Obesity Fitness Management: Effects of Music on Physical Activity among Obese Women in Singapore

Dee DeeAyra Salle, Aman, M.S., Hashim, M.N., Loo, Fung Ying
Sports Centre, University of Malaya, Kuala Lumpur, Malaysia.
deedeefitness@gmail.com

Abstract: Globesity has permeated Asia. Singapore is not isolated from this predicament with a 10.8% obesity rate in 2010. Obesity will hamper the economic growth of a country if not overcome. This study was conducted on physical activity for obesity fitness management using music (synchronous or asynchronous) as an ergogenic aid. Notwithstanding the limitations of the obese when exercising, this study researches on bodyweight high intensity exercise on body composition, fitness and metabolic profile parameters of overweight and obese women in Singapore. Ninety two voluntary overweight and obese Singaporean adult women were allocated into two treatment groups (exercise with synchronous music and exercise with asynchronous music) and a control group (exercise with no music) over a twelve-week intervention. Clinical examination, anthropometric assessment and fitness evaluations were carried out for all participant pre and post intervention. Paired sample t-test and split plot ANOVA was conducted using SPSS version 22 (IBM SPSS Statistics, Armonk, NY, USA).In solving the research questions as to whether music (synchronous or synchronous) can be used as an ergogenic aid to physical activity to obtain optimal performance from the obese, for obesity fitness management, findings from this study showed that the physical activity intervention was effective in all the groups, notwithstanding whether its synchronous, asynchronous or with no music. Improvements were seen in all the groups with regards to BMI, weight loss and body composition as well as the fitness evaluations. In terms of serum lipid analysis, only cholesterol (total cholesterol, HDL cholesterol, LDL cholesterol, total / HDL ratio) and blood glucose showed marked differences. This multi-disciplinary study has proven positively for obesity fitness management. However, noting how music impacts on blood lipid analysis, the arguments of whether "music is in the blood" needs to be examined further. The research is important in behavioural epidemiology framework because of its direct impact on population health. As similar studies in Asia Pacific are limited, this is imperative towards knowledge in obesity fitness management in progressively urban Asia which can be used as translationals in the other progressively urbanized Asian countries.

Keywords: *Music, obesity, fitness, body composition, Singapore, women*

1. Introduction

The alarming trend in obesity reaching epidemic level globally has coined the term "globesity"[1].Obesity rates across developed countries such as the USA, England, France and others are quite high, ranging from 3-4% in Korea and Japan to more than 30% in the United States [2]. The World Health Organization[3] reported that in 2008, more than 1.4 billion of the world's adult population was overweight (BMI 25-29.9 kg/m^2) and 11% were obese (BMI > $30kg/m^2$). It was projected that if the current trends continue to persist, about 60% of the world's population could be overweight or obese by year 2030[4]. Flegal et al. [5] expressed that many Asian countries have rates which are similar to that of the United States as well. According to the National Health Survey 2010 [6], Singapore revealed an annual increment of 0.65% in the prevalence of obesity over the past six years, from 6% prevalence in 2004 to 10.8% in 2010 among Singapore adults. Obesity brings metabolic diseases which hampers the functional capacity, thus negating the quality of health. It poses a major risk for non-communicable diseases, including diabetes mellitus, cardiovascular disease, hypertension and stroke. The WHO World Health Statistics 2013 reported that a high percentage of burden from diseases were due to overweight and obesity, namely 44% diabetes burden, 23% ischaemic heart disease burden, and 7 to 41% cancer burden (endometrial, breast and colon cancers). Although men may have higher rates of overweight, women have higher rates of obesity (300 million women versus 200 million men) [7]. It is the significant independent risk factor for cardiovascular disease among women as reported in the Framingham Heart Study [8]. Furthermore, Wolin et al. [9] stated that about 20% of all cancers are caused by excess weight. Obesity may also interfere with the ability to deliver other forms of treatment.

Physical activity serves as a primary role in weight management as well as weight loss maintenance [10]. In Europe and North America, evidence from research based on substantial numbers of studies indicated that physical activity is beneficial for people who are obese [11, 12]. There were many types of physical activity regime showing effectiveness in weight and fat reduction in the obese [13-15]. Modest weight losses of 5 to 10% of body weight were proven to be associated with significant improvements in cardiovascular risk factors among overweight and obese individuals having Type 2 diabetes at 1 year [16]. With the obese population, however, higher dosage and intensity of exercises will pose a problem due to their inability to perform optimally due to their limitations in terms of fitness and functions. As such, music is being used ergogenically to aid performance. Music is the source of motivation and inspiration that is valued within the sport and exercise regime [17]. Boutcher and Trenske[18] suggested that music evokes pleasant associations, possibly of masking unpleasant stimuli or act as a distraction to internal feelings associated with discomfort. Music helps in exercise performance by reducing sensations of fatigue, increasing physiological arousal, promoting relaxation and improving motor coordination [19]. Synchronous music involves performing repetitive movements in time with its rhythm, such as beat or tempo, while asynchronous music, on the contrary, involves performing while listening music playing in the background without conscious effort to stay with the rhythm [20]. Karageorghis and Terry [20] reported that synchronization submaximal exercise with musical accompaniment results in increased work output, as well as reduced the rate of perceived exertion during submaximal exercise. Previous studies have been carried out to test the effectiveness of synchronous and asynchronous music in treadmill walking [21], cycle ergometry[22], 400-m running [23] and swimming [24]. To the best of the authors' knowledge, the effects of synchronous and asynchronous music have not been tested among overweight and obese populations. The purpose of this study is thus to investigate the association of physical activity and synchronous music/asynchronous music/no music on obesity and fitness parameters.

2. Methodology

Participants: The study followed a twelve-week (3-months) randomized-controlled trial design.Ethical clearance was sought from University of Malaya Ethics Committee and National University Singapore Ethics Committee. A total of 92overweight and obese Singaporean adult women were recruited voluntarily. Only those who were sedentary, having overweight or obese problem and not on medications that would affect the outcome of the study were selected. Apart from signing the *PAR-Q*[25], health risk appraisal were conducted, which involved detailed information gathering anda thorough review of the participants' health information, medical history and lifestyle [10]. Participants underwent a pre-study medical screening conducted by certified physician for medical clearance, whereby failing the medical screening test were excluded from the study.Subjects were randomly allocated into two treatment groups [exercise with synchronous music (n = 31) and exercise with asynchronous music (n = 31)] and a control group [exercise with no music (n = 30)]. The distribution of ethnicity in this studied sample was all Malay.

Experimental design: Having provided written informed consent, participants undergo clinical examination prior and post intervention (after 12-weeks), namely serum lipid analysis on cholesterol level (total cholesterol, HDL cholesterol, LDL cholesterol, total / HDL ratio), resting heart rate, blood glucose, systolic and diastolic blood pressure, as conducted by Cuong et al. [26] in his study assessing obesity in Vietnamese adults. Health screening assessment was done by a certified physician Green Cross Medical Centre in Singapore. In addition, measurements of the subjects were taken manually for anthropometric evaluation on body composition by trained fitness professionals at the International Sports Academy, Singapore. Height and body weight were measured t the nearest 0.1cm and 0.1kg, respectively. Girth measurements for chest, abdomen, waist and hip were taken to the nearest 0.1 cm using Myotape (AccuFitness LLC, USA). Body mass index (BMI) and waist-to-hip ratio was calculated. Skin folds for triceps, abdominal andsuprailiacwas taken using calipers and fat percentage was calculated using the Jackson & Pollock equations [27] and the Jackson, Pollock and Ward [28] reference.

A guided 3-months thrice weekly physical exercise was used as the intervention. Dynamic warm ups were utilized as opposed to static stretching warm ups because of its effects on power and agility [29]. The exercise training interventions consisted of dynamic warm ups (5 minutes), intensity intervals and bodyweight exercise which included modified pushups, modified curl ups, burpees, bodyweight squats and planks (20 minutes), dynamic cool down and static stretches (5 minutes). The intensity intervals of the bodyweight movements will be executed in three sets of 12, 9 and 6 repetitions, respectively, with 90 seconds of rest in between the sets. Midway through the 12 weeks of intervention, their rest will be shortened to 30 seconds intra sets. Cardiorespiratory endurance exercises incorporated walks, jogs and runs in the stadium. The twelve static stretches were quadriceps stretch, Adductor stretch, hamstring stretch, Tibialis anterior stretch, Gastrocnemius stretch, Oblique stretch, Latissimus dorsi stretch, Pectorals stretch, Deltoids stretch, triceps stretch and Sternocledomastoid stretch. Fitness evaluations, namely Rockport walking test, push up, curl up and bodyweight squat test were conducted at baseline and post intervention. Music has been labelled as a psychological ergogenic aid with a focus on performance during exercise, pre-task and post-task. With regards to timing of music intervention, Crust [30] reported that all conditions of music exposure, namely pre and post as well as during the exercise per se, produced significantly longer endurance times than white noise for a muscular endurance test. As such, synchronous and asynchronous music were introduced during warming up and cooling down, as well as during the exercise.

Statistical analysis: Data collected were analyzed using the Statistical Package for the Social Science version 22.0 (IBM SPSS Statistics, Armonk, NY, USA). All descriptive data were expressed as means ± standard deviations. A paired sample t-test was first conducted to determine the changes before and after interventions. The level of significance used was $\alpha = 0.05$. Later, the split plot ANOVA (SPANOVA), also known as mixed design ANOVA, was carried out to explore the groups intervention (Group A = exercise with synchronous music; Group B = exercise with asynchronous music; Group C = exercise with no music) on body composition, blood lipid metabolic profiles and fitness at Time 1 (baseline, prior to intervention) and Time 2 (12-weeks after intervention), with a statistically significant level at $p < 0.05$.

3. Results and Discussions

Table 1: Distribution of subjects according to age and intervention groups (n= 92)

Groups	Exercise with synchronous music n (%)	Exercise with asynchronous music n (%)	Exercise with no music n (%)
Age (Mean ±SD)	43.00 ± 8.97	40.03 ± 10.66	40.07 ± 9.40
≤ 34	6 (19.35)	13 (41.94)	8 (26.67)
35-44	10 (32.26)	4 (12.90)	12 (40.00)
≥45	15 (48.39)	14 (45.16)	10 (33.33)
Total	31	31	30

The distribution of subjects is shown in Table 1. The mean and standard deviation of age for the studied subjects were 43 ± 9.0 years old (Group A = exercise with synchronous music), 40 ± 10.7 years old (Group B = exercise with asynchronous music) and 40± 9.4 years old (Group C = exercise without music) respectively. About 29.3% of the subjects were ≤ 34 years old, 28.3% were in the range of 35 to 44 years old, while the rest were ≥ 45 years old (42.4%).

Body composition: Table 2 Baseline and postintervention of body composition of the exercise with synchronous music (Group A), exercise with asynchronous music (Group B) and exercise without music (Group C)

Body composition	Group A		Group B		Group C	
	Pre	Post	Pre	Post	Pre	Post
Height (cm)	157.7±5.9	157.7±5.9	157.0±5.4	157.0±5.4	157.8±6.9	157.8±6.9
Weight (kg)	78.1±14.6	71.5±11.7	76.7±10.4	73.2±10.7	80.8±10.5	77.1±9.9
BMI (kg/m²)	31.3±5.1	28.7±4.2	31.1±4.0	29.7±4.1	32.5±4.4	31.0±4.1
Chest girth (in)	38.7±3.0	36.3±2.9	39.1±3.3	37.1±3.0	39.4±3.3	37.4±3.6
Abdomen girth (in)	38.2±4.3	35.1±3.2	38.8±3.7	36.2±3.7	39.8±3.5	37.5±3.5
Waist girth (in)	36.0±4.2	33.6±3.0	36.6±3.6	34.5±3.2	37.0±2.6	35.0±2.4
Hip girth (in)	43.3±3.6	40.0±3.6	43.4±3.5	40.6±2.9	45.1±3.2	42.5±4.0
Waist-to-hip ratio	0.83±0.06	0.84±0.07	0.84±0.05	0.85±0.06	0.82±0.05	0.83±0.05
Triceps fat (%)	28.0±8.0	21.2±3.6	29.1±5.9	24.3±4.6	30.6±5.4	26.4±5.9
Thigh fat (%)	41.7±12.1	29.8±8.8	43.5±8.6	33.8±8.8	44.0±11.7	36.8±12.3
Suprailium fat (%)	25.9±10.4	18.0±6.5	27.7±7.7	21.2±6.1	28.7±10.1	23.5±8.6
Body fat sum	95.6±27.1	69.0±16.4	100.3±18.2	79.3±17.5	103.3±25.4	86.7±25.0

Data were presented as the mean value ± standard deviation

Thewaist-to-hip ratio (WHR) is an easy way to see how much weight a person carries around the abdomen as opposed to around the hip region. Adults who store most of their body fat around their waists have an increased risk of high blood pressure, type 2 diabetes, heart disease and stroke compared with those who have the same amount of body fat stored around their hips and thighs. A longitudinal study for 13 years in 2011 with 60,000 subjects found that the WHR is a better indicator of ischaemic heart disease mortality [31]. Women with a WHR 0.8 or less are considered safe according to the University of Maryland Medical System.The percentage of at risk based on waist-to-hip ratio cut off analysis was 37% (n=34) during post intervention, slightly higher than the percentage at pre intervention (30.4%, n = 28). This is possibly due to time limiting factor. The mean value and standard deviation for anthropometric measurements pre and post intervention are presented in Table 2, while the paired sample t-test of the body composition is shown in Table 3.Paired sample t-test (Table 3) was conducted to evaluate the impact of exercise with different intervention of music (synchronous, asynchronous or no music) on body composition in the 3-months interval.There were very significant decreases($p<0.01$) in all the variables except for waist-to-hip ratio, where the changes were not significant (t = -1.15, t = -1.00 and t = -0.55 for Group A, Group B and Group C, respectively, as shown in Table 3). The number of subjects having more than 32% of fat at triceps, thigh and suprailiac has decreased significantly.Group A (exercise with synchronous music) showed largest paired difference in their body composition, while Group B (exercise with asynchronous music) and Group C (exercise with no music) revealed similar changes for the variables tested. However, SPANOVA analysis showed that the interaction effect is not statistically significant [Wilk's lambda = 0.338 > 0.05), indicating there was no significance in the body composition for the three groups pre and post intervention.It is suffice to say that there is changes in body composition from pre intervention to post intervention ($p<0.05$). Our results were in agreement with that of Slentz et al. [32], who also reported that physical activity is associated with significant reductions in body weight and fat mass in overweight and obese middle aged men and women in a dose-response manner.

Table 3: Paired sample t-test of body composition pre and post-training

Body Composition	Paired differences			t			Sig.		
	Group A	Group B	Group C	Group A	Group B	Group C	Group A	Group B	Group C
Weight	6.64±4.49	3.55±3.57	3.69±2.71	8.23	5.54	7.45	**	**	**
BMI	2.63±1.66	1.44±1.47	1.48±1.10	8.84	5.48	7.39	**	**	**
Chest girth	2.44±2.11	1.98±2.01	1.92±1.82	6.42	5.50	5.78	**	**	**
Abdomen girth	3.11±2.97	2.61±3.13	2.31±2.21	5.84	4.65	5.73	**	**	**
Waist girth	2.42±2.18	2.11±2.21	2.02±2.02	6.17	5.34	5.47	**	**	**
Hip girth	3.26±3.01	2.81±2.72	2.60±2.16	6.04	5.75	6.60	**	**	**
Waist-to-hip ratio	-0.01±0.05	-0.01±0.04	-0.05±0.05	-1.15	-1.00	-0.55	n.s.	n.s.	n.s.
Triceps fat	6.77±7.47	4.76±4.85	4.22±3.88	5.05	5.46	5.95	**	**	**
Thigh fat	11.92±11.42	9.69±9.86	7.22±7.19	5.81	5.48	5.50	**	**	**
Suprailium fat	7.89±10.07	6.53±7.47	5.15±5.77	4.36	4.87	4.89	**	**	**
Body fat sum	26.58±25.75	20.98±18.55	16.59±15.19	5.75	6.30	5.98	**	**	**

Data were presented as the mean value ± standard deviation
** $p< 0.01$ n.s. non-significant

All the subjects were overweight (46.7%) and obese (53.3%) before the intervention, with 5.4% of the subjects in Grade III obesity (BMI > 40.0) (Table 4). The percentage of obese dropped after the 12-weeks intervention. However, subjects were still in increased risk and high risk according to the Asian cut-offs BMI points. Physical activity is inversely associated with body weight, thus associated with lower BMI in adults [33]. Increasing physical activities showed clinically significant weight loss of more than 5% even without caloric restriction [34].

Table 4: BMI analysis based on the International BMI reference chart cut-offs (WHO)

International BMI cut-off	Pre		Post	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Underweight (BMI < 18.5)	0	0	0	0
Normal weight (BMI 18.5 – 24.9)	0	0	10	10.9
Overweight (BMI 25.0 – 29.9)	43	46.7	46	50.0
Grade I obesity (BMI 30.0 – 34.9)	27	29.4	22	23.9
Grade II obesity (BMI 35.0 – 39.9)	17	18.5	13	14.1
Grade III obesity (BMI > 40.0)	5	5.4	1	1.1
Total	92	100.0	92	100.0

Fitness evaluation: Table 5 Fitness evaluation for exercise with synchronous music (group A), exercise with asynchronous music (group B) and exercise with no music (group C) groups pre and post intervention

Fitness evaluation	Group A		Group B		Group C	
	Pre	Post	Pre	Post	Pre	Post
Push up	7.6 ± 5.2	20.5 ± 6.5	8.8 ± 5.5	18.7 ± 6.1	8.8 ± 5.0	16.9 ± 6.9
Curl up	9.4 ± 6.3	26.5±10.3	10.2 ± 5.5	20.4 ± 7.2	8.7 ± 5.1	18.7 ± 6.0
Squat	10.7 ± 8.8	37.3±13.5	12.0±14.7	32.1±18.7	11.5 ± 9.3	24.1 ± 9.3

Data were presented as the mean value ± standard deviation

Table 6: Changes in physical fitness pre and post-training

Fitness tests	Paired differences			t			Sig.		
	Group A	Group B	Group C	Group A	Group B	Group C	Group A	Group B	Group C
Push up	-12.94±7.13	-9.90±5.46	-8.13±5.93	-10.11	-10.11	-7.51	**	**	**
Curl up	-17.03±7.71	-10.13±7.17	-9.93±6.98	-12.31	-7.86	-7.33	**	**	**
Body weight squat	-26.55±11.83	-20.13±22.66	-12.63±9.46	-12.49	-4.95	-7.32	**	**	**

Data were presented as the mean value ± standard deviation

** p< 0.01

The findings for fitness evaluation were presented in Table 5 for pre and post intervention, while Table 6 shows the t-test results. The curl up test and the maximum number of push up that can be performed without rest are used to evaluate the endurance of the abdominal muscle groups and upper body muscles respectively. The changes in push up, curl up and bodyweight squat fitness tests are statistically significant, with $p < 0.01$ (Table 6). The percentage of subjects fall in very poor norm category has reduced drastically (16.3% to 1.1%, 90.2% to 29.3% and 33.7% to 3.3% for push up, curl up and bodyweight squat, respectively. Beneficial effects seen in this study is even reflected in a multicomponent exercise training program on the physical function of frail obese older adults (Villarealet al.[36]). Fitter person with less excess body fat and younger can perform more curl up than less fit, fatter or older individuals. The curl up test is recommended as a better test of abdominal muscular endurance. SPANOVA analysis revealed that the changes of physical fitness is significant for pre and post intervention (p =

0.001 < 0.05), but not for the intervention groups (p = 0.101 > 0.05). Thus, there is no significant difference in the push up, curl up and bodyweight squat for the three intervention groups.

Blood lipid metabolic profiles: Table 7 Blood chemistry and hemodynamic data of the intervention groups (A = exercise with synchronous music and B = exercise with asynchronous music) and the control group (C = exercise with no music) at baseline and at the end of intervention.

Metabolic profiles	Group A		Group B		Group C	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
BP systolic	116.39±13.74	111.14±13.63	113.18±14.20	107.94±13.35	104.09±21.07	104.55±12.14
BP diastolic	76.04±12.09	67.36±7.51	73.53±8.54	65.59±8.64	70.27±11.47	68.36±9.87
Heart rate	74.96±8.44	70.21±6.36	70.59±6.36	68.94±5.17	80.20±14.34	72.70±7.54
Total cholesterol	210.71±31.36	184.89±28.55	205.29±43.57	195.71±38.43	212.90±40.33	200.50±33.80
HDL	59.61±11.57	53.61±9.88	54.59±8.16	50.41±6.86	58.10±9.13	57.70±12.64
Total cholesterol HDL ratio	3.62±0.68	3.56±0.89	3.84±0.98	3.94±0.89	3.74±0.80	3.61±0.97
LDL	127.61±27.81	112.39±25.84	125.76±41.08	123.94±34.17	131.70±37.68	124.80±34.45
Triglyceride	118.36±47.56	94.57±34.18	124.06±79.14	106.65±43.35	121.50±44.00	90.60±35.97
Blood glucose	88.41±10.78	85.04±9.19	97.35±32.82	97.47±29.20	116.90±82.53	108.50±57.44

Data were presented as the mean value ± standard deviation

Table 8: Effect of intervention on blood chemistry and hemodynamic variables

Metabolic profiles	Paired differences			t			Sig.		
	Group A	Group B	Group C	Group A	Group B	Group C	Group A	Group B	Group C
Systolic BP	5.25±10.23	5.24±10.92	-0.46±16.80	2.716	1.977	-0.090	**	n.s.	n.s.
Diastolic BP	8.68±10.85	7.94±9.91	1.91±11.27	4.234	3.304	0.562	**	**	n.s.
Resting heart rate	4.75±6.36	1.65±3.97	7.50±8.71	3.954	1.712	2.724	**	n.s.	*
Total cholesterol	25.82±29.46	9.59±23.62	12.40±15.72	4.638	1.674	2.494	**	n.s.	*
HDL-cholesterol	6.00±7.59	4.18±6.87	0.40±9.51	4.182	2.508	0.133	**	*	n.s.
Total cholesterol / HDL ratio	0.64±0.53	-0.10±0.60	0.13±0.60	0.644	-0.690	0.683	n.s.	n.s.	n.s.
LDL-cholesterol	15.21±25.65	1.82±19.75	6.90±20.80	3.138	0.381	1.049	**	n.s.	n.s.
Triglyceride	23.79±35.06	17.41±66.23	30.90±17.03	3.590	1.084	5.737	**	n.s.	**
Blood glucose	3.37±13.09	-0.12±11.67	8.40±27.06	1.338	-0.042	0.982	n.s.	n.s.	n.s.

Data were presented as the mean value ± standard deviation
** p< 0.01
* p< 0.05
n.s. non-significant

Tables 7 and 8 show the effects of intervention groups on blood lipid metabolic profiles. The turn-up percentage for post intervention was only 60%. All blood lipid variables fell within the clinical specified normal ranges, except for total cholesterol that was slightly higher than the healthy normal range during pre-intervention. There was no change in total cholesterol / HDL ratio and blood glucose level during pre and post intervention. However, there were significant drop in all other variables (systolic blood pressure, diastolic blood pressure, resting heart rate, total cholesterol, HDL-cholesterol, LDL-cholesterol and triglyceride) for the post-intervention. A comparison between pre and post intervention in all three groups revealed significant difference ($p<0.05$) in the metabolic profiles except for total cholesterol / HDL ratio and blood glucose, especially in group A (exercise with synchronous music). Group B and group C (exercise with asynchronous music and exercise with no music) showed no significant difference in systolic blood pressure and LDL-cholesterol. SPANOVA analysis showed that main effect between groups of intervention on blood lipid metabolic profile is 0.506 [$F(18,86) = 1.938$, $p = 0.023 < 0.05$], showing that group effect is statistically significant, with a large effect size (partial eta squared = 0.289). Yet, a further post-hoc comparisons using Tukey HSD test indicated that the mean for the three intervention groups did not differ from each other significantly.

There are many studies that have investigated the effect of music on various vital signs, namely systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR), attributing some degree of music-induced anxiety relief to the beneficial impacts of music on vital signs. Several randomised studies have shown varying effects of music on these vital parameters and a metaanalysis by Loomba et al.[35]reported that compared to those who did not receive music therapy, those who did receive music therapy had a significantly greater decrease in SBP before and after (difference in means, −2.629, confidence interval (CI), −3.914 to −1.344, $P < 0.001$), a significantly greater decrease in DBP (difference in means, −1.112, CI, −1.692 to −0.532, $P < 0.001$), and a significantly greater decrease in HR (difference in means, −3.422, CI, −5.032 to −1.812, $P < 0.001$) where a two-sided alpha error < 0.05 was considered to be statistically significant, in their study. This was echoed in this study with an exception in the resting heart rate results. Compared to those who were in the asynchronous and controlled groups, those who were in the synchronous music group had a significantly greater decrease in SBP before and after ($P < 0.001$) but the asynchronous and no music registered non significant. There is significantly greater decrease in DBP for both synchronous and asynchronous groups ($P < 0.001$) but no significance in the control group. There is significantly greatest decrease in HR in synchronous group ($P < 0.001$), significant change in the control group ($P < 0.005$) but no significant changes in the group with asynchronous music. This study is imperative not only in Singapore's context but also in the other South East Asian countries riding its globalization wave. This research is applicable as an obesity fitness management targeting the dynamics of a community intervention. As South-East Asia becomes progressively urbanized, the results of this research is valuable, not only as a case study in a developed nation's fight against obesity, but can be used as translatory to achieve the recommended BMI in the developing countries of South-East Asia .

5. Conclusions & Recommendations

Findings from this study showed that physical activity intervention was effective for obesity fitness management in all the groups, notwithstanding whether it is synchronous, asynchronous or with no music. As similar studies in Asia Pacific are rather limited at the moment, this is imperative towards knowledge in obesity fitness management in progressively urban Asia as well as direct impact on public health. The findings of the present evaluation demonstrated that physical activity is a valid factor in BMI reduction impacting weight loss and fat percentage reduction. Fitness capacity research is rather limited in the samples of overweight and obese individuals in Asia entering duo obesity-fitness management programme, particularly using music as ergogenic aid. Whilst much of the research investigating the complex association between adiposity and functional capacity has only incorporated individuals across the spectrum of overweight and obesity consisting of Westerns, African-Americans, Asians consisting of the Japanese, Chinese, the present study is of particular importance as it focuses on the Malays in Singapore, of which there is no study on this ethnic group till date. Notwithstanding the types of music used or non-music for that matter in this study, it showed physical activity augmented changes in all parameters, namely body composition, fitness and metabolic profile (although negligible in blood glucose and cholesterol). This can be argued that time span to augment huge changes in blood glucose and cholesterol needs to be examined. Visceral adiposity has been shown to be an important link between cardiorespiratory fitness and markers of the metabolic syndrome. As demonstrated in this study, improved insulin sensitivity following weight loss has been particularly associated with the loss of visceral abdominal fat Goodpaster[37]. Physical activity, be it with or without diet-induced weight loss has been shown to induce greater reductions in visceral abdominal fat relative to general body fat (Ross et al.[34]).

It was further argued that a successful exercise program should be proposed at a moderate intensity and a low perceived effort because obese subjects who have low self-efficacy, poor mood status, and are not familiar with high-intensity workouts could easily drop out. It has been shown otherwise in this study. Adherence to their exercise participation was high. This might be accrued to the fact that high intensity training in this instance, even more so with the music as ergogenic aids countered their most quoted barrier to exercise, namely boredom. The findings in this study points towards Heinrich et al.[38] high intensity functional training among physically inactive overweight and obese adults which was compared to moderate-intensity training for exercise initiation, enjoyment, adherence, and intentions. They reported that high intensity functional training participants spent significantly less time exercising per week, yet were able to maintain exercise enjoyment and were more likely to intend to continue. In discussing this research against the backdrop of the obesity paradox (Lavie[39]) where it has been documented in several trials where overweight and obese individuals with established cardiovascular disease (including cardiac heart disease, heart failure, hypertension and peripheral arterial disease) have a better prognosis compared with non-overweight/non-obese patients, where fitness in fatness becomes a protective quality. The fitness of fat as being in the obesity paradox might be applicable here. For subjects in this study with pre-cursors to metabolic diseases, by propagating fitness in fatness and fitness against fatness in this obesity fitness management programme, the end result will be a reduction of weight loss but more applicably fat loss, as well as disease pre-cursors' prevention, management and treatment. Thus BMI might not be the most desirable measuring mechanism.

The emphasis should be on fitness management of the obese rather than mere obesity management. Obesity management which can come from reduction of food intake, which will affect the individual's energy level and health because of inadequacy of nutrients from low caloric intake. Obesity fitness management profers protective and prevention qualities against metabolic diseases.Physical activity produces many beneficial health outcomes that are too often deemphasized in favour of weight-based end points, as also reiterated by Shaibiet al.[40]. Benefits of exercise training includes improving insulin resistance, beta cell function, glucose tolerance, dyslipidemia, vascular function, strength, fitness and functionality. More effort should be taken to educate to shift the emphasis on fitness management in obesity programme. A more inclusive, social community initiative in terms of a holistic prevention and solution must be championed to target the disability-free quality driven lifestyle of a healthy weight. A healthy body with correct understanding of healthy environment might convert obesogenic to health-genic environment in combating and preventing obesity.support.

This study is imperative not only in Singapore's context but also in the other South East Asian coutries riding its globalization wave. This research is applicable as an obesity fitness management targeting the dynamics of a community intervention. As South-East Asia becomes progressively urbanized, noting the recommendations of (201) regarding GDP growth and the fact that, BMI of 23-25 kg/m2 is needed to assist globalization, the results of this research is valuable, not only as a case study in a developed nation's fight against obesity, but can be used as translatory to achieve the recommended BMI in the developing countries of South-East Asia . So far no country has overturned their obesity rate successfully. As reported in Today (2015) "Asean will become more econnected over time, but real action of connectivity will be in mainland S.E.A. A healthier community in one country, will translate positive benefits in terms of better quality of life, higher producticity and economy which permeates into the Asian and thereafter, the global community.

In the current study however of the three groups of synchronising movements to composed music, asynchronized movements to same music and with non-music on exercise, seems to provide across the board significant drop in all other variables (systolic blood pressure, diastolic blood pressure, resting heart rate, total cholesterol, HDL-cholesterol, LDL-cholesterol and triglyceride) during the post-intervention. However, there was no change in total cholesterol / HDL ratio and blood glucose level during pre- and post-testing. This might bring to fore the issue of inadequate time span on this study to produce significant changes in blood glucose and cholesterol parameters. A key strength of the present study is that it demonstrates that music be it synchronise or asynchronise or non music does impact optimal weight loss when it comes to high intensity exercise. It does alter the negative impact on functional limitations of the obese when executing exercise movements thus impeding their performance translated into a less optimal weight loss. Previous studies have concluded that the association between adiposity and ability to optimisation during high intensity exercise is mediated by health co-morbidities such as pain or fatigue; however the present study supports that the association is independent, and that the role of pain and fatigue in the relationship may have previously been over-estimated.

Future Directions: An urbanized Singapore's obesity threat to population health and economy presents its urgency of treatment. At the forefront is the lack of national prevalence and epidemiological data in countries in the region coupled with a lack of uniformity in reference standards and cut off points, particularly in the Asian BMI cut offs. Principles of lifestyle behavioural modification needs to be continually integrated into strategies in a nationalistic policy requiring collaboration between government and private sectors as well as the community with scientific academic findings for future development and implementation.

Acknowledgements: This research is supported by the UMRG RP008D-13HNE (University of Malaya Research Grant) for the period of 17/6/2013 to 17/6/2014.

References

Michaelowa A. Globesity: a planet out of control? *IntAff* 2010; **86**(4): 1012-3.

Organisation for Economic Co-operation and Development (OECD). (2014). Obesity Rates Rising: 10 Fattest Countries In The Developed World. http://www.oecd.org/els/health-systems/theeconomicsofprevention.htm. Retrieved 23 May 2015.

World Health Organization. Media centre. Obesity and overweight. Fact sheet No 311; 2013. Available at: http://www.who.int/mediacentre/factsheets/fs311/en/ [accessed March 2013].

Kelly T, Yang W, Chen C-S, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. *Int J Obesity* 2008; 32: 1431-7.

Flegal KM, Caroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999-2008. *JAMA* 2010; 303(3): 235-41.

Ministry of Health. *National Health Survey 2010*. Singapore: Epidemiology and Disease Control Division, Ministry of Health; 2011.

World Health Organization. Nutrition. Controlling the global obesity epidemic; 2015. Available at http://www.who.int/nutrition/topics/obesity/en/ [accessed March 2015].

Hubert HB, Feinleib M, McNamara PM, Castelli WP. Obesity as an independent risk factor for cardiovascular disease: a 26-year follow-up of participants in the Framingham Heart Study. *Circulation* 1983; 67: 968-77.

Wolin KY, Carson K &Colditz GA. Obesity and cancer. *Oncologist* 2010; 15(6): 556-65.

American College of Sports Medicine (ACSM). *ACSM's guidelines for exercise testing and prescription. (8th edition)*. Philadelphia: Wolters Kluwer/ Lippincott Williams & Wilkins; 2010.

Fogelholm M, Stallknecht B, Van Baak M. ECSS position statement: exercise and obesity. *Eur J Sport Sci*2006; 6: 15-24.

Gutin, B. Diet vs exercise for the prevention of pediatric obesity: the role of exercise. *Int J Obesity* 2011; 35: 29-32.

Amano M, Kanda T, Maritani T. Exercise training and autonomic nervous system activity in obese individuals. *Med Sci Sport Exer*2001; 33(8): 1287-91.

Murrock CJ & Gary FA. Culturally specific dance to reduce obesity in African American women. Health Promotion Practice 2010; 11(4): 465-73.

Shimamoto H, Adachi Y, Takahaski M, Tanaka K. Low impact aerobic dance as a useful exercise mode for reducing body mass in mildly obese middle-aged women. *Appl Human Sci* 1998; 3: 109-14.

Wing RR, Wei Lang, Wadden TA, Safford M, Knowler WC, Bertoni AG, Hill JO, Brancati FL, Peters A, Wagenknecht L. and the Look Ahead Research Group. Benefits of modest weigth loss in improving cardiovascular risk factors in overweight and obese individuals with Type 2 diabetes. *Diabetes Care* 2011; 34(7): 1481-6.

Simpson SD &Karageorghis CI. The effects of synchronous music on 400-m sprint performance. *J Sports Sci* 2006; 24(10): 1095-102.

Boutcher SH &Trenske M. The effects of sensory deprivation and music on perceived exertion and affect during exercise. *J Sport ExercPsychol* 1990; 12: 167-76.

Szabo A, Small A & Leigh M. The effects of slow- and fast- rhythm classical music on progressive cycling to voluntary physical exhaustion. *J Sports Med Phys Fitness* 1999; 39(3): 220-5.

Karageorghis CI & Terry PC. The physiological effects of music in sport and exercise: a review. *J Sport Behav* 1997; 20(1): 54-68.

Karageorghis CI, Mouzourides DA, Priest DL, Sasso TA, Morrish DJ, Walley CJ. Psychophysical and ergogenic effects of synchronous music during treadmill walking. *J Sports ExercPsychol* 2009; 31(1): 18-36.

Anshel MH &Marisi DQ. Effects of music and rhythm on physical performance. *Res Quart* 1978; 49(2): 109-13.

Simpson SD &Karageorghis CI. The effects of synchronous music on 400-m sprint performance. *J Sports Sci* 2006; 24(10): 1095-102.

Karageorghis CI, Hutchinson JC, Jones L, Farmer HL, Ayhan MS, Wilson RC, Rance J, Hepworth CJ, Bailey SG. Psychological, psychophysical and ergogenic effects of music in swimming. *Psychol Sport Exerc*2013; 14: 560-8.

Canadian Society for Exercise Physiology. *PAR-Q*; 2000. Available at www.csep.ca/forms. [accessed March 2015].

Cuong TQ, Dibley MJ, Bowe S, Hanh TTM, Loan TTH. Obesity in adults: an emerging problem in urban areas of Ho Chi Minh City, Vietnam. *Eur J ClinNutr*2007; 61(5): 673-81.

Jackson AS & Pollock ML. Practical assessment of body composition. *Phys Sportsmed* 1985; 13: 76-90.

Jackson AS, Pollock ML & Ward A. Generalised equations for predicting body density of women. *Med Sci Sports Exerc* 1980; 12: 175-82.

McMillian DJ, Moore JH, Hatler BS, Taylor DC. Dynamic vs static stretching warm up: The effect on power and agility performance. *J Strength Cond Res* 2006; 20(3): 492-9.

Crust L. Carry-over effects of music in an isometric muscular endurance task. *Percept Motor Skill* 2004; 98(3 pt 1): 985-91.

Morkedal B, Romunstad PR &Vatten LJ. Informativeness of indices of blood pressure, obesity and serum lipids in relation to ischaemic heart disease mortality: the HUNT-II study. *Eur J Epidemiol* 2011; 26(6): 457-61.

Slentz CA, Duscha BD, Johnson JL, Ketchum K, Aiken LB, Samsa GP, Houmard JA, Bales CW, Kraus WE. Effects of the amount of exercise on body weight, body composition and measures of central obesity: STRRIDE – a randomized controlled study. *Arch Intern Med* 2004; 164(1): 31-9.

Brien SE &Katzmarzyk PT. Physical activity and metabolic syndrome in Canada. *ApplPhysiolNutrMetab*2006; 31: 40-47.

Ross R, Janssen I, Dawson J, KungI AM, Kuk JL, Wong SL, Nguyen-Duy TB, Lee S, Kilpatrick K, Hudson R. Exercise-induced reduction in obesity and insulin resistance in women: a randomized controlled trial. *Obes Res* 2004; 12: 789-98.

Loomba, R.S., Arora, R., Shah, P.H., Chandrasekar, S. & Molnar, J. (2012). Effects of music on systolic blood pressure, diastolic blood pressure, and heart rate: a meta-analysis. Indian Heart Journal. 64 (3), 309–313.

Villareal, D. T., Smith, G. I., Sinacore, D. R., Shah, K. and Mittendorfer, B. (2011), Regular Multicomponent Exercise Increases Physical Fitness and Muscle Protein Anabolism in Frail, Obese, Older Adults. Obesity, 19: 312–318. doi: 10.1038/oby.2010.110

Goodpaster, B.H., Kelley, D.E., Wing, R.R., Meier, A. &Thaete, F. L. (1999). Effects of weight loss on regional fat distribution and insulin sensitivity in obesity. *Diabetes,* 48, 839-847.

Heinrich, K.M., Patel, P.M., O'Neal, J.L. & Heinrich, B.S. (2014). High-intensity compared to moderate-intensity training for exercise initiation, enjoyment, adherence, and intentions: an intervention study. *BMC Public Health*, 14,789. doi:10.1186/1471-2458-14-789.

Lavie, C.J., Milani, R.V. & Ventura, H.O. (2009). Obesity and cardiovascular disease risk factor, paradox, and impact of weight loss. *Journal of the American College of Cardiology*, 53, 1925-1932.

Shaibi, G.Q., Ryder, J.R., Kim, J.Y., & Barraza, E. (2015). Exercise for Obese Youth: Refocusing Attention from Weight Loss to Health Gains. *Exercise & Sport Sciences Reviews*, 43(1), 41–47. doi: 10.1249/JES.0000000000000034