Journal of Social Science and Humanities, 3 (2): 14-24, 2020
e-ISSN: 2600 - 9056

DOI: 10.26666/rmp.jssh.2020.2.3

Effects of Circuit Training on Muscular Strength and Power, Jumping Height and Body Composition in Intellectual Disabilities Individuals

*Nur Shamimi Izzaty Ariffin, Farah Izzazaya Mohd Fariq, Nurul Azuar Hamzah, & Nur Syamsina Ahmad**
Exercise and Sports Science, School of Health Sciences, Health Campus, Universiti Sains Malaysia, 16150 USM Kubang Kerian, Kelantan, Malaysia.

Abstract: This study investigated the effects of 6 weeks of circuit training (CT) on body composition, jumping height and distance, muscular strength and power in individuals with Intellectual Disabilities (ID). Thirty participants aged between 18-30 years old were randomly assigned into two groups, i.e. control (C) and exercise (E) groups. Participant in C group only followed activities designed by Community-Based Rehabilitation (CBR) center which included physical activities (simple morning warm-up) and daily activities such as gardening, walking and dancing, while participant in E was prescribed with circuit training exercise for 2 sessions/week for 6 weeks of intervention. The participant anthropometry, muscular strength and power were measured at pre- and post-test, and it was found that there was no significant reduction of body weight for both groups indicate that circuit training exercise did not contribute on weight loss. However, vertical jump height was significantly ($p<0.05$) reduced in Control group after 6 weeks of no exercise.

Key words: *Circuit training, intellectual disabilities, muscular strength, vertical jump, power*

INTRODUCTION

Intellectual disabilities (ID) is a disability characterized by significant limitations both cognitive functioning and in adaptive behavior, which covers conceptual, social, and practical skills [1]. According to the tenth revision of the WHO (World Health Organization), ID is a disorder defined by the presence of incomplete or arrested mental development, principally characterized by the deterioration of concrete functions at each stage of development and that contribute to the overall level of intelligence, such as cognitive, language, motor and socialization functions; in this anomaly, adaptation to the environment is always affected. For ID, scores for intellectual development levels must be determined based on all the available information, including clinical signs, adaptive behavior in the cultural medium of the individual and psychometric findings.

Intellectual disabilities affect all spheres of people's lives who suffer from it. It lowers the level of intellectual functioning, often stigmatizes, characteristically changing features, and decreases motor performance. Unfortunately, modern medicine cannot cure intellectual disability. However, there is a chance to improve the quality of life of people with ID through physical exercises to enhance their coordination, the quality of gait and efficiency in performing everyday activities. Example of ID includes Down syndrome, Autism, Asperger's syndrome, Dyslexia, and Learning disabilities. Early definition of Learning disabilities (LD) refer to a retardation, disorder, or delayed development in one or more of the processes speeches, language, reading, writing, arithmetic, or other school subject resulting from psychological handicap caused by a possible cerebral dysfunction and/or emotional or behavioral disturbances [2]. However, based on Department of Health [3] the current definition of LD includes the presence of a significantly reduced ability to understand new or complex information, to learn new skills (impaired intelligence) with a reduced ability to cope independently (impaired social functioning) which started before adulthood with a lasting effect on development. This definition is broadly consistent with that used in the current version of WHO International Classification of Disease.

In addition to intellectual impairment, when compared with their typically developed peers, persons with ID are more likely to be obese, less likely to be physically active and are twice as likely to develop a chronic diseases [4]. Emerson and Hatton [5] indicated the importance of ID people to participate in sports because

Corresponding Author: Nur Syamsina Ahmad, Exercise and Sports Science, School of Health Sciences, Health Campus, Universiti Sains Malaysia, 16150 USM Kubang Kerian, Kelantan, Malaysia, nursyamsina@usm.my; +60135091585

of the risks to several health problems, for example cardiovascular disease, diabetes, liver problem and hypertension [6]. While the cardiovascular and overall health benefits of exercise are well established, the positive effects of circuit training on explosive power during jumping, muscular performance and body composition are emerging. It is unclear if circuit training can improve those parameters in ID individuals. Physically active lifestyle has the potential benefit to an individual with ID at this transitory point in their lifespan. The main benefits people with disabilities obtained through participation in physically active are involving in group or structured activities, involving in casual participation, challenging their abilities and achieve their goals, meeting others, entertainment or fun, and to relax. Physical activity also could improve quality of life because ID individuals who regularly exercise reported having more frequent outings into the community than did their peers who reported exercising infrequently and they are more independent [7].

Since the priority for club teams and national federations is to ensure that athletes can successfully perform at the highest level in adult competition, it is crucial that exercise approaches have the ability to differentiate improve muscular performance and general health. Previous study by Van Biesen et al. [8] found that elite table tennis players with ID were significantly less proficient than their counterparts without ID. Thus, the different approaches are needed to improve their fitness level. It is important to note that, maturation is a major confounding variable in sport development [9]. Furthermore, for exercise programs to succeed, valid and reliable testing procedures must be accepted and implemented in a range of performance-related categories.

Circuit training is an exercise programs that incorporates different fitness activities, for example, strength, aerobic, flexibility and resistance exercises. The methods that apply in circuit training combine all-around physical (e.g.: upper body and lower body) and cardio exercise that could develop stronger muscles and aerobic fitness. Performing circuit training regularly could improve athletes' performance, and it is also an effective way to increase lean mass and decrease in body weight. To date, there is still not much research using the appropriate strategies to enhance muscular fitness, increase jumping height ad distance and reduce body weight and body fat in ID individuals. The study, in general, aim to identify the effects of circuit training on selected parameters in ID individuals.

METHODS

Participants and recruitment

Thirty-eight ID participants from two Pusat Pemulihan dalam Komuniti (PDK) in Kota Bharu district (PDK Kubang Kerian, PDK Peringat) and private care YOKuK foundation (Yayasan Orang Kurang Upaya Kelantan) were recruited in this study voluntarily. Participants were given the information sheet and explanation about the study procedure using videoto explain type of exercise that prescribed, experimental protocol and possible risk before given the consent form to signing. Participants were free to withdraw from the study anytime if they experienced any pain or did not want to continue after or during the exercises training session.

The inclusion criteria were: individual with ID in mild to moderate category slow learner, dyslexia and autism spectrum disorder (based on medical report from the staffs in PDK), aged between 18 - 30 years old, normal BMI (18.5-24.9 kg/m2), able to communicate, and capable to perform all the exercises. While the exclusion criteria individuals who were on medication or taking any supplement prior to the study period. Participants who have any health problems such as asthma, cardiac problem, spinal cord injury or had an injury in the past 6 months were excluded from this study. Recruitment of the participants needs to have approval letter from Jabatan Kebajikan Masyarakat before contacting staffs (teachers) at PDK in the Kota Bharu district PDK Kubang Kerian, PDK Peringat and YOKuK foundation. This study was approved by Universiti Sains Malaysia (USM) Research Ethics Committee (USM/JEPeM/19020127) and all the participants provided their written consent.

Study design

This study was randomised two-group that involved pre-test and post-test intervention (block randomisation was performed by using computerized randomized software) and opportunistic sampling method was used. Participants were divided into two group of Control (C) and Exercise (E) groups. The groups were distributed based on age gender, BMI and cognitive level of the participants. Flow chart was shown in Figure 1. Subjects in Control group only followed activities that designed in Pusat Pemulihan dalam Komuniti (PDK) which included physical activities (simple warm-up) and daily activities such as gardening, walking, and dancing. Therefore, Control group would not feel left out or cause cross-contamination with Exercise group. While participants in Exercise group was prescribed with circuit training exercise, 2 times per week for 6 weeks of intervention. Besides that, a questionnaire of International Physical Activity Questionnaire was used to reflect participant's physical activity level.

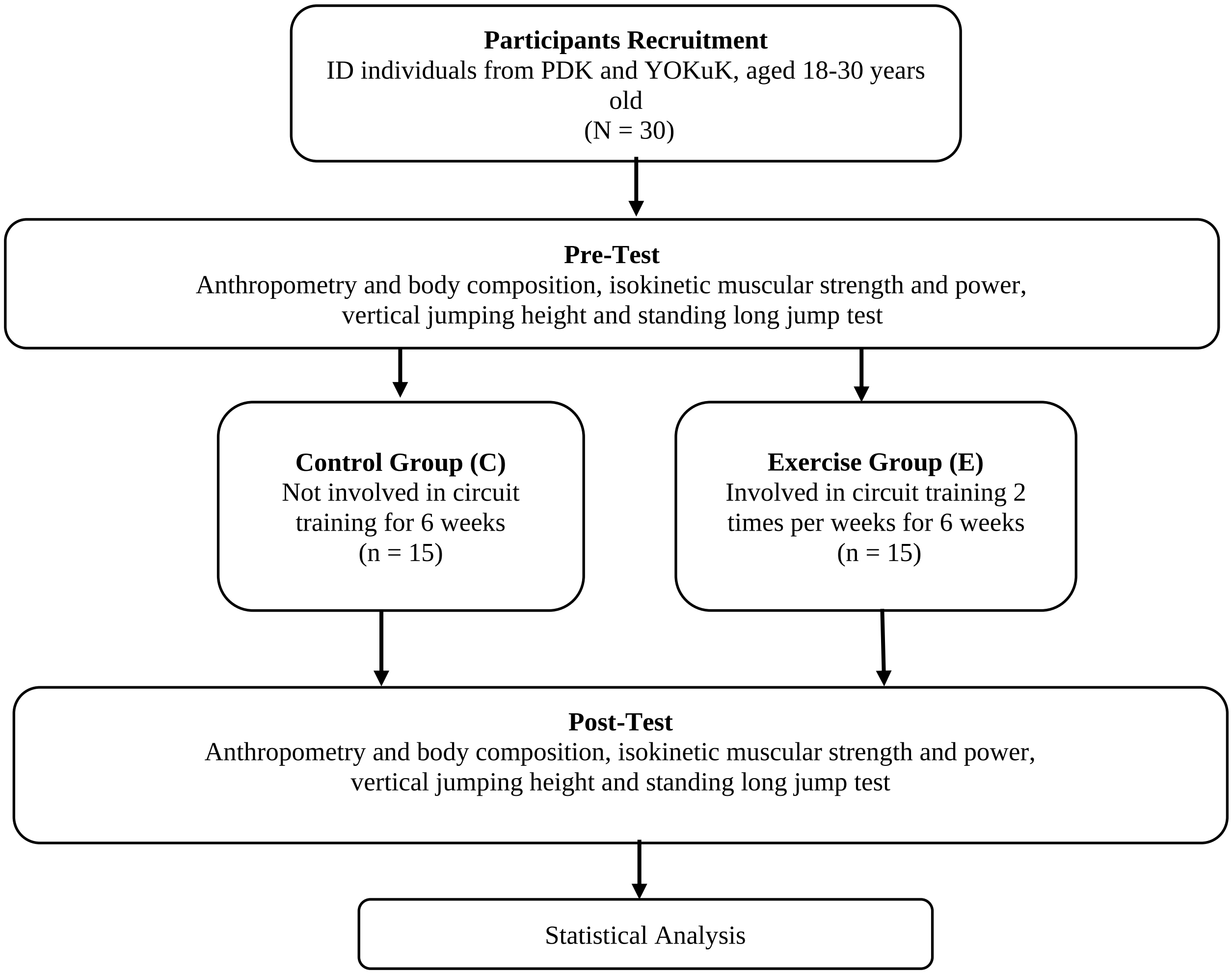

Figure 1: Flow chart of experimental design

Circuit training intervention

This circuit training programmed is adapted and modified from Pastula et al. [10] (refer to Table 1) which is conducted on ID young adults. The intervention consists of 20 to 30 minutes of supervised circuit training, two times per week on non-consecutive days for six weeks. Special education teacher was present in every exercise session. First, participants started with warming up (stretching and slow jog) for 10 minutes. Next, participants were continuing with circuit training exercise. The circuit training was designed by incorporating different types of cardio and resistant exercises that covers upper part and lower part of the body, across 6 stations.

During circuit training, researchers monitored participants' heart rate (HR) using HR monitor to make sure the participant's achieved moderate intensity (40%-60% Heart Rate Reserved) (ACSM 2006). The targeted intensity was determined by using Karvonen formula. End of the exercise, participants finished with cooling down session for 10 minutes.

Targeted heart rate reserved method= [(max HR – resting HR) x % intensity)] +resting HR [11]

Table 1 Circuit Training Program

Weeks	Time/ station (seconds)	No. of Set	Rest between station (seconds)	Intensity (Moderate – Hard)	Stations (in order)
Week 1 – Week 2	20	2	10	40 – 60% HRR	Station 1: High knee Station 2: Push-up Station 3: Back kicks Station 4: Sit up Station 5: Tuck jump Station 6: Squat
Week 3 – Week 4	30	2	10	40 – 60% HRR	Station 1: High knee Station 2: Wall push-up Station 3: Tuck jump Station 4: High plank Station 5: Squat Station 6: Back kicks
Week 5 – Week 6	40	2	10	40 – 60% HRR	Station 1: Jumping jacks Station 2: Calf raise Station 3: High plank Station 4: Squat Station 5: Punch Station 6: High kicks

Anthropometry and body composition measurement

The participants' baseline and body composition measurement were body weight (kg), height (cm) and body fat (%), fat free mass (FFM) were measured using bioimpedance analysis machine (Tanita, Japan) before and after session. BMI values was derived by the calculation of BMI= Body Weight/height2.

Muscular strength and power

In this study, participant dominant lower limb was measure to know their maximal muscular strength and power using Biodex isokinetic dynamometers. Participant seated with the hip joint at 85 of flexion and attached to the dynamometer chair with velcro straps in order to provide stability during maximal contractions

Vertical jump height

Participant's maximum vertical jump height was measured at pre- and post-test by using a wall platform that participants elevate off the ground (jump) from a standstill.

Standing long jump

Participant standing long jump distance were measured at pre-and post-test by using a mat and required to stand behind a line marked on the ground with fee slightly apart.

Statistical analysis

Statistical Package for Social Sciences Version 24.0 were used for the statistical analyses. The distribution of data for normality were assessed using the Shapiro-Wilk test. Descriptive analysis was performed on anthropometric characteristic of the participants. The two-way mixed ANOVA were performed on participants' characteristic, all muscular performance (knee flexor, knee extensor peak torque), jumping height and body composition to compare significant different between and within the groups. Significant differences demonstrated in two-way mixed ANOVA followed by post-hoc Bonferroni test. All data were reported as means ± standard deviations for participant.

RESULTS

Descriptive characteristic of participants

A total of 30 participants with mean age: 22.4 ± 3.6 years, mean body weight: 53.0 ± 10.0 kg, mean body height: 155.5 ± 8.2 cm and body mass index (BMI): 22.3 ± 4.3 kg.m2 completed the study (Table 2). Participants were randomly divided into control (male = 8, female = 7) and exercise (male = 8, female = 7) groups. Categories of disability among the participants include slow learner, dyslexia, autism and down syndrome. Among all ID participants, slow learner individuals were the highest (n=19) while the least participant in this study was mild down syndrome (n=1). The distribution of the participants were shown in Figure 2.

Table 2 Descriptive characteristics of participant

Values are mean ± standard deviation (SD), n = 15 per group, BMI, body mass index; SBP, systolic blood pressure; DBP,

	Control		Exercise		
Variables	***N***	**Mean ± SD**	***n***	**Mean ± SD**	***p* value**
Age (year)	15	21.4 ± 2.5	15	23.3 ± 4.3	0.140
Body weight (kg)	15	52.7 ± 10.7	15	53.4 ± 9.8	0.985
Body height (cm)	15	154.6 ± 9.3	15	156.4 ± 7.1	0.516
BMI ($kg.m^{-2}$)	15	22.0 ± 4.2	15	22.6 ± 4.6	0.384
Body fat (%)	15	31.7 ± 12.2	15	27.0 ± 10.3	0.650
Fat free mass (kg)	15	35.1 ± 5.8	15	38.5 ± 6.2	0.668
Resting SBP (mmHg)	15	120.4 ± 10.1	15	112.5 ± 15.1	0.199
Resting DBP (mmHg)	15	73.9 ± 6.6	15	66.7 ± 8.4	0.178
Resting HR (bpm)	15	83.2 ± 10.2	15	83.0 ± 12.2	0.525

diastolic blood pressure; HR, heart rate;

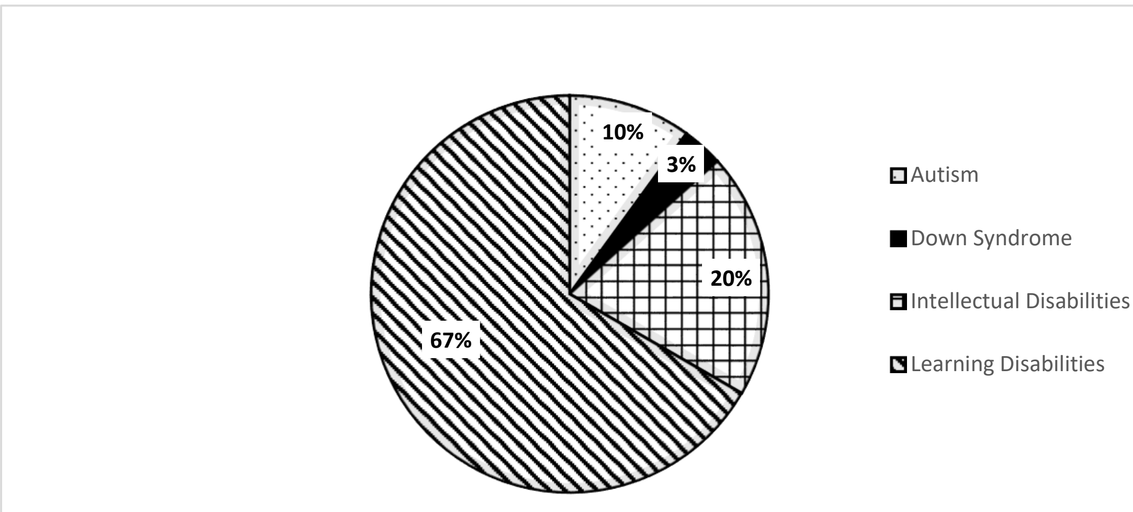

Figure 2 Categories of disability among participants

The participants baseline of mean age, body weight, body height, body mass index (BMI), percentage of body fat, fat free mass (FFM), resting heart rate and blood pressure reading at the beginning of the study for Control and Exercise groups. There were no significant differences for all anthropometry characteristic between Control and Exercise groups.

The mean resting heart rate of participants was 83.0 ± 11.1 bpm. During exercise participants were required to reach their target heart rate reserved (HRR) between 40% (127.9 ± 7.0 bpm) to 60% (150.9 ± 4.7 bpm) based on Karvonen method formula. The Exercise group wore heart rate monitor throughout 6 weeks of intervention to measure their heart-rate (HR). During exercise, participant's mean HR was 147 ± 30 and was between moderate intensity ranges indicating that the targeted intensity of exercise was achieved.

Body weight and percentage of body fat

Mean body weight and percentage of body fat at pre- and post-tests of all groups and percentage changes are presented in Table 3 and Table 4. There was no significant effect of time ($F_{1, 14} = 0.036$, $p = 0.852$) for body weight. However, there was a significant difference between group ($F_{1, 14} = 15.532$, $p=0.001$) for body weight. Additionally, there was no significant interaction between time and group ($F_{1, 14} = 0.163$, $p=0.693$). Following up this, it was indicated that there were no significant changes of body weight between Control and Exercise groups at pre- and post-tests.

Regarding fat percentage, there were no significant main effects of time ($F_{1, 14} = 1.524$, $p=0.237$) and group ($F_{1, 14} = 1.122$, $p=0.308$). Similarly, there was also no interaction between time and group ($F_{1, 14} =0.307$, $p=0.588$). Even though there were no significant differences, Control group showed higher increment in body weight and fat percentage compared to Exercise group.

Table 3 - Body weight at pre- and post-test

Group	Body weight (kg) Mean ± SD		
	Pre-test	**Post-test**	**Percentage of changes**
Control	52.7 ± 10.6	53.3 ± 11.1	1.2 ± 4.1 %
Exercise	53.4 ± 9.8	53.8 ± 10.2	0.7 ± 2.2 %

Values are mean ± standard deviation (SD), n = 15 per group

Table 4 - Body fat at pre- and post-test

Group	Body fat (kg) Mean ± SD		
	Pre-test	**Post-test**	**Percentage of changes**
Control	31.7 ± 12.2	32.3 ± 11.5	3.0 ± 7.1 %
Exercise	27.0 ± 10.3	27.1 ± 10.7	0.2 ± 10.5 %

Values are mean ± standard deviation (SD), n = 15 per group

Vertical jump height

The mean and percentage changes of vertical jump height at pre-and post-test. There's was no significant difference across time points (F1, 14=3.501, p=0.082). However, there was a significant different between group (F1, 14=11.535, p=0.004) in mean vertical jump. There's was no significant interaction between time and group (F1, 14=3.500, p=0.082). Following up this, there was no significant difference (p=0.614) between group at post-tests. However, there was a significant (p=0.033) reduction in Control group for vertical jump height after 6 weeks intervention. Nevertheless, Exercise group showed an improvement almost 10% in their jumping height and Control group reduced to 14% after 6 weeks without intervention.

Standing long jump distance

The mean and percentage changes of standing long jump at pre- and post-tests are presented in Table 5. There was no significant difference across the time points (F1, 14=2.924, p=0.109) groups (F1, 14=0.501, p=0.491) and between time and group (F1, 14=0.000, p=0.992) in mean standing long jump distance. Standing long jump distance showed a percentage changes of 3.5 ± 13.8% in Control and 4.9 ± 19.5 in Exercise groups. Overall, both groups showed a similar positive improvement in standing long jump distance at post-test.

Table 5 - Standing long jump distance at pre- and post-tests

Group	Standing long jump (cm) Mean ± SD		
	Pre-test	**Post-test**	**Percentage of changes**
Control	102.7 ± 39.9	104.8 ± 39.1	3.5 ± 13.8
Exercise	125.1 ± 40.6	127.2 ± 33.9	4.9 ± 19.5

Values are mean ± standard deviation (SD), n = 15 per group

Peak torque of knee extension at 60°s-1

The mean peak torque of knee extension at 60°s-1 for Control and Exercise groups at pre- and post- test and the percentage of change across time. There was no significant effect of time (F1, 14=1.281, p=0.277) and group (F1, 14=1.616, p=0.224. However, there was also no significant interaction between time and group (F1, 14=0.308, p=0.588). Although there was no significant difference between and within group, Control and Exercise groups showed increment in percentage changes in mean peak torque of knee extension 60°s-1 by 11.0 % and 17.9 % respectively after 6 weeks.

Peak torque of knee extension at 300°s-1

The mean peak torque of knee extension at 300°s-1 for Control and Exercise at pre- and post-tests, and the percentage of change across time can be seen in Table 6. There was no significant effect of time (F1, 14=0.611, p=0.448), group (F1, 14=2.739, p=0.120) and interaction between time and group (F1, 14=0.001, p=0.970). However, both groups showed similar increment in the percentage of the mean torque extension at 300°s-1 after 6 weeks intervention for Control (14.0 %) and Exercise group (12.1 ± 28.1 %).

Table 6 - Mean of peak torque strength for all groups at pre- and post-test

Peak torque	Groups	
	Control	Exercise
Peak torque of knee extension 60°s^{-1}		
Pre-test	77.1 ± 35.5	87.1 ± 42.2
Post-test	79.7 ± 33.0	94.9 ± 24.4
Percentage changes (%)	11.0	17.9
Peak torque of knee extension of 300°s^{-1}		
Pre-test	44.0 ± 15.9	48.3 ± 13.2
Post-test	47.6 ± 15.1	51.8 ± 10.4
Percentage changes (%)	14.0	12.1
Peak torque of knee flexion 60°s^{-1}		
Pre-test	33.0 ± 18.7	36.0 ± 15.3
Post-test	39.7 ± 17.5	39.7 ± 14.2
Percentage changes (%)	48.5	29.6
Peak torque of knee flexion of 300°s^{-1}		
Pre-test	38.1 ± 17.6	41.5 ± 17.4
Post-test	40.8 ± 15.0	45.7 ± 11.3
Percentage changes (%)	22.8	23.9

Values are mean ± standard deviation (SD), n = 15 per group

Peak torque of knee flexion at 60°s-1

The mean peak torque of knee flexion at 60°s-1 for Control and Exercise groups at pre- and post-test and the percentage of change across time are shown in Table 6. There were no significant across the time point ($F_{1, 14}$=0.066, p=0.801) but there was significant difference between the group ($F_{1, 14}$=9.493, p=0.008) and no interaction between time and group ($F_{1, 14}$=0.001, p=0.970). Following up test between group, it was indicated that there was no significant difference (p=0.084) at post-test but both groups showed positive improvement in mean peak torque of knee flexion at 60°s-1. The percentage changes in Control and Exercise groups was 48.5 % while 29.6 % respectively.

Peak torque of knee flexion at 300°s-1

The results tabulate the mean peak torque of knee flexion at 300°s-1 for Control and Exercise groups at pre- and post-tests and the percentage of change across time. There was no significant main effect of time ($F_{1, 14}$=0.824, p=0.379), group ($F_{1, 14}$=1.879, p=0.192) and no interaction between time and group ($F_{1, 14}$=0.129, p=0.725). Even there was no significant difference, there was an increment changes in the percentage of mean peak torques of knee flexion at 300°s-1 after 6 weeks intervention. For Control group it's showed about 22.8% while Exercise 23.9%.

Average power of knee extension at 60°s-1

Table 7 show the mean average power of knee extension at 60ºs-1 for Control and Exercise groups at pre- and post- test and the percentage of change across time. There was no significant main effect of time ($F_{1, 14}$=1.479, p=0.244) but there was significant main effect of group ($F_{1, 14}$=6.872, p=0.027). While the interaction between time and group there was no significant difference ($F_{1, 14}$=0.013, p=0.912). Following up test between group it was indicated that there was no significant difference (p=0.276) at post-test. It also showed an increment of percentage changes in average power of knee extension at 60°s-1 for Control (31.5 %) and Exercise (35.7 %) groups.

Table 7 - Mean of average power strength for all groups at pre- and post-test

Average power	Groups	
	Control	Exercise
Average power extension 60°s^{-1}		
Pre-test	37.4 ± 19.4	45.9 ± 17.4
Post-test	43.9 ± 21.2	51.7 ± 16.7
Percentage changes (%)	31.5	35.7
Average power extension of 300°s^{-1}		
Pre-test	61.2 ± 30.9	86.5 ± 38.6
Post-test	73.3 ± 40.2	86.1 ± 34.0
Percentage changes (%)	31.3	7.6
Average power flexion 60°s^{-1}		
Pre-test	18.5 ± 11.6	16.3 ± 9.0
Post-test	21.2 ± 13.0	21.9 ± 9.8
Percentage changes (%)	47.5	98.9
Average power flexion of 300°s^{-1}		
Pre-test	21.9 ± 25.9	29.4 ± 25.3
Post-test	32.9 ± 34.0	35.8 ± 27.8
Percentage changes (%)	59.8	73.8

Values are mean ± standard deviation (SD), n = 15 per group

Average power of knee extension at 300 ºs -1
The mean average power of knee extension at 300°s-1 for Control and Exercise at pre- and post-tests, and the percentage of change across time can be seen in Table 7. There was no significant difference between time (F1, 14=2.670, p=0.125), group (F1, 14=1.661, p=0.218) and interaction between time and group (F1, 14=2.798, p=0.117). Although there was no significant difference between and within the test, it showed an increment percentage changes in average power of knee extension at 300°s-1 in Control and Exercise groups by 31.3 % and 7.6 % respectively.

Average power of knee flexion at 60°s-1
The mean average power of knee flexion at 60°s-1 for Control and Exercise groups at pre- and post-test and the percentage of change across time are shown in Table 7. There was no significant main effect of time (F1, 14=0.004, p=0.953). However, there was significant main effect of group (F1, 14=8.858, p=0.010) but no significant interaction between time and group (F1, 14=0.035, p=0.845). Following up the test, there was no significant difference (p=0.080) between group after 6 weeks intervention. Even though there was no significant difference within group but there was a positive improvement in mean average power of knee flexion at 60°s-1 in both groups by 47.5 % in Control and 98.9 % in Exercise groups.

Average power of knee flexion at 300°s-1
Table 7 tabulates the mean average power of knee flexion at 300°s-1 for Control and Exercise groups at pre- and post-tests and the percentage of change across time. There was no significant main effect of time (F1, 14=0.623, p=0.443). However, there was significant main effect of group (F1, 14=7.740, p=0.015) but still no significant interaction between time and group (F1, 14=1.363, p=0.263). In order that, the following up test showed during the post-test there was no significant difference (p=0.084) between group. Moreover, the average power of knee flexion at 300°s-1 showed positively increment by 59.8 % and 73.8 % in Control and Exercise groups respectively.

DISCUSSION
The present study found that there was no statistically significant difference in mean body weight, height, body mass index (BMI), percentage of body fat, free fat mass (FFM) between Control and Exercise groups. These results show that all the participants were nearly similar in their physical characteristic at the beginning of the study. Moreover, the mean body weight for all the groups are as follow, Control: 21.4 ± 2.5 and Exercise:

23.3 ± 4.3. After 6 weeks of the intervention, there was no significant reduction of body weight for both groups, indicating that the circuit training exercise did not contribute on weight loss.

In a study conducted by Myers et al. [12] who recruited 20 female sedentary obese in college found significantly reduction of body composition such as body weight, BMI, and body fat percentage as well as reduction in metabolic syndrome risk factors including blood pressure, waist circumference, total cholesterol (TC) and low-density lipoprotein (LDL) after 12-weeks of combined 10 type of resistance training and aerobic training. The program was done for 3 times per week while present study just for 2 times per week for 6 weeks of circuit training. Nevertheless, Exercise group shows higher reduction of body weight, percentage (%) of body fat and body mass index compared to the Control group. Thus, the duration of exercise should be increased to 12 weeks to give a significant result.

While a previous study review by Hamilton et al. [13] shows a huge success in weight reduction for ID participants. Seven weeks of behavioral weight-control programmed with carer helps to motivate the participants. This programme also focused on nutritional and self-control knowledge. Involvement of carer has proven to be one of the factors to the participants who involved in physical activity significantly reduced body weight around 3.0 kg. The difference between previous finding and present study could be due to the differences behavioral weight control (using nutritional and self-control knowledge) and the duration of the intervention, 7 and 6 weeks respectively. Other than that, in the present study, there was no carer involvement. There was only involvement by researcher themselves to guide, supervise and support the participants in each station. However, most of the participants are not familiar with the correct technique to do exercise which somehow lead to no weight reduction. Additionally, the duration of exercise also needs to be increased to improve fat burn. Even though there was no significant reduction, the participants are still classified to have normal BMI.

Another main finding of the present study was the effects of circuit training for 6 weeks significantly ($p<0.05$) reduced height of vertical jump in Control group. Nevertheless, no differences were observed in standing long jump distance and muscular strength and power among ID group. There are 9.1 ± 36.8 % increase in height of vertical jump in Exercise group and 13.3 ± 29.3% significant reduction in jumping height in Control group. This finding implying that Exercise group could elicit greater beneficial effect on increasing muscular explosive power after 6 weeks of intervention. A study conducted by Ramirez-Campillo et al. [14] regarding plyometric training exercise believed could increase the explosive power of stretch shortening cycle (SSC) on maximum test (5 maximum repetitions [5RMs]), drop jumps (DJ), squat jumps (SJ) and counter movement jump (CMJ) after 6 weeks intervention. The result shows that there was significant increase ($p<0.05$) in SJ and CMJ performance among experimental group. The present study differences with Ramirez-Campillo et al. [14] in terms of groups of participants. The population in both studies influence the result which present study recruited disabilities people while previous study involved middle distance runner. It is speculated a longer duration is needed to see an improvement among disable group compared to an athlete. Their muscle needs longer time to train because muscular strength among disable especially down syndrome population are weak or known as sarcopenia [15]. Muscle dysfunction or weakness in Control group (6 weeks without circuit training) then become a limitation to functional performance and that the reason why their result showed significant reduction in this study.

Other previous study conducted by Giagazoglou et al. [16] finds that children with ID can improve their motor performance and balancing in jumping height by using trampoline as exercise intervention program. In their study, the result indicates that 12 weeks of intervention program involving trampoline have resulted significant improvement in all motor performance and balance ability. While, study did by Hassani et al. [17] found that participant with ID have negative performance in CMJ because the movement of the ID group in CMJ not performed a proper technique due to muscle weakness. It also been proven by Wang and Chang [18] which show that ID population shown an immature technique of CMJ compared to participant with non-ID population. They also said that due to ID influences, the motor system impairment makes the technique become deficit. Thus, rehabilitation on ID group should be start once there are diagnosed as ID since childhood.

Regarding standing long jump, the present study shows that there was no significant difference in distance in both group for standing long jump at post-test for Control (from 102.7 ± 39.9 to 104.8 ± 39.1) and Exercise (from 125.1 ± 40.6 to 127.2 ± 33.9) but both groups similarly showed positive percentage improvement after 6 weeks of circuit training intervention, i.e., Control (3.5 ± 13.81%) and Exercise (4.9 ± 19.54%). Similarly, in a previous study conducted by Matsuzaki et al. [19] examined found that subject with mental retardation tend to have less coordination of development pattern. This is because their arm and leg pattern in the standing long jump was poor due to the lack of practice and poor balancing. The reason is the person with mentally retarded have difficulty in transferring the motor skill. Thus, the researcher or carer are important to be with the participants for the whole session to guide, support and examine their movement.

Regarding isokinetic muscular strength and power, the present study found that after 6 weeks of circuit training, 8 measured isokinetic muscular performance parameters showed no significant increases in the peak torque of knee extension and flexion at 60°s-1 and 300°s-1 also in average power of knee extension and flexion at 60°s-1 and 300°s-1 in both groups. Eventually there is positive percentage changes in both groups for peak torque strength and average power of knee extension at 60°s-1 and 300°s-1 parameters.

A previous comparative study by Angelopoulou et al. [20] reported that the intervention is conducted found that there were no significantly differences found between the sedentary and mental retardation individuals. Though all angular velocities it has three velocities which is 60°s-1, 120°s-1, and 300°s-1 for peak torque of quadriceps shown higher in Mentally Disabled group than Down Syndrome. In addition, a study by Horvat et al. [15] discovered a similar result in isokinetic muscular strength in peak power and average power for hamstring and quadriceps when using two type of angular velocities (60°s-1 and 90°s-1). Similarly, the results showed that sedentary individuals performed significantly greater mean peak torque compared to Down syndrome group. The speculations of difference in the finding of both previous studies and the present study is the participant that involved in the study which is using sedentary adult with mental retardation groups to compare with Down syndrome population.

In other study between high-performance athletes with ID in comparison with able-bodied individuals showed better score on upper body muscle endurance and not on lower body muscle. Compared with age-matched physical education students, male athletes with ID score better for running speed and flexibility, and worse for strength. Female athletes with ID also score worse for strength measures. Athletes with ID also have poorer cardio respiratory endurance capacity compared with sportive peers without ID [21]. Further research should investigate the importance of reduced muscle strength to be the limiting factor.

CONCLUSION

In summary, the main finding of the present study after 6 weeks of circuit training significantly ($p<0.05$) reduced height of vertical jump in Control group. There are 9.1 ± 36.8 % increase in height of vertical jump in Exercise group but 13.3 ± 29.3% significant reduction in jumping height in Control group. This finding implying that Exercise group could elicit greater beneficial effect on increasing muscular explosive power after 6 weeks of intervention. Nevertheless, no differences were observed in body composition, standing long jump distance and muscular strength and power parameters among ID group. Eventually there is positive percentage changes in Exercise groups for standing long jump distance and peak torque strength and average power of knee extension at 60°s-1 and 300°s-1. Regarding body composition parameters circuit training exercise did not contribute on weight loss.

ACKNOWLEDGEMENT

A special thank goes to Jabatan Kebajikan Masyarakat, Putrajaya for their cooperation and participants from private care YOKuK and all the PDK's.

REFERENCES

[1] NICHCY. National Dissemination Center for Children with Disabilities [Online]. Available at: http://nichcy.org/disability/ specific/intellectual. Accessed April 10, 2012. Research in Developmental Disabilities, 33(6): 2265-2270.

[2] Kirk, S. A. 1962. Educating exceptional children. Boston: Houghton Mifflin.

[3] Department of Health. 2001. Valuing People: A New Strategy for Learning Disability for the 21st Century.

[4] Barwick, R., Tillman, MD., Stopka, CB., Dipnarine, K., Delisle, A. & Huq, M., S. 2011. Physical capacity and functional abilities improve in young adults with intellectual disabilities after functional training. Journal of Strength and Conditioning Research, 26(6): 1638-1643.

[5] Emerson, E. and Hatton, C., 2014. Health inequalities and people with intellectual disabilities. Cambridge University Press.

[6] Van Schrojenstein Lantman-De Valk, H. M., Metsemakers, J. F., Haveman, M. J. & Crebolder, H. F. 2000. Health problems in people with intellectual disability in general practice: a comparative study. Family Practice, 17(5): 405-407.

[7] Blick, R. N., Saad, A. E., Goreczny, A. J., Roman, K. & Sorensen, C. H. 2015. Effects of declared levels of physical activity on quality of life of individuals with intellectual disabilities. Research in Developmental Disabilities, 37: 223-229.

[8] Van Biesen, D., Verellen, J., Meyer, C., Mactavish, J., Van De Vliet, P. & Vanlandewijck, Y. 2010. The ability of elite table tennis players with intellectual disabilities to adapt their service/return. Adapted Physical Activity Quarterly, 27: 242-257.

[9] Pearson, D.T., Naughton, G.A. and Torode, M., 2006. Predictability of physiological testing and the role of maturation in talent identification for adolescent team sports. Journal of science and medicine in sport, 9(4), pp.277-287.

[10] Pastula, R. M., Stopka, C. B., Delisle, A. T. & Hass, C. J. 2012. Effect of moderate-intensity exercise training on the cognitive function of young adults with intellectual disabilities. The Journal of Strength & Conditioning Research, 26(12): 3441-3448.

[11] Bocalini, D.S., Lima, L.S., de Andrade, S., Madureira, A., Rica, R.L., dos Santos, R.N., Serra, A.J., Silva Jr, J.A., Rodriguez, D., Figueira Jr, A. and

Pontes Jr, F.L., 2012. Effects of circuit-based exercise programs on the body composition of elderly obese women. Clinical interventions in aging, 7, p.551.

[12] Myers, J., McAuley, P., Lavie, C.J., Despres, J.P., Arena, R. & Kokkinos, P. 2015. Physical activity and cardiorespiratory fitness as major markers of cardiovascular risk: their independent and interwoven importance to health status. Progress in Cardiovascular Diseases, 57(4): 306-314.

[13] Hamilton, S., Hankey, C. R., Miller, S., Boyle, S. & Melville. C. A. 2007. A review of weight loss interventions for adults with intellectual disabilities. The International Association for the Study of Obesity, 8: 339-345.

[14] Ramirez-Campillo, R., Alvarez, C., Henriquez-Olguin, C., Baez, E. B., Martinez, C., Andrade, D. C., & Izquierdo, M. 2013. Effects of plyometric training on endurance and explosive strength performance in competitive middle-and long-distance runners. Journal of Strength and Conditioning, 28 (1): 97-104.

[15] Horvat, M., Pitetti, K.H. & Croce, R. 1997. Isokinetic torque, average power, and flexion/extension ratios in nondisabled adults and adults with mental retardation. Journal of Orthopedic & Sports Physical Therapy, 25(6): 395-399.

[16] Giagazoglou, P., Kokaridas, D., Sidiropoulou, M., Patsiaouras, A., Karra, C. & Neofotistou, K. 2013. Effects of a trampoline exercise intervention on motor performance and balance ability of children with intellectual disabilities. Research in Developmental Disabilities, 34(9): 2701-2707.

[17] Hassani, A., Kotzamanidou, M.C., Tsimaras, V., Lazaridis, S., Kotzamanidis, C. & Patikas, D. 2014. Differences in counter-movement jump between boys with and without intellectual disability. Research in Developmental Disabilities, 35(7): 1433-1438.

[18] Wang, W.Y. and Chang, J.J. 1997. Effects of jumping skill training on walking balance for children with mental retardation and Down's syndrome. The Kaohsiung Journal of Medical Sciences, 13(8): 487-495.

[19] Matsuzaki, Y. and Hentona, T. 1994. Motor Pattern During the Standing Long Jump in Individuals with Mental Retardation. In Adapted Physical Activity (131-136). Springer, Tokyo.

[20] Van de Vliet, P., Rintala, P., Fröjd, K., Verellen, J., Van Houtte, S., Daly, D. J. & Vanlandewijck, Y. C. 2006. Physical fitness profile of elite athletes with intellectual disability. Scandinavian Journal of Medicine & Science in Sports, 16(6): 417-425.

[21] Angelopoulou, N., Tsimaras, V., Christoulas, K., Kokaridas, D. & Mandroukas, K. 1999. Isokinetic Knee Muscle Strength of Individuals with Mental Retardation, A Comparative Study. Perceptual and Motor Skills, 88: 849-855.