The Effect of Exergame Education on Balance in Children

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ABSTRACT

The purpose of this study was to investigate the effects of exergame training which can be conducted on stable floor; at school with smart board and at home with TV screen, on students' balance improvement. 53 students with age average of 10,25±0.504 were voluntarily participated to this research. In this experimental research, pretest-posttest with control group model was used as a testing model. Participant students were divided into exergame group and control group by using random sampling method. While balance training with 'nintendo wii' game console was applied to exergame group three days a week during eight weeks, control group didn't take any application. For both of the groups, pretest-posttest was evaluated through static balance measurement with 'balance error scoring system (BESS)' and dynamic balance with 'techno-body measuring device'. Furthermore, development level between these two groups was observed. Pretest results comparison was conducted with unpaired t-test. In the analysis of development level between groups, for pretest-posttest values repetitive measurement, two-way anova analysis was used. In pretest measurements, It was not observed any difference between control and exargames applied groups dynamic and static balance ability (p>,05).By the way, in static and dynamic posttest measurement, It was observed significant differences between groups in favor of exergame group (p<,05). In this study, It was considered that balance training with exergame dramatically improves both static and dynamic balance abilities. As a result, It can be suggested that exergame should be used for improving the balance in children as an alternative training method both in the schools and houses.

Keywords: *Exergame, Balance, School children*

INTRODUCTION

In recent years, depending on the significant growth concerning the exergame, new interactive motion methods have been developed, which influences physical activity programmes conducting at school (Graf, Pratt, Hester & Short, 2009). Regarding children's interest about technology, It is seen that public schools started to increasingly use exergame so as to encourage students to do physical activities. For example; dance revolution is a exergame activity that includes agility, balance and cardiac vascular endurance; encourages physical activities; unifies music and visuality as well as attractschildren's attention (Gao, Hannan, Xiang, Stodden & Valdez, 2013). In Turkey, there is 12-year compulsory education (Primary Education and Training Law, 2012). Furthermore, application of interactive board for each school is a govenment policy (Fatih Project, 2012). Therefore, Turkey's schools have the capacity of reaching to all children. Schools are important areas in terms of encouraging doing physical activity for children. With growing technology, there is urgent need to develop new approaches about improving children's health through motivating them to perform physical activities. Exergame is an alternative way to meet that need.

With offering opportunity for people to actively move on, Exergames are artificial reality games that necessitate partly or complete body movement (Vernadakis and others, 2012). Exergame including sensor based Technologies, allows the users to control the game with body movements. Thus, users freely move and do all extremity muscles activation while playing the game. As a result of children's being encouraged to bodily move on within an activity that they enjoy, exergame is a promising physical activity alternative (Mellecker and McManus, 2014). It is stated that growing technology of the exergame improves balance which has a great importance in daily and sportive life (Demir & Akın, 2018;Sheehan and Katz, 2013; Sheehan and Katz, 2012; Vernadakis and others, 2014). Therefore, as an alternative training method at school, It can be a significant importance to conduct the exergame which motivates children to provide balance improvement and can be easily used by interactive boards.

Balance is defined as the ability of protecting and stabilizing body position in any support base (Berg, Wood-Dauphine, Williams, and Gayton, 1989). Protecting balance in any action is a complicated task. Postural control primarily provides achievement of two main goals. First one is to protect the balance; in other words, to stay projection of central pressure and centre of gravity in support base under static conditions. Another aim is to constitute interface between perception and action. (Massion, Alexandrov ve Frolov, 2004). For balance, complete development of timing parameters is seen as one of the main factor of foreseen function representing maturation of central nervous system. Concerning the complication of balance control parameters, It is not suprising that development process of postural control has lasted until the end of childhood and puberty periods. Studies in recent years are crucial for researchers to understand the relation between late maturation process of central nervous system and postural control development; especially in transition periods, age 6-7 and puberty (Assaiante and others, 2005). Children and the young are different than adolescence. Thus, balance training should be conducted depending on characteristics of each age group(Weineck, 2004). Various systems were developed for balance improvement. Then, sophisticated computerized platforms were designed in accordance with both muscle system and visual systems (Yaggie & Campbell, 2006). Moving floor types; such as, wobble board, foam roller, swish ball and balance discs , were traditionally used for balance improvement (Emery, Cassidy, Klassen, Rosychuk, & Rowe, 2005). Today, balance biomotor feature is attracted great attention and new improving technologies are being researched. Therefore, game consoles like exergame becomes more popular because of their feature of cost-effective, portable and ease of use both at home and at school (Coveart, 2008).

In conclusion, by including the exergame activities, which are enjoyable and also provide the opportunity of self-study, to exercise programmes conducted for balance improvement in area of school; balance development's effectiveness can be enhanced. In this study, main purpose is to analyze the effects of exergame which can be conducted with smart boards in both school area and with any screen at home, on students' balance improvement.

RESEARCH METHOD

Research Model

The method used in this research is pretest-postest experimental objective sampling method with control group. Participants who were informed depending on Helsinki criteria, voluntarily participated to the study as being taken permission from their parents with approval form. This study was approved by Mersin University Social and Humanitarian Sciences Ethics Committee in 25/12/2017 with number of 30201175-659.

Participants

Balance development is important for children. Therefore, 10-year-old children were selected in this study. 53 secondary school students whose age average, stature and body weight in order of 10,25±0.504, 140,3±3,502, 40,3±2,103, participated to the research. As Exergame and control group, two groups were constituted with random sampling method. Children who previously played sports were not included in the study since it was thought that the previous sport had a positive effect on balance. In addition, children with any disability were not included in the study.

Data Collection Tools

Balance Error Scoring System (BESS): The balance error scoring system is a test used to measure static balance with eyes closed. With the purpose of evaluating static balance through eyes closed, balance error scoring system was applied in three ways as double leg stance (hands are upper part of iliac and feet are side by side), single leg stance (hands are upper part of iliac and non-dominant foot is on the ground) and tandem stance (non-dominate foot is back of dominant foot). Stances were performed on plane and soft foam surface through counting errors in 20 seconds. Errors are determined as opening eyes, hands lifted off iliac crest, step, stumble or fall, lifting forefoot or heel, remaining out of test position more than 5 second or moving hip into more than 30 degrees abduction. If within 20 seconds 10 error is made, test is ended (Bell and ark. 2011).

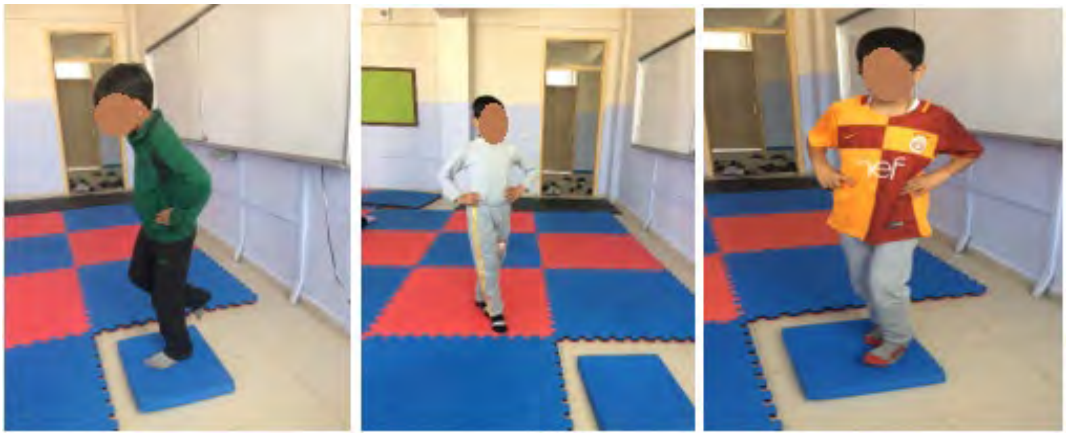

Figure 1. Measurement Method of Balance Error Score System

Dynamic Balance Measurement Method: Prokin Technobody balance device is used to measure dynamic balance with open eyes, double feet and single foot (right-left). In this device, participants try to protect balance through moving within circle seen on computer screen while they are standing on the device. Before starting measurement, device was established; device's connection with computer was supplied and each participant's name was noted down measurement form. For balance measurement there are device heading of easy, medium and hard (Akın, 2013). In this research, due to the age of the children, the device's easy head was used for dynamic balance measurements.

Participants were one by one included in the measurement after they were informed about content of the test. Computer screen was arranged as participant can easily see. For each test, after participant got balance and informed operator about the fact that he/she was ready; measurement started. While 30 seconds measurement was applied in double feet and arms freely wide open. Same application was done 10 seconds for right and left single foot. When participants were stumbled over and falled, or go down from the platform, testing repeated. Tests were applied twice and best results were gained.

Figure 2. Tecno Body Ölçüm Yöntemi

Training Programmes

Exergame group was trained with 'nintendo wi fit' game console, which was established on smart boards in the classroom, 3 days in a week, approximately 40 seconds in a day during 8 weeks. There was not any application to control group during 8 weeks.

Nintendo Wii Exergame Bracket

Nintendo wii fit plus exergame provides activities acquiring agility and coordination skills relating to platform, power, flexibility, balance and dance. One of the crucial features of this system is to offer individualized feedback based on basic antropometric measurements (Sheehan and Katz, 2013). Wii fit is a game including both fitness and entertainment, designed for everybody without regarding age. Wii Fit consists of wii game console, wii remote, nonchuck, receiver bar and balance board (Wiifit, 2007). Exergames, conducted during 8 weeks in this study are indicated below.

1. Week: Head Ball- Tightrope Tension(40')
2. Week: Table Tilt-Ski Jumping(40')
3. Week: Penguin Slide-Snowboard Slalom(40')
4. Week: Balance Balloon-Ski Slalom(40')
5. Week: Head Ball- Tightrope Tension(40')
6. Week: Table Tilt-Penguin Slide(40')
7. Week: Penguin Slide-Snowboard Slalom(40')
8. Week: Head Ball-Ski Slalom(40')

Figure 3. Exergame Training With Smartboards In Classrooms Data Analysis

Shapiro Wilk Test was applied for normality distributions (p>0,05). For compare pretest result in groups unpaired t-test was used. Also, two-way Anova analysis was used in order to analyze the difference between pretest and posttest findings. In the study, level of significance 0,05 was used in statistical processes.

FINDINGS

Static Balance Findings: Static balance BESS, pretest findings was given at Table 1 and also pretest-posttest analysis was given at Table 2.

Table 1. Exergame and Control Groups Static Balance (BESS) Pretest Comparison

Tests	Groups	n	x̄	S	Sd	t	p
BESS Pretest Total	**Exergame**	27	36,9	3,3	51	1,763	,775
Error Score	**Control**	26	35,5	3,2			

In accordance with the table, as a result of comparisons conducted by unpaired t test; It was stated that there isn't any meaningful difference in two groups' pretest static balance values (p>,05).

Table 2. Exergame and Control Groups Static Balance (BESS) Pretest-Posttest Comparison

	Exergame Group			**Control Group**			
	n	x̄(Pre Test)	x̄ (Post Test)	n	x̄ (Pre Test)	x̄ (Post Test)	p
BESS PreTest- PostTest	27	36,9	18,8	26	35,5	34,3	,000*

As it is seen in the table 2, there are meaningful differences between static balance BESS pretest and posttest results of groups (p<,05). According to the results, It was founded that exergame training conducted via smart boards in the school, improves static balance in school children.

Dynamic Balance Findings: Dynamic balance, pretest findings was given at Table 3 and also pretest-posttest analysis was given at Table 4.

Table 3. Pretest Comparison Results of All Groups' Dynamic Balance Double Feet, Right and Left Foot.

Tests	**Groups**	n	x̄	Ss	Sd	t	p
Double Feet	**Exergame**	27	406,5	60,9	51	,986	,418
	Control	26	391,0	53,0			
Right Foot	**Exergame**	27	194,3	54,1	51	,284	,165
	Control	26	190,8	30,9			
Left Foot	**Exergame**	27	187,6	46,3	51	,249	,502
	Groups	26	191,0	52,3			

According to the table 3 result of comparisons conducted with unpaired t test, It was founded that there is not any meaningful difference in double feet, right foot and left foot dynamic balance values of exergame group and control group (p>,05)

Table 4. Pretest-Pssttest Comparison Results of All Groups' Dynamic Balance Double Feet, Right and Left Foot.

	Exergame Group			**Control Group**			
	n	x̄ (Pre Test)	x̄ (Post Test)	n	x̄ (Pre Test)	x̄ (Post Test)	p
Double Feet	27	406,5	273,4	26	391,0	380,1	,000*
Rigth Foot	27	194,3	143,3	26	191,0	186,0	,008*
Left Foot	27	187,6	135,5	26	188,0	69,24	,003*

As it is seen in the table, there are meaningful differences between two groups' double feet, right foot and left foot dynamic balance pretest and posttest scores (p<,05). In accordance with the results, It was stated that exergame training which is conducted via smart boards in the school, improves dynamic balance of school children.

DISCUSSION AND CONCLUSION

In this study, It was aimed to analyze effects of exergame training, which can be conducted on stable floor; at school with smart board and at home with TV screen, on balance development of students. It was

arrived at the conclusion of the fact that exergame training applied in this research improves both static and dynamic balance in children. In the research, there were significant differences between exergame group and control group in terms of pretest-posttest static and dynamic balance values. It was noticed that exergame dramatically develops balance improvement of children.

Findings derived from the study are parallel with previous studies (Goble, Cone and Fling, 2014; Sheehan and Katz, 2013; Sheehan and Katz, 2012; Vernadakis and others, 2014). In a study involving 29 children aged 7 to 12 years with low balance characteristics, it was found that training with the nintendo wii balance board significantly improved balance (Mombarg, Jelsma and Hartman, 2013). In accordance with the results of these studies, It is founded that balance training applied with exergame improves balance performances in children. In this study, It is asserted that exergame training applied at school improves childrens' static and dynamic balance. Apart from balance development, there are studies which analyze effects of exergame training on other motoric characteristics in children (Gao, Zhang and Stodden, 2013; Barnett and others, 2012; Vernadakis and others, 2015; White and others, 2011; George and others, 2016; Lanningham-Foster and others, 2009; Sun, 2016; Lwin and Malik, 2012; Johnson and others, 2016). In these studies, It is considered that there are significant findings that exergame training's positive effects including increases physical activity level, object control and ball capacities and basic motoric abilities, energy amount spent; decreases in sedentary behaviours, motivates for physical activity, constitute positive behaviours. In a study with the purpose of analyzing the differences in children's situational motivation between fitness training in physical education lesson of elementary education and exergame training, the results show that exergame has a great power to motivate children(Sun, 2012). Furthermore, another study with the aim of the way to increase physical activity at school by 40 minutes, and, of detecting time spent for medium or high physical activity, It is demonstrated that dance activity applied with exergame increases physical activity (Maloney, Stempel, Wood, Patraitis &Beaudoin, 2012). It is observed that 12-week exergame dance training for overweight children positively effects their personal health and their pleasure level (Staiano, Beyl, Hsia, Katzmarzyk & Newton, 2018). To one of the study with the purpose of comparing physical activity among exergame training and traditional physical education lesson, non-overweight and 4 third class students who tried exergame before, were participated. As a result of the study, It is stated that exergame training highly encourage students to take part in physical activity (Shayne, Fogel, Miltenberger & Koehler, 2012). In the compilation analyzing application of exergame's effects on pyhsical activity and health conditions, fourteen studies show that exergame application increases physical activity and for most of these studies, It is observed to develop motoric abilities(Norris, Hamer, & Stamatakis, 2016). Various studies regarding exergame training at schools demonstrate that exergame enhances academic success (Staiano & Calvert, 2011), encourage to do physical activity (Lwin & Malik, 2012), can empowers self-efficacy for cardiorespiratory endurance and academic success(Gao, Hannan, Xiang, Stodden & Valdez, 2013).

Concerning the results of preview studies and this study, It can be asserted that exergame training has positive effects on balance improvement and other motoric characteristics in children. Because of that, regarding importance of balance development in early age groups, there is urgent need to apply balance training in sportive activities of children. Therefore, alternative activities like exergame training which children can easily practice without bored; but, entertained can be an important option for balance development. It is identified that efficacy of materials special to balance is the same with exergame's. Application of exergame training, which provides self-study opportunity, with interactive boards at school is easier than other materials. It is appropriate to apply exergame training which can worked by oneself because of applying ideal materials for balance is difficult by oneself.

Suggestions

- Through including exergame training, which both is an enjoyable activity and provide the opportunity of self-study, to the exercise programmes for balance development; balance ability of children can be enhanced.
- Teachers and trainers can conveniently conduct exergame training for improvement of balance depending on the findings of this study.
- It is suggested that exergame can be used in different age groups, too. In this way, exergame can be conducted as an alternative method for the sufficient development of balance

ability in early age groups.

-The investigations can be conducted regarding the effects of various exergame consoles on balance development.

-Exergame's application at school by setting up to smart board can be popularized in order to improve exergame training children's motor skill.

-Due to the motivating feature of Exergame, it can be used for movement training in overweight students.

-The effect of exergame on different motoric properties can be investigated.

-Exergame centers can be established in each school and students can be encouraged to move.

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