Effect of Stickygym games on motor development of children during Covid-19 lockdown

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Abstract

Introduction: Children's motor skills are inversely related to sedentary screen time. Public lockdown during COVID-19 has caused a further increase ın screen time. The current research aims at investigating the impact of Stickygym games on motor development of children.

Materials and Methods: 28 eligible subjects (4-6 years old) were chosen and randomly grouped into control group (n=13) and experimental group (n=15). Using TGMD-2 test, gross motor development was measured. The experimental group performed online Stickygym games for 8 weeks. Stickygym kit includes Hook & Loop strips, with two linear polyester strips that are easily but firmly attached together. Trained instructors performed online training sessions. In the end, TGMD-2 test was conducted again in person. Data analysis was done using Shapiro-Wilk, Levene and the analysis of covariance tests were with the significance level of 0.05 in SPSS 24.

Results: some locomotion skills were significantly improved by Stickygym games: bound (p =0.005), galloping (p =0.012), and running (p =0.003), as well as object control skills: overhand throw (p =0.004), underhand roll (p =0.01), and striking a stationary ball (p=0.021).

Conclusion: This play kit can be utilized by pre-school educators and parents for improving object control and locomotion skills in preschool children.

Key words: Stickygym games, preschoolers, motor development, Covid-19

Introduction

Early childhood is the most important period of healthy motor development in human life time (1). Physical activity may provide motor benefits across childhood and adolescence (2). Inadequate physical activity is one of the leading causes of non-communicable disease, which leads to about 3 million deaths worldwide each year. Only 33% of all children meet the minimum guidelines (60 minutes of physical activity per day) recommended by the World Health Organization (3). Physical activity affects many aspects of the child's development and health (4). physical activity has numerous benefits for health of children, such as enhanced mental wellbeing, blood pressure, insulin levels, and lower body fat mass (5,6) . However, in spite of these advantages, children mostly do not have physical activities on most week days (7). There is a strong relationship between level of physical activity and the fundamental motor skills (FMS) development in childhood. FMS include locomotor, manipulative, and stability skills, as the basic blocks for developing more complex, advanced motor skills to be used in sports or daily physical activities (8).

Children's fundamental motor skills are inversely related to amounts of screen-based behaviors (9). COVID-19 virus caused infection in millions of people in the world and influenced a large number of people. About 1.5 billion 5-12 years old children adopted remote learning after closure of schools By the end of April 2020 (10), and sedentary behavior has been increased as a result of social restrictions (11, 12) and opportunities for engagement of adolescents and children in physical activities have decreased (13, 14). The

studies revealed that imposed movement restrictions resulting from the pandemic harmed motor competence development in children (15). Related studies have frequently reported lack of motivation in children for being active during lockdown periods and lack of motivation of parents for supporting physical activity in their children (16). Previous research findings supported improvement of physical activity levels by implementing gamification, and gamification programs cause a significant improvement in emotional competencies and reduce anxiety levels (17, 18, 19). Scientific research shows that play is fundamental to children's learning and motor development, and it satisfies specific needs, builds pleasure and fun, and strengthens imagination (20). But because of lockdown physical activity of children were limited mostly to home. Most of children's time is spent at home. Children are interacting with family members inside the home and resources for playing and learning are available for them. If stimulating toys are available in the home, they are significant indicators for the home environment's overall quality (21). The home environment is in the host of subsystems contributing to motor development (22, 23). Based on ecological (affordance) theory, the home should be supported as a medium for learning and growth (24).

As indicated by systematic reviews, early childhood physical activity interventions have been mostly conducted by researchers or research team. Thus, potential for long-term sustainability and external validity of these interventions are greatly reduced. In educator-led physical activity program, a trend is shown towards increasing gross motor skills of children. Early childhood educators facilitate educator-led programs. In other words, researchers or other professionals do not co-facilitate these programs (25). This study aims at investigating the impact of educator-led Stickygym games on children's motor development during Covid-19 lockdown. This innovative kit is made of Hook & Loop Tapes can be arranged for various fundamental motor skill games including locomotion, manipulation and stability.

Materials and Methods

It is a quasi-experimental research with a control group and pretest-posttest design. It was

carried out in Tehran city, Iran, from January to March, 2020 during COVID-19 lockdown period. The research statistical population included children, which was recruited via announcements on social media. Pre-screening was performed using an online questionnaire to eliminate candidates who do not meet the basic requirements. The research inclusion criteria were as follows: the age range of 4 to 6 years (boys or girls), no engaging in any regular physical activity or sports program, the absence of cardiorespiratory and orthopedic disorders, and lack of medical prohibition for participation in the activity. 28 eligible subjects were selected as the statistical sample. The parents and their children were invited to attend an introductory in-person meeting and pretest session. The public health practices were followed to prevent the spread of COVID-19. Objectives of the study were explained for parents and children and illustrated some Stickygym sample games by trained instructors. The children and parents with willingness of participating in the research with a perfect knowledge of the research method and exercises completed the research entry form and consent form, and they were made ready for participation in the pretest. Gross motor development was individually examined in all children.

Using Test of Gross Motor Development-2 test (TGMD-2), gross motor development was tested. We selected the TGMD-2 since it provides motor skill assessment, which includes equipment and skills common to children at the age range of 3 to 10. It was first developed by Ulrich (1985) and its reliability (=0.87) and validity (= 0.96) were confirmed among American children 3 to 10 years old. The validity and reliability of this test were also confirmed by Zarezade and Farokhi (2009) in Iran; the internal reliability coefficient for loco-motor movement, control of object, and the total combined score was reported to be 0.78, 0.74, and 0.80, respectively (26). Then, the research subjects were randomly assigned into the two groups: control group (age: 5.20±0.43) (n=13) and experimental (age: 4.80±0.81 y) (n=15). Fundamental motor skills are measured using the TGMD-2 standardized test, which includes 6 object control subtests (dribble, strike, catch, throw, kick, roll) and 6 locomotor (gallop, run, hop, jump, leap, slide). The movements were recorded by the camera to score skills. The motor development test checklist was used to

analyze movement items. This checklist was provided based on Ulrich test (2000). The qualitative scoring method was based on analysis of body section approach which was scored as 0 and 1; the score 1 was used with fulfilling the criteria and score 0 was used when the participant does not meet the criteria. Each motor skill was performed twice and the skill score was obtained by adding criterion scores. The totals of the two subtests were summed to calculate raw scores (27). The experimental group performed an online intervention emphasized on fundamental motor skills using Stickygym kit for 8 weeks, 3 sessions weekly, and 45 min each session (10 minutes for warm-up, 25 minutes for specific Stickygym games, and 10 minutes for cool-down). Stickygym kit was designed by scientists professional in motor development and developmental psychology. The kit includes Hook and Loop strips, with two linear polyester strips that are easily attached. Hook and loop tape is most commonly known as Velcro tape or hook and loop fastener tape. The bonding strength of Hook & Loop Tape is increased by the unique and formulated design of loops and hooks. Stickygym kit includes the following pieces: two loop square plates, 6 loop strips in different colors, 6 loop dots in different colors and a 25 cm. noodle foam, 4 small soft foam balls covered by hook tape. Stickygym kit has been registered in the Secretariat of the Toy Supervision Council of Center for the Intellectual Development of Child and Adolescent of Iran in 2019 (Reg.no.99/3123593/1) (fig.1).

Figure1: Stickygym kit

Trained instructors performed online training sessions. The activities were child-centered and focused on fundamental movement skills, mobility, and movement concepts using bonding characteristics of strips, dots, dart boards, sticky balls. Multiple people can participate in the game and enjoy the fun of the game. For example, throwing sticky balls to firmly attach to strips, dots, dart boards or other catching activities (manipulation skills), walking, running, hopping, skipping, jumping skills (locomotion skills), balancing, stretching, bending and twisting activities (stability skills) individually or in combination which were performed online by the instructors. The Control group engaged in daily free play at home and online PE class (one virtual session per week-45 minutes) of their institute. In the end, TGMD-2 test was conducted like the pretest in person. Data analysis was done using the descriptive (central tendency, graphs, and tables) statistics ($P < 0.05$). Shapiro-Wilk test was used for confirming the normality of the data and equality of variances assumed by the Levene test ($P < 0.05$). Then, to investigate the between – group difference, the effect of the independent variable (Stickygym games) on the dependent variables (object control and locomotion skills) was examined using the analysis of covariance (ANCOVA) to determine whether the intervention, without interacting with the confounding factor (pretest score), could have a significant effect on the dependent variable or not. SPSS software version 24 was used for analysis of all data.

Results

The descriptive characteristics of the children participating in the research are shown in Table 1.

Table1. Characteristics of subjects

	Intervention (n = 15)	Control (n = 13)
Gender (male/female)	8/7	7/6
Age (years)	4.80+0.81	5.20+0.43

Height (cm)	115.4 ± 0.05	116.24 ± 0.06
Weight (kg)	19.2 ± 2.34	18.9 ± 3.30
BMI	16.8 ± 1.80	16.1 ± 2.14

Note: Data are given as mean ± SD

The Shapiro-wilk test results are insignificant for all research variables (P> 0.05), meaning that all measured data of the research variables have a natural distribution (Table 2).

Table 2. Summary of the results of the Shapiro-wilk test to investigate the normal distribution of research data

Variable	Group	Control		Intervention	
		statistics	significance	statistics	significance
Object control Skills	Pretest	0.93	0.21	0.91	0.18
	Posttest	0.87	0.24	0.85	0.09
Locomotion skills	Pretest	0.97	0.46	0.97	0.51
	Posttest	0.82	0.14	0.91	0.27

The results of Leven test are not significant for all variables (P> 0.05) which indicate that the variances are homogeneous (Table 2).

Table 3. Leven test results to investigate the homogeneity of the variances of research

Variable	df1	df2	F	P value
Object control	26	1	2.70	0.08
Locomotion	26	1	2.43	0.102

Findings from (Tables 4 and 5) show the result of ANCOVA which was used to evaluate the effectiveness of Stickygym games on the dependent variables (object control and locomotion skills). The result of ANCOVA related to post-test scores of locomotion skills (table 3) showed that the significant levels for run (p =0.003), galloping (p =0.012), and leap (p =0.005) were less than 0.05; hence, the mean difference in the post-test phase between the groups was significant after controlling the possible effect of the pretest score. Therefore, as can be seen, 8 week Stickygym games had a significant effect on above-mentioned variables (P <0.05).

Table 4. ANCOVA results for evaluating the effectiveness of Stickygym games on locomotion skills

Variable	Group	pretest		Post test		F	p
		M	SD	M	SD		
Run	experimental	4.10	0.91	5.39	1.2	7.52	**0.003***
	control	3.27	0.75	3.90	1.64		
Gallop	experimental	1.24	0.75	2.96	0.41	6.24	**0.012***
	control	1.41	0.22	1.51	0.37		
Hop	experimental	2.01	1.02	2.80	0.95	3.60	**0.504**
	control	2.29	1.06	2.90	1.10		
Leap	experimental	1.30	0.74	2.67	0.60	3.86	**0.005***

	control	1.90	0.32	2.00	0.35		
Jump	experimental	2.20	1.03	2.83	0.61	2.98	**1.203**
	control	2.51	0.29	2.14	0.66		
Slide	experimental	2.82	1.12	3.43	1.63	0.38	**0.720**
	control	2.12	0.34	2.63	0.46		

The result of ANCOVA to evaluate the effectiveness of Stickygym games on object control skills have been shown in Table 5. The results showed that 8 weeks of Stickygym games can significantly improve overhand throw (p =0.004), underhand roll (p =0.01), and striking a stationary ball (p =0.021) skills.

Table 5. Results of ANCOVA to evaluate the effectiveness of Stickygym games on object control skills

Variable	Group	pretest		Post test		F	p
		M	SD	M	SD		
Strike	experimental	2.00	1.21	3.88	0.82	1.27	**0.021***
	control	2.27	1.02	2.42	0.64		
Dribble	experimental	1.34	0.75	1.42	0.48	0.41	**0.412**
	control	1.41	0.41	1.61	0.33		
Catch	experimental	2.01	1.21	2.83	0.71	0.17	**0.634**
	control	2.89	1.42	2.40	0.86		
Kick	experimental	2.31	1.04	2.71	1.05	0.08	**0.530**
	control	2.11	1.32	2.20	0.85		
Throw	experimental	1.20	0.73	2.88	0.79	0.12	**0.004***
	control	1.51	1.12	1.78	1.02		
Roll	experimental	1.82	1.02	3.03	0.78	0.51	**0.010***
	control	2.12	0.34	2.63	0.46		

Discussion

The present research was conducted for examining the impact of physical training using an innovative paly kit named Stickygym on motor development of children. The findings showed that 8 week Stickygym training can have a positive effect on run, leap, and galloping skills from locomotion subscale and overhand throw, underhand roll, and striking a stationary ball skills from object control subscale of TGMD-2 test. The subjects in the experimental group could obtain higher scores in these skills than the control group after participating in the training program. Our research findings indicate that motor development of children can be improved by affordances in the home environment. The home environment primarily contributes to children development (28, 29). Hirose stated affordances are opportunities for action that events, places, or objects provide for the animal in the environment (29). In other words, the environment can stimulate action, and action opportunities or affordances are provided by home environments. Thus, motor development is stimulated. By the affordances it means materials, toys, apparatus, stimulation, availability of space, and nurturing that enhance children's development. Thus, the home environment can be regarded an affordance leading to the optimal development of children (30).

The focus of subsequent studies was on motor development and toy availability (31). Nevertheless, there is little knowledge on the motor development and multidimensional home environment (32). The multidimensional home environment includes both physical (e.g., movement play equipment in the home) and social-psychological (e.g., number of playmates, amount of parental attention, family composition, etc.) factors. In current study, designing multiple active games using Stickygym in addition of the child, engaged parents or siblings at home and may provide a multidimensional home environment which is more effective than just using as a toy.

To explain the findings about the effectiveness of our program on some fundamental motor skills, it can be pointed out Developmental Skills Interventions Approach. The basic strategy of this approach to achieve normal movement development is to encourage children to participate and engage in games and sports exercises (33). In our study, we

asked the instructors to encourage and motivate the subjects to perform the games and provide positive reinforcement and feedback.

Observational data suggest that most of the play and sport equipment are boring and unappealing to children. Talarowski et al. (2019) reported innovative playgrounds may encourage youth to spend more time outdoors, increase levels of physical activity, and have unique experiences where they can test their physical skills and develop resilience (34). One of the important issues with physical activity participation is to diversify the program and tools used (35). Although the child is naturally interested in playing, but experience new play equipment such as Stickygym kit may increase their personal pleasure and encourage children to participate in physical activity for longer time.

Gamification was probably a mechanism for the success of the training protocol proposed in our work for improvement of some motor development skills in children. Manzano-León et al. (2021) showed family leisure and gamification may reduce the psychological effect of confinement resulting from the COVID-19 (17). Physical activity levels can be improved by the positive effect of aesthetics and gamified dynamics and activities, (18) and it causes a significant improvement in emotional competencies and reduction of anxiety levels (19). The fundamental psychological needs of the self-determination theory are satisfied by physical and leisure activities in the family. Thus, it can be explained that why the subjects were motivated for continuing the activities and could raise the sensations of satisfaction and well-being (36). the determinants of active play among British children were investigated by Brockman et al. (2011), and it was found that children felt motivated for engagement in active play since they perceived it as enjoyable, preventing boredom, with mental and physical health advantages and free from adult control, structure, and rules (37).

There is consistency between our findings and another work conducted on COVID-19 confinement, which indicates the significance of family participation and recreational activities for motivating people to increase level of physical activity (38). Stickygyme games were designed to increase level of physical activities and build pleasure moments and affectivities, fun and play as well. Howard and Fearn (2011) found that under

conditions of deprivation and extreme stress, children have the ability of regulating emotional arousal and reducing anxiety levels when they play (39), parental skills can be increased and parent-child relationship can be improved (40, 41). Hence, lower levels of anxiety and stress can be experienced during COVID-19 by being more active and rested (42). So another potential explanation for the finding can be attributed to elimination of some physical activity barriers for experimental subjects. With higher involvement and success of individuals in active-play games, their skills are developed, making it easier to involve in physical activities. It would be enjoyable for them to perceive that they experience more emotional and physical well-being and their bodies would become more fit. One is motivated by these benefits and rewards, which can result in higher engagement in physical activities (43). Despite the significant positive results in some motor skills in this study, statistically non-significant differences were found between groups on hop, jump, and slide skills from locomotion subscales and dribble, catch, and kick skills from object control subscales. According to Gallahue-based appropriate developmental model, programs need to have the certain amount of training sessions' hours, components of skills, and creation of diversity in movements of children (44). So, constantly more information on dosage, content, and intensity of program is needed. Moreover, future studies on motor behavior should take these factors into account for designing appropriate motor development programs.

In the past, several studies have been published on physical activity intervention on improvement of motor development in children. The current research findings as well as other results of previous studies are encouraging interventions for improving motor skills in preschool children. The impact of an intensive structured intervention on motor skills in 3-6-year-old preschool children was investigated by Hestbaek et al. (2021), and a tendency towards a greater improvement in the intervention group was reported (45).

However, some studies reported that that the physical activity intervention impact on improving preschool children's motor development is not significantly different (46-49).

All the intervention components were educator-led in this work. All structured lessons and five unstructured sessions were implemented by educators, without any researcher

involvement at the central level. It is contrary to most early childhood physical activity interventions, in which the researcher had a salient role in facilitation, transferability, and sustainability of program, or delivered the professional development for the educators (50).

In present study all training sessions were perform online leaded by trained instructors and the experimental subjects had some interaction with peers in the screen. This virtual intervention had some similarities with Active video games (AVGs) that is an efficient approach to promote PA among children (51). In AVGs, exercise and video games are combined, and thus, players are motivated to get involved in PA when they play the games (52). For playing AVGs, a physical effort is needed from the player for interaction with the gaming environment for which he/she uses his/her lower and upper extremities for performing different activities, like catching, jumping, jogging, and dancing (53). A large number of studies have recently tried to adopt this innovative fun approach in order to promote PA and health in different age ranges. As suggested by promising findings, AVGs can be used as an effective approach to promote PA and provide health benefits comparable to traditional PA approaches in adolescents and children (54, 55)

A considerable part of time of parents and children was spent on viewing screens during lockdown periods, and it was an opportune for leveraging screen-time as a tool for increasing physical activity of preschool children. Using physical activity interventions through digital devices, like tablet or mobile apps, encouragement can be provided in real-world settings for physical activity in children. It has been recognized that using mobile-based interventions is a promising way for substantial influence on PA levels. Nevertheless, there have been few mobile-based interventions with a specific focus on enhancing children's physical activity (56). In present study although we performed device-based training program using mobile, tablet or lab tab but the participants trained interactively by online coaches and this way may affect positively on children's motor development. These findings indicate the importance of home environment enrichment that is a kind of affordances promotion can improve motor development of children. This

play kit can be used by pre-school educators and parents for improving object control and locomotion skills in children.

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