Zumba® Dance Improves Health in Overweight/Obese or Type 2 Diabetic Women

Sridevi Krishnan, MSc, PhD; Theresa N. Tokar; Mallory M. Boylan, PhD, RD, LD; Kent Griffin, PhD; Du Feng, PhD; Linda Mcmurry, RN, DNP; Christina Esperat, RN, PhD, FAAN; Jamie A. Cooper, PhD

***Objective*: To evaluate the feasibility and health improvements from a Zumba® intervention in overweight/obese women. *Methods*: Twenty-eight (14 type 2 diabetic and 14 non-diabetic) overweight/obese women (BMI: 37.3±1.5 kg/m²) 50.8±1.8 y of age, completed a 16-week intervention attending Zumba® dance classes 3 days/week, 60 minutes/class. We measured aerobic fitness, body weight, body fat %, and motivation to exercise before and after the study. *Results*: Intrinsic motivation to exercise (p < .05) and aerobic fitness (1.01 ± 0.40 mL/kg/min, p < .05) improved, and the participants lost body weight (-1.05 ± 0.55kg, p < .05) and body fat% (-1.2 ± 0.6%, p < .01). *Conclusion*: The Zumba® intervention improved health and physical fitness in women.**

***Key words*: Zumba®; exercise motivation; weight loss; Type 2 diabetes**
Am J Health Behav. **2015;39(1):109-120**
DOI: http://dx.doi.org/10.5993/AJHB.39.1.12

Approximately 11% of women 20 years or older have Type 2 diabetes mellitus (T2DM).[1] Obesity, or excessive body fat, is linked to T2DM via insulin resistance, and being overweight or obese, and lacking regular exercise are risk factors for T2DM.[2] Regular exercise is crucial in the management and prevention of T2DM. Further, losing weight and body fat can be achieved by exercise, and these outcomes reduce the risk of T2DM and cardiovascular diseases.[3] Aerobic exercise improves whole body insulin sensitivity,[4] glycated hemoglobin A1c (HbA1c) levels, and glycemic control[5] in T2DM, normal weight and obese individuals.

Adult women are less physically active than men. The Centers for Disease Control and Prevention (CDC) reports that ~24% of men reach exercise recommendations (150 minutes a week of moderate intensity physical activity) required to maintain body weight and overall health, as opposed to just 18% of women who reach those exercise recommendations.[6] Overweight and obese women also report more personal barriers (lack of motivation, moral/emotional support, boredom or feeling self-consciousness) and environmental barriers to exercise (lack of time, feeling tired, or lack of facilities) than men.[7] This is important because motivational barriers to staying physically active have a large impact on the outcomes of exercise programs.[8]

Aerobic dance has become a popular form of exercise in women.[9] Dancing is a fun, interactive form of exercise, and has been shown to sustain motivation to participate in exercise, and improve attitudes toward exercise.[10] Zumba® Fitness is a cardio-dance program that has achieved popularity. Dance workouts that increase or sustain motivation to be physically active, such as Zumba®, might be effective in overcoming commonly reported barriers.

Two recent studies have looked at the efficacy of Zumba®; however, they were carried out in healthy, normal weight adults.[11,12] Additionally, a 12-week pilot study was done with adults where approximately 69% of the participants met criteria for metabolic syndrome.[13] However, the study had a small sample size and the Zumba® intervention was less frequent than recommended by

Sridevi Krishnan, Postdoctoral Research Associate, Department of Nutritional Sciences, Texas Tech University, Lubbock TX. Theresa N. Tokar, Research Assistant, Department of Nutritional Sciences, Texas Tech University, Lubbock TX. Mallory Boylan, Professor, Department of Nutritional Sciences, Texas Tech University, Lubbock TX. Kent Griffin, Assistant Professor, Health and Human Performance lab, Texas State University, San Marcos, Texas. Du Feng, Professor, Biostatistician, Health Sciences, University of Nevada Las Vegas, Las Vegas. Linda McMurry, Executive Director Larry Combest Community Health and Wellness center, School of Nursing, Texas Tech University Health Sciences Center, Lubbock, TX. Christina Esperat, Associate Dean for Clinical Services and Community Engagement, School of Nursing, Texas Tech University Health Sciences Center, Lubbock, TX. Jamie A Cooper, Assistant Professor, Department of Nutritional Sciences, Texas Tech University, Lubbock, TX.
Correspondence; Dr Cooper; jamie.a.cooper@ttu.edu

the CDC for weight loss (150 - 250 minutes per week).[14] Therefore, evaluating the feasibility and impact on health of a more involved protocol is necessary. The feasibility and success of an exercise intervention can be measured by compliance to the protocol, retention of screened volunteers, or improvements in health outcomes.[15] Because the primary purpose of this study was to evaluate feasibility of a Zumba® dance intervention in previously sedentary, overweight/obese or T2DM women, we evaluated participant recruitment and retention, compliance to the intervention, how motivational attitudes toward exercise changed, and health outcomes. Health is multi-faceted, so to evaluate multiple components of it, we chose to measure improvements in physical fitness, and clinical parameters such as blood pressure, HbA1c, blood lipids, body weight and body fat percentage. Finally, we compared outcome measures between non-diabetic (ND) and diabetic (DM) women to see if they responded differently to the intervention.

METHODS

Sedentary female volunteers 18-65 years of age who were either overweight or obese (BMI 25-40 kg/m^2), both non-diabetic or previously diagnosed with T2DM, were recruited for this study. Television, newspaper, magazine and radio advertisements, in addition to word of mouth through local physicians, were used to recruit women to the study. Potential participants that were interested called study staff to obtain more information. Subsequently, a 30-minute telephone screening call was used to assess interest, availability, and preliminary eligibility for the study. If the woman qualified for the study (see inclusion/exclusion criteria below), she was scheduled for baseline testing. This entire recruitment process took 12 weeks to reach the final sample of women that participated and completed this study. Women were excluded if they were taking insulin, were regular exercisers (defined as more than 3 hours per week of moderate to high intensity exercise), had a history of myocardial infarction, had a pacemaker, were pregnant or lactating, or were unable to commit to the intervention. Participants were not excluded due to hypertension or dyslipidemia. Because the study included T2DM women who were not being managed by insulin, volunteers were not excluded if they were on oral hypoglycemic drugs, or on medications for hypertension or dyslipidemia. A total of 28 overweight/obese women (14 DM and 14 ND) participated in this study.

In a 3-week period prior to starting the intervention, participants were scheduled for their baseline visit. Fasting blood lipids, HbA1c, glucose, insulin, height, weight, body fat %, waist and hip circumference, cardiorespiratory endurance, muscular endurance, and flexibility were measured. Attitudes towards exercise were measured using 3 validated questionnaires.

Baseline Testing

Participants arrived at the center at 0800 hours following an overnight fast for a blood draw, anthropometric measures, and fitness tests. Twenty-five mL of blood were collected. Of this sample, 10mL were collected in EDTA Vacutainers® (Becton Dickinson and Company, Franklin Lanes, NJ), centrifuged at 2000g for 10 minutes, and the plasma was aliquoted and stored. Another 10mL were collected in Greiner Bio Vacuettes (Fisher Scientific, Waltham, MA), allowed to sit at room temperature for 30 minutes, centrifuged at 1500 g for 10 minutes, and then the supernatant was stored as serum samples. The plasma and serum samples were frozen at -80°C until analysis. Finally, a 5mL aliquot of whole blood also was collected. For anthropometric measures, age, height (Aytron Stadiometer), body weight (Digital scale), waist and hip circumference, and blood pressure (Omron Digital Blood Pressure cuff, Schaumburg, IL) were recorded. The waist circumference was measured at the smallest part of the waist, and the widest part of the hip measure was used as the hip circumference. Both measurements were verified to be recorded when the tape was parallel to the ground. Body composition was measured using bioelectrical impedance analysis (Quantum IV Analyzer, RJL Systems, Clinton Township, MI). Following the blood draw and anthropometric measurements, the volunteers were given water, juice, and granola bars before beginning the fitness tests.

Fitness Measures

The fitness parameters included 3 components of fitness: cardiorespiratory endurance, muscular endurance, and flexibility. To assess flexibility of both hamstring and lower back,[16] a sit-and-reach test was used. The chair stand test was used to measure muscular endurance,[17] and the Rockport walking test was used to estimate cardiorespiratory endurance. The Rockport walking test is a field test used to estimate maximal aerobic capacity, or VO_2max.[18] Participants walked a 1-mile course that was on a flat surface as quickly as possible. Immediately after finishing the walk, their HR, and the time (in minutes) that it took for each participant to finish were recorded. Participants were not allowed to run at any time during the walk test. The time was incorporated into the following equation to estimate VO_2max: VO_2max (ml/kg/min) = 132.853 – 0.1692*(body mass in kg) – 0.3877*(age in years) + 6.315*(sex) – 3.2649*(time in minutes) – 0.1565*(HR) where sex is "0" for women.[19]

Clinical Measures

The whole blood sample was used to measure HbA1c, total cholesterol, HDL-c and LDL-c, triglycerides and blood glucose. HbA1c and blood lipids were analyzed using the DS6 HbA1c analyzer (Drew Scientific Group, Dallas, TX) and the Cho-

Table 1
Baseline Characteristics of Study Volunteers (N = 41)

Parameter	Mean ± SD
Age (years)	49.3 ± 12.1
Height (cm)	162.3 ± 6.1
Weight (kg)	94.3 ± 18.5
BMI (kg/m2)	35.7 ± 6.2
HbA1C (%)	6.4 ± 1.1
Total cholesterol (mg/dL)	176.2 ± 31.9
LDL-c (mg/dL)	93.6 ± 26.9
HDL-c (mg/dL)	53.2 ± 14.9
Triglycerides (mg/dL)	147.3 ± 85.4
Glucose (mg/dL)	118.3 ± 37.4
Sit and reach score (cm)	18.2 ± 7.4
Chair stand test (number of repeats)	12.4 ± 1.9
Estimated VO_2 max (ml/kg/min)	25.7 ± 6.1

Note.
Mean and Standard deviation (SD) of study volunteers that started the study, including the ones that dropped out, and were not included in the final analyses.

lestech LDX System (Cholestech, Hayward, CA). Fasting insulin concentration was measured from plasma samples using RIA kits (Millipore Corp, Billerica, MA). Homeostatic Model Assessment Insulin Resistance (HOMA-IR) was calculated using HOMA-IR = [(fasting glucose (mg/dL) x fasting insulin(mU/mL))/405][20] Quantitative Insulin Sensitivity Check Index (QUICKI) was calculated as QUICKI = 1/[log(fasting insulin (mU/mL)) + log(fasting glucose (mg/dL))][21]

Attitudes towards Exercise/Physical Activity

Participants were asked to fill out 3 questionnaires: PNSE (Psychological Needs Scale for Exercise), BREQ2 (Exercise Regulations Questionnaire) and FPAI (Feelings about Physical Activity Inventory). PNSE assesses the participants autonomy, competence and relatedness. FPAI measures the participant's commitment to exercise and enjoyment derived from it, and the BREQ2 measures motivation to exercise - along with several components of it such as *amotivation* (lack of motivation), *external regulation* (rewards vs punishments for activity), *introjected regulation* (involved ego and approval-seeking for activity), *identified regulation* (recognized value of activity), and *intrinsic regulation* (internal enjoyment of activity). All these questionnaires, in addition to being commonly used, also have been validated in adult women to measure the components of motivation and attitudes towards physical activity.[22-24]

Intervention

Following baseline measurements, the participants completed a 16-week dance intervention. Zumba® dance classes were held 3 times a week (1 hour/class) and were led by a certified Zumba® instructor. Because study participants were previously sedentary, the instructor ramped up the intensity of the workout during weeks 1 through 3. The intensity of the class started out with the instructor first walking the participants through the moves for each song prior to actually performing it in sequence. By the third week, the participants had acclimated to mirroring the moves, so there was no interruption in the pace of the class, increasing the intensity of this aerobic workout. Compliance to the regimen was recorded by attendance to the exercise sessions each day by study personnel. Percent compliance was calculated as total number of classes attended over total number of classes offered expressed as a percentage. Compliance to the intervention was recorded by study personnel.

Twice during the intervention (week 1 and week 15), heart rate (HR) and blood glucose were collected during the dance classes. For HR, all volunteers wore a HR monitor (chest strap and watch) (FT7 Heart Rate Monitor Watch, Polar USA, Lake Success, NY) once during the first 2 weeks of the intervention, and again once during the last week of the intervention. Using this HR measurement, HR reserve (HRR) was calculated as previously described.[25] A One-touch glucose meter (Life-Scan, Milpitas, CA) was used to measure blood glucose immediately before and after the class.

Within one week following the completion of the 16-week Zumba® intervention, participants returned for post-testing, and were asked not to exercise for a minimum of 24 hours before their post-tests. All of the procedures from the baseline visit were repeated.

All statistical analyses were done using R Statistical Software. Because a Shapiro-Wilk test indicated non-normal data in our outcome measures, we log transformed the data to use in further analyses. To identify differences between pre-and post-intervention anthropometric, fitness and clinical measures for the study participants, paired t-tests were used, with a Benjamini-Hochberg FDR correction for multiple comparison errors. Additionally, the participants were categorized into "Below Normal" (<12), "Above Normal" (>17), and "Normal" (12-17) for the chair stand test, and "Needs Improvement" (≤23), "Fair" (24-33), and "Good" (33-37) for the sit and reach test at baseline and post intervention.[26] The cutoff values for these tests (given within parentheses), as established by the American College of Sports Medicine (ACSM), are used commonly in field test scenarios, and are both age and sex appropriate. A chi-square test was used to evaluate the proportion (percentage distribution) of volunteers in each category for these fitness tests between baseline and post-intervention. To see if the intervention affected the DM and ND groups differently in anthropometric, fitness, clinical measures, and questionnaires, 2-way within subject analysis of variance (ANOVA) with Tukey's *post hoc* tests, where necessary, were done.

RESULTS

Overall, 115 T2DM and overweight/obese women were screened. Of these, 22 women did not meet the inclusion criteria and 52 women could not commit to being present for the Zumba® classes, either because they had prior commitments (such as travel or moving during the 16-week period) or were unable to meet in the evening for the Zumba® classes because of work, child care responsibilities, or other activities. Therefore, a total of 41 women (18 DM and 23 ND) completed baseline testing (baseline information provided in Table 1). Six women dropped out within the first month, due to the strenuousness of Zumba®, and 4 more dropped out during the second month due to knee, ankle, or joint inflammation. Toward the end of the third month, 3 more dropped out due to switching work shifts or other personal reasons. Therefore, 28 women (68% retention of original study sample, 78% retention in the DM group, and 61% in the ND group) completed the 16-week intervention. The overall compliance to the dance classes was 74.4%. Compliance tended to be higher in the DM group than the ND group (78.7% ± 3.2% vs 70.0% ± 3.6%, $p = .09$). Table 2 summarizes the characteristics of the study volunteers that participated in this Zumba® dance intervention. The participants were 50.5 ± 1.8 years of age, and 19 of the 28 women were postmenopausal. Participants showed a significant reduction in body weight (-1.06±0.56 kg, $p = .04$), body fat % (-1.2±0.6%, $p = .05$), BMI (-0.39±0.19kg/m^2, $p = .04$), waist circumference (-3.82 ± 0.82cm, $p < .01$), and hip circumference (-2.94±1.35cm, $p = .04$). However, no significant changes in the waist to hip ratio, systolic or diastolic blood pressure, blood lipids, fasting glucose, insulin, insulin sensitivity or resistance or HbA1c were identified.

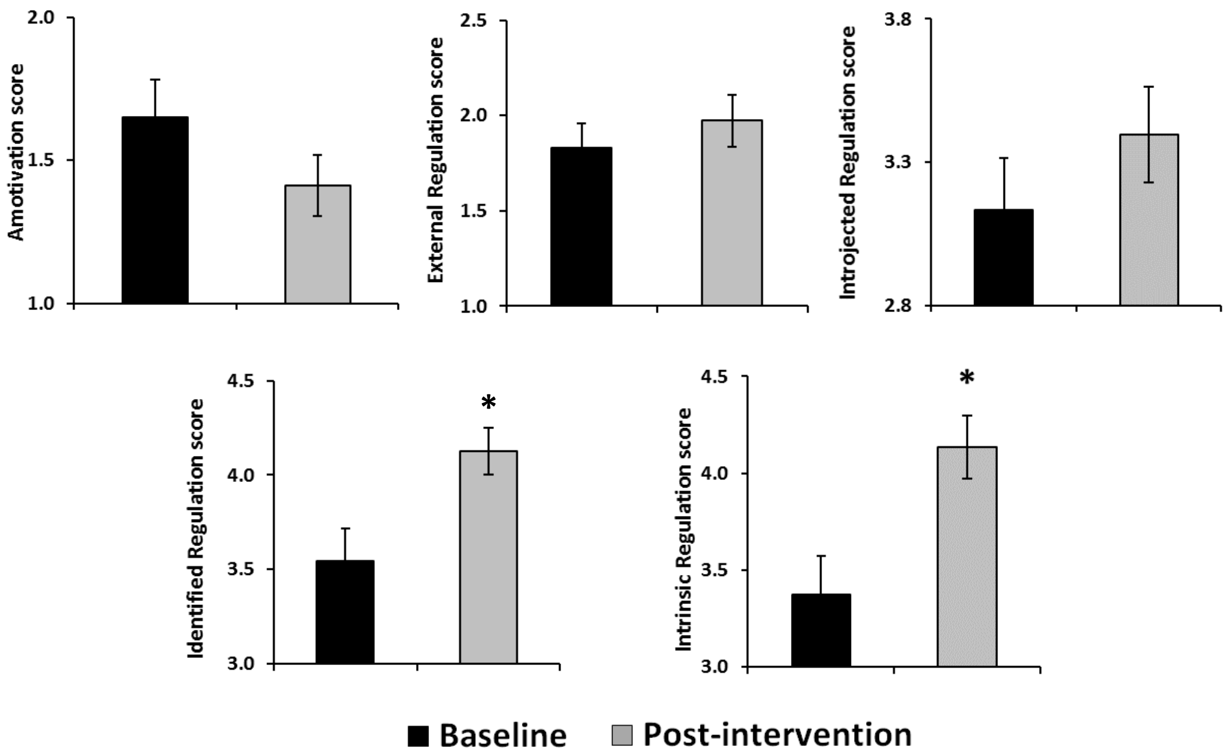
There was a significant improvement in aerobic capacity (1.08±0.41ml/kg/min, $p = .02$), flexibility (3.43±1.25cm, $p < .01$), and muscular endurance (1.43±0.69 chair stands, $p < .01$ (Table 2)). Both the chair stand test and the sit and reach test have classifications for individuals. Table 3 represents the population distribution based on their classification into "Below, Above, or Normal" for chair stand test scores, and "Needs Improvement, Fair, and Good" for the sit and reach test. Six of 28 women (21%) improved their sit and reach score from "Needs Improvement" to "Fair" from baseline to post-intervention and another 7% (2 of 28) went from "Fair" to "Good." Additionally, 14% (4 of 28) improved their chair stand test score from "Below Normal" to "Normal" and 11% (3 of 28) improved from "Normal" to "Above Normal." A chi-square test comparing the equality of proportions in this study population revealed a significantly different distribution of "Below, Above, and Normal" for the chair stand and sit and reach test scores from before intervention to post-intervention.

There was no significant change in autonomy (*freedom to exercise*), relatedness (*social connection in a group*), and competence (*ability to succeed*) as a result of the Zumba® intervention; however, positive attitudes of motivation from BREQ-2 and positive attitudes of commitment and enjoyment from FPAI were significantly higher following the intervention (Table 2). There were no changes in negative attitudes of motivation, or in commitment or enjoyment towards exercise from pre- to post-intervention (Table 2).

Figure 1 shows the differences in *amotivation, external regulation, introjected regulation, identified regulation* and *intrinsic regulation* as a result of the intervention. Both *identified* and *intrinsic regulation* were significantly higher at post-intervention than at baseline ($p < .01$); however, none of the other motivation parameters were different.

Table 4 presents baseline and post-intervention anthropometric, and select clinical and fitness parameters by group (DM vs ND). Triglycerides, plasma glucose, HbA1c, and VO_2 max were significantly higher in the DM group, compared to the ND group ($p < .01$) at baseline. The ND group had a significantly higher BMI than the DM group ($p = .03$). The only change from baseline to post-intervention in either group was body fat %. Body fat

Figure 1
Attitudes toward Exercise



Note
Individual amotivation, external regulation, introjected regulation, identified regulation and intrinsic regulation scores before and after the 16-week Zumba® intervention. A paired t-test revealed significant differences between baseline (BL) and post-intervention (PI) Identified Regulation (p = .002) and Intrinsic Regulation (p < .001) scores. No other significant differences were identified. All data are mean ± SEM.

% was significantly reduced in the DM group after the intervention (p = .006), but not the ND group (p = .877). Negative attitudes of commitment and enjoyment (from FPAI) were significantly lower in ND and DM groups after the intervention (p < .001), and positive attitudes of motivation (from BREQ2) were significantly higher in the ND group post-intervention (p = .002), but not in the DM group (p = .177). The sub-categories – *amotivation, external regulation, introjected regulation, identified regulation* and *intrinsic regulation* from BREQ2 were not significantly different between ND and DM groups at baseline or post-intervention (data not shown).

Figure 2 shows the HR, % of estimated Max HR (max HR determined as 220-Age) reached during dance classes, and blood glucose measurements from week 1 and week 15 of the intervention. The HR and % max HR reached were significantly higher at week 15 of the class compared to week 1 (HR: p = .0049, % max HR: p = .007). The highest % Max HR reached at week 1 was 74% and week 15 was 75%. However, the difference between week 1 and week 15, primarily was in sustaining >70% of Max HR at 10 – 50 minutes at week 15, compared to going over 70% only at the 30-minute time point at week 1. At week 1, the study volunteers reached a HRR% of 74±2% during the Zumba® class, but improved to 82±2% at week 15, which was a significant change (p = .008). The difference in blood glucose from before vs the end of class was not significantly different during week 1 (-8.2 ± 4.0mg/dL, p = .309) but was different at week 15 (-15.9 ± 6.9mg/dL, p = .029).

DISCUSSION

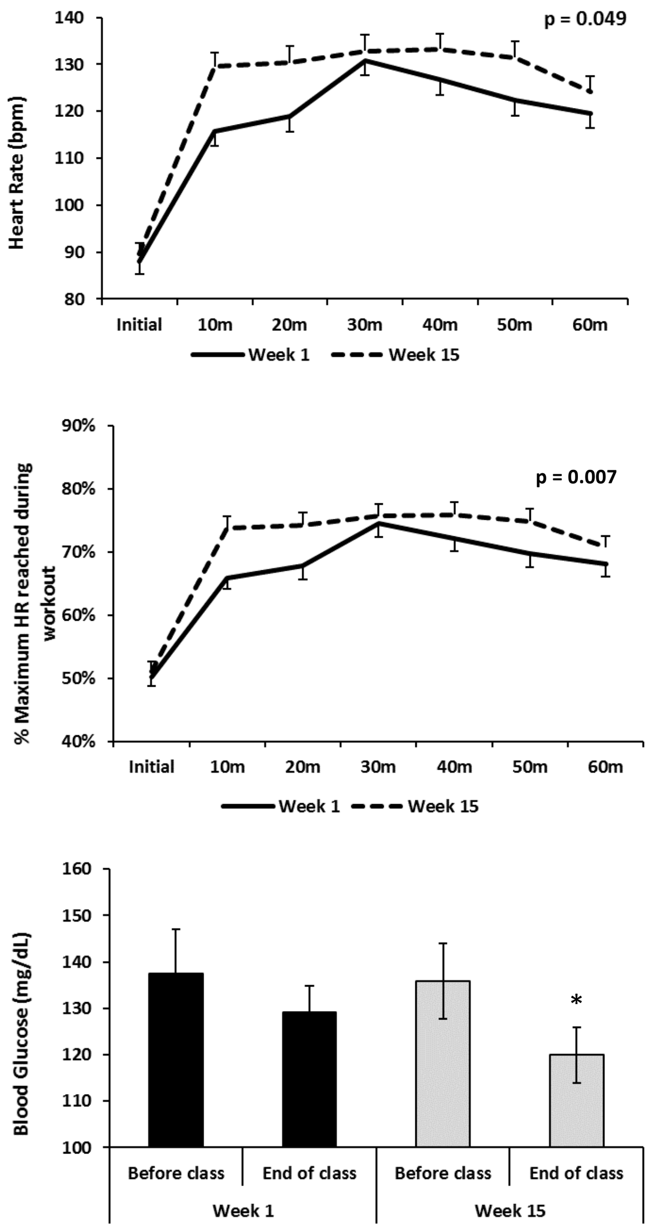
The 16-week Zumba® dance intervention was successfully completed by 28 T2DM/overweight/obese women with a 74% average compliance rate, and a 68% volunteer retention rate. We observed significant improvements in estimated VO_2 max, muscular endurance, and flexibility in these women. We also observed increased intrinsic motiva-

Table 2
Paired Comparison of before and after Parameters (N = 28)

Parameters	Baseline	Post Intervention	p-value (paired t-test)
Anthropometric Parameters			
Age (years)	50.5 ± 1.8		
Compliance (%)	74.4 ± 2.5		
Body weight (kg)	99.7 ± 4.5	98.7 ± 4.6	.040
BMI (kg/m^2)	37.3 ± 1.5	36.9 ± 1.5	.039
Body fat (%)	46.7 ± 1.0	45.5 ± 1.1	.046
Waist circumference (cm)	107.7 ± 2.7	103.9 ± 2.4	<.001
Hip circumference (cm)	127.9 ± 3.3	125.0 ± 3.9	.038
Waist:Hip ratio	0.84 ± 0.01	0.84 ± 0.02	.723
Systolic blood pressure (mmHg)	122.3 ± 3.6	115.8 ± 2.1	.133
Diastolic blood pressure (mmHg)	75.0 ± 2.2	71.9 ± 2.1	.202
Fasting Clinical Parameters			
HbA1c	6.7 ± 0.2	6.6 ± 0.2	.762
Plasma glucose (mg/dL)	126.7 ± 8.7	127.9 ± 7.0	.473
Plasma insulin (µU/mL)	17.6 ± 2.1	15.3 ± 1.7	.174
Total cholesterol (mg/dL)	173.6 ± 5.8	176.2 ± 5.9	.663
LDL-c (mg/dL)	92.7 ± 4.5	96.9 ± 4.9	.267
HDL-c (mg/dL)	52.3 ± 2.4	53.0 ± 2.1	.655
Triglycerides (mg/dL)	144.5 ± 16.3	130.8 ± 10.7	.518
HOMA-IR	5.4 ± 0.7	4.7 ± 0.6	.162
QUICKI	0.31 ± 0.01	0.32 ± 0.01	.157
Fitness Parameters			
Sit and reach score (cm)	18.5 ± 1.5	22.8 ± 1.3	<.001
Chair stand test (number of stands)	12.2 ± 0.3	14.2 ± 0.6	<.001
VO_2 max (mL/kg/min)	23.9 ± 1.4	25.6 ± 1.4	.023
Questionnaire Responses			
BREQ-2 Positive score	25.2 ± 1.2	29.9 ± 0.9	<.001
BREQ-2 Negative score	25.6 ± 1.2	26.6 ± 1.0	.361
FPAI Positive score	23.1 ± 0.9	24.3 ± 0.8	.024
FPAI Negative score	17.1 ± 0.8	14.5 ± 0.9	.002
PNSE- Competence	22.6 ± 1.2	22.5 ± 0.9	.909
PNSE-Autonomy	24.2 ± 0.9	25.6 ± 0.8	.068
PNSE-Relatedness	23.4 ± 1.0	25.5 ± 0.9	.382

Note.
We used t-tests to compare all data, presented as mean ± SEM. Bolded p values denote a significant change from baseline to post intervention at $p \leq .05$.
BMI – Body Mass Index, $HbA1_c$ – Hemoglobin $A1_c$, LDL-c – Low Density Lipoprotein cholesterol, HDL-c – High Density Lipoprotein Cholesterol, HOMA-IR – Homeostatic Model of Insulin Resistance, QUICKI – Quantitative Insulin Sensitivity Check Index, VO_2 – Volume of Oxygen, BREQ2 – Physical activity Regulation Questionnaire, FPAI – Feelings about Physical Activity Inventory, PNSE – Psychological Need Satisfaction in Exercise Scale.

Figure 2
Exercise Intensity and Blood Glucose



Note
Comparison of week 1 to week 15 of the Zumba regimen heart rate during class (top), %Maximum HR reached during class (mid) and blood glucose before and immediately after the end of class (bottom). There was a significant difference between the beginning (week 1) and the end of the intervention (week 15) in HR achieved during the workout. Blood glucose was significantly lower at the end of class than before class at week 15 (p = .029, indicated by '*'), but not at week 1 (p = .309). All data are mean ± SEM.
"*" - significantly different from baseline, p ≤ .05
HR = heart rate
m = time in minutes
bpm = beats per minutes

Table 3
Improvement in Fitness Tests after the Intervention

	Baseline			Post Intervention			
	Below Normal (% of total)	Above Normal (% of total)	Normal (% of total)	Below Normal (% of total)	Above Normal (% of total)	Normal (% of total)	χ^2 value
Chair stand test	25%	0%	75%	21%	11%	68%	0.003*
Sit-and-reach test	64%	36%	0%	54%	39%	7%	0.019*

Note.
A chi-square test for equality of proportions between baseline and post-intervention revealed significant differences.
"Below Normal," "Above Normal," and "Normal" for the chair stand test
"Needs Improvement," "Fair," and "Good," for the Sit and reach test
"*" Difference between baseline and post-intervention $p \leq .05$

tion and positive attitudes towards exercise. The Zumba® intervention was also successful in reducing body weight, BMI and body fat%.

Only 3 previous studies on Zumba® dance have been published. A pilot study by Araneta and Tanori[14] evaluated the efficacy of a 12-week Zumba® dance intervention in overweight/obese women with or without metabolic syndrome. However, the intervention had less frequent Zumba® classes (classes met twice a week), had half as many participants (N = 13), and was for a shorter duration (12 weeks). They did observe a 0.94kg weight loss (similar to the ~1kg weight loss we saw), and reported a reduction in fasting triglycerides in individuals that were not on dyslipidemic drugs, which we did not evaluate. Barene et al[11] reported significant improvements in aerobic capacity (5% increase) and body fat loss (-0.6kg) with a 12-week Zumba intervention®. Despite a different participant population in our study, we observed comparable changes (a 7% increase in aerobic capacity, and a 0.69 kg body fat loss). Finally, Donath et al[12] also showed improvements in cardiovascular and neuromuscular function (trunk flexibility, lower extremity strength, and balance) in a healthy, population of college-aged women following an 8-week Zumba® intervention. We identified improvements in flexibility and strength in our older sample as well. Therefore, it appears that Zumba® can be an effective means to improve a number of health parameters, especially if done regularly

Compliance and Retention of Volunteers

We used several methods of advertising to increase interest in the study. However, both our advertisement materials and the telephone screening did not inform the volunteers of the exact days and time of day that the Zumba® classes would be held. After the screening process was complete, qualified individuals were told about the days and times of the dance classes. Unfortunately, several of the screened volunteers were unable to accommodate the times the dance classes were being offered, and therefore, could not participate. This accounted for ~70% of the dropout rate we had between screening and baseline testing (52 of the 74 women). We also offered a meager financial compensation for study participants, primarily for their time at the baseline and post-intervention study visits; however, we do not believe this greatly affected our participation and retention results. Participants also were given access to their health information (data collected for study at the baseline and post-intervention visits) as another benefit of participating in the study.

Exercise interventions have high attrition rates (typically ranging between 25% and 50%[27]) and report an average compliance of 66%.[28] In our study, the attrition rate was 32% (68% retention), which falls within the previously reported range. Whereas the Araneta and Tanori [14] Zumba® intervention study in previously sedentary adults retained 89% of participants, this could be due to the larger sample size, more dance classes per week, and the longer intervention in our study compared to theirs. We cannot speak to the intensity of exercise in their study because it was not reported. Based on our HR data, our dance classes were moderate to vigorous intensity exercise, which is also in accordance to ACSM's recommendations.

Approximately 30% of our dropouts were due to Zumba® related physical injury or pain which is similar to what has been previously reported with Zumba®.[29] Previous studies reporting injuries sustained by other recreational activities;[30] specifically, dancers[31] have been affected by injuries to the hip, lower back, ankle and foot, which was our observation as well. Dancing places a demand on endurance, and several aspects of musculoskeletal strength and flexibility, more than other forms of exercise,[32] and a sedentary population such as ours would be more susceptible to such injuries.

Table 4
Comparing Diabetic (DM, N = 14) and Non-diabetic (ND, N = 14) Volunteers

	Baseline		Post-intervention	
	DM	ND	DM	ND
Age (years)	53.0 ± 2.2	48.0 ± 2.9	-	-
Body weight (kg)	91.1 ± 4.3	108.3 ± 7.3	90.4 ± 4.4	106.9 ± 7.6
BMI (kg/m^2)	34.1 ± 1.4	40.5 ± 2.4*	33.9 ± 1.5	39.9 ± 2.5*
Body fat (%)[a]	45.7 ± 1.3	47.7 ± 1.4	43.5 ± 1.3$	47.5 ± 1.6
Systolic blood pressure (mmHg)	126.2 ± 5.4	118.7 ± 4.9	115.5 ± 3.6	116.1 ± 2.2
Diastolic blood pressure (mmHg)	75.4 ± 3.2	74.7 ± 3.1	69.6 ± 3.3	74.1 ± 2.6
HbA1c (%)	7.7 ± 0.3	5.7 ± 0.1*	7.4 ± 0.2	5.9 ± 0.1*
Plasma glucose (mg/dL)	155.7 ± 12.7	97.5 5.1*	150.8 ± 9.8	105.1 ± 5.4*
Plasma insulin (µU/mL)	15.0 ± 2.2	20.2 ± 3.7	15.2 ± 2.0	15.5 ± 2.9
Total cholesterol (mg/dL)	177.3 ± 5.7	170.2 ± 10.3	175.9 ± 6.6	176.5 ± 10.1
LDL-c (mg/dL)	91.3 ± 5.6	94.0 ± 7.1	93.7 ± 5.5	100.2 ± 7.9
HDL-c (mg/dL)	52.5 ± 3.5	52.1 ± 3.3	52.3 ± 2.8	53.8 ± 3.3
Plasma triglycerides (mg/dL)	166.6 ± 19.6	122.4 ± 25.4*	149.6 ± 16.8	111.9 ± 12.0*
Sit and reach score (cm)	21.1 ± 2.6	16.0 ± 1.3	24.5 ± 1.8	19.4 ± 2.3
Chair stand score (number of stands)	11.9 ± 0.5	12.5 ± 0.4	14.2 ± 0.9	13.1 ± 1.1
VO_2 max (mL/kg/min)	27.1 ± 1.6	20.8 ± 2.1*	28.1 ± 1.4	21.8 ± 2.3*
BREQ-2 Positive score[a]	27.1 ± 1.6	23.3 ± 1.7	31.4 ± 0.9	28.4 ± 1.4$
BREQ-2 Negative score	25.4 ± 1.4	25.9 ± 2.1	27.3 ± 1.3	26.0 ± 1.7
FPAI Positive score	25.0 ± 1.0	21.3 ± 1.4	26.2 ± 0.9	22.4 ± 1.1
FPAI Negative score	16.2 ± 1.0	17.9 ± 1.3	13.4 ± 1.2$	15.6 ± 1.3$
PNSE- Competence	24.9 ± 1.4	20.2 ± 1.6	23.6 ± 1.3	21.4 ± 1.5
PNSE-Autonomy	23.2 ± 1.3	25.1 ± 1.4	26.6 ± 0.9	25.2 ± 1.4
PNSE-Relatedness	24.4 ± 1.5	22.4 ± 1.5	25.7 ± 1.3	23.4 ± 1.4

Note.
Two-way ANOVA indicated significant differences among groups or between baseline and post-intervention. All data are mean ± SEM
"*" Difference between groups, $p < .05$
"$" Difference from baseline to post-intervention, $p < .05$
BMI – Body Mass Index, $HbA1_c$ – Hemoglobin $A1_c$, LDL-c – Low Density Lipoprotein cholesterol, HDL-c – High Density Lipoprotein Cholesterol, VO_2 – Volume of Oxygen, PNSE – Psychological Needs Scale in Exercise, FPAI – Feelings about Physical Activity Inventory, BREQ-2 – Exercise Regulations questionnaire.
a Significant interaction between participant type(DM or ND) and test times (baseline vs post-intervention)

Despite evidence to support the demand placed by dancing on the body and the toll it might take, it was necessary to test the impact of this new type of intervention (Zumba® dance) in previously sedentary women in a way that would adhere to ACSM's guidelines for exercise.

Individual personality differences[33] and previous exercise habits and experiences[34] may play a role in determining persons' stay in an exercise program. A closer examination of our study dropouts compared to completers (13 vs 28), did not show baseline differences in anthropometric, fitness, or attitudinal measures. However, HbA1c levels were different (completers: 6.6% vs 5.9%, p = .042). As we had indicated earlier, we had greater retention in the DM group compared to the ND group, and we believe having been diagnosed with T2DM may have provided the additional motivation to stay in the intervention. A diagnosis with being overweight or obese with strong caution about prognosis for health from primary care physicians might elevate physical activity habits in otherwise sedentary individuals. With this in mind, our success in sustaining a 74% compliance rate leads us to consider Zumba® to be a feasible and sustainable exercise program, with the caveat that the volunteers understood the benefits of exercise. Future studies could investigate impact of different styles and intensities of instructors, increased or reduced class frequency, opportunities for different class times, and barriers to getting to classes to evaluate how these factors influence compliance and retention. Finally, a crucial component of success in exercise interventions is measured by long term sustainability of the program, because ~50% of individuals starting an exercise program are likely to quit within the first 6 months.[35] We did not plan on conducting a follow-up after the conclusion of the intervention. Therefore, future studies evaluating a Zumba® intervention in a high-risk, previously sedentary population, could include measurements on the difficulty of exercise due to intensity, and include a post-intervention follow-up on the sustainability of Zumba®.

Improvement in Health Outcomes

The Zumba® intervention improved Intrinsic Regulation and Identified Regulation, which are both aspects of intrinsic motivation.[36] Intrinsic motivation enables individuals to perform actions due to enjoyment of the activity or identifying with its positive outcomes, and is more effective in maintaining compliance to exercise.[37] We believe that the improvement in intrinsic motivation scores in our study is because Zumba® is a fun, sustainable form of physical activity for women, and we also speculate that this could lead to long term adherence to an exercise program. A couple of earlier studies have compared dancing and traditional forms of exercise (such as running or biking);[26,38,39] however, only one compared change in motivation as a result of these interventions. Kaltsatau et al[24] compared dance and a traditional exercise program in men recovering from congestive heart failure. They found that the dance intervention showed equal improvements in health outcomes compared to the traditional exercise program, with significantly larger increases in intrinsic motivation.[24] Our study supports this notion as well and points towards the potential for sustainability of exercise with a fun form of exercise, such as dance.

Exercise reduces body weight, improves insulin secretion, and helps maintain glycemia in individuals with T2DM.[40] Here, we have shown that a 16-week Zumba® program is effective in reducing body weight and body fat in previously sedentary women. The change in body weight from pre- to post-intervention ranged from -10.5 to +4.4kg. The average weight loss seen in this study (1.06 ± 0.55kg) is comparable to that found in several previous weight loss studies that reported weight loss ranging between 1-3 kg.[41-44] Therefore, the weight loss we saw in our study, despite the lack of dietary and other lifestyle modifications that help induce weight loss, is an additional benefit from the Zumba® intervention. Finally, in addition to inducing weight loss and body fat loss, our Zumba® intervention was effective in improving physical fitness. Aerobic or cardiorespiratory fitness, muscular endurance and flexibility are closely linked to reduction in cardiovascular disease risk in T2DM individuals.[45] Because T2DM can precipitate a number of confounding chronic illnesses, including cardiovascular complications, improving aerobic fitness is crucial.[46]

Limitations

Limitations of this study include the relatively small sample size when splitting up the participants to compare DM to ND groups and the lack of a control group. This limits our ability to extrapolate our results conclusively. We also cannot exclude dietary changes from pre- to post-intervention as a contributor to the weight loss observed here. We also did not do any follow-up measures, so the sustainability of such an intervention remains to be determined and should be investigated. Future studies comparing change in positive attitudes towards physical activity, and motivation scores between a Zumba® intervention and other forms of aerobic exercise, such as running or walking, could re-affirm our speculation about Zumba® providing greater motivation and, therefore, better adherence to an exercise program. However, despite these limitations, the changes we observed in several health parameters become clinically relevant in at-risk or diabetic individuals.

Conclusion

In conclusion, we identified that Zumba® dance is a potentially suitable form of exercise to introduce and sustain activity in previously sedentary women. Having a chronic disease diagnosis such as T2DM seemed to increase compliance and volunteer retention, more than individuals who are overweight or obese but did not have T2DM. Further, Zumba® is a high intensity workout that can improve several markers of physical fitness, increase intrinsic motivation to exercise, and is an effective means of reducing body weight and body fat %. Finally, more studies are required to determine if Zumba® is a good option for exercise prescription, because our participant retention rate was moderate and there is a risk of injury with this form of exercise. Yet, the positive health outcomes indicate promise for the feasibility of Zumba® in adult women who are overweight/obese or have T2DM.

Human Subjects Statement

The study was approved by the Institutional Review Board (IRB) at Texas Tech University Health Sciences Center. All volunteers signed a written informed consent form approved by the IRB as well (Study ID No: L12-111). All study practices adhered to the approved study protocol and IRB standards.

Conflict of Interest

The authors declare no conflict of interest.

References

1. American Diabetes Association. Your Risk. (on-line). Available at: http://www.diabetes.org/diabetes-basics/prevention/risk-factors/. Accessed Septmber 15, 2013.
2. Kahn SE, Hull RL, Utzschneider KM. Mechanisms linking obesity to insulin resistance and type 2 diabetes. *Nature.* 2006;444(7121):840-846.
3. Barnes AS. Emerging modifiable risk factors for cardiovascular disease in women: obesity, physical activity, and sedentary behavior. *Tex Heart Inst J.* 2013;40(3):293-295.
4. Winnick JJ, Sherman WM, Habash DL, et al. Short-term aerobic exercise training in obese humans with type 2 diabetes mellitus improves whole-body insulin sensitivity through gains in peripheral, not hepatic insulin sensitivity. *J Clin Endocrinol Metab.* 2008;93(3):771-778.
5. Umpierre D, Ribeiro PA, Kramer CK, et al. Physical activity advice only or structured exercise training and association with HbA1c levels in type 2 diabetes: a systematic review and meta-analysis. *JAMA.* 2011;305(17):1790-1799.
6. Selected estimates based on data from the January–September national health interview survey 2007. *Leisure-time Physical Activity.* Centers for Disease Control and Prevention. 2010. Available at: http://www.cdc.gov/nchs/nhis/released200803.htm#7. Accessed August 31, 2014.
7. Napolitano MA, Papandonatos GD, Borradaile KE, et al. Effects of weight status and barriers on physical activity adoption among previously inactive women. *Obesity.* 2011;19(11):2183-2189.
8. Ali H, Baynouna LM, Bernsen RM. Barriers and facilitators of weight management: perspectives of Arab women at risk for type 2 diabetes. *Health Soc Care Community.* 2010;18(2):219-228.
9. Bremer Z. Dance as a form of exercise. *Br J Gen Pract.* 2007;57(535):166.
10. Kaltsatou A, Kouidi EI, Anifanti MA, et al. Functional and psychosocial effects of either a traditional dancing or a formal exercising training program in patients with chronic heart failure: a comparative randomized controlled study. *Clin Rehabil.* 2014;28(2):128-138.
11. Barene S, Krustrup P, Jackman SR, et al. 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.
12. Donath L, Roth R, Hohn Y, et al. The effects of Zumba training on cardiovascular and neuromuscular function in female college students. *Eur J Sport Sci.* 2014;14(6):569-577.
13. 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.
14. American College of Sports Medicine. ACSM Position Stand on Physical Activity and Weight Loss Now Available (on-line). Available at: http://www.acsm.org/about-acsm/media-room/acsm-in-the-news/2011/08/01/acsm-position-stand-on-physical-activity-and-weight-loss-now-available. Accessed July 30, 2014.
15. Adamsen L, Midtgaard J, Rorth M, et al. Feasibility, physical capacity, and health benefits of a multidimensional exercise program for cancer patients undergoing chemotherapy. *Support Care Cancer.* 2003;11(11):707-716.
16. Baltaci G, Un N, Tunay V, et al. Comparison of three different sit and reach tests for measurement of hamstring flexibility in female university students. *Br J Sports Med.* 2003;37(1):59-61.
17. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. *Res Q Exerc Sport.* 1999;70(2):113-119.
18. Kline GM, Porcari JP, Hintermeister R, et al. Estimation of VO_2max from a one-mile track walk, gender, age, and body weight. *Med Sci Sports Exerc.* 1987;19(3):253-259.
19. Seneli RM, Ebersole KT, O'Connor KM, Snyder AC. Estimated VO_2max from the Rockport Walk Test on a non-motorized, curved treadmill. *J Strength Cond Res.* 2013;Epub ahead of print.
20. Wallace TM, Levy JC, Matthews DR. Use and abuse of HOMA modeling. *Diabetes Care.* 2004;27(6):1487-1495.
21. Katz A NS, Mather K, Baron AD, et al. Quantitative insulin sensitivity check index: a simple, accurate method for assessing insulin sensitivity in humans. *J Clin Endocrinol Metab.* 2000;85(7):2402-2410.
22. Wilson PM, Rogers WT, Rodgers WM, Wild TC. The psychological need satisfaction in exercise scale. *J Sport Exerc Psychol.* 2006;28(3):231-251.
23. Markland D, Tobin V. A modification to the behavioural regulation in exercise questionnaire to include an assessment of amotivation. *J Sport Exerc Psychol.* 2004;26(2):191-196.
24. Corbin CB, Nielsen AB, Borsdorf LL, Laurie DR. Commitment to physical activity. *Int Jf Sport Psychol.* 1987;18(3):215-222.
25. Segerstrom AB, Glans F, Eriksson KF, et al. Impact of exercise intensity and duration on insulin sensitivity in women with T2D. *Eur J Intern Med.* 2010;21(5):404-408.
26. Howley E, Thompson D. *Fitness Professional's Handbook: 6th Edition.* Champaign: Human Kinetics; 2012:137, 193.
27. Linke SE, Gallo LC, Norman GJ. Attrition and adherence rates of sustained vs. intermittent exercise interventions. *Ann Behav Med.* 2011;42(2):197-209.
28. Dishman RK. *Exercise Adherence: Its Impact on Public Health.* Champaign: Human Kinetics Books; 1988:5-9.
29. Inouye J, Nichols A, Maskarinec G, Tseng CW. A survey of musculoskeletal injuries associated with zumba. *Hawaii J Med Public Health.* 2013;72(12):433-436.
30. Luciano Ade P, Lara LC. Epidemiological study of foot and ankle injuries in recreational sports. *Acta Ortop Bras.* 2012;20(6):339-342.
31. Jacobs CL, Hincapie CA, Cassidy JD. Musculoskeletal injuries and pain in dancers: a systematic review update. *J Dance Med Sci..* 2012;16(2):74-84.
32. Motta-Valencia K. Dance-related injury. *Phys Med Rehabil Clin N Am.* 2006;17(3):697-723.
33. Flegal KE, Kishiyama S, Zajdel D, et al. Adherence to yoga and exercise interventions in a 6-month clinical trial. *BMC Complement Altern Med.* 2007;7:37.
34. Shang J, Wenzel J, Krumm S, et al. Who will drop out and who will drop in: exercise adherence in a randomized clinical trial among patients receiving active cancer treatment. *Cancer Nurs.* 2012;35(4):312-322.
35. Dishman RK. *Exercise Adherence: Its Impact on Public Health.* Champaign: Human Kinetics Books; 1988:21.
36. Ryan RM, Deci EL. Intrinsic and extrinsic motivations: classic definitions and new directions. *Contemporary Educational Psychology.* 2000;25(1):5,35.
37. Deci E, Ryan, RM. *Intrinsic Motivation and Self-Determination in Human Behavior.* New York: Springer; 1985:54-67.
38. Belardinelli R, Lacalaprice F, Ventrella C, et al. Waltz dancing in patients with chronic heart failure: new form of exercise training. *Circ Heart Fail.* 2008;1(2):107-114.
39. Kaltsatou AC, Kouidi EI, Anifanti MA, et al. Functional and psychosocial effects of either a traditional dancing

or a formal exercising training program in patients with chronic heart failure: a comparative randomized controlled study. *Clin Rehabil.* 2014;28(2):128-138.

40. Sigal RJ, Kenny GP, Wasserman DH, et al. Physical activity/exercise and type 2 diabetes: a consensus statement from the American Diabetes Association. *Diabetes Care.* 2006;29(6):1433-1438.
41. Hill BR, De Souza MJ, Wagstaff DA, Williams NI. The impact of weight loss on the 24-h profile of circulating peptide YY and its association with 24-h ghrelin in normal weight premenopausal women. *Peptides.* 2013;49:81-90.
42. Ueda SY, Miyamoto T, Nakahara H, et al. Effects of exercise training on gut hormone levels after a single bout of exercise in middle-aged Japanese women. *SpringerPlus.* 2013;2(1):83.
43. Guelfi KJ, Donges CE, Duffield R. Beneficial effects of 12 weeks of aerobic compared with resistance exercise training on perceived appetite in previously sedentary overweight and obese men. *Metabolism.* 2013;62(2):235-243.
44. Mason C, Foster-Schubert KE, Imayama I, et al. Dietary weight loss and exercise effects on insulin resistance in postmenopausal women. *Am J Prev Med.* 2011;41(4):366-375.
45. Balducci S, Zanuso S, Cardelli P, et al. Changes in physical fitness predict improvements in modifiable cardiovascular risk factors independently of body weight loss in subjects with type 2 diabetes participating in the Italian Diabetes and Exercise Study (IDES). *Diabetes Care.* 2012;35(6):1347-1354.
46. Barengo N, Antikainen R, Peltonen M, Tuomilehto J. Changes in all-cause and cardiovascular disease mortality in three different Finnish population cohorts with and without diabetes. *Int J Cardiol.* 2013;S0167-5273(13):01449-01446.