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Effect of Nintendo Wii Fit Exercise Program to Health-related Physical Fitness and Quality of Life among University Students

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Abstract

The purpose of this study is to investigate the effect of Nintendo Wii Fit exercise program to health-related physical fitness and quality of life among university students. Written, informed consent was obtained prior to the participation of the subjects. They participated in the exercise group (n = 25) and control group (n = 25) by themselves. Height, weight, body composition, BMI and WHR, blood pressure, HR and physical fitness (**V**O2max, muscular strength, muscular endurance, flexibility, etc.), and health-related quality of life (SF-36 questionnaire is used) were measured in the pre- and post-exercise program. In this result, we found interaction effects between the exercise group and control group in muscle mass. Further, the percentage of body fat, WHR, HR, maximum oxygen uptake (**V**O2 max), muscular strength, muscular endurance, and flexibility showed a significant difference in time between the two groups. Lastly, the physical functioning, body pain, and general health of SF-36 showed also statistical difference in duration between the two groups. The results in this paper suggested that the Nintendo Wii Fit exercise program during 12 weeks may influence the body composition, health-related physical fitness, and QOL of university students.

Keywords: Body Composition, Multicomponent Exercise, SF-36

1. Introduction

In modern society, obesity is becoming recognized as a significant health risk factor which increases the incidence of adult diseases (e.g., obesity, hypertension, and diabetes mellitus - also known as lifestyle diseases). Among the various causes of obesity, lack of physical activity is closely related[1]. According to the 2012 Korea National Health and Nutrition Examination Survey (KNHANESV-3), the level of moderate physical activities has lowered among Korean adults older than 19 years old[2]. Therefore, increasing physical activity to prevent obesity in our country's adults is highly important.

In particular, regular physical activity among university students is not only closely related with improving the quality of life post-adulthood although it is a significant reference in the prevention of a plethora of chronic diseases[3]. Students tend to neglect physical activity because of the stress about by their future life and their job[4,5].

It has been reported that sustained physical activities not only provide positive impacts on musculoskeletal, cardiovascular, respiratory, and endocrine systems but also take various psychological effects[6]. It is, however, always not easy to maintain regular exercise and it has been known that people often discontinue it due to loss of interest and enjoyment, lack of time and money, and other negative experience from exercise[7].

Nintendo Wii Fit is an interactive and movement-based virtual reality video gaming system that is being used within a variety environment. Wii Fit includes over 40 activities in four different components of fitness: aerobics, strength, yoga, and balance[8]. Given the popularity of Nintendo Wii, the use of this game system to promote physical activity seems promising[9]. Therefore, an increase of physical activities with the use of the Wii Fit exercise game may contribute to the promotion of quality of life, as well as health, among university students.

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2. Methodology

2.1 Participants

In the present study, 50 students of J University located in Jeollabuk-do were recruited. Healthy subjects do not have exercise habits and Nintendo Wii Fit is used by non-experienced university students. Written and informed consent was obtained prior to the participation of the subjects. Subjects were able to choose to be in either the exercise group or the control group. They participated in the exercise group (n = 25) and control group (n = 25) by themselves.

2.2 Wii Fit Exercise Program

A week's training period was given for subjects as regards the Wii Fit exercise program. Afterwards, they underwent the mixed exercise program (a total of 75 minutes) consisting of a 5 minute-warm up, 30-minute aerobics, 20-minute strength training, 15-minute yoga, and 5-minute cool down, 3 times per week over 12 weeks. The warming up and cooling down were comprised of simple stretches. Subjects underwent basic run for the aerobics. The Nintendo Wii Fit programs were used for the strength training and yoga sessions. Detailed contents of the Wii Fit exercise program were summarized in Table 1.

2.3 Measures

All of the measurements were carried out before and after the 12-week Wii Fit exercise program. Body composition (height, body weight, BMI, lean body mass, body fat percentage, and WHR) was assessed using a body composition analyzer (In Body 720, Biospace, Korea). Blood pressure and heart rate: resting blood pressure and heart rate were measured in the brachial artery of the arm using an automatic blood pressure meter (TM2655, Biospace, Korea). Physical fitness test: Cardiopulmonary endurance, muscular strength, muscular endurance, and flexibility were assessed using maximum oxygen uptake (**V**O2max), grip strength, sit-up, and bend over reach, respectively.

For the assessment, participants were asked to avoid vigorous physical activities, drinking, and medications a day before the assessment and the day of measurements. In order to assess Quality of Life (QOL), the translated version of the 36-item Short-form Health Survey (SF-36) of the Medical Outcomes Study (MOS), developed by Ware and Sherbourne[10] and translated and validated by Ko, Chang, Kang, Cha and Park[11] for Korean subjects, was utilized.

3. Results

3.1 Homogeneity Test for Participants of the Study Groups

The results of the homogeneity test for respective groups (i.e., the exercise group and the control group) before the implementation of the 12-week Wii Fit exercise program were shown in Table 2. No statistical significance was noted for tested variables (e.g., age, height, body weight blood pressure, heart rate, body composition, physical fitness, and health-related quality of life [SF-36]) in-between groups; hence, the homogeneity was obtained for the study.

3.2 Changes in Body Composition and Physical Fitness

Changes in the body composition of participants before and after the implementation of the 12-week Wii Fit

Table 1. Wii Fit Exercise Program

Category	Activities	Time
Warming Up and Cooling Down	Simple Stretches	10 min
Aerobics	Basic Run	30 min
Strength Training	Single Leg Extension, Sideways Leg Lift, Arm and Leg Lift, Single-Arm Stand, Torso Twists, Rowing Squat, Single Leg Twist , Lunge, Push-up and Side Plank, Triceps Extension	20 min
Yoga	Deep Breathing, Half-moon, Cobra, Bridge, Spinal Twist, Shoulder Stand, Warrior, Tree, Sun Salutation, Standing Knee, Chair, Triangle, Downward Facing Dog	15 min

Table 2. Homogeneity test between the exercise and control groups

Variable	Exercise (n=25)	Control (n=25)	t	p
Age (yr)	22.80 ± 1.71	23.04 ± 1.37	-0.548	0.586
Height (cm)	169.25 ± 6.93	168.08 ± 7.42	0.573	0.569
Weight (kg)	63.85 ± 6.06	63.30 ± 10.70	0.223	0.825
SBP (mmHg)	113.40 ± 10.93	114.76 ± 14.39	-0.376	0.708
DBP (mmHg)	73.80 ± 7.62	73.48 ± 9.10	0.135	0.893
HRrest (bpm)	79.24 ± 8.52	79.28 ± 7.01	-0.018	0.986
Body composition				
Lean body mass (kg)	45.39 ± 6.01	45.19 ± 8.94	0.095	0.925
Muscle mass (kg)	46.00 ± 6.38	45.60 ± 10.17	0.167	0.868
Body fat (%)	25.33 ± 7.11	25.50 ± 6.74	-0.088	0.93
BMI(kg/m^2)	22.72 ± 2.09	22.17 ± 2.32	0.872	0.387
WHR	0.83 ± 0.02	0.82 ± 0.03	0.255	0.800
Physical fitness				
Vo2max (ml/kg/min)	39.47 ± 9.28	39.01 ± 7.12	1.99	0.843
Grip strength (kg)	34.83 ± 8.21	34.77 ± 9.58	0.023	0.982
Sit-up (beats/min)	33.78 ± 12.15	32.92 ± 7.06	0.234	0.816
Sit and reach (cm)	13.9 ± 7.67	14.12 ± 5.72	0.079	0.937
SF-36				
Physical functioning	92.00 ± 4.30	90.93 ± 8.47	0.561	0.577
Role limitation-physical	91.20 ± 8.57	90.80 ± 10.87	0.144	0.886
Role limitation-emotional	87.20 ± 16.43	88.60 ± 17.29	-0.293	0.771
Social functioning	58.80 ± 7.26	59.20 ± 5.72	-0.217	0.83
Mental health	69.60 ± 10.95	68.48 ± 10.41	0.371	0.713
Vitality	66.60 ± 14.56	62.40 ± 15.69	0.981	0.331
Body pain	77.33 ± 9.48	76.00 ± 12.80	0.418	0.678
General health	70.56 ± 12.32	69.44 ± 8.48	0.374	0.71

Values are means ± SD of two groups, Results of independent t-test represent p values. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HRrest: Heart rate of rest, BMI: Body Mass Index, WHR: Waist hip ratio.

exercise program were compared in both the exercise and control groups (Table 3). Statistically significant interaction between the two groups was noted in muscle mass (F = 20.239, p<0.001) while body fat percentage and WHR statistically differed as regards time between the two groups (F = 4.150, p = 0.047; F = 6.146, p = 0.017).

Changes in the physical fitness of participants before and after the implementation of the 12-week Wii Fit exercise program were compared in both the exercise and control groups and summarized in Table 4. HR showed statistical difference in time between the two groups (F = 4.199, p = 0.046).

In the fitness test, maximum oxygen uptake (VO2max), grip strength, sit-up, and bend over reach statistically differed in the duration between two groups (F = 4.034, p = 0.05; F = 12.991, p = 0.001; F = 4.081, p = 0.049; F = 4.188, p = 0.046).

3.3 Changes in QOL

Effects of the implementation of a 12-week Wii Fit exercise program on QOL were investigated and summarized as shown in Table 5. In SF-36, physical functioning, body pain, and general health were statistically different in terms of duration between the two groups (F = 4.709, p = 0.035; F = 4.12, p = 0.048; F = 11.804, p = 0.001).

Table 3. Changes of body composition between the exercise and control groups

Variable	Group	Pre	Post	diff%	F-Value		
					Groups	*Times*	*Group × Times*
Weight (kg)	Exercise	63.85 ± 6.06	63.84 ± 6.78	-0.02	0.004	2.389	2.444
	Control	63.30 ± 10.70	64.32 ± 10.16	1.61	(0.975)	(0.506)	(0.501)
Lean body mass(kg)	Exercise	45.39 ± 6.01	46.53 ± 6.51	2.49	0.251	0.268	3.158
	Control	45.19 ± 8.94	44.57 ± 9.29	-1.37	(0.619)	(0.607)	(0.082)
Muscle mass (kg)	Exercise	46.00 ± 6.38	48.49 ± 7.33	5.41	2.405	0.728	20.239
	Control	45.60 ± 10.17	41.94 ± 8.79	-8.03	(0.128)	(0.398)	(0.000)*
Body fat (%)	Exercise	25.33 ± 7.11	23.26 ± 7.24	-8.17	0.397	4.15*	3.696
	Control	25.50 ± 6.74	25.44 ± 6.34	-0.24	(0.532)	(0.047)	(0.060)
BMI (kg/m^2)	Exercise	22.72 ± 2.09	22.27 ± 1.32	-1.98	0.225	0.906	3.213
	Control	22.17 ± 2.32	23.31 ± 2.04	5.14	(0.638)	(0.346)	(0.079)
WHR	Exercise	0.83 ± 0.02	0.81 ± 0.03	-2.41	0.345	6.146*	3.194
	Control	0.82 ± 0.03	0.82 ± 0.03	0	(0.559)	(0.017)	(0.080)

Values are means ± SD of two groups. Results of two-way repeated ANOVA represent F values. *p<.05
BMI: Body Mass Index, WHR: Waist Hip Ratio, diff%: Difference inPercentage.

Table 4. Changes in physical fitness between the exercise and control groups

Variable	Group	Pre	Post	diff %	F-Value (p)		
					Groups	*Times*	*Group × Times*
SBP (mmHg)	Exercise	113.40 ± 10.93	112.32 ± 11.67	-0.95	0.457	0.068	0.324
	Control	114.76 ± 14.39	115.16 ± 10.20	0.35	(0.502)	(0.795)	(0.572)
DBP (mmHg)	Exercise	73.80 ± 7.62	72.96 ± 8.17	-1.14	0.088	0.004	0.543
	Control	73.48 ± 9.10	74.48 ± 8.66	1.36	(0.768)	(0.949)	(0.465)
HRrest (bpm)	Exercise	79.24 ± 8.52	76.60 ± 6.99	-3.33	0.418	4.199*	3.501
	Control	79.28 ± 7.01	79.16 ± 7.36	0.15	(0.521)	(0.046)	(0.067)
Vo2max (ml/kg/min)	Exercise	39.47 ± 9.28	42.56 ± 9.22	7.83	0.685	4.034*	2.542
	Control	39.01 ± 7.12	39.36 ± 7.72	0.9	(0.412)	(0.05)	(0.117)
Grip strength (kg)	Exercise	34.83 ± 8.21	37.03 ± 8.56	6.32	0.092	12.991*	2.708
	Control	34.77 ± 9.58	35.59 ± 8.83	2.36	(0.762)	(0.001)	(0.106)
Sit-up (beats/min)	Exercise	33.78 ± 12.15	38.90 ± 15.74	15.16	1.065	4.081*	3.491
	Control	32.92 ± 7.06	33.15 ± 9.70	0.7	(0.037)	(0.049)	(0.068)
Bend over reach (cm)	Exercise	13.97 ± 7.67	15.54 ± 7.10	11.24	0.225	4.188*	3.005
	Control	14.12 ± 5.72	14.23 ± 6.04	0.78	(0.637)	(0.046)	(0.089)

Values are means±SD of two groups. Results of two-way repeated ANOVA represent F values. diff%: Difference inPercentage. *p<.05

4. Discussion

The body is composed of various components and the ratio of these components has been widely utilized as indicators for the assessment of nutritional status, obesity, health related fitness, and health and clinical areas[1]. Seoand Na[12] reported that the implementation of a combined exercise of running and muscle resistance was effective in reducing body fat percentage and increasing muscle mass among obese women in their twenties.

Similarly, Joo[1] also demonstrated that complex exercise significantly reduced the percentage of body fat and WHR among female college students. In the exercise group with 12-week Wii Fit exercise program, muscle mass was increased by 5.41% while body fat percentage and WHR were decreased by 8.17% and 2.41%, respectively which

Table 5. Changes of Quality of life(SF-36) between the exercise and control groups

Category	Items	Group	Pre	Post	diff %	F-Value		
						Groups	*Times*	*Group* × *Times*
Functional status	Physical functioning	Exercise	92.00 ± 4.30	95.36 ± 3.11	3.65	2.97	4.709*	1.418
		Control	90.93 ± 8.47	91.60 ± 8.93	0.74	(0.091)	(0.035)	(0.240)
	Role limitation (physical)	Exercise	91.20 ± 8.57	91.80 ± 10.30	0.66	0.307	0.113	0.05
		Control	90.80 ± 10.87	88.80 ± 13.17	-2.2	(0.582)	(0.738)	(0.823)
	Role limitation (emotional)	Exercise	87.20 ± 16.43	91.47 ± 11.63	4.9	0.053	2.072	0.019
		Control	88.60 ± 17.29	84.53 ± 16.30	-4.59	(0.818)	(0.156)	(0.892)
	Social functioning	Exercise	58.80 ± 7.26	57.20 ± 5.42	-2.72	2.083	0.98	1.021
		Control	59.20 ± 5.72	60.00 ± 6.45	1.35	(0.155)	(0.327)	(0.011)
Well-being	Mental health	Exercise	69.60 ± 10.95	83.84 ± 12.73	20.46	1.991	3.681	1.93
		Control	68.48 ± 10.41	69.12 ± 14.86	0.93	(0.165)	(0.061)	(0.171)
	Vitality	Exercise	66.60 ± 14.56	70.00 ± 12.99	5.11	3.497	0.676	0.534
		Control	62.40 ± 15.69	62.60 ± 9.70	0.32	(0.068)	(0.415)	(0.469)
	Body pain	Exercise	77.33 ± 9.48	70.21 ± 10.64	-9.21	1.474	4.12*	1.527
		Control	76.00 ± 12.80	74.33 ± 15.39	-2.2	(0.231)	(0.048)	(0.223)
Overall evaluation of health	General health	Exercise	70.56 ± 12.32	75.36 ± 7.63	6.8	1.313	11.804*	1.746
		Control	69.44 ± 8.48	72.00 ± 11.43	3.69	(0.258)	(0.001)	(0.193)

Values are means ± SD of two groups, Results of two-way repeated ANOVA represent F values. diff%: Difference inPercentage. *p<.05

was statistically significant. Such observations are consistent with previous studies demonstrating that muscular exercises induce the activities of enzymes responsible for glycolysis, increase storages of ATP and creatine phosphate in muscles, and expand sizes of muscle fibers[13] thereby increasing basal metabolic rate as well as energy expenditure and decreasing body weight, body fat mass, and body fat percentage, consequently[14].

The heart rate is one of the most fundamental indicators for bodily reactions in response to physical activities. In the results, we found that the exercise group had decreased HR by 3.33% which was statistically significant. La Rovere et al.[15] reported that regular exercises induce vagus nerves activities, hence balancing the autonomic nervous system.

There are multiple studies indicating that aerobic exercises positively influence maximal oxygen uptake[16,17]. Yoon et al.[18] demonstrated that the 8-week exercise program using the Nintendo Wii Fit aids in upper limb muscle endurance among male high school students with mental disability. Other previous literatures have reported positive impacts of multi component exercise on physical fitness[5,14,19]. Similarly, this study found that maximum oxygen uptake (VO2max), muscular strength (grip strength), muscular endurance (sit-up), and flexibility (bend over reach) were increased by 7.83%, 6.32%, 15.16% and 11.24%, respectively, after the implementation of the 12-week exercise program. These were all statistically significant in the exercise group. Such results take place not only because aerobics and strength training in the Wii Fit exercise program play an important role in the enhancement of cardiopulmonary functions and increase in muscular strengths but also since continuous yoga training may improve the mobility of joints.

The QOL is a multi-dimensional and subjective concept regarding one's feeling on one's health status. Such is generally based upon individuals' subjective attitude and experience about their body as well as their social/mental health[20]. Kim et al.[21] addressed that people with regular physical activities represent better health-related QOL compared to those without such activities. In the current study, it was demonstrated that, in the exercise group, sub-indices of physical functioning and general health were elevated by 3.65% and 6.8%, respectively, whilst body pain was decreased by 9.21%. These effects were all statistically significant. The results explain that the Nintendo Wii Fit exercise program may arouse subjects' interest and facilitate active exercises, thereby improving their QOL through making positive changes in their bodily composition, as well as physical fitness.

These results provide preliminary data regarding the possibility that the Nintendo Wii Fit exercise program

may positively influence physical fitness and general health among university students who are being threatened their health owing to lack of physical activities.

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