

## Effect of a Nursing Intervention on Muscle Tone of Children with Down Syndrome

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**Abstract:** Down syndrome (DS) is the most common chromosomal disorder which is characterized by decreased muscle tone or hypotonia. The purpose of this study was to identify the effect of a nursing intervention on muscle tone of children with Down syndrome. The Design of this study was quasi-experimental research design. A purposive sample of 60 children diagnosed with Down syndrome was selected to carry out this study. This study was conducted at three centers for children with special needs in Shebin El-Kom and Tala city. In Shebin El-Kom, it conducted at El Basma and Wogod centers for children with special needs. In Tala city, it was conducted at El Basma center. Two instruments were used for data gathering .A structured interview questionnaire involved children's characteristic such as age , sex ,associated problems with DS. The second tool was Arm, Leg, and Trunk muscle tone scale . The results of this study indicated that, nursing intervention in the form of therapeutic massage improved muscle tone of children with Down syndrome on posttest. Conclusion, this study concluded that children who received , nursing intervention in the form of therapeutic massage had better muscle tone than children who didn't receive therapeutic massage. Therefore, it is recommended that, nursing intervention in the form of therapeutic massage should be applied to improve muscle tone of children with Down syndrome

**Keywords:** Down syndrome; Nursing intervention; Muscle tone

### Introduction

Down Syndrome (DS), also known as trisomy 21, is a condition in which a person has an extra chromosome. Chromosome is small "package" of genes in the body. They determine how a newborn infant body forms during pregnancy and how the newborn infant body function as it grows in the womb and after birth.

This extra copy changes how the newborn infant body and brain develop which can cause both mental and physical challenges for the newborn infant (Centers for Disease Control and Prevention, 2013). It is typically associated with physical growth delays, characteristic facial features, and mild to moderate intellectual disability (Weijerman, 2010).

Children with Down syndrome need to achieve their best growth and development. Nurses need to provide

care to promote their growth and development. However, Down syndrome is the most common chromosomal disorder. In Egypt, Down syndrome occurs in 1 per 1000 live births (El Gilany et al., 2011). Moreover, the estimated incidence of Down syndrome is between 1 in 1,000 to 1 in 1,100 live births worldwide. Each year approximately 3,000 to 5,000 children are born with this chromosome disorder in USA (WHO, 2015).

Children with Down syndrome have decreased muscle tone or hypotonia (Martin, 2004). Hypotonic patients display certain physical characteristics that are caused by their decreased muscle tone. Motor skills delay is often observed, along with hypermobile or hyper flexible joints, drooling and speech difficulties, poor reflexes, decreased strength, decreased activity

tolerance, rounded shoulder posture, with leaning onto supports, and poor attention (O'Sullivan, 2007).

Because of these certain physical characteristics, children with Down syndrome don't develop motor skills in the same way that the typically-developing child does (National Down Syndrome Society, 2012).

Down syndrome is a lifelong condition; services early in life will often help Newborn infants and children with Down syndrome to improve their physical and intellectual abilities. Most of these services focus on helping children with DS to develop their full potential. These services include speech, occupational and physical therapy and they are typically offered through early intervention programs (Centers for Disease Control and Prevention, 2013).

Children with Down syndrome needed programs to face their developmental challenges especially the ones related to improper motor development (Guralnick, 2010). However, limited controlled studies tested the impact of massage intervention on muscle tone of children with Down syndrome. One pilot massage study with 13 children with Down syndrome (1-4 years) suggested that massage therapy could provide positive effects on muscle tone and motor development (Linkous and Stutts, 2010). Therefore, this study was done to identify the effect of a nursing intervention on muscle tone of children with Down syndrome.

#### **PURPOSE**

The purpose of the study is to identify the effect of nursing intervention on muscle tone of children with Down syndrome.

#### **HYPOTHESIS**

Children who will receive the nursing intervention in the form of therapeutic massage will have better muscle tone than children who will not.

#### **Operational definition of nursing intervention:**

The nursing intervention included gentle circular rubbing of soft tissue, moving muscles (full range of motion in a clockwise direction) and applying some pressure on some pressure points.

#### **METHODS**

- 1) Research design:- A quasi-experimental research design was used.
- 2) Research Setting: this study was conducted at three centers for children with special needs in Shebin El-Kom and Tala city that are available in El-Menuofia governorate. In Shebin El-Kom, it conducted at El Basma and Wogod centers for children with special needs. In Tala city, it was conducted at El Basma center.
- 3) Sampling:- A purposive sample of 60 children diagnosed with Down syndrome was selected from the previously mentioned settings. Sample size has been calculated using the following equation:  $N = (z^2 \times p \times q) / D^2$  at CI 95% and power 80%. The sample size will be 60 children. A simple random sample was used to assign the children into study (30 children) and control groups (30 children). Children in the study group received massage therapy sessions (2 sessions/week) for two months. Meanwhile, children in the control group only received routine care at the three for children with special needs.

#### **Inclusion Criteria:**

1. All children should have confirmed diagnosis with Down syndrome.
2. Children age ranged from 1 to 4 year.

#### **Exclusion Criteria**

1. Children with severe emotional troubles.
2. Children with physical impairments.

3. Children with musculoskeletal disorders.

4) Instruments: Two Instruments were utilized for data collection.

**Instrument one:** It involved a structured interview questionnaire. It was developed by the researchers to assess characteristic of children such as child's age, sex, health problems of children at birth and health problems associated with Down syndrome.....et

**Instrument two:** It involved Arm, Leg and Trunk muscle tone scale (ALT) and developed by Hernandez-Reif et al., (2006) and adopted by the researchers to assess muscle tone of children. It contained 3 items related to the assessment of hypotonicity, normal tone and hypertonicity of arm, leg and trunk muscles (1.00 to 4.00).

**Scoring System**

Scoring Items		Score
Hypertonicity	Severe	4
	Moderate	3
	Mild	2
	Slight	1
Normal	Normal	0
Hypotonicity	Slight	-1
	Mild	-2
	Moderate	-3
	Severe	-4

**Procedure :**

1) An official permission to carry out the study was obtained from the directors of selected centers after submitting an official letter from the Dean of the Faculty of Nursing at El-Menoufia University explaining the purpose of the study and methods of data collection. Meetings were conducted first with the directors of the centers to obtain permission for conducting the

research explaining the aim and expected outcomes.

2) The data collection instrument was developed after a review of past and current, local and international related literature including books, articles, periodicals and magazines to get acquainted with the various aspects of the research problem and to acquire the needed knowledge to conduct the study and prepare the necessary instrument.

3) For validity assurance, the instruments were submitted to a jury of five nursing and medicine experts (one assistant professor of pediatric nursing, an assistant professor of medical surgical nursing, a professor of physiotherapy and two professors of pediatrics children with special needs).

4) The reliability of the instrument was tested to determine the extent to which items in the questionnaire were related to each other by Cronbach's co-efficiency Alpha ( $\alpha=0.97$ ).Reliability analysis on the ALT revealed high internal consistency (Cronbach alpha = 0.9043; Split-half alpha for Part 1 = 0.9070 and alpha for Part 2 = 1.000).

5) A pilot study was carried out on 10 % of the total sample (six children) after the Instruments were developed and before starting the data collection to test the applicability, practicability, clarity and the feasibility of the study tools and to estimate the needed time to fill the tool. No modifications were required for the tools, so the pilot study was included in the sample of the study.

6) For ethical Consideration an oral acceptance was obtained from the children' parents before enrolling their children in the study. This consent was obtained after

explaining the aim and nature of the study. The study was voluntary, harmless, anonymous, and confidentiality of response would be respected. All children and their parents had the full rights to refuse to participate in the study and withdraw at any time.

7) Data was collected over a period of 8 months starting from February to September 2014.

8) Before the first session all children and caregivers in the two groups were interviewed to collect data about characteristics of children. Each interview lasted from 45 to 60 minutes at private room. Afterwards, an assessment of children's arm, legs and trunk muscle tone was done.(pretest).

9) For study group: during intervention phase: each child received nursing intervention in the form of 2 sessions/ week for two months (one time/ at the same time each day). The session lasted for 30 minutes. It was conducted in a private room. The child was asked to lay on a small mat on the floor for 30 minutes. The researcher rubbed the soft tissue gently, softly and slowly starting by legs, feet, stomach (slow circular rubbing with one hand), chest (gentle stroking), arms, face (small circles to entire scalp and face) and back (gentle stroking from top to coccyx). Back and forth rubbing was used. Each part was rubbed and stroked for three times. Complete flexion and extension movements were done for each joint.

For control group: Children in the control group only received routine care in the center.

Evaluative phase: posttest was done after 2 months for children in study and control groups. It was done to reassess children's muscle tone of arm, legs and trunk.

#### **DATA ANALYSIS:-**

Data was entered and analyzed by using SPSS version 16. Graphics were done using Excel program. Quantitative data was expressed as mean and standard deviation and analyzed by using ttest for comparison between two groups of normally distributed variables. Qualitative data was expressed in the form of number and percentage. It was analyzed by using chi-square test ( $X^2$ ) Wilcoxon test and Mann–Whitney were used for explaining relationship between not normally distributed quantitative variables. Level of significance was set as P value < 0.05 for all statistical tests.

#### **RESULTS:**

Table 1 showed that the mean age of children was  $2.37 \pm 0.61$  in the study group compared to  $2.50 \pm 0.63$  in the control group. Also, this table showed that the majority of children in the study and control groups were males (80.0 % & 76.7 %,) respectively. Regarding the associated problems with Down syndrome, approximately half of children in the study and control groups (50.0% and 46.7%) had congenital heart diseases. Also, 70% of parents in the study group had no consanguinity compared to 76.7% in the control group. However, no statistical significant differences were found between children in the two groups at 5% level of statistical significance.

Table 2 showed that children in the study group had better arm and leg muscle tone post nursing intervention than pre nursing intervention ( $2.97 \pm 0.89$  Vs  $2.10 \pm 0.92$  and  $2.93 \pm 0.87$  Vs  $2.10 \pm 1.12$ ). Therefore, there were statistical significance differences between muscle tone pre and post nursing intervention at 5% level of statistical significance. On the other hand, there were no statistical significant changes in muscle tone for children in the control group pre and post nursing intervention.

**Effect of a Nursing Intervention on Muscle Tone of Children**

Table 3 clarified that post nursing intervention, children in the study group had better muscle tone than pre nursing intervention. Before nursing intervention, 33.4%, 30.0%, 26.7% and 40.0% had severe left arm, right arm, left leg and right leg hypotonia. Post nursing intervention, children who had severe hypotonia were only 3.3%, 3.3%, 13.3% and 10.0% respectively. Also, the same table showed that there were no statistical significant changes between muscle tone of children in the control group pre and posttests at 5% level of statistical significance. Therefore, there were no statistical significance differences at 5% between pre and post nursing intervention regarding degree of hypotonia.

Table 4 represented that there were no statistical significance differences between muscle tones of children in the study and control groups' pre nursing intervention. Although, post nursing intervention, children in the study

group showed better muscle tone for arms and legs than children in the control group (2.10±0.92 Vs 2.93±0.91 and 2.10±1.12 Vs 2.87±0.89). Therefore, there were statistically significance differences between study and control at 5% and 1% levels of statistical significance.

Table 5 clarified that post nursing intervention, children in the study group had better muscle tone than pre nursing intervention (10.56 ±4.61 Vs 14.20 ±4.42). Also, post nursing intervention, children in the study group had better muscle tone than children in the control group (10.56 ± 4.61 Vs 14.20 ± 4.42). Therefore, there were highly statistical differences at 5% and 1 % levels of statistical significance.

Figure 1 indicated that children in the study group showed better muscle tones post nursing intervention than pre nursing intervention

**Table (1) Characteristics of studied children in the study and control groups.**

Items		Study group N0= 30		Control group N0= 30		$\chi^2$
		No	%	No	%	
Gender	male	24	80.0	23	76.7	0.1 <sup>ns</sup>
	female	6	20.0	7	23.3	
children's age per months	12-	21	70.0	17	56.7	1.3 <sup>ns</sup>
	24-	7	23.3	11	36.7	
	36-	2	6.7	2	6.7	
X ± SD		2.37 ± 0.61		2.50 ± 0.63		T test 0.83 <sup>ns</sup>
Associated problems with DS for the children						1.19 <sup>ns</sup>
-no problems		11	36.7	10	30.0	
-congenital heart diseases		15	50.0	14	46.7	
-GIT problems		0	0.0	1	3.3	
-more than one problem		4	13.3	5	16.7	
Presence of consanguinity						0.34 <sup>ns</sup>
-No		21	70.0	23	76.7	
-yes		9	30.0	7	23.3	

**NB:** <sup>ns</sup> p>0.05

**Table (2) Means and standard deviations of muscle tones for children in the studied groups pre and post nursing intervention**

*Effect of a Nursing Intervention on Muscle Tone of Children*

Items	Study group		Wilcox on test	P-value	Control group		Wilcox on test	P-value
	Pre	Post			Pre	Post		
	X ± SD	X ± SD			X ± SD	X ± SD		
Arm	2.97 ±0.89	2.10±0.92	5.09*	.001	2.97±0.89	2.93±0.91	0.00 <sup>ns</sup>	1.0
Leg	2.93±0.87	2.10±1.12	4.63*	.002	2.93±0.87	2.87±0.89	1.41 <sup>ns</sup>	.16
Trunk	2.60±0.89	2.53±0.86	1.59 <sup>ns</sup>	.112	2.97±0.89	2.83±0.95	1.63 <sup>ns</sup>	.102

NB: <sup>ns</sup> p>0.05      \* p<0.05

**Table (3) Distribution of children in the studied groups pre and post nursing intervention according to their degree of hypotonia.**

Items		Study group				$\chi^2$	Control group				$\chi^2$
		Pre		Post			Pre		Post		
		No	%	No	%		No	%	No	%	
<b>left arm</b>	normal	0	0.0	1	3.3	13.1*	0	0.0	0	0.0	.00 <sup>ns</sup>
	slight	1	3.3	7	23.3		1	3.3	1	3.3	
	mild	9	30.0	11	36.7		9	30.0	9	30.0	
	moderate	10	33.4	10	33.4		10	33.3	10	33.3	
	severe	10	33.3	1	3.3		10	33.3	10	33.3	
<b>right arm</b>	normal	0	0.0	2	6.7	11.2*	0	0.0	0	0.0	.36 <sup>ns</sup>
	slight	2	6.7	7	23.3		2	6.7	3	10.0	
	mild	9	30.0	10	33.4		9	30.0	10	33.3	
	moderate	10	33.3	10	33.3		10	33.3	9	30.0	
	severe	9	30.0	1	3.3		9	30.0	8	26.7	
<b>left leg</b>	normal	0	0.0	3	10.0	12.5*	0	0.0	0	0.0	.44 <sup>ns</sup>
	slight	2	6.6	4	13.3		2	6.7	2	6.7	
	mild	6	20.0	14	46.7		6	20.0	8	26.7	
	moderate	14	46.7	5	16.7		14	46.7	12	40.0	
	severe	8	26.7	4	13.3		8	26.7	8	26.7	
<b>right leg</b>	normal	0	.0	4	13.3	10.01*	0	0.0	0	0.0	.29 <sup>ns</sup>
	slight	4	13.3	5	16.7		4	13.3	5	16.7	
	mild	6	20.0	8	26.7		6	20.0	7	23.3	
	moderate	8	26.7	10	33.3		8	26.7	7	23.3	
	severe	12	40.0	3	10.0		12	40.0	11	36.7	
<b>trunk</b>	normal	0	.0	1	3.3	4.35 <sup>ns</sup>	0	0.0	0	0.0	.49 <sup>ns</sup>
	slight	4	13.3	4	13.3		1	3.3	2	6.7	
	mild	8	26.7	13	43.4		9	30.0	10	33.3	
	moderate	14	46.7	11	36.7		10	33.3	9	30.0	
	severe	4	13.3	1	3.3		10	33.3	9	30.0	

NB: <sup>ns</sup> p>0.05      \* p<0.05

**Table (4) Means and standard deviations of muscle tone for children in the studied groups pre and post nursing intervention.**

Items	Pre nursing intervention		U-Test	Post nursing intervention		U-Test
	Study	Control		Study	Control	
	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Arm	2.97± .89	2.97± 0.89	0.0 <sup>ns</sup>	2.10 0.92	2.93 ±0.91	3.7*
Leg	2.93±0.87	2.93±0.87	0.0 <sup>ns</sup>	2.10±1.12	2.87±0.89	2.92**
Trunk	2.60±0.89	2.97±0.89	0.14 <sup>ns</sup>	2.53±0.86	2.83±.0.95	1.31 <sup>ns</sup>

NB: <sup>ns</sup> p> 0.05      \* p< 0.05      \*\*p<0.001      U-test=Mann–Whitney

**Table (5) Total muscle tone for children in the study and control groups pre and post nursing intervention**

Total Muscle tone score	Study (n=30)	Control (n=30)	Test	P-value
	Mean ±SD	Mean ±SD		
Pre nursing intervention	14.30 ±4.25	14.66 ±4.35	t=0.33	0.743 <sup>ns</sup>
Post nursing intervention	10.56 ±4.61	14.20 ±4.42	Mann Whitney=2.69*	0.007 <sup>(S)</sup>
Test P value	Wilcoxon=4.76** <0.001 <sup>(HS)</sup>	Paired t=0.65 0.42 <sup>ns</sup>		

NB: <sup>ns</sup> p> 0.05      \* p< 0.05      \*\*p<0.001

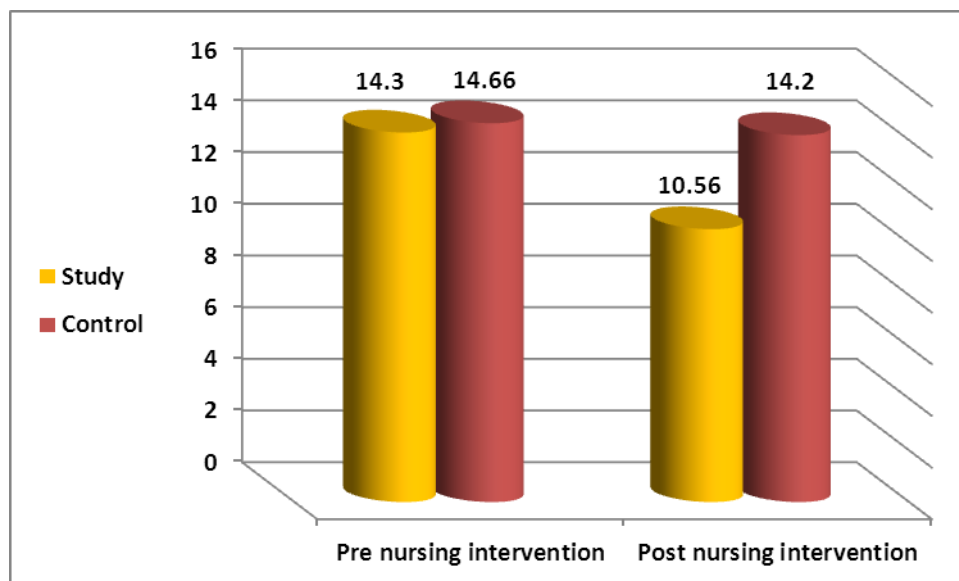


Figure (1) Total score of muscle tone

## **DISCUSSION**

Down syndrome, a genetic condition affecting one in about 800 children born in the United States. It is characterized by cognitive deficits, speech problems, motor and perceptual developmental problems (National Institutes of Child Health and Human Development, 2007). Children with Down syndrome also frequently present with decreased muscle tone or hypotonia (Bodensteiner et al., 2013). This study was a quasi-experimental research which hypothesized that children with Down syndrome who received nursing intervention (therapeutic massage) had more improved muscle tone than children who didn't have nursing intervention.

Concerning numbers of males and females in the study and control groups (table 1), the findings of the present study clarified that the majority of children in the study and control groups were males. This result was consistent with Hernandez-Reif et al. (2006) in their study about "effect of massage therapy on Down syndrome", and Ghoneim (2012) in her study about "impact of physical exercise on Down syndrome in Menoufia Governorate". They reported that the majority of children who had Down syndrome were males. Some studies attributed this to the impact of boys' genetic chromosome Y mechanism on the segregation of chromosome 21 (Doctortipster, 2011). Other Egyptian studies clarified that mothers who were younger or older than 35 were more liable to get boys with Down syndrome (El Gilany et al., 2011).

Regarding the age of studied children, the same table showed that there were no statistical significant differences between children in the study and control groups at 5% level of significance. This could reveal the homogeneity of the sample in both groups of the study. In other words,

there were chronological similarities in age.

Regarding consanguineous marriages. Also, table 1 revealed that 30% of pediatric patients with DS were a result of consanguineous marriages. This result was consistent with Shawky et al., (2013) in their study about "Consanguinity and its relevance to clinical genetics". They reported that consanguineous marriage was detected in 28.8% of patients with Down syndrome.

Regarding muscle tone of children in the study and control groups' pre and post nursing intervention (table 2), the present study revealed that post intervention, children in the study group showed increased muscle tone. This could be attributed to the effect of Swedish (percussion) and Tapotement massage techniques on muscles. In other words, these techniques were used to vibrate tissues, trigger cutaneous reflexes and cause vasodilatation. Also, sensitivity of muscle contractions might increase. Tapotement could also stimulate muscle contractility and thus muscle tone could be increased. These findings were consistent with Hernandez-Reif et al., (2006) who reported in their study about "Children with Down syndrome improved in motor functioning and muscle tone following massage therapy" that therapeutic massage was effective in improving and increasing muscle tone of children.

On the other hand, these findings were inconsistent with Angelopoulou et al., (2000), in their study about "Bone mineral density and muscle strength in young men with mental retardation with and without Down syndrome". They reported that young men with Down syndrome have decreased arm and leg muscle strength. Also, these findings were not in line of agreement



with Field et al., (2005) in their study about "Effect of massage therapy on muscle tone of children with cerebral palsy". They reported that children with cerebral palsy had reduced muscle tone after massage therapy. This may be attributed to the only utilization of different types of massage techniques (effleurage and petrissage massage) which might help to increase blood flow by increasing the arteriolar pressure. As well as, effleurage and petrissage massage helped to increase muscle temperature as a result of rubbing the muscle. Besides, rubbing was expected to decrease neuralexcitability and reduced muscle tone. However, Petrissage massage was believed to relieve muscle spasm when used as stretch for contracted muscle tissue and increased the elasticity of muscles. In the current study, percussion and Tapotement massage was utilized.

Also, children in the control group (table 3), showed no changes in muscle tone after two months. These findings were consistent with Weerapong et al., (2005) who studied "The Mechanisms of Massage and Effects on Performance, Muscle Recovery and Injury Prevention". These could be attributed to the effects of nursing intervention in the form of therapeutic massage sessions, in which massage could provide several benefits to the muscles. Massage helped to produce mechanical pressure, which was expected to increase muscle compliance, increase neural excitability. Also, it caused increased muscle tone and improved range of joint motion.

Also, children in the study group showed improved muscle tone after therapeutic massage sessions than children in the control group (table 4,5). These findings were consistent with Haakana (2008) in his study about "The Acute Effects of Massage on

Muscle Tone and Perceived Recovery". He reported that, there was a significant reduction in muscle tone between children in control group. On the other hand, in the same study children who received therapeutic massage had increased muscle tone. This may be interpreted as increased muscle strength might have contributed to improved muscle tone as a result of pressure stimulation during massage intervention. Thereby, the functional activity of muscles, movement and coordination will be improved due to improvement of muscle strength.

### **CONCLUSION**

Based on the findings of this study and research hypothesis, it is concluded that children who received nursing intervention "therapeutic massage sessions" had better muscle tone than children who didn't receive therapeutic massage. Therefore, therapeutic massage was effective in improving muscle tone of children with Down syndrome.

### **RECOMMENDATIONS**

Based on the findings of the current study, the following recommendations can be suggested:-

- 1) Nursing intervention in the form of Therapeutic massage may be integrated as a part of routine daily care for children with Down syndrome.
- 2) Preparing a physiotherapy room in the centers of children with special needs should be emphasized. A well trained and licensed nurse should be available for conducting therapeutic massage for children with DS.
- 3) This study needs to be applied on a

larger sample of children and at different study settings to ensure the generalizability of results.

- 4) This study can be replicated using another type of massage in order to identify the most effective type of massage on improving muscle tone of children with Down syndrome.

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