

## 12-WEEKS OF AQUA ZUMBA FITNESS® AND METABOLIC SYNDROME IN OBESE WOMEN

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### Abstract

**Background:** The rate of obesity is consistently increasing in Malaysia, especially among women, which exposes the population to various metabolic and other mortality diseases. The aim of this study was to compare the effect of 12 weeks of Aqua Zumba® Fitness programmes on metabolic diseases indicators for obese young and middle-age women. **Methods:** Eighty previously sedentary obese (BMI >30 kg/m<sup>2</sup>) women (age 20-59 years old) were randomized to either a 12-week Aqua Zumba® regimen (AZ, n=40) or control group (C, n=40). Experiment group were involved in 12-weeks of Aqua Zumba® Fitness programmes, 3 times per week, 60 minutes per session, with an intensity of 50-75% of maximum heart rate. Body fat percentage (BF%), visceral fat (VF), waist circumference (WC), resting blood pressure (RBP), blood glucose (BG), and blood lipids (HDL and TG) were measured at baseline (week-0) and post-exercise intervention (week-13). **Result:** A significant difference ( $p<0.05$ ) was found in changes of BF%, VF, WC, RBP, BG, HDL, and TG following 12-weeks of Aqua Zumba® Fitness programmes in both obese young and middle-age groups. However, the obese young group demonstrated significant superior changes with improvements of BF%, WC, and BG ( $p<0.05$ ) compared to obese middle-age group. **Conclusion:** As a result, Aqua Zumba® Fitness elicits favorable changes in all metabolic parameters among obese women. Furthermore, the aging process affects metabolic responses towards exercise, with less prolific results in improvement of BF%, WC, and BG found in the middle-age group.

**Keywords:** Aqua Zumba, aqua exercise, metabolic syndrome, obesity

## **Introduction**

Obesity has increased dramatically across the globe and this trend is likely to continue in the coming years. Obesity is strongly associated with the risk of type 2 diabetes, cardiovascular disease, hypertension, certain types of cancers, and even mortality. Malaysia has been recognized as Asia's fattest country, with almost half of the population either overweight or obese. Obesity rate increased drastically from 4.4% in 1996 to 14% in 2006, then rises to 15.1% in 2011 and continued to increase to 17.7% in 2015 (IPH, 2015). Based on the latest reports, over half a million adults were obese and this appears to be more prevalent among women (16.7%) than men (11.4%) (Ghee, 2016; WHO, 2017).

High body mass index (BMI > 30kg/m<sup>2</sup>) due to excessive fat accumulation is a major cause for metabolic syndrome, thus escalating the risk for various chronic non-communicable diseases and mortality (James, Rigby, & Leach, 2004). Weight gain is substantially associated with increases in fasting blood glucose levels, triglycerides, blood pressure, large abdominal circumference, and low levels of high density lipoprotein cholesterol (James et al., 2004). According to National Cholesterol Educational Program Adult Treatment Panel (NCEP ATP III, 2005), a combination of three or more of these factors is termed a metabolic syndrome, one of the most widely used diagnostic set of criteria for metabolic syndrome (Huang, 2009; James et al., 2004). Scientific evidence shows that increasing obesity rates have demonstrated a parallel increase in prevalence of metabolic syndrome and incidence of type 2 diabetes, cardiovascular disease, and other related medical problems (Okura et al., 2007).

Exercise therapy has been recognized as a meaningful approach for obesity treatment as it increases energy expenditure and promotes weight loss, hence reducing susceptibility to metabolic syndrome and other related health diseases. To date, water-based exercise is becoming popular than land-based exercise and is mostly recommended to obese, disabled, elderly, healthy and pregnant women (Claesson et al., 2008; Kasprzak & Pilaczyńska-Szcześniak, 2014; Wininger, 2002). This is because water-based exercise is safer and more appropriate for these populations, as the absence of load-bearing compression on the joints reduces the risk of injury to the musculoskeletal system (Kantyka, Herman, Roczniok, & Kuba, 2015). In addition of safety purposes, water-based exercise also substantially benefits physical, mental, and social aspects of the individual (Kantyka et al., 2015). Among the wide range of water-based activities offered, Aqua Zumba® Fitness programme is in-trend among women. Aqua Zumba® Fitness is among the latest exercise programmes introduced by Zumba LLC which consists of numerous combinations of Latin-dance fitness movements with existence of Latin music. It is a form of intermittent aerobic exercise performs at moderate intensity. Based on numerous investigations of the benefits of water exercise, little is known of the effects of this latest aqua programme on metabolic syndrome improvement in obese individuals. Moreover, the differences, if any, of the effects of Aqua Zumba® between different age groups have not been fully investigated so far. Therefore, the aim of the present study was to examine the effects of 12-weeks of Aqua Zumba® Fitness programme on improving metabolic syndrome indicators among obese young and middle-age women.

## **Methodology**

### *Participants*

Participants were sedentary obese women who either study or work in University Teknologi MARA (UiTM) Shah Alam. Respondents with cardiac disease, hypertension, hypotension, diabetes mellitus, endocrine disorder, abnormal menstruation, musculoskeletal injuries, or those being treated with any type of drugs, or consuming any type of supplements were excluded. A total of 100 women aged 20 to 59 years old were chosen for this study (Table 1). The selected participants fell within three categories: 1) obese, defined as a BMI (30 to 40 kg/m<sup>2</sup>) and body fat percentage (35 to 45 percent); 2) sedentary, defined as not involved in any structured physical activities for the past six months; and 3) healthy, defined as not having any medical problems or physical disabilities. Participants were required to complete an informed consent form prior to their participation. This study was approved by Review Board of the University Teknologi MARA, 600RMI (5/1/6).

### *Research procedures*

Prior to selection of participants, screening procedures were conducted on respondents who volunteer to participate in this research project to ensure they met all criteria required. From a total of 214 women, only 100 sedentary obese women who were free from any medical problems and physical disabilities were selected and assigned 12-week of intervention programs consisting of Aqua Zumba (n=25, obese young, aged 20-39; n=25, obese middle-age, aged 40-59) or control group (n=25, obese young, aged 20-39; n=25, obese middle-age, aged 40-59). All participants in the Aqua Zumba group successfully completed 36 sessions of Aqua Zumba routines. Eight participants from control group (n=3, obese young; n=5, obese middle-age) were unable to complete the study successfully due to pregnancy (n=2), accidents (n=1), and personal reasons (n=5). Measurements of BF%, VF, WC, RBP, BG, HDL, and TG were administered by the same tester prior and following 12-week intervention period. All testing took place in exercise physiology laboratory. The objectives of this project were to examine the effects of Aqua Zumba® Fitness programme on metabolic syndrome parameters among obese women and to compare the metabolic syndrome improvement in response to Aqua Zumba® Fitness between different age groups.

### *Outcome measures*

Height was measured prior to other assessments to the nearest 0.1 cm using a bodymeter (SECA, Germany). A Bioelectrical Impedance Analysis (BIA), InBody 720 (Biospace, Korea) machine, which is commonly utilized for estimating body composition parameters, was used to measure body mass, body mass index (BMI), and body fat percentage (BF%). Waist circumference (WC) was measured to the nearest 0.1 cm horizontally at the narrowest point of the distance between xiphoid prominence and umbilicus.

The resting systolic and diastolic blood pressure levels of the participants were taken in mmHg using digital blood pressure monitor (OMRON, HEM-7130) by having the participants sit comfortably on a chair with a backrest and the cuff firmly positioned on the participant's left forearm. The arm rested on a table and parallel to heart level. The readings were taken after participants rest in sitting position for 10 minutes.

High density lipoprotein (HDL), triglyceride (TG), and glucose levels were measured from the fasting blood samples. Five millilitre venous blood samples were drawn from participants via venipuncture procedures performed by qualified medical personnel. Blood was collected into two vacutainer tubes which were yellow top with K2EDTA (lipid profiles) and grey top with potassium oxalate and sodium fluoride (glucose). All blood parameters were assayed automatically using clinical chemistry analyzer machine (Siemen ADVIA 2400, USA) performed at the Pusat Perubatan Universiti Malaya (PPUM) haematology laboratory.

#### *Aqua exercise regimens*

The participants were assigned to an exercise group to perform Aqua Zumba® Fitness routines for 3 days/week and 60 minutes per session (10-min warm-up, 45-min conditioning, 5-min stretching/cool down), led by a qualified Aqua Zumba instructor (zin id: 1220302), and supervised by two certified lifeguards for safety purposes. The Aqua Zumba® exercise routines comprised of four core rhythms (Merengue, Salsa, Cumbia, Reggaeton) that involves variations of total body movements performed in standing head-out with water level fixed near to the chest. The exercise started with basic steps, slow tempo (60-80bpm) for the first 4 weeks and progressed to combination of basic steps at slow to moderate tempo (70-100bpm) for the next 4 weeks, and finally progressed to more advanced combination of steps at moderate to fast tempo (90-110bpm) for the last 4 weeks. Exercise intensity gradually increased from 50 to 75% corresponding to participants' heart rate maximum (HRmax). Targeted exercise heart rate was monitored throughout the 12-weeks intervention using carotid palpation method performed by the participants. All participants were trained in and familiar with the correct procedures of performing carotid palpation. Table 1 present the details on Aqua Zumba® Fitness programme.

Participants were also advised not to change their caloric intake throughout the 12-week intervention as this study was mainly aimed to examine the improvement on metabolic syndrome parameters through aqua exercise programme. Participants were instructed to update their daily food diaries using three-day food records (two weekdays and one weekend) during the 12-week intervention period. Total calories consumed were monitored and calculated in weekly basis via Diet Four Plus software version 10.

**Table 1:** Aqua Zumba® Fitness programme

Rhythm/movement	Week 1 – 4	Week 5 - 8	Week 9 – 12
Merengue (side steps, front/back steps, beto shuffle)	60-80 bpm	70-100bpm	90-110bpm
Salsa (step out, two-step)			
Cumbia (step-drag,machete)	50-55% HRmax	55-65% HRmax	65-75% HRmax
Reggaeton (stomp, running man)			
Abs routines (abs crunch, pike crunch, oblique twist, torso rotations)			

*Statistical Analysis*

SPSS for Windows software was used for most of the statistical analyses. Data were analysed using a mixed within-between subject ANOVA to determine within group effect (pre and post) and between groups effect (young obese versus middle-age obese versus control obese) on all metabolic syndrome parameters. In addition, magnitude of change ( $\Delta$ ) using manual calculation ( $(V_2 - V_1 / V_1 \times 100)$ ) was also reported to compare the percentage difference between exercise groups (young obese versus middle-age obese) on variables that obtained significant within group effect. One-way analysis of variance was used to determine mean differences in caloric intake between groups (Aqua Zumba young, Aqua Zumba middle-age, control young, and control middle-age) across interventions. Data were presented as mean (*M*) and standard deviation (*SD*). Significance was set at alpha level  $p < .05$  for all tests.

**Results**

Table 2 demonstrated that there was no significant difference between groups for all physical characteristic ( $p > .05$ ) except for age ( $p < .05$ ). Therefore, we can conclude that all groups possessed equal physical dimensions.

**Table 2:** Demographic characteristics of participants by group

Variable	Exer. Mid-age	Control Mid-age	Exer. Young	Control young	P-value
Age	44.89 ± 4.37	45.36 ± 5.97	26.14 ± 5.25	27.05 ± 5.28	0.014
Height	157.91 ± 9.89	158.63 ± 8.51	160.90 ± 10.45	158.39 ± 9.76	0.082*
Weight	83.21 ± 8.85	83.23 ± 10.241	82.628 ± 9.677	81.83 ± 8.00	0.177*
BMI	33.266 ± 5.362	32.983 ± 5.432	32.946 ± 4.102	33.35 ± 4.52	0.479*
BF%	44.94 ± 5.69	45.48 ± 4.49	45.19 ± 5.21	45.25 ± 4.87	0.384*

\* $p > 0.05$  in Levene’s test for homogeneity

Both trained groups regardless of age showed significant ( $p \leq 0.05$ ) improvements in all selected metabolic indicators except for resting diastolic blood pressure ( $p \geq 0.05$ ) following 12-weeks of Aqua Zumba® Fitness programmes (Table 3). No significant changes were observed in most of metabolic parameters in both non-exercise groups ( $p \geq 0.05$ ). However, body fat percentage, waist circumference, and blood glucose were found significantly ( $p \leq 0.05$ ) increased in control mid-age group. Following Post Hoc analysis using Tukey adjustment, trained young obese women had significant superior

reductions ( $p \leq 0.05$ ) in blood glucose ( $\Delta$  35% in young; 28% in mid-age), body fat percentage ( $\Delta$  23% in young; 15% in mid-age), and waist circumference ( $\Delta$  8% in young; 4% in mid-age) compared to training middle-age obese group. However, both groups demonstrated similar reduction in visceral fat ( $\Delta$  19% in young; 16% in mid-age), triglycerides ( $\Delta$  45% in young; 43% in mid-age), and increment in HDL-C ( $\Delta$  31% in young; 29% in mid-age) with  $p \geq 0.05$  (Table 4).

Moreover, for the total caloric intake, there were no significant differences ( $p > 0.05$ ) in caloric intake among both trained groups across 12-weeks interventions. In contrast, the control mid-age group shows significant differences ( $p < 0.05$ ) in caloric intake across 12-weeks interventions with calories consumed demonstrated the highest at the final four weeks (week 10 to week 12). This indicates that only training groups maintained the same calories consumed throughout the intervention period.

**Table 3:** Metabolic syndrome parameters at baseline and following 12-week of intervention period

Variable/ baseline-post score	Exe. mid-age	Control mid-age	Exe. young	Control young
Body Fat (%)	<i>bcd</i>	<i>abd</i>	<i>acd</i>	<i>abc</i>
Baseline	44.94 ± 5.69	45.48 ± 4.49	45.19 ± 5.21	45.25 ± 4.87
Post	38.13 ± 3.31	48.10 ± 3.99	34.58 ± 4.62	44.28 ± 5.99
Visceral fat	<i>cd</i>	<i>ab</i>	<i>cd</i>	<i>ab</i>
Baseline	20.20 ± 5.45	20.72 ± 7.92	18.76 ± 6.57	19.58 ± 8.98
Post	17.01 ± 6.16	19.00 ± 9.72	15.25 ± 6.42	20.51 ± 7.39
Waist circumference (cm)	<i>bcd</i>	<i>abd</i>	<i>acd</i>	<i>abc</i>
Baseline	105.23 ± 10.92	105.85 ± 10.79	104.23 ± 9.77	105.05 ± 9.42
Post	100.76 ± 11.48	107.82 ± 9.89	97.24 ± 9.11	103.50 ± 11.41
Blood glucose (mmol/L)	<i>bcd</i>	<i>abd</i>	<i>acd</i>	<i>abc</i>
Baseline	6.84 ± 0.54	6.86 ± 2.48	6.79 ± 0.30	5.98 ± 1.10
Post	5.02 ± 0.35	7.35 ± 1.07	4.42 ± 0.32	5.36 ± 2.11
HDL-C (mmol/L)	<i>cd</i>	<i>ab</i>	<i>cd</i>	<i>ab</i>
Baseline	1.22 ± 0.32	1.26 ± 0.30	1.24 ± 0.35	1.24 ± 0.51
Post	1.57 ± 0.27	1.28 ± 0.35	1.62 ± 0.27	1.24 ± 0.41
Triglyceride (mmol/L)	<i>cd</i>	<i>ab</i>	<i>cd</i>	<i>ab</i>
Baseline	1.71 ± 0.63	1.74 ± 0.83	1.68 ± 0.32	1.54 ± 0.47
Post	0.98 ± 0.26	1.73 ± 0.47	0.93 ± 0.78	1.58 ± 0.83
Systolic BP (mmHg)	<i>cd</i>	<i>ab</i>	<i>cd</i>	<i>ab</i>
Baseline	131.59 ± 7.33	132.94 ± 11.51	129.93 ± 9.81	130.54 ± 9.75
Post	128.20 ± 6.14	131.90 ± 11.85	125.78 ± 9.21	129.83 ± 11.92
Diastolic BP (mmHg)	<i>NS</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>
Baseline	89.02 ± 9.79	87.82 ± 10.08	87.71 ± 10.45	88.54 ± 7.59
Post	87.91 ± 8.02	88.00 ± 7.39	87.01 ± 6.71	87.80 ± 9.11

Post Hoc group comparison: *a* = sig. different with exe. mid-age, *b* = sig. different with exe. young, *c* = sig. different with control mid-age, *d* = sig. different with control young. NS: no significant different

## **Discussion**

The key finding of this study was that 12 weeks of the Aqua Zumba® Fitness programme elicited significant positive changes in all metabolic syndrome parameters in both young and middle-age obese women. This is in alignment with findings from other studies on water-based exercise intervention done on various age group of overweight, obese and healthy populations (Igarashi & Nogami, 2017; Kantyka et al., 2015; Kasprzak & Pilaczyńska-Szcześniak, 2014; Yoo, Kim, & Song, 2013).

The Aqua Zumba® fitness programme has significantly reduced body fat percentage, visceral fat, and waist circumference in both training groups. It is well established that regular aerobic exercise contribute to significant reductions in body fat mass in various populations (Kantyka et al., 2015; Nuttamonwarakul, Amatyakul, & Suksom, 2012). In this case, Aqua Zumba® is also categorized as a form of aerobic exercise. Continuous rhythmic movement in large muscle groups during aerobic exercise accelerates combustion of fat (mainly subcutaneous fat) as major energy source due to activation of oxidative energy system (Klijn, van der Baan-Slootweg, & van Stel, 2007). Furthermore, aerobic exercise perform in aquatic environment further increase utilization of fat as energy source due to cool temperature of the water and its provides full body resistance (Barbosa, Marinho, Reis, Silva, & Bragada, 2009; Klijn et al., 2007). The decrement of fat mass will affect the changes in body shape which hip and abdominal circumference will reduce gradually (King, Carek, Mainous 3rd, & Pearson, 2003). However, the body metabolism rate decreases with age due to decrement in muscle protein metabolism and hormonal function (Short et al., 2003). Thus, we assumed that the young training group obtained superior reduction in body fat percentage and waist circumference compared to training middle-age group following Aqua Zumba® Fitness programme due to decrement in metabolism rate in middle-age group.

The present study has demonstrated significant alterations on lipid profiles (HDL-C and triglycerides) and blood glucose in both training groups after Aqua Zumba® Fitness programme. These findings were supported by previous work by Kantyka et al. (2015), Kasprzak and Pilaczyńska-Szcześniak (2014), Nuttamonwarakul et al. (2012). The alterations in blood lipids parameters might due to increase in lipoprotein lipase activity in skeletal muscle and adipose tissue (Tladi, Phanton, & Moffatt, 2006). Lipoprotein lipase activity was found increased after chronic exercise (ranging from five to 14 weeks) and this positively correlates with an increase in high density lipoprotein (HDL-C) and decrease in triglycerides level (Tladi et al., 2006). The mechanism probably associated with the reduction of fasting blood glucose is a decrease in insulin resistance to mediated glucose uptake by muscles during exercise and post-exercise (Nuttamonwarakul et al., 2012; Pasetti, Gonçalves, & Padovani, 2012). Regular aerobic exercise increases the number of insulin receptor in the muscle which increases insulin binding to monocyte sites. This allows muscles to utilize glucose efficiently especially during exercise, therefore decreasing glucose levels (MacArdle, Katch, & Katch, 2010).

However, training young age group ( $\Delta$  35%) see a higher reduction in fasting blood glucose compared to training middle-age group ( $\Delta$  28%) following 12-weeks Aqua Zumba® Fitness. Aging process increases insulin resistance thus affect glucose

metabolism rate during and post-exercise in middle-age group compared younger age group (Short et al., 2003). Another possible reason is that training young age group obtained greater changes in body fat percentage ( $\Delta$  23% in young; 15% in mid-age), and waist circumference ( $\Delta$  8% in young; 4% in mid-age) compared to training middle-age group, as previous studies showed that changes in waist circumference and percentage of body fat were among the factors leading to reduction in blood glucose (Kasprzak & Pilaczyńska-Szcześniak, 2014; Ross et al., 2004).

Current study found that Aqua Zumba® Fitness significantly reduced resting systolic blood pressure in both young and middle-age obese women. Torres-Ronda and Schelling i del Alcázar (2014) mentioned that water-based exercise is able to reduce blood pressure due to water properties such as the temperature, hydrostatic pressure, resistance, buoyancy and viscosity of water. A number of studies have investigated the mechanism of blood pressure reduction after dynamic aerobic aqua exercises (Brett, Ritter, & Chowienczyk, 2000; Cunha et al., 2016; Farahani et al., 2010; Igarashi & Nogami, 2017; Mouroto et al., 2009) and these studies explained the mechanism of reduction in resting systolic blood pressure after exercise training was due to the decreased of vascular resistance. Decreased vascular resistance after training is mediated by the changes in altered vascular responsiveness, changes in vascular structure, and changes in sympathetic nervous (Farahani et al., 2010). It is estimated that change in systolic blood pressure by -10 mmHg following exercise training would reduce the risk of developing coronary heart disease by 17%, major cardiovascular disease by 20%, risk of suffering stroke by 27%, and overall mortality by 13.4% (Ettehad et al., 2016; Igarashi & Nogami, 2017).

## **Conclusion**

This study indicates that 12 weeks of the Aqua Zumba® Fitness programme effectively improved metabolic syndrome indicators thus, reduce risk for metabolic related diseases and mortality in obese women. Furthermore, younger age group benefited more from this exercise especially on reducing abdominal obesity compared to older age group due to drop in body metabolism and insulin resistance due to aging. Therefore, it can be concluded that age is one of the factors that affects metabolic responses towards exercise. Since Aqua Zumba® Fitness programme was effective, it is recommended that a future study investigate the comparative effects between Aqua Zumba® Fitness and other existing water-based exercises on both male and female obese populations in improving their overall health aspects.

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