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RESEARCH ARTICLE
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EFFECT OF VISUAL AIDS ON THE MOTOR DEVELOPMENT OF CHILDREN WITH DOWN SYNDROME

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ABSTRACT
Down syndrome (DS) is a common chromosomal disorder associated with delayed motor development due to hypotonia and cognitive deficits. This study aimed to evaluate the effect of visual aids on the motor development of children with DS aged 2–6 years. A comparative cohort design was used with 70 participants equally divided into two groups, those using visual aids and those without. Motor performance was assessed using the **Gross Motor Functional Measure–88 (GMFM-88)** across five domains. Results showed that children using visual aids achieved significantly higher mean scores in all motor domains ($p < 0.001$), particularly in standing and walking/jumping/running. Interactive games were the most effective and commonly used form of visual aid. The study concludes that consistent use of visual aids can significantly enhance gross motor skills, coordination, and independence in children with DS, making them a valuable component of early rehabilitation programs.

Keywords: Down syndrome; Global health issue; motor development; visual aids; hypotonia; gross motor function; GMFM-88; cognitive deficits; early rehabilitation; interactive games; pediatric physical therapy; coordination; functional independence.

INTRODUCTION
Down syndrome is a genetic disorder and is one of the most frequently seen genetic disabilities. (1) It is the most common chromosomal condition in humans which is caused by an extra copy of part or complete chromosome 21, and is still a global health issue because of its high occurrence and impaired quality of life.(2) Although there have been advances in prenatal screening for DS, global incidence continues to be approximately one in 800 live births, although rates vary according to different countries and cultural backgrounds.(3) The prevalence of DS is 1-2 cases per 1000 births in Caucasian and Asian countries, and depends on the maternal age distribution, notably the proportion of mothers at or older than 35 years of age. In a study conducted on the prevalence of DS in Thailand, two hundred twenty-six DS cases (121 male and 105 female) were diagnosed, with an average prevalence of 1.21/1000 births (95% CI 1.05-1.37). The prevalence rates of DS with 95% CIs in three provinces of

Thailand in which the study was mainly conducted in, each year of the study ranged from 0.86-1.99 per 1000 births (4) By the estimated values of a study conducted in China, DS affects one per 700 newborns, but the reported ratios of prevalence at birth, were much lower than those from western countries. Chinese account for a large part of the world population, almost one fifth, which means a huge number of deliveries of live births with DS will be conducted each year.(2) There are a few characteristic features of DS that help separate it from other chromosomal abnormalities even without a formal diagnosis, such as slanting eyes, Over-expression of the chromosome results in a decrease of the overall number of neurons in the central nervous system, a delay of myelination, and dysregulation of cell cycles that lead to overproduction of protein precursors and subsequently cause neurotransmission abnormalities. Consequently, children with DS show impairment in cognitive domains such as concentration, communication, memory, and task performance compared to healthy peers. (5) Genetic differences can clearly be observed between children who develop typically and children with DS. These differences include hypotonia, joint laxity, decrease muscle strength, short stature and significant medical co-morbidities Due to an atypical cerebrum size and maturation disorders of central nervous system, delays in motor development are very obvious and irreversible.(1) Delays in motor development are seen in children with intellectual disability along with impairments in adaptive functioning and daily living skills that compromises their autonomy and independence and also limits their participation in activities of daily living. (6) Typically associated with this disorder, are physical growth delays, characteristic facial features, and mild to moderate intellectual disability. (7) With the growth and complexity of motor tasks a certain gap can be seen as milestones of motor development are not successfully reached. Generally seen delays can include variabilities in speed, and symmetry of general movements. Disorder in motor development can be seen in children with DS, such disorders may include problems with postural control. So, approaches being used directly analyze motor abilities are also used indirectly to analyze body posture.

Compared to non-disabled individuals, individuals with DS are also less able to stabilize the positions of their joints. An adverse effect can be seen on proprioceptive feedback from sensory structures muscles/joints and the efficacy of co-contractions due to the hypotonicity observed in DS population. In motions such as sitting on the floor and turning 360 degrees, abnormal positions of the body parts (e.g. legs and hips) are frequently observed during motion.

A main effect of DS is the lack of motor ability. However, identification and proper analyzing can lead to correction or attenuation of several types of motor disorders. (7) An important protocol is to use intervention programs that may attenuate the effects of such disorder and contribute to the overall improvement of the quality of life, as there is no complete cure for DS.

A common, infrequently reported issue for children with DS is the musculoskeletal complications that accompany the congenital anomaly. Ligamentous laxity, along with low muscle tone, not only increases the risk of the number of musculoskeletal disorders but also leads to a delay in the acquisition of motor milestones. Joint laxity, as mentioned above, is associated with delay in ambulation and is also considered to be almost universal in children with DS, combined with hypotonia, the combination of which leads to a widespread impact on functional abilities and musculoskeletal disorders. Therefore, it results in a delayed acquisition of motor milestones, and low levels of physical activity in children with DS. (5) In the 1950s and 1960s, serious studies on establishing the gross motor milestones for children with DS began to appear. Palisano et al. worked on motor function growth curves (for mild motor impairment and moderate-severe impairment) including eight gross motor skills limited to two published studies. Establishment of gross motor milestones for children who develop normally have been widely used by paediatricians and other health care professionals to determine how an individual child's development compares to that of other normally developing children.

Understanding of normal development is used as a screening tool by the clinicians, enabling them to recognize delayed development, thus allowing them to pinpoint the exact diagnosis of every delayed developmental milestone and allowing early prognosis, therapeutic intervention, services and plan of care for each child, pertaining to his/her condition. Currently the schedule used for screening involves comparison of typically developing children with those of DS. Because of this, professionals are

limited in their ability to identify each child's milestones compared to his peers (other children with DS) and provide an exact prognosis as to when the child is expected to achieve a particular milestone. (8) Prognosis is possible by using the Test of Infant Motor Performance (TIMP), early in development, an ecologically valid test that measures postures and movements' reflecting infants' interactions with their caregivers with high predictive and discriminative validity. (9)

Gross motor and fine motor skills of children with DS who participated in Early Intervention Programs had shown to improve over time. Studies regarding the importance of early physical therapy interventions, such as the one carried out by Malak et al. assessed the effect of physical therapy (PT) on gross motor function in children with DS. They found that standing and walking skills, among other motor skills, were significantly delayed despite PT treatment. (1) Typical development of functional motor skills can be seen between ages 2-7 years and despite similarities in the pattern of development, the rate of development of children with DS is slower compared to typically developing children.(10) Postural control, gross motor skills and fine motor skills have mainly been the areas of research in previous studies and little research is based on methods for improving these areas of lacking. (5) The children with DS will show worse gross motor skills compared to borderline functioning (BLF) and typically developing children by having lower scores for locomotion for example walking, jumping, galloping, running, hopping, sliding and leaping along with object control tasking such as throwing, catching, bouncing, kicking, pulling and pushing. Moreover, children with borderline functioning would perform poorly on object control tasks, compared to typically developing children and would perform better compared to DS group. Gross motor skills were tested by the test for gross motor development (TGMD). Aimed at noting 2 skill sets: 7 locomotion and 5 object control tasks, TGMD is a criterion references test. (6). Various physical therapy protocols combine with scales of measurement have been used in the past to correctly identify and improve motor impairment. However, to accurately ensure progress after an intervention, an effective and evaluative measure is required. An instrument's ability to detect meaningful change over time, i.e., "sensitivity," is vital to its usefulness in this context. The Gross Motor Functional Motor Scale (GMFM) and the Pediatric Evaluation of Disability Inventory (PEDI) have been validated as responsive tools. The GMFM has two versions: the original version (GMFM-88) and the more recent version called the GMFM-66, which comprises 66 items chosen using a Rasch analysis. Variables such as the age of the child, the length of follow-up period, the sex of the child, and the assessment instrument can have an expected amount of change on the results. (11) There have been gaps in the studies we've seen being conducted on children with DS mainly pertaining to the lack of interventional study on how to positively increase the current rate of motor development including both gross motor and fine motor skills. The purpose of this study is to work on tertiary mode of care which includes limiting further progress of motor function deterioration and to see if the use of visual aids has any effect on rate of motor development in children with DS between the ages 2-6 years.

Our hypothesis is that significant differences will be visible in motor abilities of children with DS who have been using visual aids for at least one year compared to DS children who have not used visual aids for a significant period of time, have not been consistent or have not used them at all. The scale that has been chosen for this study is the GMFM-88 which has a higher intra rater reliability and greater sensitivity to slightest change in motor function.

LITERATURE REVIEW

As stated by Charlene Foley et al musculoskeletal complications are very common in DS children such as pes planus and hypotonia of skeletal muscles which leads to spine, hip and knee instability which can further lead to hypermobility. Delayed ambulation is noted in these children, and they have a higher risk of developing inflammatory arthritis. To prevent any further pathology annual assessment and screening can be done to rule out the early musculoskeletal anomalies. Children with DS also have lower levels of physical activity and delayed acquisition of motor milestone which contributes to lower bone mass and reduced muscle strength and they can be misdiagnosed because of over attributing of motor difficulties caused by hypo-mobility and hypermobility (12). Feeding and swallowing difficulties are also seen in children with DS. M.A Anil and colleagues mentioned in their

study that oral problems that are caused by poor oro-motor mobility and developmentally poor chewing patterns are predominantly present in children with DS. Field, Mitchell et al concluded that restricted tongue movements are caused by oral hypo tonicity which further leads to oral problems (13). Norms for children with DS as are uncertain whereas gross motor milestones are established well for children who develop typically. The gross motor development of a particular child with DS is delayed compared to typically developing children and the assessment of motor development of a child with DS can be based on comparing performance of a DS child to typically developing children (8). The motor delays in DS children are a result of reduced size of brain, cerebrum and pathophysiological processes. Children having DS commonly have delays in standing position and walking ability. Physical therapy is significant for children having DS as both motor function and balance are often correlated (14). Mental and motor developmental delay is present in children with DS as mentioned in this research by Michiel J Volman. The delay in motor development is more pronounced than the delay in mental development, which has an impact on the adaptive behavior and also causes marked limitation in functional activities of 5- to 7-year-old children. Children with DS were better predicted by the level of motor ability than the level of performance and mental ability; studies suggest that working on functional skills of these children will enhance their self-care activities and social function with an active involvement in the community. (15)

The major milestones such as sitting, standing, reaching and grasping are generally delayed in these children. Maria Spano and her colleagues suggested that a slightly higher correlation between mental age and motor performance have been reported in these children, and no child over the age of 11 achieved the level of a normal 7-year-old. Studies of children with DS focused on the presence of physical features associated with the syndrome which might affect their performance with poor manual dexterity; however, some areas of motor abilities especially with absence of rehabilitation seem to be more affected than the others (16). Postural sway caused by motor delay and reduced cognitive mechanisms is significant in children with DS. In a research study Pena et al assessed dual task effects on postural control during sit to stand, which showed lowered stability during sit to stand and greater postural sway as compared to typically developing children, they also mentioned that neuromotor dysfunction may also impair coordination processes during dual task function , nevertheless these children are able to participate in the community and show good functional performance in daily life activities (17). Difficulties with early postural control requiring speed, postural control and balance are often shown in children with DS (14). According to (18) motor function development in children with DS is associated with cognitive development specifically in the first three years of life, with balance function closely related to motor skills. Motor development of children with DS was also correlated with language development as well as cognitive development (19); results of this study suggest that the achievement of walking in children with DS could also help enhancing later cognitive and language development. However, this research by Beqaj et al (1) suggests that there is a significant delay of motor skills in individuals having DS compared to otherwise normal individuals, but the developmental sequence is the same. In more complex skills there is more prominent delay in development. This study (5) anyhow contradicts with the previously mentioned research. In this study Kim and colleagues concluded that early motor development did not have a significant effect on later cognitive function.

As far as balance is concerned, children with DS have poor postural balance with difficulties in maintaining antigravity situations. Mohamed A. Eida concluded that the antigravity control was more related to static balance than dynamic balance in late childhood and in order to improve posture balance and muscle strength isokinetic training program must be performed with physical therapy three times a week for 12 weeks to become more active and sociable with the community (20). Dynamic balance in these chidren can be assessed during gait training. Belluscio et al used inertial sensors and spatiotemporal parameters to assess balance in 15 children with DS. The gross motor functional measure GMFM was used in each patient and the result showed reduced gait symmetry and motor functions such as setting, standing, walking were affected by ligamentous laxity and hypotonia. Inadequate upper body stabilization was observed during walking strategies (21).

Children with DS experience relative strengths in limitation, social interaction and cognitive deficits. In a study Milojevich and his fellows gave social skill therapy SST to children having DS in order to enhance their recall memory. These children also experience impairment in long term memory thus SST promoted the social interaction, enhanced the cognitive functioning and improved short term memory of these children (22). Fundamental movement skills (FMS) are seen delayed in these children. Capio et al observed impaired movement pattern components in sub-skills caused delayed FMS because balance issues, intellectual impairments and postural deficits were reported in these children, but with training programs for children with low movement proficiencies the limitations can bypass with adoptive mechanisms (10). Motor development is one of the skills that are affected in DS leading to poor postural control and inability to stabilize the position of their joints. However, the motor development of children with DS can be improved using computational skills as reported by Seibra and colleagues in a study. They used computational support in motor ability analysis and as a result they presented three different directions , one of them was the use kinetic-like devices in which visual information was used, second direction was the augmentation of the information in one or more accelerometer working together for example implementation of the applications for real time correction of posture and the third direction being the development of automatic forms of analysis, for example automatic gait classification in which the gait changes were automatically detected. In all three directions the investigator was able to detect changes in motor function (7). DS is associated with intellectual and mental disability along with deficiencies experienced within the physical, motor, and functional domains. As mentioned by Samire Beqaj et al in their research the muscular strength is affected by orthopaedic, neurological, and cognitive impairments in children with DS. These children have reduced fine motor skills and impaired grip strength which affects the performance of daily activities along with problems in attention, communication, interaction, behaviour, safety, play, and skills needed for participation in family and community. (23) These children are characterized by sensorimotor performance deficit and perceptual dysfunction in addition to significant limitation in adaptive behaviour. They are slower at both initiating and executing goal-directed movements including perceptual-motor slowness.

In order to determine evidence-based principles on which effective interventions can be based, research on the development and control of movements in typically developing individuals and individuals diagnosed with DS were compared by Sacks and Buckley (24). This research and a few other research have shown that the proper recognition and investigation of motor problems is integral to intervention programs (25) (26) (27). According to the current literature, in order to analyse and follow the changing pattern of motor abilities, visual observation is necessary (28).

Movement patterns of patients such as sitting to standing, crawling, kneeling, standing with feet together, running, picking objects from floor and others are observed by health professionals. Measuring scales are used by health professionals along with their observations, to score these items. An example of this measuring scale is Gross Motor Function Measure (GMFM) (29, 30). The Gross Motor Function Measure (GMFM), used as an assessment and evaluation tool for Gross Motor Function in children with CP was originally validated by Russel and colleagues. In order to detect changes in Gross Motor Function in children having CP, who are undergoing appropriate interventions, this study (31) by Alotaibi et al suggests that GMFM-88 and GMFM-66 are the most appropriate outcome measures used. The Gross Motor Function Measure (GMFM-88 and GMFM-66) is a tool which is commonly used by health care professionals in order to measure gross motor function in children with CP. The motor development of children having CP closely correlates to the motor development of children having DS; hence GMFM is an effective outcome tool for measuring gross motor function of children diagnosed with DS. Biases can be presented using such scales as human observation can be purely intuitive, nonetheless using these scales can be convenient as they are easy to apply. The 6-minute walk test (6MWT) (32) ,for example measures 4 points i.e., distanced walk, heart rate, blood pressure and perceived exertion. The later aspect might be varied while the former three give an accurate analysis. Another downside of using these scales is their lacking ability to identify and to support detailed and fine motor problems. For identifying and analysing motor problems in individuals, mainly children, research efforts have been made (33) regarding the use of

computational resources to fill the above-mentioned gaps. This study (34) reports the testing of GMFM in children with DS. According to the evidence pf reliability, validity and responsiveness, GMFM is recommended for use when assessing children with DS than the motor scale of BSID-2. A few other examples of these measuring scales are Abnormal Involuntary Movement Scale (AIMS) (35). According to Marieke E van den et al , to facilitate goal-oriented and functional physiotherapeutic interventions the test of basic motor skills was developed, which is used to evaluate and monitor changes in basic motor skills consisting of 15 test items, such as raising legs when supine ,walking and standing up with or without support and rolling from supine to prone or from prone to supine, GMFM on the other hand was designed to evaluate gross motor skills of children with CP consisting of 88 items which are grouped into five dimensions , lying, standing, walking, running, and jumping. The result of this research suggests that both BMS and the GMFM are responsive measures of changes in gross motor skills for children with DS who are 3 years or younger in age and an active participation of parents in interventions has a positive effect on early child development of children with DS (36). According to Pallisano et al the complexity of movement increases with age and children with DS need more time to learn movements. By the age of 6, the motor abilities which are measured by GMFM are not completely achieved, while certain motor abilities are measured at a specific age. The largest changes were seen in infancy, while smaller changes were observed in older children (37).

In comparison with DS, CP is well defined developmental disability with motion restriction and impairment of muscle tone, movement and posture. Children with CP have cognitive, intellectual and motor dysfunction. Research by Fabiana machado mentions the use of interactive games with movement sensor in children having CP. The result of this study showed that, by the use of movement repetition patterns there was a marked increase observed in the GMFM scores and improvement in physical functioning was also seen which has a significant impact on gross motor functions. (38)

To enhance the motor development of individuals with DS research were conducted for development of motor delays using virtual reality. According to the research (39) studying the motor development process in individuals with DS during a virtual reality task to explain the use of virtual reality for intervention programs is of prime importance. This study focused on the analysis of the motor development process in individuals with DS during a virtual reality task. Even though the timings of movement were higher in individuals with DS compared to typically developing individuals, individuals with DS were able to learn movements from virtual reality. Virtual reality specifically helps enhancing motor control, muscle activity, cerebral activity and functional independence by multiple-monopolar anodal transcranial direct current stimulation and sham stimulation over the primary motor cortex (40).

Carrogi- Vianna and his colleagues conducted research (41) which aimed to assess the acceleration characteristics in teenagers having DS relative to typically developing teenagers, while playing bowling and golf videogames on the Nintendo® Wii™. In another research (42) Boleracki and Farkas developed an animal counting video game for young adults with down syndrome, which did not only assist in the development of counting skills for adolescents having down syndrome but also created an environment for all viewers. In addition to this, it helped promoting imagination and motivation in the virtual community. Videogames (Wii games) used by DS children may not only elicit improvement in motor skills but also help them give motor control. Berg and Becker worked to examine outcomes of motor functions following an intervention program of 8 week period with the support of the families of children having DS using Nintendo Wii games (42). As mentioned by Yee-Pay Wuang in a research, in order to assess the effectiveness of virtual reality Wii gaming was used in down syndrome children where the users were made to interact with the environment and scenarios were created, they are made to practice positive sensory feedbacks which could be manipulated systematically and the outcome of the study was improved motor proficiency, visual-integrative abilities, and sensory integrative function with children who used VRWII (43). Neuromotor dysfunction is also common in DS children. Robbin Hickman and his colleagues observed the effect of video gaming in children with neuromotor dysfunction, the result showed improvement in visual perception, motor coordination, postural movement control and sensory and behavioral abilities in these children; however, the study

had some limitations. The sample size was too small and another challenge was the inability of these children to perform their daily living activities independently (44).
However, most research in the international literature suggest that the most commonly used modes of visual aids in the motor development of children having DS were Nintendo Wii videogames and virtual reality techniques. Not sufficient work has been done on the use of other modes of visual aids for motor development of children with DS which can be flashcards, cartoons, animated movies, color and counting games etc.

METHODOLOGY

3.1 Research Design

The study design is comparative cohort.

3.2 Study Duration

The study was conducted in 6 months, from January 2019 till June 2019. For 6 weeks the literature was reviewed through different databases. Questionnaire was developed by from one of the studies and were filled out by investigators while assessing the participants based on their performance. It took 4 weeks to collect the data from March to April. Reporting of the results was inscribed after the data was collected and questionnaires were sorted out. It took eight weeks to write down the research paper and two weeks for the final project report.

3.3 Study Setting

The study was conducted in twin cities and data was collected from five institutes for children with disabilities in Islamabad and Rawalpindi, Pakistan.

3.4 Sample Size

The sample size was calculated using WHO sample size calculator and taking the following parameters: Level of significance – 5% Power – 80% Population mean (Mean GMFM-88 score in Down syndrome children without aid) – 68.15* Population standard deviation – 25 Anticipated mean (Expected GMFM-88 score in DS children with visual aid) – 85 Sample size – 35 in each group

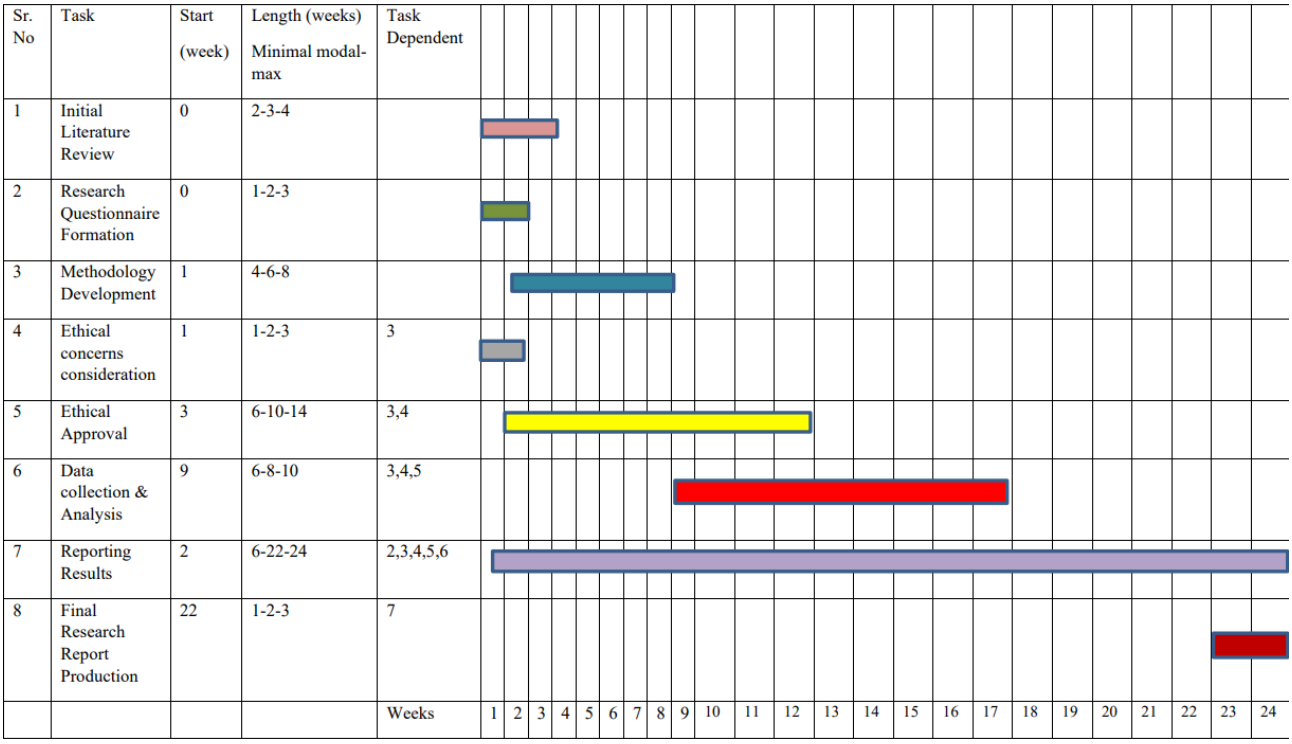

Fig 1.

3.5 Sampling Technique
The sampling technique selected was non-probability, convenient sampling to select participants for the study.

3.6 Sample Selection
Inclusion criteria: The ages of the participants should be between 02-06 years. The participants also needed to be a clinically diagnosed case of Down syndrome.
Exclusion criteria:The age limit should not be exceeded at either end, and the participant should not have any comorbid conditions (such as cardiovascular or musculoskeletal)

3.7 Data Collection Instrument(s):
The Gross Motor and Functional Motor Scale-88 (Gmfm-88) was used to analyze the motor functional status of the participants. Gmfms-88 is comprised of five subgroups that constitute a total of eighty-eight points. The five subgroups include Lying and Rolling, Sitting, Crawling and Kneeling, Standing, Walking/Running/Jumping. The questionnaire was selected carefully using previous literature. Scoring of each participant was based on their performance and ability to follow commands. The use and duration of use of visual aids along with its effect was a major point of question during the course of the study.

Data Collection Procedure:
Written informed consent was obtained from each participant's Parent/guardian. Participants were screened on the basis of inclusion and exclusion criteria. The questionnaire was filled with by an investigator while the participant was being asked to perform various tasks. Data was collected quantitatively. The statistical analysis of data was done using IBM-SPSS version 2.0. Independent T test was applied.

3.8 Ethical Considerations
The study followed the international ethics guidelines and principles of Helsinki declaration. The study was done after getting written consent from individuals. Participant's contact information was accessible to the researchers in order to gain any further information. The confidentiality of the individuals was assured, and all data was only used in the proposed research.

RESULTS
Table 4.1

VARIABLES		**FREQUENCY (%)**
Diagnosed DS		100.0
DS Type		100.0
Age	2-3 years	21.4
	3-6 years	78.6
Gender	Male	52.9
	Female	48.6
Disabilities	Neurological	1.4
	Cognitive	14.3
	Intellectual	35.7
	None	50.0
Use of V.A.	Interactive Games	37.1
	Cartoons	10.0
	Flashcards	2.9

VARIABLES		FREQUENCY (%)
	None	50.0
Duration of V.A.	1 year	35.7
	2 years	14.3
	None	50.0

Table 2.

VARIABLES	Mean ± SD
Diagnosed DS	.000 ± .000
DS Type	.000 ± .000
Age	.7857 ± .41329
Gender	.4714 ± .50279
Disabilities	2.7286 ± 1.41341
Duration of V. A	.6429 ± .72303
Use of V. A	1.7286 ± 1.40312

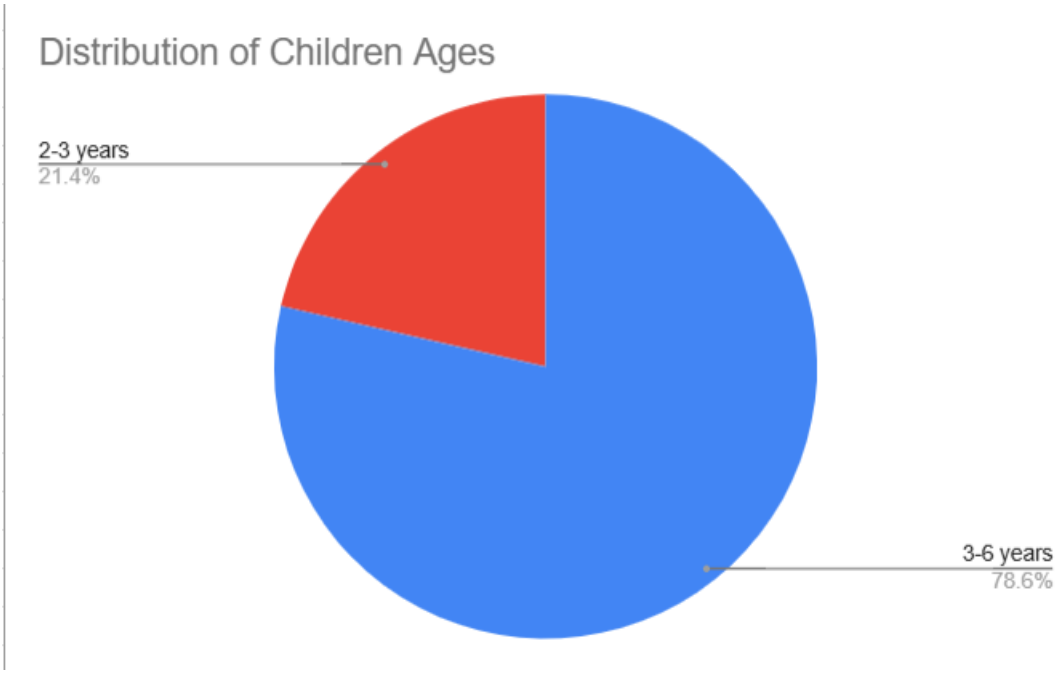

Fig 2.

The minimum age of participants in this study was 2 years, and the maximum age was 6. The participants were divided into further two categories, based on their ages. The frequency of participants falling underage group 2-3 years old was 21.4%, while those falling underage group 3-6 years old being 78.6% as shown in the figure above. A total of (n=70) children participated in this study. The sample comprised of males 52.86% and females 47.4% as shown in this figure below. Majority of these children were enrolled in special education institutes.

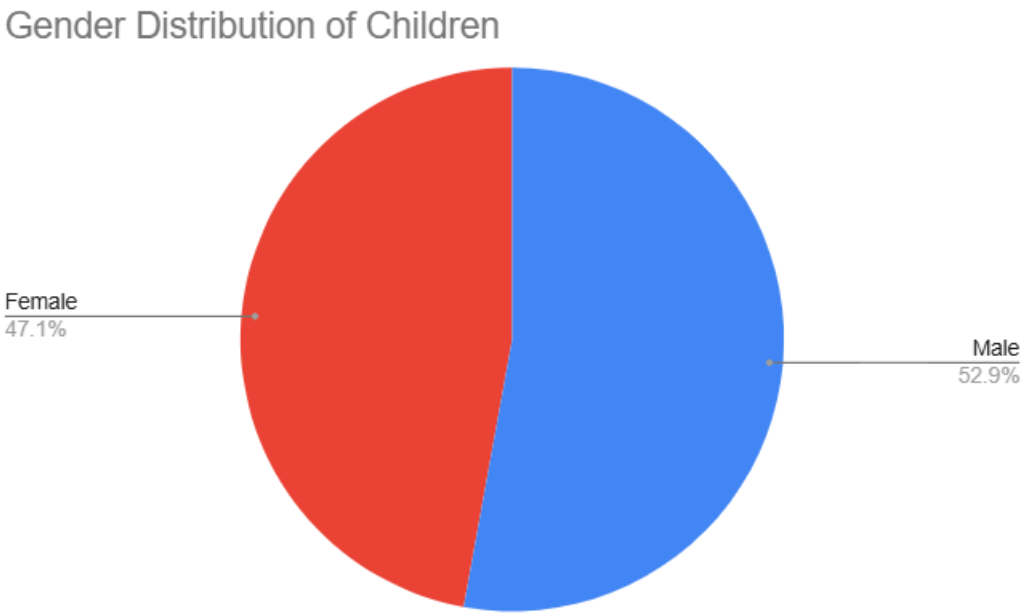

Fig 3.

The children who participated in this study were diagnosed with DS, therefore affected by disabilities associated with this disease. Disabilities were further divided into four categories; neurological disabilities were found among only 1.23% of the population, while cognitive disability in 14.29%, intellectual disability being 35.71% and highest number of participants 48.57% were not affected by any other disability as shown in this figure below.

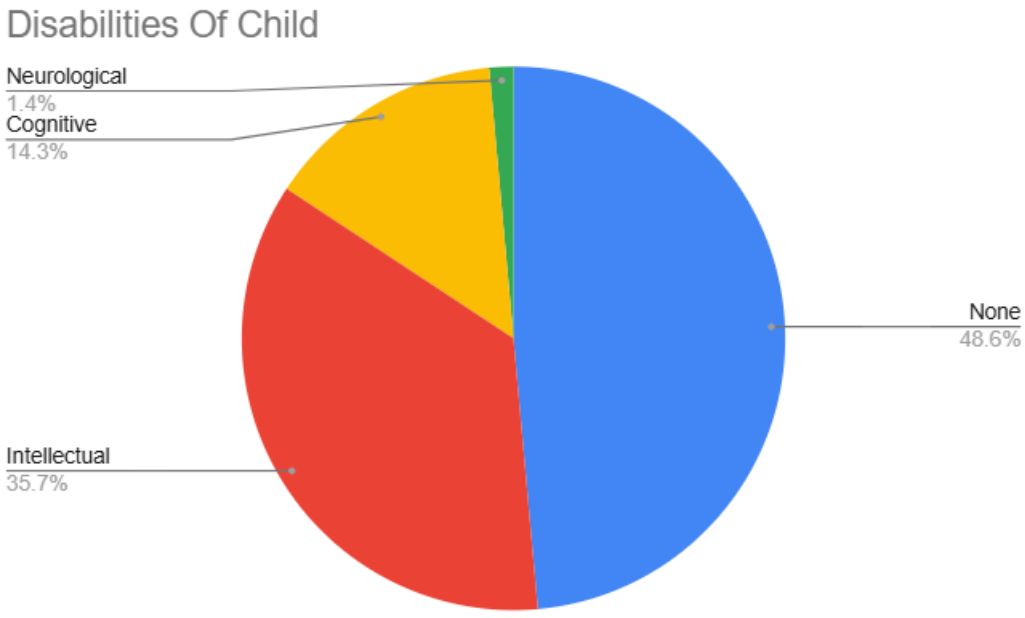

Fig 4.

The total number of participants (n=70) were divided into two categories based on the use of visual aids. One category being the nonexperimental group consisting of 50% of the participants (n=35) used no visual aids, while the experimental group (n=35) used different form of visual aids. Among the different forms of visual aids being used most of the participants with a frequency of 37.14% used interactive games, some children with a frequency of 10% watched cartoons as a source of visual aids. 2.86% of the children used flash cards as shown in this figure.

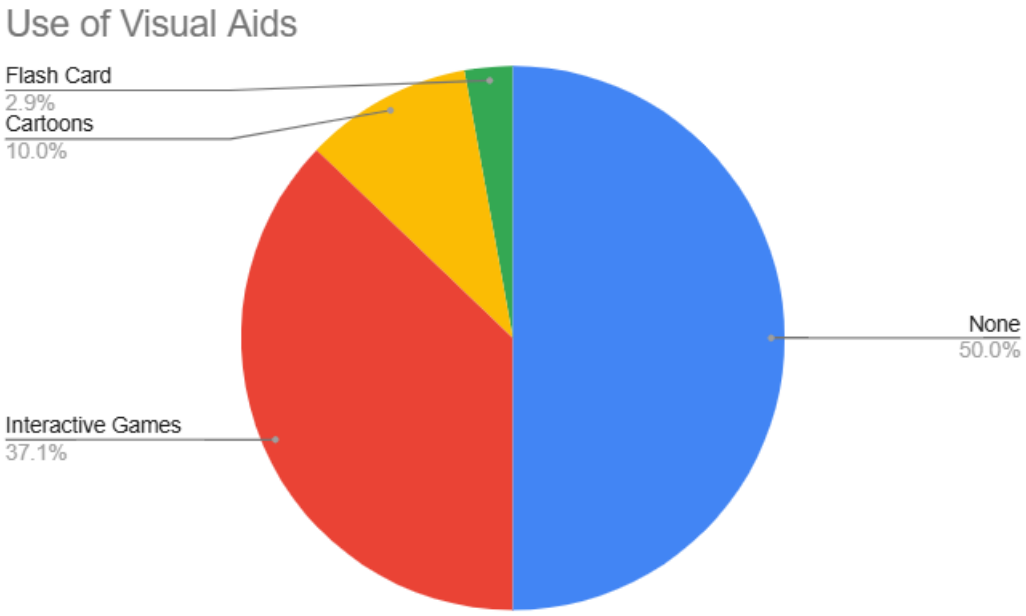

Fig 5.

As mentioned earlier 50% of the participants in this study had no access to visual aids (experimental group), while the other half of the participants were categorized based on the duration of their use of visual aids. As shown in the figure below, 35.71% of participants were using visual aids from 1 year, while 14.29% of the children were using visual aids from the past two years.

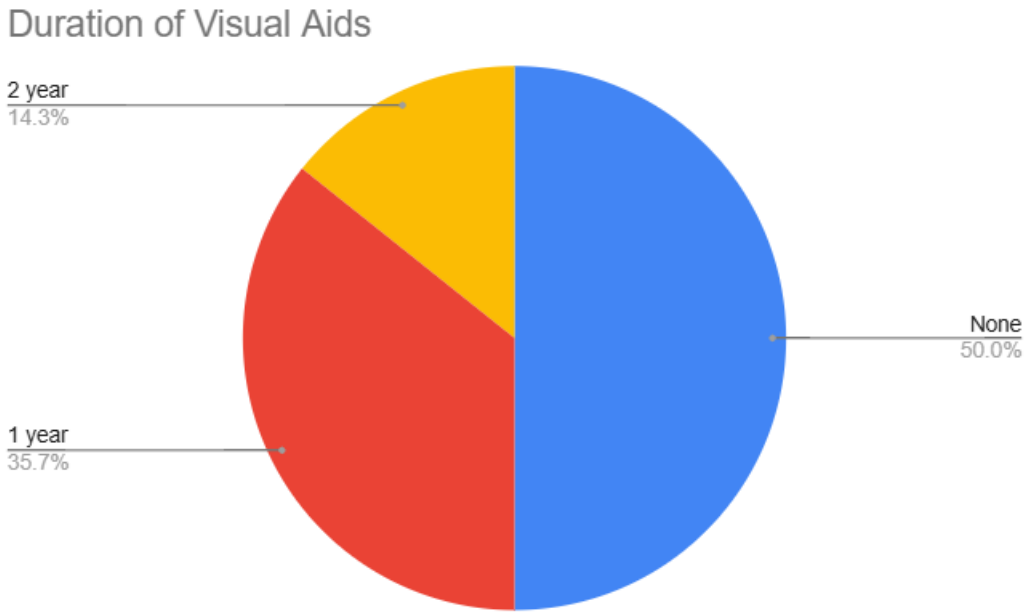

Fig 5.

INFERENTIAL RESULTS

Independent t test was applied to find out the association b/w the use of visual aids and their efficacy on motor development. There is positive correlation between their use and improvements in the functional motor skills of children. Five variables were independently tested and the scores showed that each variable had shown higher results for children who used V.A.

For instance, lying and rolling showed a significance of (0.51) and p value (0.00) which shows that children showed very positive results for the use of V.A. Similarly, the component of running, walking

and jumping showed an even more efficient result with both significance and p value of (0.00). This confirms the hypothesis. The results for the rest of the components can be seen in the table.

Table 3.

VARIABLES	With V.A (Mean ± SD)	Without V.A (Mean ± SD)	P-value (2-tailed)
Lying and Rolling	85.5714 ± 13.4702	54.0229 ± 18.69741	.000
Sitting	86.4371 ± 12.01925	54.8514 ± 18.20561	.000
Crawling and Kneeling	97.0314 ± 11.89253	52.0571 ± 20.77284	.000
Standing	86.4000 ± 10.30913	50.5657 ± 24.64685	.000
Walking, Jumping and Running	84.9343 ± 11.39713	48.2686 ± 21.25096	.000

DISCUSSIONS

The primary objective of our study was to find out the association between the use of visual aids and the effects it has on the motor development of children with DS.

The main findings of our study showed significant differences in the scores of motor development between children who used visual aids from at least one year and those who did not use visual aids at all. In this study the mean score of motor development in the component of lying and rolling for those who used visual aids was 85.57, while the mean score for those who had no access to visual aids was 54.02, which distinctly supports the idea that there is a marked increase in the motor development with incorporation of visual aids in early stages of life. Considering the main findings of our study, Standing and Walking, running and jumping with a p value of (0.00) showed highest significance, which means that these variables were most efficiently affected by the use of visual aids and the children using them were better at performing these tasks. Children that were agitated failed to perform several tasks as efficiently which may have had a slight impact on the study results however majority that used visual aids clearly had a better understanding of verbal commands, better attention spans and lesser fear of avoidance pertaining to tasks that involved higher level of balance and coordination such as standing on one leg and hopping.

In a study, conducted by Beqaj at all in 2017, children with DS were compared to TD children. The children with DS underwent physical therapy sessions once a week and showed an increase in chronological development of skills over time. Development of early skills such as “grasp small object and put them in mouth” (SD ± 1.5) did not show a significant score, while largest values were seen in skills that develop later such as “may run gently” (SD ±15.5). Values for range and variance showed similar patterns as SD. (1)

According to a study by Jooyeon ko et al in the year 2014, difference between younger and older children suffering from CP could be seen when the mean age of participants was considered. Four subgroups were assessed, and the largest effect size was seen in the IV/V that is the scores of younger children with CP indicated large functional change with therapy (SD ± 16.7) than scores of older children. Similar results can also be seen in the present study being performed on DS children. (11)

LIMITATIONS

Some limitations of this study which needed to be addressed are the following.

- There was limited time to complete this project and oftentimes the participants were irritated and were not very cooperative, for which we required their teachers to help us gather our data.
- While collecting our data, the use of visual aids was confined to games and television in these children, as most of them didn’t have access to other types of visual aids.
- Not many parents enrolled their children in special institutes at a very young age due to lack of awareness, therefore

- maintaining an equal ratio of both categories of these children with respect to their age, was not possible, causing a decreased generalizability.
- Due to lack of knowledge and parental attention, the children enrolled in government sector special institutes showed irritability, aggression and unresponsiveness in obeying commands, whereas those enrolled in private sector special institutes were more cooperative and highly responsive due to better facilities.

RECOMMENDATIONS

In spite of some of the limitations mentioned above, the use of visual aids seems to be an effective intervention for the motor development of children with DS. Children should be recommended to use different types of visual aids to enhance their daily life physical activities, moreover the use of V.A also help improving the attention span, balance, coordination and the ability to follow verbal cues. They must be encouraged to use visual aids at an early age with consistency in order to achieve optimal results and improve the quality of life.

In order to assess the efficiency of the use of visual aids further research can be conducted comprising randomized control trials in which two groups can be assessed over a period of time by incorporating visual aids as an intervention program. Different variables such as age, gender, type of visual aid being used and frequency of use that may have an impact on physical functioning and limiting further motor deficits.

CONCLUSION

To conclude, the use of visual aids has a significant impact to upswing the physical functioning of children with DS. Higher levels of independence in physical activity were found among children who had been given visual aids in the form of interactive games and cartoons for at least a year. Furthermore, there is a strong positive correlation between motor development and the use of visual aids in younger people. As hypothesized, the results imply a marked increase in motor functioning with respect to different determinants such as lying, rolling, crawling, sitting, standing, walking, jumping and running. The results suggest that the use of visual aids can be given as a potential intervention regarding the improvement of level of physical activity, motor functioning and limiting progressive motor disability.

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