Original Article

The Effect of "Kashi Practices" on the Improvement of Psycho-Motor Skills in People with Down Syndrome

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Objectives: The aim of this study was to evaluate the effect of "Kashi practices" on the improvement of psycho-motor skills in people with Down syndrome.

Methods: In this research, 28 men with Down syndrome between 21 and 43 years of age (mean age 25.917 ± 3.889) were randomly assigned to either a control (n=14) or an experimental group (n=14). All persons in the experimental group followed 12 weeks of selected exercise training (Kashi practices) three times a week. Prior to the start of the study, and after the three-month training period, each member in both groups was assessed according to the Bruininks Oseretsky Test of Motor Proficiency (BOTMP).

Results: The results indicated that Kashi practices could cause a significant improvement in psycho-motor skills in several variables such as strength, endurance, power, agility, reaction time, balance and running speed in the experimental group ($P<0.05$). These changes were not significant in control group ($P>0.05$) in any compression.

Discussion: These results showed that Kashi practices could cause a significant improvement in psycho-motor skills and can be an important step to improve physical fitness, physical activity and quality of life in people with Down syndrome.

Key words: Kashi practices; Psycho-motor skills; Down syndrome

Submitted: 6 June 2015
Accepted: 8 August 2015

Introduction

Approximately 12% of people of all ages with intellectual disabilities have lifelong developmental delays (DD). This number is predicted to double by 2030, with Down syndrome being the most frequent chromosomal cause of DD (1). Down syndrome (DS) is the most common chromosome abnormality and the most common genetic cause of intellectual disabilities in humans (2,3). It occurs equally in all races with an overall incidence approximately occurring in 1 out of every 700 to 1,200 live births (2,4,5). People with DS commonly experience mild to severe intellectual disabilities, although the mean level of disability remains mild to moderate (6). Also, there are a number of medical and health-related complications that are associated with the syndrome, including congenital cardiac and respiratory problems (7,8), Hypertension (9), low cardiovascular fitness (7), hypothyroidism (10), obesity (10,11), motor developmental problems (12-14), muscle hypotonicity (8,15-18), decreased muscle strength (8,16-19), joint hypermobility (8,16,17,20), and balance and postural deficits (20-24).Also, the brain of an individual with Down syndrome at or shortly before birth is in many respects indistinguishable from the brain of a normal individual (25). There are a number of medical and health-related complications that are associated with the syndrome, including nervous

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system disorders (26), sensory impairments (8), cognitive deficits (27,28) and some problems in processing, interpreting, and elaborating information (29), speech (30,31), eye-hand coordination, laterality, visual motor control and reaction time (32).

These impairments contribute to a delay in the acquisition of motor skills in children with Down syndrome and also to the development of atypical motor patterns (33-35). This is also preponderance to disorders such as cardiovascular problems, hormonal problems, musculoskeletal disorders, depression, Alzheimer's, higher BMI, lower levels of lean mass, reduced bone mass-related parameters and other problems. These become more pronounced with age, and create mobility and participatory problems in these individuals, which increase the needs of physical activity programs to improve psycho-motor skills in order to improve their health and quality of life. Also, due to lack of exercise, obesity can also be seen in these people more than in others, which indicates a higher level of attention should be given to physical activity and fitness in these individuals (36). There is a close relation between physical activity and the longevity of people with Down syndrome, which indicates the importance of designing a physical activity program for increasing life expectancy and health promotion in these individuals (37). Some researchers, however, mentioned that many of the training programs carried out in children and adolescents with DS did not yield the desired responses, and that more research is needed to clarify the issue (38). Therefore choosing the best training program for these people is very important. The effect of different types of strength (39-41), endurance (35) and aerobic (42) training for these people has been determined. Also, several researchers have concluded that a combination of exercises in balance and strength (37,41), strength and aerobic (43,44) and these combined with plyometric jumps (45), are more beneficial for these individuals. Other researchers have shown the positive effects of some special techniques such as riding (46) and cycling (47). Combining the functionality of physical therapy and the creative aspect of dance with music can also stimulate and challenge individuals with Down syndrome physically and cognitively, which can improve their memory and increase physical fitness while allowing them to express their emotions (51). Therefore, according to the results of several studies in this case, it can be concluded that combining training with the use of some special techniques is more useful for these people. Based on several of the studies mentioned above, the researchers attempted to design a combined exercise training program (Kashi practices) for individuals with Down syndrome. This training program consisted of five parts: balance training, strength and power training, muscular endurance and aerobic training, psycho-motor skills training, and other exercises such as the use of vibration machines, local dances and games (table 1). This selected exercise training program begins with Fundamental Movement Abilities and is to be completed with Specialized Movement Abilities.

A beneficial effect of Educational-Training Kashi Practices has been proved in the improvement of cardiovascular function (48), balance (49) and muscle strength (50), decreased hypotonia (51), an improvement in information processing, reduction in mental and neurological complications (52), improvement of psycho-motor skills and changes in physical characteristics (53), as well as a significant reduction in the incidence of initial dementia symptoms (48). The authors intend to investigate the effect of Kashi practices (the combination of a variety of specific exercises for people with Down syndrome) on the improvement of psycho-motor skills in people with Down syndrome.

Methods

Participants: The samples consisted of men with Down syndrome who live in Nemoneh Disability Rehabilitation Centre in Tehran. Authorization and the consent of the people responsible for this centre were obtained. The inclusion criteria were: individuals over 20 years old, ability to understand simple instructions and ability to stand and walk independently. The exclusion criteria in both groups were absence in pre- and post-tests, and in the experimental group were: inability to attend more than two thirds of the training sessions or more than three sessions in a row. Out of the 34 men with mild to moderate retardation, 28 met the study criteria in this centre. In this study, 28 men with Down syndrome between 21 and 43 years old (mean age 25.917±3.889) were randomly assigned to either a control (n=14) or an experimental group (n=14). However, the data for one person in the experimental group was not used, because he missed more than three intervention sessions in a row. Three people in control group were not

included because they couldn't participate in pre- or post-tests and, as a result, they did not participate in the study. All the conditions, such as eating, physical activity, sleeping and participation in the educational program were exactly the same in both the control and experimental groups, except that the experimental group participated in selected exercise training. The Iranian professional code of ethics was followed in this research. Full agreement letters for all participates were signed; it has been agreed that all the data should be kept privately and securely.

Instrument: For assessing the effects of selected exercise training on reaction time, muscular endurance, agility, balance and power, both prior to the start of the study, and after the three-month training period, each member of both groups was assessed by some subscales of the Bruininks Oseretsky Test of Motor Proficiency (BOTMP). In addition, for assessing strength a wrist and trunk dynamometer was used, and for assessing running speed, a 45m running test was performed, both before and after the training.

Procedure (selected exercise training: Kashi practices): The basic elements of all entailed sporting activities were cardiovascular exercise, strength training, balance, and flexibility (54). Due to the low levels of cardiovascular fitness, poor levels of muscular strength and balance, and the postural deficits of individuals with DS, our activity program mainly focused on these important elements However, because of the hyper mobility and joint laxity that is common in DS, flexibility is not a recommended activity for this population. According to several studies mentioned above, researchers attempted to design a combined training program (Kashi practices) for individuals with Down syndrome. This training program consisted of five parts: balance training, strength and power training, muscular endurance and aerobic training, psycho-motor skills training, and other exercises such as the use of vibration machines, local dances and games (table 1). This selected training program begins with Fundamental Movement Abilities and is to be completed with Specialized Movement Abilities.

Table1. Kashi practices for people with Down syndrome

Kashi practices for people with Down syndrome				
Balance training	Strength and power training	Muscular endurance and aerobic training	Psycho- motor skills training	Other training
1- static balance training 2- walking and running on a line 3- walking and running on the balance beam 4- axial movements 5- hopping 6- cycling	1- exercises with rehabilitation and medicine ball 2- weight training 3- calisthenics 4- plyometrics training 5- jumping	1- walking 2- roping 3- running 4- step training 5- cycling	1- throwing, catching, kicking and striking eight models of balls 2- galloping, skipping, sliding and leaping 3- targeting 4- implementation of group dancing 5- football and basketball penalty, 6- football and basketball dribbling 7- volleyball setting	1- use of vibration machines 2- games with rules 3- local dance

The training duration was 50 minutes for the initial session, rising to 150 minutes in the final weeks. The practice continued for three sessions per week for three months in total, based on previous studies which had reported significant improvements in individuals with Down syndrome following a 10-12 week special training program (37,55-57). Considering the utility of this type of training, Kashi practices were planned for 12 weeks and led by 14 trainers and assistants (one trainer/assistant for each one or two participants). The intensity of the program rises gradually from light to difficult. Motivational techniques were incorporated to improve the adherence of participants. Also, the Lotan (2007) guidelines on quality physical intervention activities for persons with Down syndrome were followed, in order to determine the intensity of the exercises (58).

Statistical Analysis: All analyses were performed by SPSS software. Descriptive statistics were calculated for all the variables. Comparison of all data between pre- and post-test in the experimental and control groups were evaluated using a t-test for dependent samples. A multi-variable analysis of variance (MANOVA) was used for the compression of psycho-motor skill variables between the experimental and control groups in pre- and post-test.

Results

The age of the 23 adults with DS included in this study ranged from 21 to 39 years, with an average

age of 29.185 ± 3.932 years, an average weight of 63.363 ± 12.591 kg and an average height of 153 ± 5.021 cm. Multi-variable analysis of variance showed that pre-test differences between control and experimental group in psychomotor skills were not statistically significant [Wilks' Lambda=0.771, f(6,17)=0.843, P=0.554], but in post-test compression, they were statistically significant [Wilks' Lambda=0.428, f(6,17)=3.8=787, P=0.014]. This means that after three months' training, we had significant improvement in the psycho-motor skills of the experimental group.

Muscular performance: for determining the effect of selected exercise training on muscular performance, muscle power (by vertical and long jump tests), muscle strength (by wrist and trunk dynamometer tests) and muscle endurance (by push up and long and sit tests) were assessed.

Table 2. Muscular performance in pre and post-tests in experimental and control groups

Variable name	group	Phase assessment	Mean	Std.	Dependent t test		
					t	df	P-value
vertical jump	Con.	Pre.	15.636	6.727	1.70	10	0.120
		Post.	13.636	7.696			
	Exp.	Pre.	13.769	8.808	-3.196	12	0.008
		Post.	17.307	10.41			
long jump	Con.	Pre.	48.636	17.676	0.534	10	0.605
		Post.	47.181	19.787			
	Exp.	Pre.	51.923	36.784	-3.605	12	0.004
		Post.	68.615	41.877			
trunk strength	Con.	Pre.	38.918	34.598	-1.696	10	0.077
		Post.	44.490	34.766			
	Exp.	Pre.	39.538	22.199	-4.818	12	0.000
		Post.	50.692	28.741			
wrist strength	Con.	Pre.	22.617	9.646	-0.020	10	0.984
		Post.	22.654	8.881			
	Exp.	Pre.	20.446	6.976	-3.941	12	0.002
		Post.	24.707	8.082			
push up	Con.	Pre.	5.636	4.980	1.455	10	0.176
		Post.	5	4.049			
	Exp.	Pre.	5.369	3.180	-5.524	12	0.000
		Post.	10.769	3.515			
long and sit	Con.	Pre.	4	4.538	1	10	0.341
		Post.	2.636	2.802			
	Exp.	Pre.	7.307	8.128	-3.083	12	0.009
		Post.	12.384	9.786			

Table (2) shows muscular performance in pre- and post-tests in the experimental and control groups. According to these data, it is clear that all compression between pre- and post-test in six variables (vertical jump, long jump, wrist strength, trunk strength, push up and long and sit) in the experimental group were significant (P<0.05), but in the control group weren't significant (P>0.05). These results show that the selected exercise training program has a positive effect on muscle performance in individuals with Down syndrome.

Table 3. Balance, reaction time, running speed and agility in pre- and post-tests in experimental and control groups

Variable name	group	Phase assessment	Mean	Std	Dependent t test		
					t	df	P-value
balance	Con.	Pre.	15.363	7.311	-1.513	10	0.161
		Post.	16.909	7.942			
	Exp.	Pre.	14.538	10.219	-4.319	12	0.001
		Post.	21.615	9.870			
reaction time	Con.	Pre.	43.697	4.176	0.432	10	0.675
		Post.	42.833	7.723			
	Exp.	Pre.	46.397	4.321	8.659	12	0.000
		Post.	31.820	5.422			
speed of running	Con.	Pre.	22.942	5.397	0.758	10	0.446
		Post.	22.546	5.836			
	Exp.	Pre.	23.380	8.325	5.180	12	0.000
		Post.	18.838	6.531			
agility	Con.	Pre.	13.754	2.995	1.081	10	0.305
		Post.	13.387	2.277			
	Exp.	Pre.	12.876	2.940	10.733	12	0.000
		Post.	9.746	2.430			

Balance, reaction time, running speed and agility: for assessing balance, reaction time and agility, subscales of BOTMP test were used. For assessing running speed, a 45 m running test was used. Following the Kashi practices, the individuals in the intervention group showed a statistically significant improvement in scores of balance, reaction time, running speed and agility ($P<0.05$), while no significant change was seen in the control group scores ($P>0.05$). The results of this section of the study show that this type of exercise training significantly improves the balance, reaction time, running speed and agility of adults with Down syndrome (table 3).

Discussion

Down syndrome individuals, as a result of an extra copy of chromosome 21, have some disorders in their physical characteristics and a delay in motor development. Accurate assessment of psycho-motor skills in individuals with Down syndrome is therefore very valuable. Gross motor skills are the foundation of fine and complex motor skills. The growth retardation in these skills also influences the learning and control of motor skills, physical activity, academic success, mental functioning, social interaction and compatibility. One study by Barreto and colleagues showed that an exercise training program based on the principles of psycho-motor skills, not only improved the health and physical fitness of these individuals, but also improved their mental and social characteristics (46).

According to the data presented in this study, it is clear that this combination of specific exercises (Kashi practices) can cause a significant improvement in psycho-motor skills in several variables, such as strength, endurance, power, agility, reaction time, balance and running speed in the experimental group ($P<0.05$). These changes were not significant in control group, however, ($P >0.05$) in any compression. This result shows that the changes were only significant in the experimental group in terms of improved psycho-motor skills. It can be concluded that this significant improvement in psycho-motor skills of the experimental group was in response to the selected exercise training program. Thus, implementing this training program could have a significant effect in improving psycho-motor skills in adults with Down syndrome.

One of the most important factors that Down syndrome affects in these individual is hypotonia. Hypotonia is a first sign of musculoskeletal problems in DS individuals. Hypotonia is a cause of weakness in muscular performance and delays motor development (59). This weakness in psycho-motor skills can be a barrier to self-confidence and self-esteem. Therefore, assessing psycho-motor skills and designing a physical activity program for these individuals are very important and very effective in adapting them to their community and improving their physical and mental health. Appropriate levels of muscular performance are associated with the health of these people, helping them to live independently and have autonomy, especially in old age (60). A low level of muscular performance is one of the risk factors for osteoporosis, low bone density, muscle pain, weight gain due to lack of exercise and even problems such as weight loss, intolerance to cold, bad mood and loss of memory (43). A low level of muscular performance not only reduces mobility, but also creates problems for performing everyday tasks (37,40,56).

The results of this study show that muscular performance, as assessed by strength, power, endurance, speed, agility and balance, showed improvements by following a three-month program of Kashi practices. An improvement in the muscular performance of these individuals is very important, as it increases their quality of life and health. This type of disabled people cannot do mental work. They are only able to perform physical tasks. One of the benefits of strength training for individuals with Down syndrome is in preparing these people for working in the community. Some researchers have also shown the positive effect of strength training in performing daily activities (39,61). Thus we can conclude that by improving muscular performance, we can expect to improve the daily activities and social interactions of these people. Another important result in this research was an improvement in reaction time.Alpha

Reaction time was measured in this study to evaluate the effect of selected exercise training on information processing and nervous system function. Reaction time shows the speed of information processing in the nervous system. After executing the selected exercise training program, and especially psycho-motor skills training, improvement in nervous system function was seen.

Many studies have demonstrated the impact of physical activity on improving cognitive and nervous system function (62-64). According to neuronal group selection theory, the cortical and subcortical networks within the brain are dynamically organized, and it is hypothesized that the neural networks and connections are established and/or strengthened by afferent information produced via behaviour and motor experience (65,66). The brain produces new neurons in the olfactory bulb and dentate gyrus of the hippocampus throughout life. Increasing evidence indicates that this process has a very important role in learning and memory. The new cells are preferentially activated during learning tasks (67). Researchers found that an increase in neurogenesis is associated with improved cognition and the strongest neurogenesis stimulus is exercise (39). Physical activity also accelerates the maturation of dendritic spines in new-born neurons (68), and regulates hippocampal neurogenesis, synaptic plasticity, and learning (67). This change in synaptic plasticity seems to be specific to the dentate gyrus, indicating that neurogenesis might be important (39). Thus, an exercise-based increase in the highly plastic cells of the dentate gyrus might explain, in part, the profound effect of physical activity on memory function (69). We can explain the improvement of information processing and nervous system function in the experimental group with these mechanisms.

In this study, an analysis of the results showed that physical and mental improvement was created after three months of Kashi practices. One of the important factors in improving people's physical and mental health is an improvement in fitness. After training in the experimental group an increase in physical activity was seen. The results of several studies on people with Down syndrome have shown that these individuals are less physically active than other people (8,14,35,66). One reason for this problem is a failure in brain development and muscle hypotonia during early development, which makes these individuals different from other children, even from early childhood (14). It is clear that physical activities improve health and relieve some of the medical problems of people with Down syndrome, and also improve the status of the musculoskeletal system (70). Thus, Kashi and his colleagues, with the help of three months of selected exercise training (Kashi practices), assessed some psycho-motor skills, thus concluding that this style of training can improve strength, endurance, power, agility, reaction time, balance and running speed. This improvement will be very useful for the physical and mental health of these individuals.

Conclusion

Recent research demonstrates that this type of training could successfully improve psycho-motor skills, as assessed by strength, endurance, power, agility, reaction time, balance and running speed. It is clear that physical activity enhances the body composition, skeletal health, and several aspects of psychological, psychological and neurological health and these benefits are equally seen in individuals with Down syndrome. Exercise programs appear to have the potential to positively affect the overall health of adults with DS, thereby increasing their quality of life and years of healthy life (1). Parents, teachers, and health professionals need to encourage people with Down syndrome to take part in more frequent moderate to vigorous physical activity. Physical exercise is a very important factor that might lead to increased physical and mental health throughout life. Physical activity modifies brain function in the anterior cingulate cortex, a prefrontal cortical area implicated in the regulation and control of behaviour (29). In recent years, physicians have only relied upon medication practices for the treatment of these patients. A few researchers have taken pains to identify best practices for improving the physical and mental health of these people. It has thus been established that early intervention could reverse the functional decline frequently associated with these disorders (71).

Given the high rates of age-related, early-onset of these disorders among adults with Down syndrome, programmatic screening, monitoring, and preventive interventions are required to limit secondary disabilities and premature mortality. This study showed that physical activity can be helpful in improving physical and mental health in adults with Down syndrome. As a conclusion, it can be affirmed that all of these changes shown in the study had a positive impact on reducing the symptoms of dementia, and improving the general health of individuals with Down syndrome. The major challenge to realize these changes was the establishment of a correct training plan. Choosing the correct training program is of major importance in designing rehabilitation exercises. Gonzalez-

Aguero et al. (2010) mentioned that many of the training programs carried out with children and adolescents with DS did not yield the desired responses, and more research is needed to clarify the issue (38). Therefore trainers, parents and caregivers should take great care in selecting appropriate training for these people. All the parts of the exercises conducted in this study are based on previous research and based on scientific principles, with even the combinations of different exercises being based on scientific findings. The beneficial effect of Educational-Training Kashi Practices has thus been proved in the improvement of cardiovascular function (48), balance (49) and muscle strength (50), decreased hypotonia (51), an improvement in information processing, reduction in mental and neurological complications (52), improvement of psycho-motor skills and changes in physical characteristics (53), as well as a significant reduction in the incidence of initial dementia symptoms (48). It is proposed to evaluate the effect of this type of training in various aspects of the physical, psychological and neurological characteristics and quality of life in individuals with Down syndrome at different ages. In other words, after an appropriate and complete evaluation, it can be recommended as a complete training for the community.

Acknowledgments

This research was carried out in the Nemoneh Disability Rehabilitation Centre in Tehran. It is necessary to acknowledge the help of all the colleagues who helped in implementing this research, especially the Special Olympic team of Iran. Two experts in physical education (Mr. Davood Homayon Biroon and Ms. Neda Azarakhsh) were the main trainers in this study. A great thanks is due to the 11 men with mild mental disorders who helped as assistant trainers in the centre. We must also thank the faculty members of University of Rome Foro Italico and University of Rome La Sapienza. Teachers from these universities helped us in the understanding of the scientific principles of disabilities.

Declaration of interest: none declared

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