Contribution of a Proposed Motor Education Programme to the Improvement of Overall Dynamic Coordination and Motor Balance in Children with Down syndrome

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Received: 01/2024 **Published: 05/2024**

Abstract:

The study aimed to determine the effect of a motor education programme on the development of general dynamic coordination and motor balance in children with Down syndrome (8-10 years old), and to determine the differences between the experimental and control groups. The study sample consisted of 16 children with Down's syndrome, with mental retardation ranging from 50 to 75 degrees, from the special school "Tamani" in Algiers. The researcher used the experimental method, dividing the sample into an experimental group and a control group, each containing 8 children with Down syndrome. The proposed motor programme was applied to the experimental group for 24 weeks, at a rate of 3 sessions per week.

The results showed that the motor education programme had a positive effect on the development of motor competence in the motor dimensions represented by bilateral coordination, upper limb coordination, dynamic and static balance.

Keywords: motor education, general dynamic coordination, motor balance, Down syndrome.

Introduction:

Down syndrome is one of the most common genetic causes of intellectual disability, accounting for 25% of people with intellectual disability. It is a disorder that can be observed during pregnancy using modern techniques and we

find 1 case per 770 new births, which is about 1.3/1000. (Deloeuvre, 2018, p5) In the absence of a medical treatment solution, thanks to much research, people with Down syndrome have been able to achieve continuous improvement, positive development and care to reduce the difficulties they suffer. The quality of the guidance provided to assist them, the accuracy of the follow-up and the regularity of the duration remain the best solutions for the care of this population (Cuilleret, 2017, p7).

For the proper care of individuals with Down syndrome, it is preferable to provide care through a multidisciplinary team, and the specialist should be aware of the problems experienced by individuals with Down syndrome. In order to achieve better results and effectiveness, it is advisable to provide care at an early stage. Specialists in "education through movement" (as Jean Le Boulch calls it) also play an effective role in this process, helping the child to acquire the necessary motor skills to discover his environment and master the basic movements to ensure greater independence in his movements. In this regard, Roberta O'Shea adds that motor care should aim to help the child achieve functional independence to the greatest extent possible, targeting the child's development and motor coordination skills, as well as the development of stabilising movements of the joints close to the axis, skills that help with walking, muscle tension, postural control and balance, and endurance, while ensuring that the movements practised with the child are meaningful to the child and his or her family (O'Shea, 2023, p. 134).

Children with Down syndrome develop their skills more slowly than typical children, but the degree of delay varies from child to child. Some begin to walk in the second year of life, while others do not acquire the ability to walk until the fourth year of life. Specialists play an important role in stimulating children with Down syndrome to develop their motor skills (Duffy, 2017, p. 13).

Motor coordination is the ability to perform one or more correct movements. We find motor coordination between the upper and lower limbs (hands and legs), or coordination between the upper limbs (hands), and coordination between vision and movement (vision and hands or legs), and hearing and movement. For good motor coordination, there must be a good mental representation of movement, a clear body image, the ability to adjust in time, and good visual perception (Juhet, 2018, p. 25). Individuals with Down syndrome take longer to execute movements, which requires more reliance on feedback responses, which in turn takes longer to process the returned information (Silva, Silva and Correia, 2013).

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In this regard, Nathalie Noack adds that there are three characteristic symptoms of motor-cognitive competencies in individuals with Down syndrome: slowness in reaction and motor execution, extreme variability, and poor motor coordination.This includes developmental and adaptive aspects, with disturbances in the development of different motor co-ordinations, disturbances in school success or in activities of daily living.It also includes the analysis of the immediate movement systems, such as the specific goals of the movement, the critical events of a motor task, by knowing the elements related to the individual (predispositions, muscular and ligamentous condition, nervous state,

sensory abilities, postural elements preceding the motor act) and the elements related to the environment (type and number of sensory stimuli, temporal dimensions, spatial definition, feedback). Describing coordinated movements in this context supports research in the field of neurophysiology of movement (Noack, 1997, p. 68).

Researchers Daun Skelton and Susie Dinan argue that motor balance is the result of the complex interaction of different sensory and motor systems, and that loss of motor balance occurs when the base of support is small. Loss of balance can affect motor coordination and overall motor activity (Juhet, 2018, p.23).

In individuals with Down syndrome, the physical deformities and muscular hypotonia that characterise them, often accompanied by ligament laxity, impede different stages of motor development and the acquisition of skills necessary to perform motor tasks (muscle tone control, relaxation, motor coordination, balance). These concomitant problems also cause difficulties in motor learning, which is evident in the programming, control and execution of movements (Rondal and Rasore-Quartino, 2007, p.116).

Noack adds that postural deformities contribute to a change in the visual field and thus change the frame of reference for head and eye position, but in an inappropriate way in space. Since vision requires adjustment of the postural system, which in turn affects head and eye position and postural curvatures in children with Down syndrome, this exacerbates balance difficulties and alters the relationship between the body and the environment, as well as the perception of the position of body parts in space (Noack, 1997, p.66).

In this study we aim to determine the effect of the proposed motor programme on overall dynamic coordination and motor balance in children with Down syndrome aged 8 to 10 years.

1. Methodology:

PSYCHOLOGY AND EDUCATION (2024) 61(5):681-709
ISSN:1553-6939

1.1 Research approach:

Given that the subject of our research is related to the proposal of a physical education programme for children with Down syndrome, and to determine the impact of the designed and proposed programme on general dynamic motor coordination and motor balance, we believe that this study is appropriate for the experimental method, as the study relies on experimentation, which is appropriate for the subject of our study. The experimental method is "an intentional and controlled expression of the specific conditions of a defined reality or phenomenon that is the subject of study, and then the observation of the resulting effects on that reality or phenomenon. It involves the manipulation of one or more of the independent variables usually present in the research problem and its hypotheses, in order to understand their effects on the dependent variables" (Actouf, 2019, p.36).

The researcher in this study adopted the experimental method as it is appropriate for the topic.The researcher chose the experimental design with two equivalent groups with pre-test and post-test measurements for each group.

Experimental group Treatment Post-test

Control Group Post-test

1.2 Study variables:

1.2.1 - Independent variable: This is the experimental variable and in our study, the proposed physical education programme is the independent variable.

1.2.2 Dependent variable: The results obtained by the children in both general dynamic coordination and motor balance.

1.2.3 Extraneous or confounding variables

* Age: the children participating in the study must be of the same age group.

* Degree of mental retardation: The intelligence quotient (IQ) of all the children taking part in the study must be at the same level, between 50 and 75 points, which the researcher obtains from the official records of the special school.

* Early intervention: The age at which the children received early intervention, as all the children in the study received early intervention before the age of three.

* Type of Down syndrome: There is a difference in motor and intellectual outcomes between the three types of Down syndrome (free, translocation, mosaic), so all the participants in the study were of the free type.

- Associated diseases: In particular, the chronic diseases associated with Down syndrome, for which the sample size was reduced in order to exclude elements suffering from acute chronic diseases.

- Sport or physical activity outside the motor programme: Activities outside the proposed motor programme may influence the children's results in the post-test. There are two external activities included in the school programme activities, namely external trips and swimming every Saturday, except for holidays, which both the experimental and control groups benefit from, in addition to the daily transport to school, which is also equivalent.

- School location and conditions: The researcher ensured that the environmental conditions were the same for the experimental and control groups, namely the specialised Tamani school in Algiers, Algeria. For this confounding variable, the researcher was satisfied with a relatively small sample size in the study in order to better control for external conditions that could affect the study results.

1.3 Research community and study sample:

1.3.1 Research community:

The research community represents the social group on which the applied study is to be carried out through the adopted methodology. Our research community consists of children with Down's syndrome who are beneficiaries of educational and psychological support at the level of the province of Algiers, whose age ranges from 8 to 10 years.

1.3.2 Study sample:

The sample used in scientific research is a model that includes and reflects an aspect or part of the units of the original community concerned by the research, being representative of it so that it carries its common characteristics. This model or part saves the researcher from studying all the units and elements of the original community. (Qandilji, 2012, p. 186)

Our research sample consists of 16 children with Down syndrome (free type), enrolled in Tamani school for school reintegration (specialised school) for the academic year 2022/2023. The researcher was forced to conduct his research on a limited sample because conducting the research on the original community would cost the researcher a lot of time, effort and money. This sample was deliberately chosen because it is the one to which the motor programme will be applied, in addition to the pre- and post-measurements.

1.3.3 Criteria for the selection of the study sample (children with Down syndrome):

- Selection of children with Down syndrome with the least absenteeism, in order to be able to control the progress of the experiment, based on the reports of the previous year.

- They should have the same mental age and level of education.

- The age of early support should be the same for all children (support begins before school entry by psychologists in a clinic working in partnership with the Tamani Specialist School).

- The health record should be the same for all children, especially regarding chronic diseases associated with Down's syndrome.

- The same external practice of motor activity, such as participation in a sports club (the school allocates a swimming session and excursions according to a specific schedule every Saturday).

1.3.4 Homogeneity and equivalence of the study sample (experimental and control groups):

In order to control the variables that affect the accuracy of the research results, the researcher resorted to verifying the homogeneity of the experimental and control groups in the variable and dimensions of general mobility and dimensions of adaptive behaviour.

Table 1: Demonstrates the Age Homogeneity of the Sample

Measures Variables	Experimental Group		Control Group		"F" Value	Significance Value	Significance
	Mean	Standard Deviation	Mean	Standard Deviation			
Age (months)	112.94	10.82	113.18	10.05	0.073	0.091	(-)

From Table 1 above, we can see that the significance value is greater than 0.05, indicating that the two groups are homogeneous in terms of age.

2. Study tools:

2.1 Proposed motor programme:

The proposed motor programme consists of 4 main pillars and 2 sub-pillars. The programme was applied to the children in the study sample for a period of 24 weeks. The contents of the programme are detailed in the following table:

Table 2: Pillars and content of the proposed motor programme

Program Axes	**Contents**
General Dynamic Coordination	Walking Exercises Running Exercises Various Types of Jumping Movements Hanging and Climbing Movements
Balance	Foot Sensation Movements Self-Confidence Building Exercises Posture Adjustment Static Balance Movements Dynamic Balance Movements
Visual-Manual Coordination	Manual Sensation Movements Visual Tracking of Objects Various Types of Throwing Movements Receiving Movements Manual Agility Movements
Muscle Tension	Pushing and Pulling Movements Stopping Moving Objects Foot Striking Movements
Simple Motor Paths	Jumping Paths of Various Types

	Climbing Paths Balance Paths Multiple Paths
Motor Games	Races Modified Basketball Modified Semisport Games Bowling Games

2.2 Bruininks-Oseretsky Test of Motor Proficiency 2005:

The researcher used certain subtests from the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) 2005, while omitting the other subtests.

Table 3 shows the subtests used in the study for the Bruininks-Oseretsky Test of Motor Proficiency 2 (BOT-2) 2005.

Bilateral Side Coordination	Vertical Jump Test: Hands and feet in the same direction. Toe and Finger Tap Test: Striking the foot and index finger simultaneously.
Upper Limb Coordination	Ball Bounce and Catch Test: Striking the ball on the ground and catching it with both hands. Small Ball Bounce Test (Tennis Ball): Bouncing the small ball with alternating hands.
Balance	Walking Forward on a Line Test with eyes fixed on a target drawn on the

	wall. Standing on a Balance Beam with one leg and eyes open.

2.3 Statistical Methods: SPSS software package was used.

3-Presentation of study results:

3.1 Presentation of pretest results:

Table 4 shows the differences in the motor coordination and balance dimensions in the pretest between the experimental and control groups.

Statistical Methods / Motor Dimensions		Experimental Group		Control Group		"F"value	Calculated "T" Value	Significant Value	Significance
		Mean	Standard Deviation	Mean	Standard Deviation				
Balance	Dynamic Balance	.88	.835	1.00	.756	.399	-.314	.758	(-)
	Total Balance Score	1.50	1.309	1.75	1.282	.000	-.386	.705	(-)

Bilateral Coordination	Toe and Finger Tap Test	1.13	.835	1.25	.707	.205	-.323	.751	(-)
Upper Limb Coordination	Ball Striking	.75	.707	1.00	.756	.074	-.683	.506	(-)
	Total Score	2.50	1.927	2.63	1.923	.438	-.130	.899	(-)

From Table 4 we can see that there were no significant differences in the pre-test measures between the experimental and control groups in the dimensions of balance and motor coordination, as the p-value is greater than 0.05.

Table 5 shows the U-value, Z-value and their significance for the differences between the mean ranks of the experimental group and the mean ranks of the control group in the pretest on the Bruininks-Oseretsky test.

Statistical Methods General Motor Dimensions	Experimental Group		Control Group		Values			Type of Significance
	Mean Rank	Sum of Ranks	Mean Rank	Sum of Ranks	U	Z	Significance Value	

Bilateral Coordination	**Vertical Jump Test: Hands and Feet in the Same Direction.**	8.94	71.50	8.06	64.50	28.500	-.403	.687	(-)
	Total Score	8.44	67.50	8.56	68.50	31.500	-.055	.956	(-)
Balance	**Static Balance**	8.06	64.50	8.94	71.50	28.500	-.403	.687	(-)
Upper Limb Coordination	**Small Ball Bounce Test with Alternating Hands**	7.63	61.00	9.38	75.00	25.000	-.810	.418	(-)

As shown in Table 5 above, the differences between the mean ranks of the experimental and control groups were not statistically significant for the motor coordination and balance dimensions, as the p-value is greater than 0.05.

3.2 Presentation of the post-test results:

Table 6 shows the t-values and differences in the balance dimension in the post-test between the experimental and control groups.

Statistical Methods General Motor Dimensions		Experimental Group		Experimental Group		Control Group	Calculated "T" Value	Significance Value	Significance	Effect Size
				Mean Rank	Sum of Ranks					
Balance	**Dynamic Balance**	2.88	.835	1.25	1.035	.375	3.457	.004	(**)	0.45
	Static Balance	2.00	.756	.88	.835	.399	2.826	.013	(*)	0.36

Based on Table 6, the differences between the mean balance scores of the experimental and control groups in the post-test were statistically significant, favouring the post-test of the experimental group at different and acceptable levels of significance. The effect sizes ranged from 0.36 to 0.45 for the balance dimension, indicating a large effect size.

Table 7 shows the U-value, Z-value and their significance for the differences between the mean ranks of the experimental group and the mean ranks of the control group in the post-test of the Bruininks-Oseretsky test.

BalanceStatistical Methods / **General Motor Dimensions**		Experimental Group		**Control Group**		**Values**			**Type of Significance**	**Effect Size**
		Mean Rank	**Sum of Ranks**	**Mean Rank**	**Sum of Ranks**	U	Z	**Significance Value**		
Bilateral Coordination	Jump test in place hand and man in the same direction	11.63	93.00	5.38	43.00	7.000	-2.730	.006	(**)	0.78
	Test hitting	11.75	94.00	5.25	42.00	6.000	-2.885	.002	(**)	0.81

	foot and index finger at the same time									
	College Degree	12.50	100.00	4.50	36.00	.000	-3.451	.001	(***)	1
Balance	College Degree	11.94	95.50	5.06	40.50	4.500	-2.947	.003	(**)	0.86
Upper Limb Coordination	Test hit the ball and hold it with both hands	11.75	94.00	5.25	42.00	6.000	-2.864	.004	(**)	0.81
	Small Ball Layout Test With Successive	10.75	86.00	6.25	50.00	14.000	-1.996	.046	(*)	0.56

	Hands									
	College Degree	11.75	94.00	5.25	42.00	6.000	-2.821	.005	(**)	0.81

Based on Table 7, the differences between the mean ranks of the experimental and control groups in the post-test were statistically significant in favour of the experimental group in the dimensions of motor coordination and balance, at different and acceptable levels of significance. The effect sizes ranged from 0.56 to 1 across all dimensions, indicating a medium to very strong effect size.

4. Discussion of study results:

4.1 Discussion of the overall dynamic coordination results:

As shown in Tables 4, 5, 6 and 7, there were statistically significant differences between the pre-test and post-test in the motor coordination dimension, which was measured by 4 subtests: jumping in place with hand and leg in the same direction, hitting the foot and index finger at the same time (bilateral coordination), hitting the ball on the ground and catching it with both hands, and bouncing the tennis ball alternately between the hands (upper limb coordination), in addition to the total score for each dimension. The researcher supports this improvement with the effect size (practical significance), which indicates the positive impact of the proposed comprehensive motor education programme.

Swinnen (1995) states that coordination requires synchronisation between the limbs in a specific cycle, i.e. contraction must follow a specific order and rhythm.

Schmitz (1994) adds that motor coordination is the ability to perform movements in a smooth and controlled manner and that coordinated movements

are characterised by speed, range and a specific direction. Chevalier et al (2009) confirm that coordination is a spatio-temporal adjustment of muscle contractions to produce a movement that adapts to the intended goal, and all these requirements depend on the central nervous system, which understands and assimilates the movement and where the commands to direct the movement come from. This is related to the assimilation of information, method and goal that precedes the movement, as well as the assimilation of information and method after the movement (Kamash, 2012).According to Doutrelaux (2009), citing Harre et al, motor coordination is the result of diverse motor learning, and the proposed motor programme included a high proportion of exercises aimed at motor coordination, starting with various types of jumping exercises, which accounted for 9.56% of the approximate total time of the proposed motor programme.

Vayer (1984) suggests that jumping is considered an ideal exercise for developing motor coordination and that jumping is necessary to improve other areas of motor skills. Al-Zuraiqat (2012) states that jumping is an activity that requires a high degree of balance, therefore we need to develop balance and muscle strength (we will discuss these two factors later). Al-Khuwaili et al. (1998) recommended various jumping exercises, in addition to other movements, to develop coordination for people with intellectual disabilities, such as walking with different rhythms and different patterns (on the toes - on the heels), running with different rhythms and different patterns, jumping in its different types and patterns, hopping on one foot with alternation, climbing stairs and ropes, bouncing a ball, throwing a ball at the skittles, throwing a ball as far as possible in different patterns, in addition to other exercises in different proportions that target coordination, including: walking (4. 94%), running (5.71%), throwing and receiving (7.25%), climbing stairs (6%), climbing (7%), movement patterns (10%), and simple motor games appropriate to the children's

abilities (8%). The general principles of developing motor coordination were taken into account, such as starting with pre-controlled movements and gradually increasing the difficulty of the exercise. In the proposed jumping exercises, it was started with exercises to feel the foot, then jumping from top to bottom with the support of the hands, i.e. providing assistance to the child, then moving to jumping from bottom to top, then coordinating the take-off and landing with the support of the hands, and then repeating the same types of jumps but gradually reducing the percentage of support and assistance to the child. It has also been taken into account not to rush the progression and not to move to a higher level until the child with disabilities has mastered the level of skill he/she is learning, in addition to using previous acquisitions and not hesitating to return to them to consolidate the learning.In addition to using previous skills and not hesitating to return to them in order to consolidate them, as recommended by the French Federation of Sports for All in the principles of developing motor coordination.

The coordination characteristics of people with Down syndrome have been taken into account. Noack (1997) found that when a person with Down's syndrome is asked to accelerate movements such as jumping, there is a decrease in the final results. In essence, the synchronised coordination of the lower limbs in jumping and propulsion is unstable. For this reason, recommendations have been made to provide a clear initial demonstration and then allow the child to perform the required movement at his or her own pace.

Doutrelaux (2009) states that the development of motor coordination depends on the effectiveness of the visual, auditory, tactile, motor and postural-dynamic analysers. The visual analyser is considered to be the primary analyser and here John Miller, citing Cuilleret (2007), points out that the visual detection points are unstable in individuals with Down syndrome. When the detection point is on the right axis, the child turns 90 degrees and the detection point is divided into

two points, which proves that the child sees distorted images, hindering their spatio-temporal exploration in visual interactions, which are the basis of communication. Therefore, tools with bright colours were used and the problem of lighting in the motor education room was addressed. In addition, the impact of the auditory analyser was taken into account, as hearing problems are widespread in people with Down syndrome and affect perceptual messages (Cuilleret, 2011). The language is understandable with a small vocabulary, with an emphasis on demonstrating movements before engaging in an activity and participating with them to create motivation for practice.

As far as the tactile analyser is concerned, optimal use was made of the three spaces dedicated to the proposed motor programme, including the psychomotor education room, the sand pit and the schoolyard.

Whenever the weather conditions were suitable, sessions without shoes (barefoot) were carried out on the sandpit in order to develop tactile sensations, given their importance in motor coordination.Jean Luc Cayla and Rémy Lacrampe (2007) added that, in order to develop motor coordination, it is necessary to take into account the variety of working positions, to always start with the execution of skilled movements, not to rush the work and to return regularly to the back to monitor the acquisition and consolidate the learning.This has been applied to people with Down syndrome (according to their abilities).

This particular group is characterised by an extreme variability in the recall of results in their motor performance, because they have difficulties in updating their information (or programs), especially in motor tasks that require speed. They do not adequately assess the situations to which they are exposed in order to adapt their motor responses to the circumstances, especially when there are multiple situations. This extreme variability can be explained by a failure to select the appropriate response, which can occur even in a typical child. In the case of more than one choice, the child uses the response that is most

appropriate to the context in order to have the best chance of success and achieve the goal. This aspect of extreme variability can be improved by repeatedly using different situations and improving their quality ((Noack 1997), as recommended by Cayla and Lacrampe 2007) by controlling and varying several factors to increase the complexity of the exercises, such as speed (acceleration and deceleration in performance), the balance factor (variation of starting positions, variation of working conditions), the variation of the speed factor (acceleration and deceleration in performance), the variation of the speed factor (acceleration and deceleration in performance), the variation of the speed factor (acceleration and deceleration in performance), the variation of the balance factor (variation of starting positions, variation of working conditions): running on bare sand), the factor of complex situations (setting up obstacles, integration of movement sequences, different movement sequences), the factor of uncertainty and change (use of fixed means, influence on the child during movement performance through language, variation of information) and the factor of external conditions (reduction of target size, change of measurements such as distance).

4.2 Discussion of the dynamic balance results:

From the tables numbered (04), (05), (06) and (07), we have observed statistically significant differences between the pre-test and the post-test in the dynamic balance dimension (static balance, dynamic balance). This improvement was reinforced by the effect size (practical significance 0.81, 0.86, 1), which indicates the positive effect of the proposed physical education programme. Considerable time was allocated to balance, with an approximate time of 6% for dynamic balance and 5% for static balance, as balance is particularly important in daily life skills and sports skills, and is also related to all other sports skills. Al-Shazly (1995), Khalil (2000), and Hassanein (1995) point out that dynamic balance is of paramount importance in both the demands

of daily life and in various motor skills and sports. Balance is an essential component in the performance of both basic and complex motor skills. Shehata and Al-Shazly (2006) have emphasised that balance is one of the motor elements that must be considered when teaching or learning motor skills, as it is the foundation upon which these movements are based (as we will see later in the skills of running and walking). Essam Abdel Khaleq Moustafa (1994) affirms that balance is the starting point for motor performance. The proposed motor programme included balance and postural exercises, including exercises to develop foot sensation, self-confidence exercises, postural and upright exercises, and various static and dynamic balance positions. The researcher took into account preparatory learning (préapprentissage) (Cuilleret 2003) before moving on to basic balance movements, where foot sensations (sensations plantaires) and confidence exercises (mise en confiance) formed the basis.

The preparatory stage for the main learning process takes into account the gradual introduction of levels of difficulty according to their appropriateness for the child. Vygotsky, citing Rigal 2010, referred to this as the reference framework for presenting challenges to children based on their developmental zones (determining the current level achieved and then moving immediately to the next higher level). The level of difficulty should be slightly above the learner's current ability, but adapted to their abilities so that learning can take place.

It is important not to neglect individual levels of learning, as Alkhouli and Rateb 2007 stated that comparisons between children's levels should be avoided due to the principle of individual differences. A child may succeed in one motor task but fail in another, so comparisons between them are not helpful and can lead to negative emotional responses such as anxiety, tension, fear or even aggression, in addition to shaking the self-concept. This has been observed in the current study with children with Down syndrome in exercises to develop self-

confidence, where we have recorded those who suffer from a pathological fear of this type of movement.

This principle was taken into account because of the hypersensitivity of children with Down syndrome from a psychological point of view (Rondal 1985, Réthoré Marie Odil 2000), which, according to the researcher, led to an increase in the effectiveness of the proposed programme.

The development of balance does not depend solely on the quality of the exercises, as Hassanein (1987) states that both the centre of gravity, the line of gravity that forms the balance polygon, and the psychological and physiological factors influence balance. In addition, Susan Hall (1995) adds that there are several mechanical factors that affect balance, including an increase in body mass, increased friction between the body and the contact point, and positioning the centre of gravity as close as possible to the base of support. Therefore, appropriate doses were given to achieve the positive effect of the proposed programme, since individuals with Down syndrome are characterised by disturbances at the morphological level, where Noack (1997) mentioned that children with trisomy have deformities in the shoulders, head tilting backwards, hip deformities, flat feet and muscle laxity, which cause changes in the base of support. In another study, Henderson (1981) showed that the various reductions in the bases of support (supports) of the polygon of equilibrium and the disappearance of visual cues have a negative effect on postural control, as his study found that only two out of 18 children were able to maintain balance on one leg with their eyes closed, and only one was able to maintain balance with their eyes closed. In addition, Cuilleret (2003), referring to Peuchel's studies, adds that balance in individuals with Down syndrome is limited by the fragility of the spine, as well as changes in vestibular fluid pressure and cerebellar dysfunction. It was therefore recommended that balance problems should be addressed on a case-by-case basis, emphasising the importance of individualised

work, as the morphological deformities vary from person to person. At the end of the session, time was set aside for individual work with children with Down syndrome, targeting areas of weakness, and vice versa for more advanced children, which is described by specialists as golden work.

The proposed training programme aimed to improve balance by stimulating the sensory systems, as recommended by Atef and Abdullah (1984), who suggested diversifying balance exercises and practising them on different surfaces and fields. In addition, Abernathy et al. (1997), Powers and Hawley (1996) and Ehsan Sharaf and Kamel Meera (1995) emphasised the importance of the vestibular system in the inner ear for both static and dynamic balance, as the ability to maintain balance depends on the efficiency of the vestibular system as well as the sensorimotor centres in the muscles, tendons and joints. Balance is achieved through the lymphatic fluid in the cochlea and the semicircular canals of the vestibular system.

The proposed programme also takes into account visual stimulation, which plays a crucial role in balance, according to Lephart et al. (1998). Visual input is one of the most important sensory systems for perceiving the external environment in terms of the location and speed of movement of objects. Visual cues also contribute to body balance by using external objects as reference points or landmarks to guide the body to a specific location and surrounding objects.

In addition, the researcher attributed the improvement observed in the experimental group to an increase in muscle tension.

5. Conclusion of the study

Through this field study, we have tried to shed light on a category of people with special needs (children with Down's syndrome), which is one of the most common and widespread syndromes among people with intellectual disabilities.

The field study confirmed that the physical education programme had a positive impact on improving motor skills (bilateral coordination, balance, upper limb coordination) and that these skills contribute to the ability to move and navigate in the environment. The targeted motor skills are the large motor skills responsible for moving and controlling the large muscle groups used in sitting, standing, walking, throwing and jumping. These skills are needed to adapt to the environment, which helps them achieve independence and self-help.

Children with Down syndrome have a lot of potential that can be harnessed and used to perform activities of daily living. It is usually observed that a child with Down syndrome can easily improve in the development of motor coordination and balance skills if they receive appropriate training. However, these children are slower than other children without disabilities. Nevertheless, they are able to acquire skills in sitting, walking, running, jumping, horse riding and other sports activities.

In conclusion, we call on all professionals and stakeholders in the field of education to identify children with Down's syndrome at an early stage, intervene and set up special schools for them so that they can catch up with their typical peers in the educational process. In particular, it is necessary for them to practise various motor activities and gradually progress to sports activities based on play and various spontaneous movements. We also recommend that all those who work with this group accompany the motor and sports activities with other educational programmes and coordinate with specialists in other fields to ensure the effectiveness of the care process.

References:

Arabic Language References:

Hassanein, M. S. (1995). Measurement and evaluation in physical education and sports, part one, 3rd edition. Dar Al-Fikr Al-Arabi, Cairo.

Al-Khouly, A. A., & Rateb, A. K. (2007). Theories and programmes of motor education for children. Dar Al-Fikr Al-Arabi, Cairo.

Al-Zuraiqat, I. A. (2012). Down syndrome: Characteristics and Considerations, 1st edition. Dar Wael for Publishing and Distribution, Amman, Jordan.

Abu Shahab, S. N. (2017). Chromosomes and genetic genes. Al-Warraq for Publishing and Distribution.

Al-Shathli, A. F. (1995). Rules of balance in the sports field. Dar Al-Maaref, Alexandria, Egypt.

Shehata, M. I., & Al-Shathli, A. F. (2006). Field applications of motion analysis in gymnastics. The Egyptian Library, Alexandria, Egypt.

Qe'dan, H. A. (2014). Emotional and Behavioural Disorders in Down Syndrome: A therapeutic training programme. Dar Wael for Publishing, Amman.

Qandilji, A. I. (2012). Methodology of scientific research. Dar Al-Yazouri Scientific for Publishing and Distribution, Amman, Jordan.

Kamash, Y. L., et al. (2014). Child development: Structural, Functional, Psychological. Dar Al-Khaleej for publication and distribution, Amman, Jordan.

Kamash, Y. L. (2012). Motor learning and human growth, 1st edition. Dar Zahran for Publishing and Distribution, Amman, Jordan.

Mahfoudh, H. A., & Khalifa, N. F. (n.d.). System of motor education: Theories and Applications, 1st edition. Mansha'at Al-Maaref, Alexandria.

The list of foreign language references

1. Abernethy, B., Hanrahan, S., Kippers, V., Mackinnon, L.T., & Pandy, M. (1997). The biophysical basis of human movement (2nd edition). Palgrave MacMillan.

2. Ammann, I. (2012). Down syndrome: Speech-language pathological approach, theoretical foundations and advice for caregivers. De Boeck Solal, Brussels, Belgium.

3. Cayla, J.-L., & Lacrampe, R. (2007). Practical manual for training: 110 questions and answers developed. Amphora, Paris.

4. Cuilleret, M. (2000). Down syndrome: Tools and advice (3rd edition). Masson, Paris.

5. Cuilleret, M. (2003). Down syndrome: Help and advice (4th edition). Masson, Paris.

6. Cuilleret, M. (2007). Down syndrome and related genetic disabilities: Potentials, abilities, future (3rd edition). Masson.

7. De Lièvre, B., & Staes, L. (2014). Psychomotricity at the service of children, adolescents and adults: Educational concepts and applications (6th edition). De Boeck.

8. de Rubens Figueroua, F. J., Del Pozza Magara, B., Pablo Hach, J. L., Calderón Jiménez, C., & Castrejon Urbina, R. (2003). Cardiac malformations in children with Down syndrome. Revista Española de Cardiología, 56(9), 894-899.

9. Delouvre, G. (2018). Understanding Down syndrome. Guy Delouvre Edition.

10. Dotrolaux, J.-P. (2009). Motor coordination: Sensory neural support of movement. University of Toulouse 3 Paul Sabatier.

11. Duffy, R. (2017). The essential guide to Down syndrome. Need 2 Know.

12. Duriez, F. (2008). Hearing impairment in children with Down syndrome 21. Masson.

13. Juhet, Jean Charles. Psychomotricity at the service of the elderly. Presses de l'Université Laval, 2018.

14. Lauzon, Francine. Psychomotor education: Source of autonomy and dynamism. Presses de l'Université du Québec, Québec, Canada, 2001.

15. Noack, Nathalie. Elements of reflection on the development and psychomotor characteristics of the person with Down syndrome. Évolutions Psychomotrices, vol. 9, no. 36, 1997.

16. O'Shea, Roberta. Paediatrics for the Physiotherapist Assistant. Elsevier Health Sciences, 2023.

17. Rethoré, Marie Odile. ANIT study day on Down's syndrome. Palais de la Culture, Algiers, 2001.

18. Rigal, Robert. Human Motoricity: Foundations and Pedagogical Applications, Volume 2: Motor Development, 3rd edition. Presses de l'Université du Québec, Québec, Canada, 2003.

19. Rigal, Robert. Motor and psychomotor education in preschool and primary school. Presses de l'Université du Québec, Québec, Canada, 2010.

20. Rivière, James. The psychomotor development of the young child: New Ideas and Current Approaches. Solal Éditeur, Marseille, France, 2000.

21. Rondal, Jean-Adolphe and Alberto Rasore-Quartino. Therapies and Rehabilitation in Down Syndrome. Wiley, 2007.

22. Scialom, Philippe, François Giromini and Jean Michel Albaret. Psychomotricity teaching manual, 4th edition. De Boeck Solal, 2014.

23. Scialom, Philippe, François Giromini and Jean Michel Albaret. Psychomotricity Teaching Manual: Methods and Techniques. De Boeck Solal, Paris, 2015.

24. Silva, I.F.S., Silva, H.M., & Correia, M.S. (2013). The influence of swimming on the process of motor coordination development in children with Down syndrome. Fiep Bulletin, 83. http://www.fiepbulletin.net/index.php/fiepbulletin/article/view/2729/5314

25. Smith, B. A., Kubo, M., Black, D. P., Holt, K. G., & Ulrich, B. D. (2007). Effects of practice on a novel task - treadmill walking: Preadolescents with and without Down syndrome. Physical Therapy, 87(6), 1-12.

26. Spano, M., Mercuri, E., Rando, T., Panto, T., Gagliano, A., Henderson, S., et al. (1999). Motor and perceptual-motor skills in children with Down syndrome: Variation in performance with age. European Journal of Paediatric Neurology, 3(1), 7-13.

27. Swinnen, S. P., Downskia, N., Verchueren, S., Serrien, D. J., & Daelman, A. (1995). Relative phase destabilisation during interlimb coordination: The disruptive role of kinesthetic afferences induced by passive motion. Journal of Experimental Brain Research, 439-454.

28. Ulrich, B. D., Ulrich, D. A., Collier, D. H., & Cole, E. L. (1995). Developmental changes in the ability of infants with Down syndrome to produce treadmill steps. Physical Therapy, 75(1), 14.

29. Ulrich, D., Ulrich, B., Angulo-Kinzler, R., & Yum, J. (2001). Treadmill training of infants with Down syndrome: Evidence-based developmental outcomes. Pediatrics, 108(5), E84-E84.