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primary school children in Eastern Cairo and detect the comorbidity with other disorders that might lead to learning difficulties, namely dyslexia. Regarding prevalence of DCD distribution, current study reported that 16.1% (194/ 1200 children) of included students were diagnosed to have DCD with IQ score >85.

Ali and colleagues (2016) calculated the prevalence of developmental coordination disorder in Egyptian children. The 1025 normal children of both sexes participated in this study. They reported that 5.9% of Egyptian children from (5- 15) years old were suspected for DCD which is lower than the present study. The girls represented 38.3%, while boys were 61.7% which is in line with present study. In addition, the higher percentage was found in younger children (48.3%). This study is in accordance with our results regarding the same range of age (6- 9) years. Finally, 60% showed lower scores in fine motor/ handwriting, 10% in control during movement, while 30% had lower scores in general coordination. Their data indicate that developmental coordination disorder is a prevalent disorder that requires more attention and clear diagnosis.

Yang and colleagues (2022) conducted a metaanalysis to generate a reliable prevalence estimate of DD worldwide in primary school children and explore the potential variables related to that prevalence. In agreement with our results, the prevalence was higher in boys than in girls but was not significantly different across different writing systems. The pooled prevalence of DD was 7.10%.

On the other hand, Maziero and colleagues (2020) highlight how, in a working memory paradigm, children with dyslexia perform worse in verbal memory tests and children with DCD perform worse in a spatial working memory test. Children with dual diagnoses perform worse in both tasks. Beyond the motor deficits, about half of all children with DCD show difficulty in learning to write (Biotteau et.al, 2019).

Downing and Caravolas, (2018) reported that children with dyslexia (singular and comorbid) spelled less accurately than children with DCD and controls. On legibility, all disorder groups scored significantly lower on letter formation and letter spacing than controls. For word spacing and line alignment, children with DCD (singular and comorbid) received significantly lower ratings than controls, while dyslexics did not. Finally, Downing demonstrated that dyslexia and DCD have independent and shared impairments and are frequently comorbid with one another. The patterns of these impairments as well as the nature of comorbidity between the two highlights the multifactorial nature of the disorders. The multifactorial nature of dyslexia and DCD also manifested in their multifaceted handwriting difficulties (Downing, 2018).

El- Sheikh et.al, (2016) evaluated the frequency of dyslexia in Egyptian primary school students. The main results showed that the prevalence of dyslexia in the studied sample was 11.3% and prevalence of dyslexia in boys was slightly higher than that in girls. These results are in accordance with our results of the prevalence of dyslexia and also they are in agreement with dyslexia prevalence in boys that was slightly higher than

that in girls, putting in consideration the slight difference in age between the two studies.

Recommendations:

For better children's school achievement, different assessment tools could be used for early diagnose of DCD among primary school children. It is important to pick up undetermined DCD children and find out its effect on children's academic abilities as reading, leading to Dyslexia.

Acknowledgment:

I would like to express my hearty appreciation and thankfulness to all the children and their parents for accepting to participate in the research and dedicating much of their time, the teachers, and principals of participating schools for their cooperation with the researcher. I wish to express my deep thanks and gratitude to my supervisors for their constructive criticism, scientific instructions, and discussion throughout this work.

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Table (1): Correlation Between DEST About Risk Quotient And Diagnosis With Different Parameters Of DCD, Using Pearson Correlation Coefficient Among Children Of DCD And IQ >85.

DCD	Dest			
	Risk Quotient		Diagnosis	
	R- Value	P- Value	R- Value	P- Value
Control During Movement	-0.225	0.002**	-0.139	0.053
Fine Motor/ Handwriting	-0.299	<0.001**	-0.144	0.046*
General Coordination	-0.100	0.165	-0.060	0.404
Total DCD	-0.291	<0.001**	-0.163	0.023*

Using: r- Pearson Correlation Coefficient (p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant).

Table (1) presented that, there were statistically significant negative correlation between risk quotient of dyslexia of the studied children group according to their DCD about control during movement, fine motor/ handwriting and Total score of DCD, it was (r- value -0.225; -0.299 and -0.291) respectively and (p-value 0.002; <0.001 and <0.001) respectively; while general coordination showed an insignificant correlation with p-value (p> 0.05). Also, a statistically significant negative correlation between diagnosis of dyslexia of the studied children group according to their DCD about fine motor/ handwriting and Total DCD, it was (r- value -0.144 and -0.163) respectively and (p-value 0.046 and 0.023) respectively; while general coordination and control during movement showed insignificant correlation with p-value (p>0.05).

Table (2) Correlation between Total score of DCD with different parameters of DEST, using Pearson Correlation Coefficient among children of DCD and IQ >85.

DEST	Total Score Of DCD	
	R-Value	P-Value
Rapid Naming	-0.212	0.003**
Beads	0.160	0.026*
Phonology	0.170	0.018*
Stability	-0.261	<0.001**
First Letter	0.102	0.156
Memory Of Numbers	0.066	0.357
Names Of Numbers	0.102	0.156
Names Of Letters	0.164	0.023*
Vowels	0.126	0.081
Coping	0.223	0.002**
Risk Quotient	-0.291	<0.001**
Diagnosis	-0.163	0.023*

Using: r- Pearson Correlation Coefficient (p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant).

Table (2) presented that, there were statistically significant positive correlation between total score of DCD of the studied children group according to their DEST about Beads, Phonology, Names of letters and Coping, it was (r-value 0.160; 0.170; 0.164 and 0.223) respectively and (p-value 0.026; 0.018; 0.023 and 0.002) respectively. Also, a statistically significant negative correlation between total score of DCD of the studied children group according to their DEST about Rapid naming, Stability, Risk quotient and Diagnosis of deslyxia, it was (r-value -0.212; -0.261; -0.291 and -0.163) respectively and (p-value 0.003; <0.001; <0.001 and 0.023) respectively. There is no statistically significant correlation between total score of DCD of the studied children group according to their First letter, Memory of numbers, Names of numbers and Vowels, with p-value (p>0.05).

Table (3) Correlation between mean of IQ score with different parameters of DCD, using Pearson Correlation Coefficient among children of DCD and IQ> 85.

DCD	Mean Of Iq Score	
	R-Value	P-Value
Control During Movement	0.175	0.015*
Fine Motor/ Handwriting	0.299	<0.001**
General Coordination	-0.061	0.402
Total DCD	0.192	0.007**

Using: r- Pearson Correlation Coefficient (p- value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant).

Table (3) presented that, there were statistically significant positive correlation between mean of IQ score of the studied children group according to their DCD about control during movement, fine motor/handwriting and Total DCD, it was (r- value 0.175, 0.299 and 0.192) respectively and (p-value 0.015; <0.001 and 0.007) respectively. There is no statistically significant correlation with general coordination, with p- value (p>0.05).

Table (4) Correlation between mean of IQ score with different parameters of DEST, using Pearson Correlation Coefficient among children of DCD and IQ >85.

DEST	Mean Of IQ Score	
	R- Value	P- Value
Rapid Naming	-0.314	<0.001**
Beads	0.362	<0.001**
Phonology	0.138	0.055
Stability	-0.034	0.634
First Letter	0.338	<0.001**
Memory Of Numbers	0.240	0.001**
Names Of Numbers	0.121	0.093
Names Of Letters	0.227	0.001**
Vowels	0.321	<0.001**
Coping	0.348	<0.001**
Risk Quotient	-0.415	<0.001**
Diagnosis	-0.305	<0.001**

Using: r- Pearson Correlation Coefficient (p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant).

Table (4) presented that, there were statistically significant positive correlation between mean of IQ score of the studied children group according to their DEST about Beads, First letter, Memory of numbers, Names of letters, Vowels and Coping, it was (r- value 0.362, 0.338, 0.240, 0.227, 0.321 and 0.348) respectively and (p- value <0.001, <0.001, 0.001, 0.001, <0.001 and <0.001) respectively. Also, a statistically significant negative correlation between mean of IQ score of the studied children group according to their DEST about Rapid naming, Risk quotient and Diagnosis of dyslexia, it was (r- value -0.314, -0.415 and -0.305) respectively and (p-value <0.001, <0.001 and <0.001) respectively. There is no statistically significant correlation between mean of IQ score of the studied children group according to their Phonology, Stability and Names of numbers, with p-value (p>0.05).

The prevalence of dyslexia among diagnosed DCD students was 8.8% (17/ 194), and in boys it was slightly higher (53%) than that of girls (47%).

Discussion:

This descriptive cross- sectional study was conducted on 1200 students in 10 primary schools from grade (1- 3), in eastern Cairo to assess the prevalence of the developmental coordination disorder in a sample of

question on a five point Likert scale when comparing the motor performance between their child and his/her peers. Each question is scored from (1- 5) points, giving a total score from (15- 75) points and a high score excludes DCD. On the other hand, scores lower than 46 are considered to be suspected DCD. The DCDQ'07 correlates well with other well established tests such as the Bruininks Oseretsky Test of Motor Proficiency and the Movement Assessment Battery for Children, also the high internal consistency and discriminate function makes it suitable as a screening tool (Wilson et.al, 2009).

- ✧ Draw a Person test (DAP test or Goodenough- Harris Test): It is a psychological projective personality or cognitive test used to evaluate children and adolescents for a variety of purposes. Each child was given the following instructions: I want you to make a picture of a person (man and woman on separate papers). Make the very best picture that you can. Take your time and work very carefully. Try very hard and see what a good picture you can make.
- ✧ DEST: This battery contains screening tests of attainment and ability. These determine whether a young child is experiencing difficulty in areas known to be affected in dyslexia. A profile of skills provides valuable information that can be used to guide in school support. The DEST consists of 10 subtests: rapid naming, bead threading, phonological discrimination, postural stability, rhyme/alliteration, forwards digit span, digit naming, letter naming, sound order and shape copying (Nicolson and Fawcett, 1994; Fawcett and Nicolson, 1995). After performing DEST, the risk quotient value for each DCD child was estimated using specific equation and then used to diagnose DD cases.

Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Qualitative data were expressed as frequency and percentage. The following tests were done:

1. Pearson's correlation coefficient (r) test was used to assess the degree of association between two sets of variables. Value of (r) ranges from 1 to 1. 0= no linear correlation, 1= perfect positive correlation, -1= perfect negative correlation.
2. Scatter plot: a graph in which the values of two variables are plotted along two axes, the pattern of the resulting points revealing correlation present. P-value< 0.05 was considered significant. P-value <0.001 was considered as highly significant.

Limitations:

Difficulty accessing schools and refusal of caregivers and/or children to participate in the study.

Ethical Approval And Consent:

The research and ethics committee of faculty of postgraduate childhood studies, Ain Shams University approved the research protocol, the author received the approval of required authorities of the Ministry of education before commencement. Finally, a written informed consent was

attained from each participant and his guardian. Guardians were informed about the questionnaire to be used in our study and approved their child's participation.

Results:

Figure (1) describes the DCD distribution of total study population. There were 205 children (17.1%) were prevalence for DCD and 995 children (82.9%) of normal.

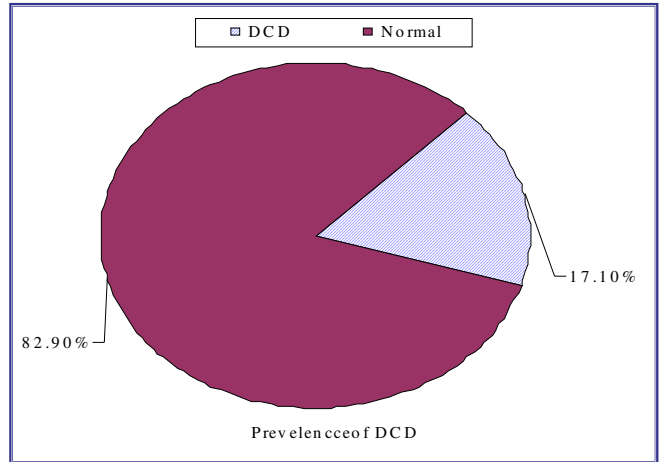


Fig. (1) Prevalence of DCD distribution among all study group.

Figure (2) describes the IQ score for DCD children distribution of total study population. There were 11 children (5.4%) were Score <85 and 194 children (94.6%) of score >85.

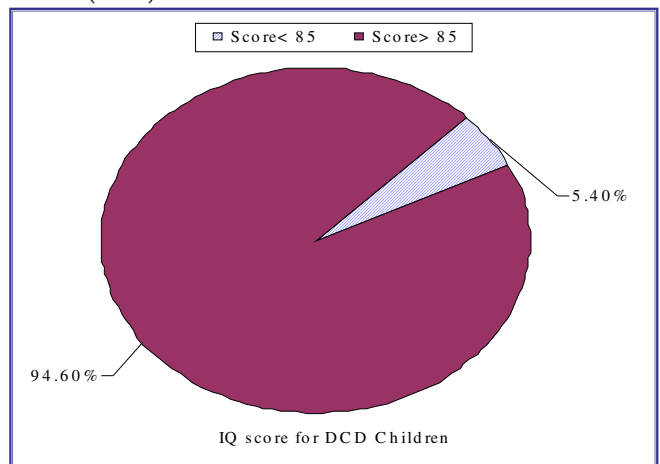


Fig. (2) IQ score of DCD children.

Fig. (3) illustrated that there is statistically significant positive correlation between age and total score of DCD.

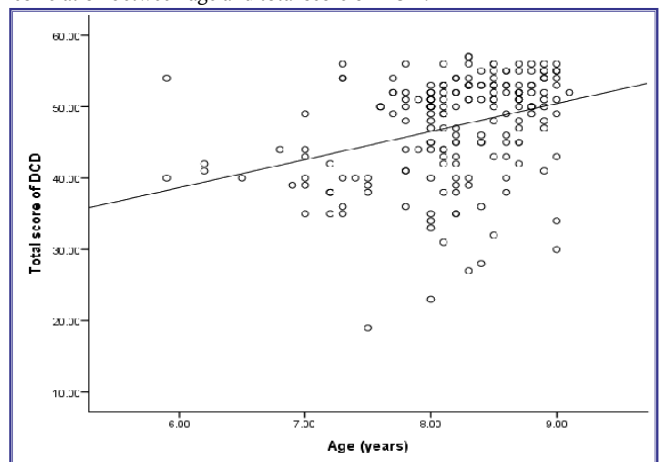


Fig. (3) Scatter diagram; correlation between age in years of DCD children and total score of DCD.

Introduction:

Developmental coordination disorder (DCD) is a neurodevelopmental condition characterized by a marked impairment in the development of motor skills or motor coordination that develops early on and interferes with an individual's activities of daily living (Blank and Barnett, 2019). DCD is a common and chronic disorder resulting in considerable consequences in daily life. Prevalence estimates of 5- 6% are most frequently quoted in the literature (American Psychiatric Association, 2013; Blank et.al, 2012) but ranges in reports between 1.4% and 19%, making it one of the more common childhood disorders (Amador, Ruiz et.al, 2018), also DCD and dyslexia are diagnosed in approximately 4- 5% of adults. (Potard et.al 2022)

At least 2% of all individuals with normal intelligence experience severe consequences of motor coordination difficulties in everyday living including academic performance, and a further 3% have a degree of functional impairment in activities of daily living (ADL) [Lingam et.al, 2009]. The diagnosis of DCD requires meeting four diagnostic criteria, including (A) impaired ability to acquire and execute motor skills at an age appropriate level (B) significant interference with activities of daily living, academic performance, leisure and play (C) early onset in the developmental period and (D) the movement difficulties are not better explained by intellectual disability, visual impairment or other neurological conditions affecting movement (Blank et.al, 2019).

DCD children because of their difficulties with coordination of fine and gross motor skills, they are usually unable to successfully participate in school, sports and leisure games, which often leads to exclusion, teasing, or even bullying (Zwicker et.al, 2017). Children with DCD show diminished physical activity levels and fitness compared to their well coordinated peers and are therefore at a higher risk of developing a range of poor health outcomes such as metabolic, cardiovascular and musculoskeletal diseases (Hands et.al, 2015, Faught et.al, 2005).

Developmental Dyslexia (DD) is a behaviorally defined Neurodevelopmental Problem (NDP) characterized by severe and persistent difficulties in acquiring fluent and accurate word reading and spelling skills, which cannot be better explained by inadequate instruction, intellectual disability, low chronological age or impairments in hearing or vision (Peterson& Pennington, 2015; World Health Organization, 1992). Apart from weaknesses in word reading, spelling accuracy and fluency, dyslexia is sometimes accompanied or preceded by oral language problems (Snowling et.al, 2020). Most researches have suggested that dyslexia can be said to affect 3- 10% of the population, depending on the exclusionary criteria and the specific cut offs that are used for its diagnosis (Peterson& Pennington, 2015). Recent studies have suggested that dyslexia typically occur as a result of multiple deficits rather than a single phonological deficit (Carroll et.al, 2016; Fletcher& Grigorenko, 2017) and sometimes no phonological problems at all can be observed in diagnosed cases (Snowling et.al, 2020). Reading disorders seem to coexist most clearly with ADHD and motor deficits/ DCD (Gillberg, 2010; Peterson&

Pennington, 2015).

DD and DCD are neurodevelopmental disorders that impede the child's ability to learn reading and to master motor skills, respectively. There is firm evidence of an overlap between these two disorders, with different rates of comorbidities (Flapper and Schoemaker, 2013). This significant overlap has led researchers to believe in a common etiology, with shared causes to speech, language and motor abnormalities. An attractive hypothesis states that DD and DCD have impairments of the procedural learning system (Nicolson and Fawcett, 2007) which subserves the learning of new, and the control of established, sensorimotor and cognitive skills, rules and habits (Knowlton et.al, 2017). Impairment of this system would therefore explain deficits found in an extremely wide range of motor and perceptual skills in DCD children (Wilson et.al, 2013, 2017; Adams et.al, 2014), as well as secondary motor symptoms widely reported in DD (Ramus et.al, 2003, Ramus, 2004).

Methodology

Participants:

We adopted a descriptive, cross sectional, school based study design. This study was conducted in ten national (private and governmental) primary schools in Eastern Cairo, but from different educational districts that represented different socioeconomic levels. One thousand and two hundred (1200) students from grades one, two and three were enrolled in this study. Two hundred and five (205) students of the participants were diagnosed with DCD according to Developmental Coordination Disorder Questionnaire (DCDQ'07) (Wilson et.al, 2009). Eleven (11) students with DCD had been excluded because of their intelligence quotient (IQ) was below 85 according to Draw a Person test (DAP test). Then we performed Dyslexia Early Screening Test (DEST) (Nicolson and Fawcett, 1994; Fawcett and Nicolson, 1995) on 194 students with DCD whose IQ were above 85 (92 boys, 102 girls representing 47.4% and 52.6% respectively) aged from (5.9- 9) years and free from any neuromuscular, musculoskeletal disorders and upper and/or lower limb deformities as an exclusion criteria. The current study was performed within the context of school health setting requiring the use of simple brief and easy to administer assessment measures.

Methods:

✎ DCDQ'07: It is a screening tool to assess coordination disorders. It was developed in 2000. It is designed for parents of children aged (5- 15) years (Wilson et.al, 2009). The questionnaire contains 15 items grouped into three distinct factors: control during movement, fine motor/ handwriting and general coordination (Civetta and Hillier, 2008). In addition to observation during physical exercise period. The first factor (items 1- 6) is related to motor control while the child was moving or while an object was in motion and is labeled "control during movement". The second factor "fine motor/handwriting" (items 7- 10) and the third factor relates to "General coordination" (items 11- 15). Scoring system was explained to each parent. The parents were instructed to grade the performance of their child in each

Developmental Coordination Disorder (DCD) among Primary School Children in Eastern Cairo in Egypt and its Correlation with Dyslexia

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Summary

Background: Developmental coordination disorder (DCD) is a neurodevelopmental condition characterized by a marked impairment in the development of motor skills or motor coordination that develops early- on and interferes with an individual's activities of daily living. Developmental Dyslexia (DD) is a behaviorally defined Neurodevelopmental Problem (NDP) characterized by severe and persistent difficulties in acquiring fluent and accurate word reading and spelling skills.

Aims: To assess prevalence of DCD in sample of primary school children in Eastern Cairo, Egypt and detect its comorbidity with dyslexia.

Materials& Methods: This study was conducted on 1200 students from 10 primary schools from grades (1- 3) in Eastern Cairo using DCDQ'07 Questionnaire (To assess DCD), DAP test or Goodenough- Harris Test (To assess IQ) and Dyslexia Early Screening Test (DEST).

Results: Regarding prevalence of DCD distribution, current study reported that 16.1% (194 /1200 children) of included sample were diagnosed to have DCD with IQ score > 85, 47.4% (92 children) of them were males and 52.6% were females (102 children) and 87.1% (169 children) of them were at private schools while the rest 12.9% (25 children) were from public schools. Regarding age distribution of diseased children, we noted that about 2/ 3 of them (137 children, 70.6%) were (8- 9) years. There is a statistically significant positive correlation between age of children and control during movement, fine motor/handwriting, general coordination and total score of DCD. Also, there is a statistically significant negative correlation between risk quotient of DEST and control during movement, fine motor/handwriting and total score of DCD. There is a statistically significant positive correlation between total score of DCD of studied children group and Beads, Phonology, Names of letters and Coping of DEST.

Conclusion: Prevalence of DCD in a sample of primary school children in Eastern Cairo, Egypt is 16.1%.

Keywords: Developmental Coordination Disorder, Dyslexia, Primary school children.

اضطراب التناسق التنموي بين الأطفال في المدارس الابتدائية بشرق القاهرة بمصر وعلاقته بعسر القراءة

المقدمة: ان اضطراب التناسق التنموي هو حالة نمو عصبي يتميز بخل ملحوظ في نمو المهارات الحركية التي تنمو في بداية الحياة وتتدخل مع الأنشطة الشخصية في الحياة اليومية أثناء الطفولة بالنظر إلى العمر الزمني للطفل، وليس بسبب حالة طبية عامة معروفة، كما يتسم الأطفال المصابون بعسر القراءة بصعوبات في القراءة والكتابة والتهجئة. ويمكن أن يرتبط عسر القراءة أيضا بالعجز في العمليات المعرفية، مثل الذاكرة وسرعة المعالجة، وإدارة الوقت والتناسق والمهارات. بالإضافة إلى ذلك، يمكن أن تحدث عيوب بصرية و/ أو صوتية، بالإضافة إلى صعوبات في الأداء الأكاديمي. وقد يعاني الأطفال المصابون بعسر القراءة من عجز حركي. وقد يظهر عدد كبير من الأطفال الذين يعانون من عسر القراءة ضعفا في التناسق الحركي، مما قد يؤدي إلى مشاكل في البراعة اليدوية، ومهارات الكرة، وكذلك في مهارات التوازن.

الهدف: تقييم انتشار مرض اضطراب التناسق التنموي في عينة من أطفال المدارس الابتدائية بشرق القاهرة بمصر الذين تتراوح أعمارهم من (٦- ٩) سنوات وعلاقة اضطراب التناسق التنموي وإحدى مشاكل التعلم كعسر القراءة.

الطريقة: أجريت هذه الدراسة الوصفية المقطعية على ١٢٠٠ طالب في ١٠ مدارس من الصف الأول إلى الثالث بشرق القاهرة لتقييم انتشار اضطراب التناسق التنموي في عينة من أطفال المدارس الابتدائية وتم اجراء طرق البحث التالية: استبيان اضطراب التناسق التنموي واختبار رسم الشخص واختبار التشخيص المبكر لعسر القراءة.

النتائج: جاءت النتائج لتدل على أن نسبة انتشار مرض اضطراب التناسق التنموي في عينة من اطفال المدارس الابتدائية بشرق القاهرة ١,١٦% (١٩٤/ ١٢٠٠ طالب) ومعدل النكاه الخاص بهم أعلى من ٨٥، وكانت نسبة الأطفال من الذكور ٦,٤٧% بينما كانت نسبة الإناث ٤,٥٢%. كما لوحظ أن حوالي ثلثي الأطفال تتراوح أعمارهم بين (٨- ٩) سنوات وقد وجد أن هناك علاقة عكسية بين معدل الخطورة لعسر القراءة ومرض اضطراب التناسق التنموي للأطفال.

الاستنتاج: انتشار اضطراب التناسق التنموي في عينة من أطفال المدارس الابتدائية بشرق القاهرة بمصر بلغ ١,١٦%.

الكلمات المفتاحية: اضطراب التناسق التنموي، عسر القراءة، أطفال المدارس الابتدائية.