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Predictability of Hand Skills after Cognitive Rei Therapy in Down Syndrome

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ABSTRACT

Background: *Cognitive remediation therapy (CRT) is a non biological treatment that aims at correcting cognitive deficits through repeated exercises. Its efficacy in patients with Down syndrome is not well recognized yet, as children with Down syndrome have visual-perceptual dysfunction as a result of limited sensory experience from the lack of normal motor control.* ***Objective:*** *The purpose of the present study was to assess the impact of the RehaCom software as a cognitive remediation therapy in performance of fine motor skills in children with Down syndrome.* ***Methods:*** *Twenty-six children with Down syndrome with age ranged between seven and ten years participated in this study. All those children showed average intelligence level. First, evaluation of fine motor dysfunction by Peabody Developmental Measuring Scale 2 (PDMS-2) and the visual perceptual test reaction duration (maximal and minimal) was detected for each child. Then, children were divided into two equal groups: a control and a study group. Therapy program for enhancing fine-motor skills was given to the two groups. In addition, children within the study group received Visual-perceptual integrative therapy program (Rehacom). Post treatment evaluation was done after three months.* ***Results:*** *At the end of treatment, children within the study groups showed significant improvement with regard to grasping, fine-motor quotient and maximum and minimal reaction time of visual perceptual test performance ($P<0.05$).* ***Conclusion:*** *Visual-perceptual training improves fine-motor skills performance in children with Down syndrome.*

Key words: *Visual perception, Cognition, Hand skills, Down syndrome.*

INTRODUCTION

Down syndrome is the common chromosomal causes intellectual disal an illness or disease, and conception. in the incidenc syndrome is one in every 700 worldwide and it affects peopl and social backgrounds[10]. Dow disability that is characterized limitations both in intellectual fu in adaptive behavior as conceptual, social, and pract skills. In children with Down sy have been a number of observed motor characteristics such as joint hypermobility, reduced reflexes, persistence of primitiv a delay in the appearance of r and equilibrium reactions th contributed to delayed develop studies have shown that childr syndrome generally have defici coordination, laterality, speed, r equilibrium and visual motor co

There is evidence sup children with Down syndrom impairments in perceptual-moto example, when children with Do perform motor tasks requiring actions (such as catching), the appear to be attributable to regulating the temporal asp actions[13]. Charlton et al.,[2] children with Down syndrome l in properly adjusting both th temporal aspects of their grasp a object size or task goal. Difficul

of the perceived object properties in action planning may point to a dysfunction in relating information about limb position with respect to the environment to task demands.

Early intervention approaches for facilitating fine-motor development in infants and children with Down syndrome have traditionally emphasized the acquisition of motor milestones. As increasing evidence suggests that fine- motor milestones have limited predictive power for long-term motor outcomes, researchers have shifted their focus to understanding the underlying perceptual-motor competencies that influence motor behavior in Down syndrome[8].

Cognitive and perceptual deficits are two of the most puzzling and disabling difficulties that a person can experience. Thinking, remembering, reasoning and making sense of the world around us is fundamental to carrying out daily living activities. The perceptual-motor process is a chain of events through which the individual selects, integrates and interprets stimuli from the body and the surrounding environment. Basically perception includes both cognition and visual perception as sub components[11].

The growing interest in recovery has led to development of multiple therapeutic strategies for cognitive rehabilitation, that is, the remediation or alleviation of cognitive deficits resulting from neurological damage[16]. Cognitive rehabilitation is an interactive and dynamic training process involving the patient and treatment team[9]. The biological basis of its amelioration of neuropsychological sequelae resides in brain neuroplasticity[4,9].

METHODS

Subjects

A non randomized controlled clinical trial was conducted on twenty-six Down syndrome children, aged 7 to 10 years. Children were selected from the El Tarbia El Fekria School for children with special needs and the study was conducted at Rehacom laboratory, Faculty of Physical therapy, Cairo University. To maintain homogeneity of the samples, children were selected according to predetermined criteria including: (1) being able to do reaching with grade 3; according to a modified functional reaching
their IQ level was within a
according to (Stanford-Beneh) t
was approved and conducted in
the standards of the Ethics Co
Faculty of Physical Therap
University. First, a written info
was obtained from the pare
guardians of all participants
children were assigned into t
control group (n=13) receiving a
function training program, and
(n= 13) receiving the same exe
given to the control group, i
attention and concentration tra
was given using the Rehacor
participants received 36 trainin
three months, three sessions pe
were closely monitored for pos
effects during training.

Instrumentations:

Peabody Developmental
(PDMS-2) was used for evalu
motor abilities for each child
groups.

RehaCom software wa
evaluation of cognitive abilities
in the two groups and it was
treatment of children in the
starting from the level where t
evaluation.

Evaluation procedures:

Children in both groups v
to evaluation of their cognitive
Rehacom system. The system
basic assessment program an
training procedures that are use
function assessment and trai
usefulness of the software has
by using the dynamics which is
increase in task difficulty level
individual patient progress.

All RehaCom protocols
levels of difficulty which we
automatically on the screen wh
performed the previous task s
support of training for the follo
level. Each child in both groups
starting from level eight at the s
the study.

**Peabody Developmental Mot
(PDMS-2)**

PDMS-2 is an early childhood motor development scale that is used for assessment and training of gross and fine motor skills. The assessment is composed of six subtests that measure interrelated motor abilities that develop early in life. Grasping: This 26-item subtest measures a child's ability to use his or her hands. It begins with the ability to hold an object with one hand and progresses up to actions involving the controlled use of the fingers of both hands. Visual-Motor Integration: This 72-item subtest measures a child's ability to use his or her visual perceptual skills to perform complex eye-hand coordination tasks such as reaching and grasping for an object, building with blocks, and copying designs. Fine Motor Quotient (FMO): It is a composite of the results of the two subtests that measure the use of small muscles. Scoring criteria and record of scores: After administration of all tests in grasping, raw scores were expressed as the total points accumulated by a child on each subtest. Also standard score of each subtest was converted form raw scores of that subtest. The PDMS-2 is based on scoring each item as follows: 2: The child performs the item according to the criteria specific for mastery. 1: The child performance shows a clear resemblance to the item mastery criteria but doesn't fully meet the criteria. 0: The child cannot or will attempt the item, or the attempt doesn't show that skill is emerging.

Treatment procedures:

Cognitive rehabilitation using RehaCom software: interactive computerized cognitive rehabilitation was demonstrated for each child in the study group individually. The RehaCom includes activation and stimulation of several cognitive domains such as attention, memory, visual-spatial processes and executive functioning. The program contains several modules with h different levels of difficulty. Recording the number of er completion time for all patients results file enabled continuity sessions and database storag Computer gave patients approp on performance. Attention and program is composed of 2 difficulty levels. During treatme the following parameters wer Acoustic feedback parameter solution time. Limitation depen of difficulty, for the easiest ta level, one minute was given. In limitation expanded for 5 second difficult it is 3 min and 15 sec, errors.

The hand function trainin all children were given for thre week, with each session lasted c program included exercises to function based on reaching, gra carrying and more complex ski manipulation and bilateral ha child was asked to do many act grasping and transferring cube, placing pegs, releasing cube, bu with 3 cubes, manipulating p pages, constructing puzzles, wri and cutting paper by using scis

RESULTS

A total 26 children with Do and their parents were recruited study. Table 1 shows the mean a deviation (Mean ± SD). The c control group were 8.31 years ± those in the study group were 1.09. The percentage of girls t control group and study group and 61.54% and 30.77% respectively.

Table (1): Demographic characteristics for subjects in both groups.

	Control group n=13	Study group n=13
Age (yrs.)	Mean ±SD 8.31 ± 1.11	Mean ±SD 8.23 ± 1.09
Sex (G/B)	n(%) 5/8 (38.46%/61.54%)	n(%) 4/9 (30.77%/69.23%)

N: number yrs: years G: girls B: boys

Unpaired t test was used to show difference between the two groups regarding attention and concentration level. Pre-treatment Mean ± SD for both control and study groups were (1.38 ± 0.65) and (1.46 ± 0.66), respectively revealed no statistical significant difference with t = 0.299 and p-value = 0.767. On the other hand, post treatment Mean ± SD for both groups were (5.77 ± 1.09) and (3.46 ± 1.56) respectively with t = 4.368 and p value = 0.001, showed a statistically significant difference.

As shown in table 2 Pre-treatment $\bar{x}$ ± SD of maximum reaction time (second or milli seconds) for both control and study groups were (45232.00 ± 2333.47) and (46532.08 ± 4318.75), respectivel = 0.955 and p value = 0.349. minimum reaction time were 435.73) and (1835.69 ± 507.62), with t = 1.065 and p-value 0.29 non-significant difference betv groups.

Regarding Minimal react results showed a statisticall reduction of the time as mean v control and study groups after (1400.31 ± 475.88) and (768. respectively, with t test = 4.277 0.001 (Table 2).

Table (2): Compassion of Attention & concentration levels and reaction time before and for both groups.

variable	Control group Mean ± SD	Study group Mean ± SD	t-vale	P value
Att.& Con. Level				
Pre	1.38± 0.65	1.46 ± 0.66	0.299	0.767
Post	3.46 ± 1.56	5.77 ± 1.09	4.368	0.001*
Max. Rea. Time (msec)				
Pre	45232.00 ± 2333.47	46532.08 ± 4318.75	0.955	0.349
Post	33634.77 ± 2817.25	28115.38 ± 2254.85	5.515	0.001*
Min. Rea.Time (msec)				
pre	1638.15± 435.73	1835.69 ± 507.62	1.065	0.298
post	1400.31 ± 475.88	768.38± 239.57	4.277	0.001*

*: Significant SD: standard deviation Max: Maximum Min : Minim

As shown in Table 3, Pre-treatment average grasping scores for control and study groups were 2.15 ± 0.80 and 2.54 ± 1.27, respectively, with t test = 0.926 and p value =0.364 indicating statistically insignificant differences. Pre- treatment average visual motor integration for control and study groups were 3.15 ± 0.38 and 3.08 ± 0.28 with t = 0.594 and p value = 0.5 statistical insignificant differenc fine motor quotient for both cor groups were 55.92 ± 2.56 and respectively; with t= 0.642 revealing statistically insignific

Table (3): Comparison of Pre- and post-treatment standard score of grasping, VMI a quotient for both groups.

Variable	Control group Mean ± SD	Study group Mean ± SD	t	p
Standard score grasping				
Pre	2.15 ± 0.80	2.54 ± 1.27	0.926	0.364
post	3.77 ± 1.96	5.92 ± 2.10	2.701	0.012*
Standard score VMI				
Pre	3.15 ± 0.38	3.08 ± 0.28	0.594	0.558
post	3.92 ± 0.28	4.85 ± 0.90	3.539	0.002 *
Fine motor quotient				
Pre	55.92 ± 2.56	56.85 ± 4.51	0.642	0.527
post	63.08 ± 6.29	72.31 ± 6.94	3.552	0.002 *

*: Significant SD: standard deviation

On the other hand, post treatment average grasping score of study group and control groups were 5.92 ± 2.10 and 3.77 ± 1.96, respectively; with t test = 2.701 and p value = 0.012 . While post treatment average visual motor integration of control and study groups were 3.92 ± 0.28 and 4.85 ± 0.90, respectively; with t test = 3.539 and p value = 0.002 showing a statistically significant change in favor to the study group. Post treatment average fine motor quotient of study group was 72.31 ± 6.94, whereas that of the control group was 63.08 ± 6.29; with t test = 3.552 and p value = 0.002 showing a statistically significant difference in favor to the study group.

DISCUSSION

This study is the first to investigate the impact of cognitive remediation therapy (RehaCom) on fine motor performance in children with Down syndrome. Cognitive functions concerning attention and concentration abilities were measured at the beginning of treatment by Rehacom system, in both control and study groups, showed a decrease in levels of attention and concentration, and increase in maximum, median and minimum reaction time. Children with Down syndrome have some degree of mental disabilities that reflects the cognitive impairment which is supported by Mark[7], who reported that the most common condition associated with Down syndrome is cognitive impairment as cognitive development is often delayed, and all individuals with Down syndrome have moderate to severe learning difficulties that last throughout their lives. He also stated that the average brain size of a person with Down syndrome is small. Scientists have reported alterations in the structure and function of certain brain areas such as the hippocampus and cerebellum in those children. Specifically, the hippocampus, which is responsible for cognitive function[7].

The improvement regarding grasping and VMI scores in both groups may be attributed to the use of different tools with different colors, sizes, shapes, and textures, which were attractive and motivating to children to complete the task in an acceptable form. This has been supported who recommended that treatr dysfunction should receive grea physical and occupational thera grasp and manipulation hav negative impact on various as living. He added that, there evidence of the value of th directed to functional outcomes individual.

The significant difference grasping and visual motor integ treatment evaluation betwee control groups could be attri improvement of grasping and integration as a result of combin hand function training progra different exercise by computer could have facilitated the a concentration during training might have increased the fine of the child.

Improvement in the study attributed to auditory feedbac system that formed a positive ve This in turn could have enable pay more attention and concen selection, and thus, impro performance.

Motivation and encourag by Rehacom system throu progression in level of dif attractive form that motivated cl their maximal effort in order to l sign indicating the correct answ Rehacom screen which displaye different shapes and colors m child attention and concentrati period of time, which is s Bertenthal and Von Hofsten[11] that the vision is particularly learning new motor skills.

The current results are in a those findings of Lewis and I stressed the effect of motiva relationship to improving phys They investigated the effects social and environmental m enhancing performance usi motivational tools.

The results of the current in agreement with Cook and Wo

stated that normal upper extremity functions, including the ability to reach for grasp and manipulate objects, are the basis for fine motor skills which are important to activities of daily living such as feeding, dressing, grooming, and handwriting. They reported that the upper extremity control is intertwined with both fine and gross motor skills. Thus, recovery of the upper extremities function is an important aspect of retraining the patient in most areas of rehabilitation.

These results may also be explained by improvement of visual cognitive components which included visual attention, memory, discrimination, and VMI. O'sullivan & Schmitz[11] suggested that increasing attention and concentration occurs by improving alertness, vigilance selective, divided or shared attention, enhancing integration of visual information with previous experiences, improving the ability to detect features of stimuli for recognition, matching and categorization.

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Conclusion

With the limitation of this study cognitive remediation therapy has a positive impact on fine-motor performance in Down syndrome children.

REFERENCES

1- Bertenthal, B. and Von Hofsten, J.: The components of normal movement during the first year of life and abnormal development. Infant behavior and development; 22: 139-155, 1998.
2- Charlton, J., Ibsen, E. and Lavelle, B.M.: Control of manual skills in children with Down syndrome. In D.J. Weeks, R. Chua & D. Elliott (Eds.), Perceptual-motor behavior in Down syndrome: Champaign, IL: Human Kinetics; 25-48, 2000.
3- Cook, A.S. and Woolacott, M.J.: Motor control therapy and practical application, 2nd edition, Lippinocot, Philadelphia, 67-70, 164-166, 2000.
4- Helmstaedter, C., Loer, B. and Wohlfahrt, R.: The effects of cognitive rehabilitation on memory outcome after temporal lobe epilepsy surgery. Epilepsy Behav.; 12: 402-409, 2008.
5- Jobling, A. and Virji-Babul, N.: Down syndrome: Play, Move and Grow. Vancouver: Available from: Down Syndrome Research Foundation. Sperling Avenue, I Columbia, Canada V5B 4J8 20(
6- Lewis, M. and Russel, D.: neurodevelopmental with cast occupational therapy prograr Neurol.; 39(10): 664-670, 1990.
7- Mark, D.: Abnormal ps Integrative approach 6th ec learning; 2011.
8- Naznin, V.B., Kimberly, K. Perceptual-motor deficits in Down syndrome: Implications Down Syndrome Research and 74-82, 2006.
9- Neil-Pirozzi, T.M., Strangm Goldstein, R.: A controlled trea internal memory strategie following traumatic brain ir Trauma Rehabil.; 25: 43-51, 20
10- Opitz, J.M. and Gilbert-Bar "Reflections on the Pathoger Syndrome". American Journa Genetics; 7: 38-51, 1990.
11- O'sullivan, S.B. and Schmitz, Rehabilitation; Assessment and ed. Pa: EA. Dais Company, Ph 745, 2001.
12- Savelsbergh, G., van der Kamp and Planinsek, T.: Inform coupling in children with Dow D.J. Weeks, R. Chua & D. Perceptual-Motor Behavior Syndrome; 251-276, 2000. C Human Kinetics.
13- Uyanık, M. and Kayıhan, H.: D Sensory Integration, Vestibu and Neurodevelopmental Thera for Children International E Rehabilitation 2010. Avail sandiegodownsyndrome.org
14- Uyanik, M., Bumin, G. and Investigation of the Relatio Sensory/ Motor/ Perceptual Hand Functions in Childrer syndrome. Neurorehabilitatio Repair; 15(4): 263-268, 2001.
15- Virji-Babul, N., Kerns, K. Perceptual-motor deficits in Down syndrome. Down syn and Practice; 10: 74-82, 2006.
16- Wilson, B.A., Gracey, F., I Bateman, A.: Neu rehabilitation. Theory, model outcome. New York: Cambri Press; 2009. 380 p. [Links]

17- Wilton, J.C.: Casting, splinting and physical and occupational therapy of hand deformity and dysfunction in cerebral pal 19: 573-584, 2003.

الملخص العربي

التنبؤ بمهارات اليد بعد العلاج المعرفي في الأطفال المصابين بمتلازمة داون

عالجة غير بيولوجية تهدف إلى تصحيح العجز المعرفي عن طريق التدريبات المتكررة. لم يتم التعرف على فاعلية هذا المرضى الذين يعانون من متلازمة داون بشكل جيد حتى الآن حيث أن الأطفال الذين يعانون من متلازمة داون لديهم لبصري نتيجة لضعف كلاً من الخبرة الحسية ونقص في التحكم الحركي الطبيعي . **الهدف :** كان الهدف كإحدى وسائل الأداء الحركي الدقيق في أطفال متلازمة داون Rehacom من هذه الدراسة تقييم تأثير . **الأساليب :** تم اختيار ستة ابا بمتلازمة داون تراوحت أعمارهم بين 7 إلى 10 سنوات متوسطي مستوى الذكاء وقد تم تقسيمهم إلى مجموعتين . تم بعد ذلك تقييم ضعف الحركية الدقيقة باستخدام مقياس البيبودي كمقياس لنمو كما تم أيضا قياس الحد الأقصى ، نى من متوسط وقت رد الفعل لاختبار الإدراك الحسي البصري وجرى تقييم كل طفل في كلتا المجموعتين قبل وبعد ن العلاج . أعطيتا لمجموعة الضابطة برنامج علاج لتعزيز المهارات الحركية الدقيقة التحكم . Rehacom بينما أعطيت ل البرنامج بالإضافة إلى برنامج تنبيه الإدراك الحسي . **النتائج :** أظهرت النتائج أن هناك تغير ذو دلالة إحصائية في شمل كلاً من القدرة الحركية على استخدام اليد ونقص في الحد الأقصى والمتوسط ، والحد الأدنى من متوسط وقت رد الإدراك الحسي البصري بعد مدة العلاج المقترح مع المزيد من التحسن لصالح المجموعة الدراسة : النتائج (< 0.05) ات المعرفية لها تأثير إيجابي على أداء المهارات الحركية الدقيقة في أطفال متلازمة داون .