RESEARCH ARTICLE

Visual Motor Integration among Children with Down Syndrome in Community Based Rehabilitation Centers

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Abstract:

Background: Children with Down Syndrome (DS) shows a significant delay in physical, mental and functional skills which eventually limit their participation in academic. Majority of DS seek services from community based rehabilitation (CBR) center in provides services including academical skills such as handwriting. Visual motor integration (VMI) is the crucial factors that involve during handwriting, however VMI issues often being sideline since common intervention in CBR centers focused on clinical symptoms of DS. Therefore, identifying the VMI performance among children with DS can improve their skills especially in academicals. **Objectives**: To identify the level of performance in VMI among children with DS. **Method**: A cross-sectional study, 33 participants in CBR centers in Kuala Selangor. VMI performance was evaluated using the Beery-Buktenica Developmental Test of Visual-Motor Integration (Beery VMI) fifth edition. **Results**: 30 participants (90.90%) showed that majority of the children with DS are in the very low performance in VMI. There is no significant different between level of performance in VMI among children with DS with respect to chronological age and gender. **Conclusion**: Demographical data such as chronological age and gender does not influence the level of VMI performance among children with DS.

Keywords: *Visual motor integration; community based rehabilitation; Down Syndrome*

1. INTRODUCTION

Down syndrome (DS) is caused by abnormalities in trisomy 21 whereas the presence in the genome of three rather than the normal two chromosomes 21 influences physical, mental, and functional skills [1]. In Malaysia, it is recorded that the incidence of DS in Malaysia is 1 in 950 births [2]. Children with DS also shows a significant delay in physical growth, hypotonia, poor muscle strength and endurance [3], besides intellectual disability that the severity differently ranged and eventually affect executive functions especially in attention, perception speed and motor control [4],[5]. However, early initiative with proper and intensive intervention during childhood, DS transition to mainstream school could be possible.

In public hospitals in Malaysia , most of DS children are treated at outpatient rehabilitation clinic during their toddler period. As they grow, less frequent appointments from the hospital have seen them seeking services at community-based rehabilitation (CBR) centers. Hence forth, CBR centers can be considered as a transition phase for these children before embarking into mainstream. One of aim of CBR is to provide basic foundation in learning particularly in reading and writing.

Academicals skills including handwriting performance [6], ability to concentration, reading [7], spelling, or solving arithmetical problems [8]. These skills rely on functionality children in visual motor integration (VMI) skills thus, it is crucial to be develop early in childhood before formal education [9].

VMI defined as a person ability to integrate both visual skills and motor ability whereas involve the ability of the eyes and hand to work together in smooth, efficient patterns [10],[11]. Lahav [12] added that VMI is one of the component of visual perception skills that involve motor element based on maturation and integration of cognitive, visual, perceptual and motor skills. In addition, VMI also indirectly involve in extra-curricular, sporting activities and recreation performance [13].

There is dearth agreement on the influence of gender on VMI performance. Nicole and Watter [13] underscore that gender does not influence VMI performance, meanwhile a study found females perform better than males. The study concluded that female's development was faster and acquisition VMI skills earlier from male [14]. A study in South Africa shows that the older participant scored better VMI, visual perception and motor coordination [15]. Unfortunately, throughout the literature review that is done

in this study, there is no study that fully elaborate on development of VMI hence, the maturation of VMI remain vague and there is no definite conclusion can be made toward the development of VMI.

However, VMI issues often get sideline since common intervention in CBR for people with DS are more geared towards obvious clinical symptoms of DS such as gross motor, language also cognitive ability. Henceforth, identifying and integrating VMI along with other treatment will result in more favourable outcome to ward children with DS.

The objectives of this study were to identify the level of performance in VMI among children with Down Syndrome and to identify any differences between level of performance of VMI with respect to age and gender among children with Down Syndrome.

2. METHODOLOGY

Cross-sectional design was used to explore the intention of this study.

Participant

Convenience sampling strategy was deployed. The Raosoft Sample Size Calculator at confidence level of 95% indicated sample size of 33was enough. Samples were gathered from five centers around Kuala Selangor district. Inclusion criteria was set for children who are in preschool age (5 -7 years), with valid diagnosis of DS. Since active participation of samples are required the inclusion criteria was extended that they should able to understand instructions and can maintain concentration for at least 30 minutes. On the other hand, children were excluded if they have poor vision or having others disability such as deafness and blindness.

Instrument

In this study, we use the Beery-Buktenica Developmental Test of Visual-Motor Integration (Beery VMI) fifth edition. The Beery VMI is designed to assess the extent to which individual can integrate their visual and motor abilities also known as eye-hand coordination, to identify children that may need special assistance through early screening, to test the effectiveness of educational and others intervention, and to advance research. Research also indicate that Beery VMI is virtually culture-free besides its speciality whereas it can be done in a group or in individual sessions.

The fifth edition of Beery VMI is focused more on early childhood education. It has been expended to include standardized norms for two-year olds, provides 600 development steppingstones norms and introduces visual-motor teaching method for birth through elementary school. Full Form Beery consisting of 30 items, can be used with individual age 2 through 100 years old. This form was used in this study. The Beery VMI raw scores was transform into child's age equivalents or standard scores.

The Beery VMI is an instrument that was designed to measure VMI and to reflect developmental age differences. One point was given to the correct imitated and copied item up to three consecutive failures. Ceiling is established after three consecutive failures have been reached. The raw score is then calculated by subtracting one point for each incomplete shape forms to the ceiling. After that, standard score is derived from raw score, enabling different range of standard score interpret a different level of performance in VMI.

According to the test manual, interscorer reliabilities were 0.92 for Beery VMI, 0.98 for Visual Perception, 0.93 for Motor Coordination. The correlation between the DTVP P-2 Position in Space and VMI Visual Perception was 0.62 [16]. Others research [17] have proven its discriminant validity of the VMI test in screening children with handwriting dysfunction based on the area under the receiver operating characteristic curve which at 0.89. research conducted by [18] have evidence of convergent validity that support the interpretation of VMI scores as measuring perceptual organization between children and adolescence with Traumatic Brain Injury (TBI) and Attention Deficit/Hyperactivity Disorder (ADHD).

Procedure

Before conducting the test, a consent form that contain a briefly explanation about the nature of the study and the data was used only for research purposes only should be given to the parents that give a permission to the children to take part in the study. After that the children were evaluated their VMI performance using The Beery VMI in individual session with the researcher. During the test, demonstration is firstly being done until the children get the idea of the task given, thus the children's performance will be evaluated and recorded in the scoring form.

Statistical Analysis

The collected data was analysed using Statistical Package for Social Science (SSPS) version 25 software, with the p – value < 0.05 is set as statistically significant. The Shapiro-Wilk test of normality was conducted in order to select the statistical testing whether parametric or non-parametric testing that suitable for the study. A not normally distributed data with significant result of p-value < 0.05 were presented in this study hence, nonparametric testing was conducted. The descriptive analysis was included to describe demographical data such as gender, age, and races besides, this information was analysed by using mean and standard deviation (SD). Inferential analysis was hypothesis testing that aimed to identify relationship and determine the hypothesis of the study whether to be accepted or rejected. A Kruskal – Wallis was used to analyse a significant different between level of performance in VMI among children with DS with respect to chronological age meanwhile the Mann – Whitney test was used to analyse the significant differences between level of performance in VMI among children with DS with respect to gender.

3. RESULT AND DISCUSSION

The objectives of this study were to identify the level of performance in VMI among children with DS and to identify any differences between level of performance of VMI with respect to age and gender among children with DS. Table 1 summarized the result obtained in term of gender, age and race of the participants.

Table 1. Demographic data of the participant.

Variable	n	Percent (%)
Gender		
Male	24	72.70
Female	9	27.30
Chronological age, mean (SD)	1.85 (0.94)	
5 years	17	51.50
6 years	4	12.10
7 years	12	36.40
Race		
Malay	32	97.00
Chinese	1	3.00

3.1. Level of performance in VMI among children with Down Syndrome

The descriptive analysis of the level of performance in VMI among children with DS is M = 1.09, SD = 0.29 were illutrated in Table 2. There were three participants that rank in low performance (9.10%) meanwhile, the rest of the remaining participants (90.90%) were at very low performance. Based on the result, most of the children were rank at very low in level of performance in VMI and there were no significant different between level of performance in VMI with respect to age and gender among children with DS.

Delayed in development including one or both of these areas which is VMI, visual perception and/or motor coordination could me the factors of poor performance in VMI [3]. Decrease in VMI performance is not only affecting by problem in perception on one's own, but children with poor motor performances also give influence the result and in general there will be difficulties when to integrate both motor and visual component [19],[20],[13].

Problem in articulation development was found to be related to poor performance in VMI in a study conducted by Memisevic and Hadzic [21] as Grieco et al. [4] stated that, individual with DS have greater in late development of morphosyntactic skill development, low articulation and speech intelligibility. Additionally, low performance in VMI could be because of deteriorate functionality of the frontocerebellar structure that responsible in articulation and working memory [22].

Children with DS have poor performance may because of decrease in motivational and slow in functional ability because it is believed that high in motivation will lead to successful adaptive functioning as children with DS are predisposed toward experience and learning [23].

Children with reading disabilities have deficit in VMI performance because of inability to distinguish and produce sensory motor information in short period of time [7] beside that, problem in multisensory processing that involving auditory, visual, vestibular and tactile processing where these were found to influence their low performance especially in adaptive behaviours and involvement in school activities [24]. These also indirectly supported the poor performance among children with DS. In Malaysia, different approaches and culture in learning is applied to suit the children well within their environment, in contrast in China preschool children perform better in VMI is because of Chinese's unique orthography characters which give advantages in reading and writing Chinese besides, early exposure to education, using chopsticks was believed one of the cultural influences on VMI development [25].

Table 2. Level of performance in VMI among children with Down Syndrome

Level of Performance in VMI Among Children with Down Syndrome	Standard Score	n	Percent (%)
Low	70 – 79	3	9.10
Very low	>70	30	90.90

3.2. Level of Performance in VMI among Children with Down Syndrome with Respect to Chronological Age and Gender.

Based on Kruskal-Wallis test that used to determine a significant different between level of performance in VMI among children with DS and their age, there was no significant different with outcome at is 3.01 (2) and p – value at 0.22. Table 3 summarize the finding in this study.

A study found that at age range above than six years old, children with DS will have difficulty in motor ability with a touch of cognitive functioning and eventually cause delay in an attending other skill areas including social, communication, cognitive and self-help skills [26].

Volman, Visser & Lensvelt-Mulders [27] found that at age five to seven years old, mental ability of children with DS appear to be the least predictor of functional status compared to performance in motor ability where children with DS demonstrate difficulty in adaptive and functional skills since they compensate problems in motor coordination and postural control.

On the other hand, other studies' finding oppose these finding and they suggest that as children with DS get older, a linear improvement pattern in performance on VMI and its supplemental tests were recorded within age ranging of six to 16 years which also mean that their performance in graphomotor controls especially imitate and visually discriminate between figures and getting better [23].

Moreover, Ercan, Ahmetoğlu and Aral [28] claimed that VMI skills among children win second grade perform better than children enrolled in kindergarten and first grade and support that as the age increases their VMI skills also progress to develop.

Table 3. Level of Performance in VMI among Children with Down Syndrome with Respect to Chronological Age.

Variable	Chronological age	n	Median (IQR)	X^2 statistic (df)[a]	*P* value[a]
Level of performance in VMI among children with Down Syndrome	5 years	7	1.00 (0)	3.01 (2)	0.22
	6 years	4	1.00 (0)		
	7 years	12	1.00 (0)		

[a]Kruskal-Wallis test

Table 4 illustrated the result of Mann-Whitney test between the levels of performance in VMI among children with DS with respect to gender. The outcome of Mann-Whitney test is Z = -1.58 and p = 0.11 thus, the difference in scores male and female participants are not statistical different.

A finding in a study conducted by Harmancı Başkut [29], there were no significant different between them in other words both female and male students displayed a same development in handwriting readiness within their age groups. Some views that gender does not affect VMI performance [13],[25]. In contrast, Coallier et al. [30] found that female kindergarten children perform better in VMI compared to males, also suggested a further exploration in children's developmental trajectory of visual-motor skills for better understanding of gender difference besides that, a study in China also shared a same result whereas girls exhibit a better VMI performance because girl's development were faster compared to boys [14]. Meanwhile, boys are more likely socialized and active in their surrounding and result in increases the development of VMI skills in the study conducted in peri-urban and rural communities in South African [31]. Male's gender also had significant factor in both articulation and VMI compared to female, who had a slightly more in language performance [21].

Table 4. Level of performance in VMI among children with Down Syndrome with Respect to Gender

Variable	Male (n=24) Median (IQR)	Female (n=9) Median (IQR)	*Z* statistic[a]	*P* value[a]
Level of performance in VMI among children with Down Syndrome	1.00 (0)	1.00 (1)	-1.58	0.11

[a]Mann-Whitney test

4. CONCLUSION

The purpose of the study is to identify the level of VMI performance among children with DS and to determine any significant differences between the level of VMI performance in respect of chronological age and gender among children with DS. The study is administered to 33 children with DS at various CBR within Kuala Selangor. There are 30 children with DS that ranked under very low performance in VMI and another 3 children were at low VMI performance. There is no significant difference between the level of VMI performance with respect of chronological age and gender among children with DS. It means that children who is older shows a similar level of performance in VMI with younger age group meanwhile, male and female children with DS also demonstrated a similar development in VMI.

Thus, this study agrees both demographical data, age and gender does not influence the level of VMI performance among children with DS. Since fine motor and posture plays an important role in visual motor integration, future research should consider the maturity of these two systems as inclusion criterion, to isolate and explore VMI in DS children.

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