similar increases in autonomy scores after participating in dance mat "exer-gaming" sessions,[10] and significantly lower beliefs in external control after a step dance exercise programme.[8] It has been highlighted in the literature that dance-based exercises promote greater acute and chronic mood changes, compared to other types of exercises, such as running, strength training or ice skating.[33,36] Furthermore, high-intensity workouts, which is a unique feature of Zumba® compared to other types of dance, have been shown to promote greater chronic well-being improvements than lower-intensity exercises.[37] These observations, together with the moderate effect sizes linked to our results suggest that a home-based Zumba® intervention is beneficial for these psychological aspects.

No improvements were observed in the present study in psychological subscales involving the environment or relationships with others. These results are not surprising because the Zumba workouts were performed alone, and it would be interesting to investigate if Zumba® classes could improve these aspects. On the other hand, the lack of beneficial effects on body image was unexpected, and in contrast with previous findings about the benefits of dance interventions.[35] This element could be particularly important for exercise participation because it has been shown that women's motivation exercise greatly relies on a need to improve self-esteem and body image.[4] However, a meta-analysis[38] highlighted that the benefits of exercise on body image could be moderated by a variety of factors, such as age, gender ethnicity, or social interactions. These factors might explain the contrasting results between our study and previous investigations.

Several associations were found in the present study between psychological variables and either body composition or fitness. The negative association between baseline body fat levels and the changes in the *relations with others* and *importance given to sport competence* scores in the present study are in accordance with findings from Carr and Jaffe,[13] showing negative correlations between body mass index and interpersonal discrimination and self-satisfaction. However, in contrast with this previous study,[13] we did not find any significant association between the change in body fat as a result of our intervention and any of the psychological measures, except one (*importance given to bodily attractiveness)*. It seems that changes in body composition are not always accompanied by improvements in self-perception. Indeed, using the same PSPP questionnaire as our study, Anderson et al.[39] found that eight-week of exercise based on walking with and without electrostimulation resulted in significant body fat loss, but did not change any of the PSPP items, except one (*perceived level of physical conditioning and exercise*). Greater fitness levels have been associated with better psychological outcomes, such as decreased stress, increased mental resources and self-control in several studies.[11-12] Within this context, we showed that improvements in fitness parameters following participation in Zumba® were linked to improvements in the *perceived physical strength and muscular development* and its *importance*, *purpose in life*, and the *importance given to physical conditioning level and exercise*. These results are very encouraging, and suggest that Zumba® affects specific psychological outcomes, but not others. However, the paucity of similar data in the literature highlights the need to further studies on the psychological effects of Zumba®.

Several limitations could be identified in the present study. The first one is the relatively low sample size, leading to small to moderate effect sizes. In addition, we only monitored physiological parameters during one weekly Zumba® session, and these measures relied on direct HR measurement, but indirect VO_2 or caloric expenditure evaluations. Finally, we did not control for all the potential confounding factors that could have affected our results, including sleep quality or changes in social interaction during the eight-week intervention.

Conclusion

The results of the present study suggest that a home-base Zumba® programme is beneficial for sedentary women to improve aerobic fitness and some psychological aspects, such as *perceived physical strength and muscular development*, *autonomy* and *purpose in life*. In addition, some associations were observed between the changes in fitness and psychological outcomes. However, no changes in body composition were observed, highlighting that a longer intervention, different style of Zumba and/or a combination with changes in diet might be necessary. Further studies should focus on the psychological benefits of Zumba®.

References

1. Gallagher R, Zelestis E, Hollams D, Denney-Wilson E, Kirkness A. Impact of the Healthy Eating and Exercise Lifestyle Programme on depressive symptoms in overweight people with heart disease and diabetes. *Eur J Prev Cardiol* 2013; 21(9): 1117-1124.

2. Hamer M, Stamatakis E. Low-dose physical activity attenuates cardiovascular disease mortality in men and women with clustered metabolic risk factors. *Circ Cardiovasc Qual Outcomes* 2012; 5(4): 494-499.

3. American College of Sports Medicine (ACSM). *Guidelines for exercise testing and prescription (*9th edition). Philadelphia, PA: Lippincott, Williams & Wilkins, 1999.

4. Stamatakis E, Chaudhury M. Temporal trends in adults' sports participation patterns in England between 1997 and 2006: the Health Survey for England. *Br J Sports Med* 2008; 42(11): 901-908.

5. Barene S, Krustrup P, Jackman SR, Brekke OL, Holtermann A. Do soccer and Zumba exercise improve fitness and indicators of health among female hospital employees? A 12-week RCT. *Scand J Med Sci Sports* 2013 [Epub ahead of print].

6. Barene S, Krustrup P, Brekke OL, Holtermann A. Soccer and Zumba as health-promoting activities among female hospital employees: a 40-weeks cluster randomised intervention study. *J Sports Sci.* 2014; 2(16): 1539-1549.

7. Donath L, Roth R, Hohn Y, Zahner L, Faude O. The effects of Zumba training on cardiovascular and neuromuscular function in female college students. *Eur J Sport Sci.* 2014; 14(6): 569-577.

8. Asci FH. Sex differences in psychological effects of exercise. *Int J Psychol* 2009; 44(4): 313-320.

9. Murrock CJ, Madigan E. Self-efficacy and social support as mediators between culturally specific dance and lifestyle physical activity. *Res Theory Nurs Pract.* 2008; 22(3): 192-204.

10. Azevedo LB, Burges Watson D, Haighton C, Adams J. The effect of dance mat exergaming systems on physical activity and health-related outcomes in secondary schools: results from a natural experiment. *BMC Public Health.* 2014; 14:951.

11. Brandon JE, Loftin JM. Relationship of fitness to depression, state and trait anxiety, internal health locus of control, and self-control. *Percept Mot Skills.* 1991; 3(2): 563-568.

12. Kettunen O, Kyröläinen H, Santtila M, Vasankari T. Physical fitness and volume of leisure time physical activity relate with low stress and high mental resources in young men. *J Sports Med Phys Fitness*. 2014; 54(4): 545-551.

13. Carr D, Jaffe K. The psychological consequences of weight change trajectories: evidence from quantitative and qualitative data. *Econ Hum Biol*. 2012;10(4): 419-430.

14. Fox KR, Corbon CB. The Physical Self-Perception Profile: Development and preliminary validation. *J Sport Exer Psychol*. 1989; 11: 408-430.

15. Ryff CD. Psychological well-being in adult life. *Curr Dir Psychol Sci.* 1995; 4: 99-104.

16. Demura S, Sato S, Kitabayashi T. Estimation accuracy of percent total body fat and percent segmental fat measured by single-frequency bioelectrical impedance analysis with 8 electrodes: the effect of difference in adiposity. *J Sports Med Phys Fitness.* 2005; 45(1): 68-76.

17. Luque V, Escribano J, Zaragoza-Jordana M, Rubio-Torrents C, Ferré N, Gispert-Llaurado M, Closa-Monasterolo R. Bioimpedance in 7-year-old children: validation by dual x-ray absorptiometry - part 2: assessment of segmental composition. *Ann Nutr Metab.* 2014; 64(2): 144-55.

18. British Association of Sport and Exercise Sciences (BASES). *Sport and Exercise Physiology Testing Guidelines: Volume I - Sport Testing.* Winter EM, Jones AM, Davison RCR, Bromley PD, & Mercer TH (Eds). Routledge, UK, 2007.

19. Howley ET, Bassett DR Jr, Welch HG. Criteria for maximal oxygen uptake: review and commentary. *Med Sci Sports Exerc.* 1995; 27: 1292-1301.

20. Luettgen M, Foster C, Doberstein S, Mikat R, Porcari J. Zumba: Is the "fitness-party" a good workout? *J Sports Sci Med.* 2012; 11: 357- 358.

21. Shargal E, Shtrik R, Zigel L, Schwartz B, Pilz-Burstein R. Heart rate monitoring as a reliable tool for assessing energy expenditure in obese individuals. *J Sports Med Phys Fitness* 2011; 51(3): 473-479.

22. Warbuton DER, Breding SSD, Horita LTL, Zbogar D, Scott JM, Esch BTA, et al. The health benefits of interactive video game exercise. *Appl Physiol Nutr Metab.* 2007; 32: 655-663.

23. Ferguson, C.J. An effect size primer: a guide for clinicians and researchers. *Prof Psychol* 2009; 40: 532–538.

24. Baechle TR, Earle RW, Wathan D. *Essentials of Strength Training and Conditioning.* 3rd edition. Human Kinetics, Champaign, IL, USA, 2008.

25. Billat LV. Interval training for performance: a scientific and empirical practice. Special recommendations for middle- and long-distance running. PartI: aerobic interval training. *Sports Med.* 2001; 31(1): 13-31.

26. Storen O, Helgerud J, Stoa EM, Hoff J. Maximal strength training improves running economy in distance runners. *Med Sci Sports Exerc*. 2008; 40(6): 1087-1092.

27. Turner AM, Owings M, Schwane JA. Improvement in running economy after 6 weeks of plyometric training. *J Strength Cond Res.* 2003; 17(1): 60-67.

28. Jankauskiene R, Kardelis K, Pajaujiene S. Body weight satisfaction and weight loss attempts in fitness activity involved women. *J Sports Med Phys Fitness* 2005; 45(4): 537-545.

29. Araneta MR, Tanori D. Benefits of zumba fitness among sedentary adults with components of the metabolic syndrome: a pilot study. *J Sports Med Phys Fitness* 2014 [Epub ahead of print].

30. Otto RM, Maniguet E, Peters A, Boutagy N, Gabbard A, Wygand JW, et al. The energy cost of Zumba exercise. *Med Sci Sports Exer* 2011; 43(5): S329.

31. Blundell JE, Stubbs RJ, Hughes DA, Whybrow S, King NA. Cross talk between physical activity and appetite control: does physical activity stimulate appetite? *Proc Nutr Soc.* 2003; 62(3): 651-661.

32. Hanna, JL. The power of dance: health and healing. *J Altern Complement Med.* 1995; 1(4): 323-331.

33. Kim S, Kim J. Mood after various brief exercise and sport modes: aerobics, hip-hop dancing, ice skating, and body conditioning. *Percep Mot Skills* 2004;7: 104(3Pt 2), 1265-1270.

34. Wininger SR, Pargman D. Assessment of factors associated with exercise enjoyment. *J Music Ther.* 2003; 40(1): 57-73.

35. Burgess G, Grogan S, Burwitz, L. Effects of a 6-week aerobic dance intervention on body image and physical self-perceptions in adolescent girls. Body Image 2006; 3(1): 57-66.

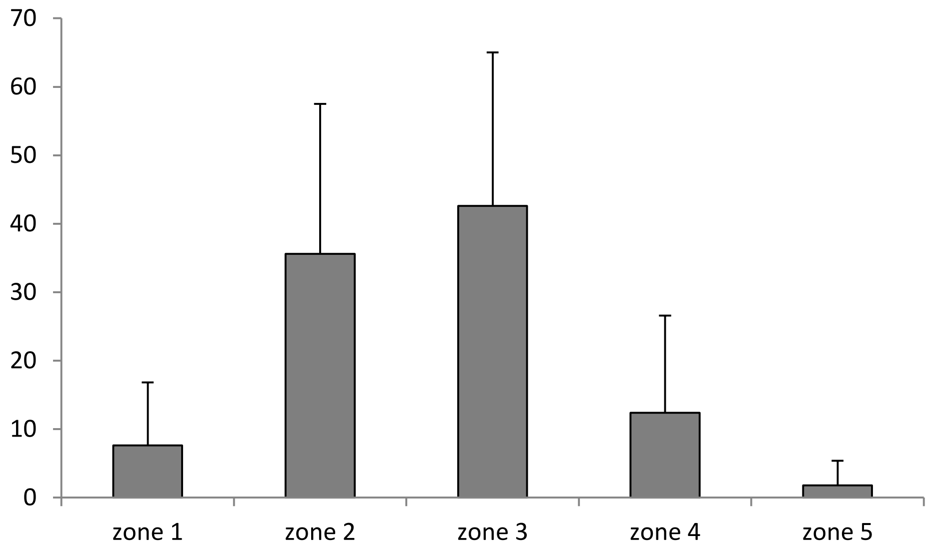
36. Gerber M, Brand S, Elliot C, Holsboer-Trachsler E, Pühse U. Aerobic exercise, ball sports, dancing, and weight lifting as moderators of the relationship between stress and depressive symptoms: an exploratory cross-sectional study with swiss university students. Percept Mot Skills. 2014;119(3):679-697.

37. McGrath JA, O'Malley M, Hendrix TJ. Group exercise mode and health-related quality of life among healthy adults. *J Adv Nurs.* 2011; 67(3): 491-500.

38. Campbell A, Hausenblas HA. Effects of exercise interventions on body image: a meta-analysis. J Health Psychol. 2009; 14(6): 780-793.

39. Anderson AG, Murphy MH, Murtagh E, Nevill A. An 8-week randomized controlled trial on the effects of brisk walking, and brisk walking with abdominal electrical muscle stimulation on anthropometric, body composition, and self-perception measures in sedentary adult women. Psychol Sport Exerc. 2006; 7: 437-451.

Figure 1. Percentage of total time spent in various HR zones during one Zumba® workout. Zone 1: HR<40% of heart rate reserve (HRR); zone 2: 40% of HRR≤HR≤60% of HRR; zone 3: 60% of HRR≤HR≤75% of HRR; zone 4: 75% of HRR≤HR≤85% of HRR; zone 5: HR>85% of HRR.



Time spent in heart rate zones

(% of total session time)

Table 1. Changes in anthropometric and physical fitness variables between pre- and post-tests in the Zumba and Control groups (RE_{low} and RE_{high}: running economy at low and high running speeds, respectively; $VO2_{max}$: maximal oxygen consumption; muscle mass is estimated; 95%CL: 95% confidence interval of the difference between pre- and post-tests; η_p^2: partial eta squared).

		PRE	POST	p value, η_p^2	95%CL
RElow ($mL\ O_2.kg^{-1}.km^{-1}$)	Control Zumba	235±16 248±28	236±35 231±16	Group: p=0.851, η_p^2: 0.004 Time: p= 0.138, η_p^2: 0.224 Interaction: p=0.091, η_p^2: 0.286	-3 to 19
REhigh ($mL\ O_2.kg^{-1}.km^{-1}$)	Control Zumba	244±50 227±29	241±56 217±31	Group: p=0.182, η_p^2: 0.174 Time: p= 0.051, η_p^2: 0.366 Interaction: p=0.182, η_p^2: 0.174	-2 to 12
VO_{2max} ($L.min^{-1}$)	Control Zumba	2.23±0.15 2.26±0.24	2.19±0.13 2.33±0.28	Group: p=0.425, η_p^2: 0.058 Time: p= 0.663, η_p^2: 0.018 Interaction: p=0.077, η_p^2: 0.270	-0.07 to 0.05
VO_{2max} ($mL.kg^{-1}.min^{-1}$)	**Control** **Zumba**	**38.3±5.3** **38.1±4.6**	**37.3±5.4** **39.3±4.0***	Group: p=0.683, η_p^2: 0.016 Time: p=0.668, η_p^2: 0.018 **Interaction: p=0.010, η_p^2: 0.532**	**Control: -0.1 to 1.9** **Zumba: -2.1 to -0.4**
HR_{max} (bpm)	Control Zumba	192±16 190±9	190±16 192±9	Group: p=0.963, η_p^2: 0.002 Time: p= 0.804, η_p^2: 0.006 Interaction: p=0.093, η_p^2: 0.256	-2 to 2
Body mass (kg)	Control Zumba	61.3±8.6 59.4±8.3	62.3±8.0 59.5±8.1	Group: p=0.447, η_p^2: 0.056 Time: p= 0.053, η_p^2: 0.358 Interaction: p=0.065, η_p^2: 0.316	-1.0 to 0.3
Body fat (%)	Control Zumba	23.5±16 26.7±5.7	23.6±3.5 26.4±5.1	Group: p=0.552, η_p^2: 0.032 Time: p= 0.704, η_p^2: 0.012 Interaction: p=0.222, η_p^2: 0.128	-0.9 to 0.6
Muscle mass right arm (kg)	Control Zumba	2.1±0.2 1.9±0.3	2.1±0.2 2.0±0.3	Group: p=0.390, η_p^2: 0.100 Time: p= 0.289, η_p^2: 0.150 Interaction: p=0.729, η_p^2: 0.016	-0.1 to 0.1
Muscle mass left arm (kg)	Control Zumba	2.0±0.2 1.9±0.3	2.0±0.2 1.9±0.3	Group: p=0.355, η_p^2: 0.114 Time: p= 0.801, η_p^2: 0.008 Interaction: p=0.905, η_p^2: 0.002	-0.1 to 0.1
Muscle mass trunk (kg)	Control Zumba	22.3±3.6 21.9±5.1	22.3±3.7 21.9±5.2	Group: p=0.891, η_p^2: 0.002 Time: p= 0.743, η_p^2: 0.014 Interaction: p=0.908, η_p^2: 0.002	-0.3 to 0.2
Muscle mass right leg (kg)	Control Zumba	7.2±0.8 7.0±1.2	7.3±0.8 7.0±1.2	Group: p=0.864, η_p^2: 0.004 Time: p= 0.353, η_p^2: 0.108 Interaction: p=0.151, η_p^2: 0.248	-0.1 to 0.1
Muscle mass left leg (kg)	Control Zumba	7.2±1.3 7.2±1.4	7.4±1.5 7.3±1.3	Group: p=0.857, η_p^2: 0.006 Time: p= 0.077, η_p^2: 0.270 Interaction: p=0.086, η_p^2: 0.420	-0.1 to 0.1

*: significant difference between pre- and post tests, $p < 0.05$.

Table 2. Changes in psychological variables between pre- and post-tests in the Zumba and Control groups (95%CL: 95% confidence interval of the difference; η_p^2: partial eta squared).

		PRE	POST	p value, η_p^2	95%CL
Physical Self-Perception Profile Questionnaire					
Perceived sport competence	Control Zumba	13.1±4.2 13.3±4.6	13.4±3.7 14.8±3.9	Group: p=0.322, η_p^2: 0.090 Time: p= 0.171, η_p^2: 0.168 Interaction: p=0.171, η_p^2: 0.168	-1.5 to 0.3
Perceived level of physical conditioning and exercise	**Control Zumba**	**14.2±2.9 14.6±5.1**	**16.4±3.3* 16.6±4.0***	Group: p=0.171, η_p^2: 0.146 **Time: p= 0.005, η_p^2: 0.758** Interaction: p=0.926, η_p^2: 0.002	**-3.0 to -0.6**
perceived bodily attractiveness	Control Zumba	14.8±5.3 15.2±4.4	16.0±4.9 16.2±5.4	Group: p=0.064, η_p^2: 0.296 Time: p= 0.050, η_p^2: 0.370 Interaction: p=0.695, η_p^2: 0.012	-2.2 to 0.8
Perceived physical strength and muscular development	**Control Zumba**	**14.7±1.7 13.9±2.1**	**15.4±1.8 16.6±2.3***	Group: p=0.857, η_p^2: 0.006 **Time: p= 0.002, η_p^2: 0.694** **Interaction: p=0.021, η_p^2: 0.480**	**Control: -1.7 to 0.3 Zumba: -3.9 to -0.7**
Perceived physical self-worth	Control Zumba	13.8±2.1 14.1±3.3	14.0±4.1 14.8±3.4	Group: p=0.113, η_p^2: 0.188 Time: p= 0.077, η_p^2: 0.270 Interaction: p=0.851, η_p^2: 0.002	-1.4 to 0.2
Importance of sport competence	**Control Zumba**	**4.4±1.6 4.5±1.8**	**5.0±1.4 5.2±1.8**	Group: p=0.871, η_p^2: 0.004 **Time: p= 0.006, η_p^2: 0.808** Interaction: p=0.751, η_p^2: 0.014	-1.0 to -0.2
Importance of physical conditioning level	Control Zumba	5.7±0.5 6.1±1.3	5.9±1.2 6.7±0.9	Group: p=0.198, η_p^2: 0.216 Time: p= 0.156, η_p^2: 0.260 Interaction: p=0.372, η_p^2: 0.106	-0.9 to 0.2
Importance of bodily attractiveness	Control Zumba	5.7±1.1 6.0±1.1	6.0±1.1 6.4±1.1	Group: p=0.466, η_p^2: 0.072 Time: p= 0.196, η_p^2: 0.218 Interaction: p=0.824, η_p^2: 0.006	-0.9 to 0.2
Importance of physical strength and muscular development	**Control Zumba**	**4.7±0.8 4.5±0.9**	**4.9±0.7 5.9±1.0**	Group: p=0.775, η_p^2: 0.012 Time: p= 0.077, η_p^2: 0.270 **Interaction: p=0.048, η_p^2: 0.396**	**Control: -0.7 to 1.7 Zumba: -1.7 to -0.4**
Scales of Psychological Well-being Questionnaire					
Autonomy	**Control Zumba**	**34.4±3.0 33.7±3.4**	**34.1±4.1 36.8±3.2**	Group: p=0.864, η_p^2: 0.004 Time: p= 0.200, η_p^2: 0.210 **Interaction: p=0.028, η_p^2: 0.464**	**Control: -3.0 to 5.0 Zumba: -5.4 to -0.1**
Environmental mastery	Control Zumba	43.0±4.9 41.2±7.2	42.5±7.7 42.5±7.0	Group: p=0.455, η_p^2: 0.052 Time: p= 0.527, η_p^2: 0.036 Interaction: p=0.447, η_p^2: 0.052	-2.3 to 1.2
Personal growth	Control Zumba	46.3±5.4 45.5±5.0	46.8±5.6 46.6±4.1	Group: p=0.707, η_p^2: 0.014 Time: p= 0.361, η_p^2: 0.076 Interaction: p=0.982, η_p^2: 0.002	-2.9 to 1.1

		PRE	POST	p value, η_p^2	95%CL
Positive relations with others	Control Zumba	45.0±7.8 43.8±7.5	44.4±7.4 45.0±7.9	Group: p=0.673, η_p^2: 0.016 Time: p= 0.639, η_p^2: 0.020 Interaction: p=0.312, η_p^2: 0.092	-2.0 to 1.3
Purpose in life	**Control** **Zumba**	**45.1±4.0** **43.1±4.1**	**44.1±3.9** **44.9±4.0***	Group: p=0.367, η_p^2: 0.082 Time: p= 0.859, η_p^2: 0.004 **Interaction: p=0.021**, η_p^2: **0.480**	**Control: -2.0 to 6.0 Zumba: -3.2 to -0.3**
Self-acceptance	Control Zumba	41.5±6.2 40.3±8.4	42.6±6.1 41.6±6.9	Group: p=0.859, η_p^2: 0.004 Time: p= 0.074, η_p^2: 0.264 Interaction: p=0.086, η_p^2: 0.420	-2.8 to 0.5

*: significant difference between groups, $p < 0.05$.