THE EFFECT OF AN AQUATIC OR LAND-BASED INTERVENTION PROGRAMME ON GROSS MOTOR SKILLS OF SELECTED CHILDREN WITH DOWN SYNDROME

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SUMMARY

Children with Down Syndrome (DS) follow a unique pattern of motor development than neuro-typical children in their early years of development. They find it hard to acquire the movement skills that is expected of them and this leads to a possibility of leading a sedentary lifestyle during adolescence and later in life. According to researchers, an intervention program that focus on improving gross motor skills (GMS) can benefit children with DS tremendously.

The primary aim of the study was to explore the effect of land and aquatic interventions over a 9-week period in children with DS to improve their GMS. The sample of convenience consisted of participants (N=31) between the age range of seven to 16 years, they were selected from four different schools in Somerset-West, Stellenbosch, Bellville and Mitchell's Plain. The mentioned schools immediately showed interest in the study. Two schools participated in the land-based and the other two schools in the aquatic-based intervention program. The Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) was used to assess the children's gross motor skills to determine their strength and weaknesses. The BOT-2 assessed four composites, namely: fine manual control; manual coordination; body coordination; and strength and agility. The pre- and post-tests took two weeks to complete, whereas the aquatic- and land-based interventions were seven weeks long, with two, 40 minute sessions per week. The researcher compared the results of the aquatic and land programs.

It was concluded that the land group's GMS level was higher than the aquatic group at the pre- and post-tests. Both groups improved their overall score with the same amount of points and the researcher could, therefore, speculate that both intervention programs had an influence on their improvement. Both interventions could most likely be implemented at schools with learners that have special learning needs (SLN).

OPSOMMING

Kinders met Down Sindroom (DS) volg ’n unieke motoriese ontwikkelingspatroon tydens hulle ontwikkelingsjare in vergelyking met neuro-tipiese kinders. Kinders met DS vind dit baie moeilik om verwagte motoriesevaardighede teen ’n sekere ouderdom te bemeester, wat tot ’n moontlike sedentêre leefstyl gedurende adolessensie en in die latere lewe kan lei. Die implementering van ’n intervensieprogram wat daarop fokus om kinders se groot motoriese vaardighede (GMV) te verbeter kan volgens navorsers baie voordelig wees.

Die primêre doel van hierdie studie was om te kyk wat die effek van land en water intervensies oor ’n 9-weke periode in kinders met DS sal wees om hulle GMV te verbeter. Die gerieflikheidsteekproef het uit deelnemers (N=31), tussen die ouderdom van sewe tot 16 bestaan, wat vanuit vier verskillende skole in Somerset-Wes, Stellenbosch, Bellville en Mitchell’s Plain geselekteer was. Genoemde skole het dadelik belangstelling in die studie getoon. Twee skole het deelgeneem aan die land-gebaseerde program en die ander twee aan die water-gebaseerde intervensieprogram. Die “Bruininks-Oseretsky Test of Motor Proficiency” (2005) (BOT-2) is gebruik, om die kinders se GMV tydens die studie te assesseer asook om hulle sterk- en swakpunte te bepaal. Die BOT-2 assesseer vier hoofareas: fyn motoriese beheer; fisiese koördinasie (*manual coordination)*; liggaamskoördinasie; en krag en ratsheid. Voor- en na-toetse het elk twee weke geneem om te voltooi, die water- en land-gebaseerde intervensies was sewe weke lank met twee sessies per week, van 40 minute elk. Die navorser het die land en water programme se resultate vergelyk.

Die gevolgtrekking was dat deelnemers in die land groep hoër getoets het met die voor- en na-toetse in hulle groot motoriese ontwikkeling in vergelyking met die water groep. Albei groepe het verbeteringe getoon in hulle algehele telling en daarom kon die navorser spekuleer dat die intervensieprogramme ’n effek gehad het op hulle verbeteringe. Beide intervensies van hierdie studie kan heel moontlik by skole, met spesiale leer behoeftes geïmplementeer word.

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“There needs to be a lot more emphasis on what a child can do instead of what he cannot do” (Dr Temple Grandin).

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LIST OF ABBREVIATIONS

DS	Down Syndrome
BOT-2	Bruininks-Oseretsky Test of Motor Proficiency (2nd edition)
GMS	Gross motor skills
CHD	Congenital heart disease
DNA	Deoxyribonucleic acid
STM	Short term memory
ADI	Atlanto-dental interval
MPV	Metatarsus primus varus
DSM	Diagnostic and statistical manual of mental disorders
ASD	Autism spectrum disorder
ADHD	Attention deficit hyperactivity disorder
IQ	Intelligence quotient
RT	Responsive training
EI	Early intervention
TGMD-2	Test of gross motor development (2nd edition)
SAPIK	South African Professional Institute of Kinderkinetics
WCED	Western Cape Educational Department
IEP	Individualized exercise programmes
LSD	Least significant difference
SD	Standard deviation
EIP	Early intervention programmes
VMI	Visual-motor integration
FMS	Fundamental movement skills

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CHAPTER ONE

PROBLEM STATEMENT

INTRODUCTION

Down Syndrome (DS) is characterized as an intellectual disability and it is one of the most common disabilities around the world with an overall prevalence of 10.4/1000 per births (Li *et al*., 2013:187). Exactly how each individual looks can become quite complex and variable, but there are a few factors that can be observed with the naked eye. Individuals with DS have invariably dermatoglyphic features such as the body shape, hand palms, fingers soles and toes, as well as mildly to severe cognitive impairment (Roper & Reeves, 2006:231). One of the prominent health issues that individuals with DS face, is low levels of physical fitness (Li *et al*., 2013:187).

Physical fitness can be divided into three major types. Firstly, physiological fitness, which refers to the metabolic and bone system. The second type is health-related fitness, which entails body composition, cardiovascular fitness, flexibility, muscular endurance and strength. The last type is skill-related, comprising agility, balance, coordination, power, speed and reaction time (Lotan, 2007:8). Health and skill-related fitness are the two types of fitness that were incorporated in the current study. It has been found that individuals with DS have lower levels of balance and aerobic fitness than those without DS (Dodd & Shields, 2005:2051; Li *et al*., 2013:187).

Individuals with DS tend to be inactive and overweight, which is an aspect that significantly increases across age groups (Pitetti *et al.*, 2013:52). Many children and adults are at a high risk of becoming obese leading to other risk factors such as a limited exercise, poor diet, lower resting metabolic rates, hypotonia (low muscle tone) and hypothyroidism (Dykens *et al*., 2002:490).

Early childhood development is extremely important when it comes to children with DS. Because of the delay in their motor development and hypotonia, parents still want their children to be able to run, jump and skip, and like any other child, children with DS want to play and have fun (Van Cleve & Cohen, 2006:53). Therefore, the development of DS

children's gross motor skills (GMS) is extremely important for their everyday functioning (Pitetti *et al.*, 2013:52). The aim of the current study was to compare the differences between the land and aquatic intervention programs in selected children with DS to improve their GMS. The programs focused on balance, coordination and strength. Both environments potential benefits will be discussed in detail in Chapter 2.

PROBLEM STATEMENT

Numerous studies have shown that children with DS follow a different pattern of gross motor development than neuro-typical children in their early years. Therefore, it has been concluded that the implementation of a quality land-based intervention have enhancing effects on the physical development of children with DS as well as social, emotional and cognitive growth that can lead to long-lasting health benefits for this population. Despite evidence in literature about the benefits of land-based interventions, the proposed study aspired to explore two different intervention environments for selected children with DS.

The main aim of this study was to explore the effect of land and aquatic interventions on GMS of selected children with DS.

The following objectives were investigated to determine:

- The effect of a land and aquatic environment on the following selected motor skills:
  - Fine Motor Precision, Fine Motor Integration, Manual Dexterity, Bilateral Coordination, Balance, Running Speed and Agility, Upper-limb Coordination and Strength of each subject.

Research hypothesis (H1):

A water-based intervention program will improve the GMS of children with DS to a greater extent than a land-based program.

Null hypothesis (Ho):

A water-based intervention program will not improve the GMS of children with DS to a greater extent than a land-based program.

PURPOSE OF THE INVESTIGATION

Children with DS have their own individual challenges in all areas of development such as: language and communication; cognitive, social and emotional; gross and fine motor movements; as well as self-help, and therefore, the development of proficient motor skills is very important and it is a lifelong process in this population (Jobling, 1998:283).

The purpose of this study was to assess selected children's level of GMS with a scientific test-battery, the Bruininks- Oseretsky Test of Motor Profiency (BOT-2). This test has been known to be a valid and reliable assessment for this population. After the assessments, selected GMS that most children with DS struggle with were identified and both intervention programs were planned according to the abilities of the children. The researcher wanted to investigate what the effect of the aquatic and land intervention programs would have on the children with DS, and in which environment they would improve the most. After the interventions, the researcher might be able to determine which environment would be more beneficial for children with DS.

Children with DS's development and environment play a big role in their current development and although the children are more or less the same age, their abilities to execute movements are not the same according to the norms for their chronological age (Dodd & Shields, 2005:2056). Children with disabilities are less active than neuro-typical children and the benefits of regular physical activity for disabled children are tremendous (Fragala-Pinkham *et al*., 2008:822). Therefore, this study aimed to assist children with DS to improve their GMS in order to help them with their daily activities.

IMPORTANCE OF THE STUDY

The development of children with DS's GMS is very important for optimal growth and functioning. One of the characteristics that can be identified with children with DS are the delays in their motor function development (Jobling, 1998:284). Children with DS follow the same pattern of development as neuro-typical children, just at a slower rate. The gross motor development of children with DS are affected by numerous factors such as hypotonia, ligamentous laxity, decreased strength and short arms and legs (Dodd & Shields, 2005:2051). Children with DS generally have problems or deficits in hand-eye coordination, strength, balance, endurance, laterality, speed and visual motor control.

Therefore, the intervention programs focused on strength, balance and coordination (Uyanik & Kayihan, 2010:3).

There are multiple advantages of doing interventions on land and in an aquatic environment that are beneficial for children. Therefore, the current study was set out to determine in which environment the children would improve their GMS the most. This environment can then be recommended for children with DS.

METHODOLOGY

A sample of convenience was used for this study. It was difficult to find participants, and therefore, the researcher had to approach schools that showed interest in the study. The participants (N=31) were selected from 4 different schools in the Western Cape. Two schools were identified as the land group (n=13) and the other two schools formed the aquatic group (n=18). All the children that showed interest and met the inclusion criteria were included in the current study. The participant's ages varied from seven to 16 years old.

The BOT-2 test battery was used to assess the GMS of the children to determine on what level of GMS they were and what their abilities were, as well as to compare the results of the land and aquatic intervention program pre- and post-test. The pre-and post-test took two weeks to complete and each intervention program was seven weeks long. The children participated in two, 40 minute sessions per week. The methodology will be discussed in more depth in Chapter 3.

LIMITATIONS

- The children were very challenging in the group setting and it was difficult to give them individualised attention.
- Due to the group setting it was difficult to ensure that the children completed the activities correctly.
- The children who participated in the aquatic intervention had to get used to the new and unfamiliar environment as the swimming pool was not at their school, whereas the land group did the intervention at the school.
- The GMS of the land group was not on the same level as the aquatic group.

- The children's behaviour, mood swings and concentration could have had a possible effect on the sessions and the results.
- The children fatigued quickly during some sessions.
- Some children got sick during the interventions and missed out on a few sessions.
- Due to a small sample size the results of the interventions cannot be generalised.

STATISTICS ANALYSIS

The statistical analysis of the current study was done with the assistance of the Director of the centre for Statistical Consultation, Professor Martin Kidd, at Stellenbosch University. The participant's tests were scored according to the BOT-2 manual scoring criteria. Mixed model repeated measures ANOVA, was used with the group and time as fixed effects and the participants as random effects. The researcher mostly used the group*time interaction to determine whether there were differences in the measurements over time between the land and aquatic groups. Summary statistics was reported with means and standard deviations and a 5% significance level ($p<0.05$) was used for determining significant effects. The use of Cohen's D effect sizes was also calculated to determine if there was any practical difference between the two groups after the pre- and post-tests.

SUMMARY OF CHAPTERS

Chapter two comprises a literature review on children with DS focusing on associated characteristics such as social-emotional behaviour, physical, cognitive and medical aspects. The GMS, co-morbid factors, as well as land and aquatic interventions, will be discussed. In Chapter three, the methodology of the study, the principles that the intervention programs were based on, as well as what the interventions focused on, were discussed. In Chapter four the results will be discussed. Lastly, Chapter five will be discussed and consists out of the conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

INTRODUCTION

Humans are made up of genes and chromosomes that come together to create a unique individual. Individuals with Down syndrome (DS) have a variety of features that are caused by trisomy, where chromosome 21 is affected (Pitetti *et al.*, 2013:47). Individuals with DS are associated with characteristic flat facial features, a small nose and a flat nasal bridge, eyes that look up and outwards, short fingers, hypotonia, as well as intellectual disability. Hypotonia is a state of low muscle tone and it is one of the main struggles that a child with DS faces, leading to numerous other constrains that influences a child's motor skills (Uyanik & Kayihan, 2010:3, 4).

The development of a child's motor skills, especially balance and coordination, is very important for the overall development of a child with DS. In the article of Wang (2004:33), it is alleged that as soon as a child can crawl, GMS can be taught. This is an extremely important milestone that should take place during the preschool years to prevent that other problems might occur during adolescence and later in life. Movement, the ability to move around, play and partake in activities (Glenn *et al*., 2013:186), is not only a contributing factor to the physical domain, but also to the social, emotional and cognitive development of a child (Wang, 2004:33, 34). Due to the unique development of a child with DS, the influence of hypotonia effects their balance and coordination (Uyanik & Kayihan, 2010:3, 4).

Children with disabilities are less active because they often have less strength, endurance and flexibility, amongst other factors, that limit their movements (Pitetti *et al.*, 2013:52). Therefore, it is necessary for children with DS to participate in physical activities in order to experience the advantages in being active (Shields *et al.*, 2009:308). Participation in physical activities can increase muscle strength, bone density, improve self-esteem and decrease stress and anxiety (Fragala-Pinkham *et al*., 2010:162,163).

Interventions that individuals with DS can adopt to improve their muscular strength, endurance, flexibility, balance, cardiovascular and respiratory efficiency have been implemented by Getz *et al*. (2007:219), Dimitrijević *et al*. (2012:172) and Naučni *et al*. (2012:58).

In this literature review, there will be an in-depth discussion on the nature of DS, as well as the prevalence of DS in South Africa and other countries. The emotional, behavioural, physical, mental, cognitive and medical characteristics of individuals with DS will also be discussed. Thereafter, activities and interventions on land and in an aquatic environment will be explored.

BACKGROUND

In 1838 Esquirol, a psychiatrist, provided the first phenotypical description of trisomy 21. Esquirol did research about the phenotypic differences between intellectual disabilities and psychosis. A decade later in 1848, Seguin developed and established the first training program for children with intellectual disabilities and gave an extended description of trisomy 21 (Sherman *et al*., 2007:221). In 1866, John Langdon Down, a British physician, described the phenotype of children with trisomy 21. He observed that their faces are flat and broad, their cheeks are very round, their eyes are further apart from one another and they have very thick lips (Pitetti *et al.*, 2013:47). Furthermore, he added that they have a large and thick tongue and a small nose, and their bodies give an overall appearance that it is too large. As soon as DS was recognized as a separate entity, it became much easier to identify associated determinants (Sherman *et al*., 2007:221; Megarbane *et al*., 2009:611, 612).

Down (1866) observed that DS arises from parents who had tuberculosis. According to Down, blood circulation and temperature plays a role in the everyday functioning of a child with DS. During summer children with DS may improve tremendously intellectually and regress during the winter. During the 1800's trisomy 21 was labelled as 'mongolism'. In 1961 geneticists started to complain about the term 'mongolism' and it was replaced with Down syndrome, Anomaly or Trisomy 21 Anomaly (Sherman *et al*., 2007:221).

DS occurs when an extra copy of chromosome 21 is present, which is also called trisomy 21 (Pitetti *et al.*, 2013:47). It is currently the most common chromosomal abnormality in humans. The extra chromosome that occurs with trisomy 21 appears in all the cells of individuals with DS. However, in some cases the chromosome only appears in some cells and is labelled as mosaic trisomy, which implies that during cell division one or more of the cell lines lost the 21st chromosome (Mai *et al*., 2013:711, 722).

Through modern technology today, medical doctors can identify DS during the first and second trimester of pregnancy because it is a chromosomal disorder that occurs during conception. Methods that medical doctors use to screen for DS are non-invasive such as

maternal protein serum assessments and ultrasound. With non-invasive screening they use cell free foetal DNA that is collected from the maternal blood. Thus, women can know before birth in order to prepare themselves. However, some people do not want a child with DS and chose to abort (Mai *et al*., 2013:711, 722). In a study that was performed in Cape Town over a 20-year period, the number of DS pregnancies terminated were very small, about 6.1%. In this study, 18.3% of terminations were white pregnancies, 5.8% coloured and 1.4% black pregnancies (Molteno *et al*., 1997:434).

Over 300 genes have been identified with chromosome 21. When genes interact with each other and affect development in important ways it is called overexpression. Specific gene overexpression's might affect the development of a child's brain leading to a cognitive impairment, which can range from mild to severe (Roper & Reeves, 2006:231). With cognitive impairment the most common barriers are expressive language, syntactic processing and verbal working memory. These individuals might be at risk for a number of diseases such as congenital heart disease (CHD), childhood onset of leukaemia and Hirschsprung disease. Hirschsprung disease can be present at birth and is caused by a blockage of the large intestine. It can occur due to poor muscle movements in the bowel (Roper & Reeves, 2006:231). Not all individuals with DS have an extra chromosome 21, birth defects or a medical condition, although it is normally relatively frequent among them. Congenital heart defects occur in about 50% of individuals with DS and digestive abnormalities in about 10% (Silverman, 2007:225, 228).

PREVALENCE

Molteno *et al*. 1997:429 coordinated a study that looked at the recorded birth prevalence of DS at the Groote Schuur Hospital in Cape Town, South Africa. Molteno and his research team investigated whether there was any decline in the birth prevalence of DS over a 20-year period, from 1974 to 1993 (Molteno *et al*., 1997:429, 431). Between 1974 and 1991 the total DS births recorded increased from 20 358 to 33 096. In 1981, the researchers at Groote Schuur reported that there was a higher number of white DS people in Cape Town than coloureds or blacks. In 1974 there was a total of 3 622 white DS births, which decreased to 1 013 in 1993. Between 1974 and 1983 the coloured DS births fluctuated, but from 1983 to 1993 it was steady. There were 2 705 black DS births in 1974 and 13 000 in 1993 (Molteno *et al*., 1997:429, 431).

Over the 20-year period of the study mentioned above, the overall DS prevalence was 1.49 per 1 000 births. However, the prevalence rate differed amongst the different race

groups. In the white population it was 1.88, in the coloured population it was 1.45 and for the black population it was 1.29 per 1 000 births (Molteno *et al*., 1997:431). Furthermore, the study also indicated that mothers over the age of 35 were more prone to give birth to children with DS. The prevalence of babies that were born with DS in mothers older than 35 were as follows: white- 35%; coloured- 52% and black mothers 60%. Birth prevalence for all three race groups during the 20-year period was 1.3 per 1000 births (Molteno *et al*., 1997:431).

Research performed in the United States (US), regarding the prevalence of children with DS born in 2009, estimated that 5 400 infants with DS were born per year. This study was performed across 10 regions in the US and reported a DS prevalence of 8.3 per 10 000 children from 0- to 19-years-old (Shin *et al*., 2009:1566-1568). The study made use of surveillance programs to estimate birth defects in infants. The prevalence increased each year by at least 0.9%, from 1979 to 2003, implying that the prevalence increased from 9.0 to 11.8 per 10 000 live births. The overall prevalence of DS at birth was 5 times more in older women. In 2002 in the US, 1 out of every 971 children between the ages of 0- to 19-years-old had DS. This study was one of the very first studies done on the estimation of DS prevalence among children and adolescents in the US (Shin *et al*., 2009:1566-1568).

Birth defects, such as babies being born with DS or any structural malformations, are becoming more common (González-Agüero *et al.*, 2010:716). This has significant effects on the health and development of the child. This is a public health issue and leads to infant mortality and a possible lifelong disability (Parker *et al*., 2010:1008-1012).

CHARACTERISTICS

Psycho-social and emotional development

Everyday individuals develop on an emotional level and as a person gets older there are certain emotions that exhibit easier and leads to certain behavioural traits and actions. Children with DS do not all have the same personality traits and characteristics, but there are associations that can be made (Dykens *et al*., 2002:489). Children with DS are perceived as being more immature, warm, kind, naïve, honest, cuddly and compliant. Behavioural problems can occur at any age during childhood and adolescents and it can range from mild to severe (Dykens *et al*., 2002:489).

Dykens *et al.* (2002:485) investigated the behavioural traits of children with DS. The participants (N=211) completed a questionnaire regarding their behaviour. Dykens and co-workers concluded that aggressive behaviour was the highest in the 10- to 13-year-old age group and lowest in adolescents (14- to 19-year-old). Aggressive behaviour that was exhibited included being argumentative, demanding attention and swearing, however, physically aggressive acts or fights did not appear often. Stubbornness and disobedience was a very common character trait of children with DS (Dykens *et al*., 2002:485, 489).

Change in behaviour is supported by the longitudinal study of Määttä *et al*. (2006:39). Mental health and adaptive behaviour in individuals (N=129; age > 30) with DS was reviewed in the study of Määttä and co-workers. The study investigated intellectual and behavioural disabilities in men and women between the ages of 29 and 35. The results showed that women had better cognitive abilities than men and severe behavioural problems were more common in men (Määttä *et al*., 2006:42).

In a study by Coe *et al*. (1999:149-153) mothers and teachers reported that 1 out of 3 children with DS have behaviour challenges, with attention problems being the most prominent. Big concerns that teachers reported were that children with DS tend to withdraw socially. They also presented psychotic behaviours, this is when a child exhibits ongoing inappropriate behaviour for more than a month (Coe *et al*., 1999:149-153).

From the literature it seems to be clear that that emotional and behavioural problems play a role in children with DS' everyday tasks. Children are unique and their characteristic traits may differ, but it is important to be vigilant when working with children with DS.

Cognitive development

Cognition is an individual's mental process that includes conscious and unconsciousness processes (Silverman, 2007:228). It is vital to look at the cognitive phenotype of children with DS to gain a better understanding. Children with DS' phenotype can be defined as a number of characteristics that comes from an interaction with its genotype within the environment such as: language development; performance; memory and differences in population. Genotype is a set of genes in the DNA that are responsible for certain traits (Fidler, 2005:88, 89).

The brain is an organ in the human body that constantly develops. There are neural systems in the brain that need to develop in order for the systems to reach a level of maturity at a specific time (Silverman, 2007:228, 229). When an overexpression of genes takes

on chromosome 21, some problems with the development of the brain could arise and this could have an influence on the functioning of an individual. The cognitive profile of an individual with DS could possibly change, as he/she becomes older (Silverman, 2007:228, 229).

According to Silverman (2007:229) individuals with DS have a very distinct and unique cognitive phenotype. When such an individual executes or engages in an activity, it demands a lot from the cognitive system to complete the task. These demands are affected by the structure of the processing system (Silverman, 2007:229). For example, a simple task like nodding the head places no demand on the cognitive system and it is an effortless action. However, a more complex task like riding a bicycle puts more demand on the cognitive system. In this case, the body will need the engagement the cognitive system and more attention will be necessary to execute the task. For a neuro-typical individual, easy tasks would come spontaneous, but for individuals with DS, easy tasks can be very difficult (Silverman, 2007:229-234).

Individuals with DS cannot be compared to an individual with a cognitive impairment. However, there are certain similarities such as deficits in speech, language production and auditory short term memory. Children with DS have difficulties with hearing and speech articulation, especially with their verbal domain, which affects their verbal memory span (Määttä *et al*., 2006:37). They struggle more with verbal materials being presented auditorily than visually. When individuals have mild to moderate intellectual disabilities and better speech, they are able to express their feelings much easier and also in a verbal way, which can be very helpful for communication (Määttä *et al*., 2006:37; Conners *et al*., 2008:245).

Children with DS have extreme limitations with memory span and they struggle to keep their attention and focus. A delay in the cognitive development can affect the short-term memory (STM) of an individual. STM is the ability to keep information for brief periods of time. The ability to use STM, as well as its capacity and efficiency, relates to the cognitive functioning of an individual. Jorm (1983), as cited in Broadley *et al*. (1999:56), allege that a low STM capacity can lead to developmental delays and language disorders. The cause of this delay is not solely that children or adults find it difficult to concentrate, but it comes from the functioning of their memory. Therefore, children with DS need longer periods of time to learn new techniques and strategies for greater improvements to take place. It is very important to begin with early interventions, which will be discussed in greater detail later in this chapter, in order for children to benefit from it. In neuro-typical children their

STM develops tremendously in their childhood years and it increases vastly over a period of time (Broadley *et al*., 1999:56, 61).

Conners *et al*. (2008:246) performed a study with 20 children with DS between the ages of six- to 14-years-old. Their intervention program aimed to see if auditory verbal memory span would improve by doing rehearsal training exercises over a three-month period. They concluded that it is possible to increase children with DS's auditory verbal memory span over a period of time, which could also lead to the improvement of their language and reading skills, as well as their STM (Conners *et al*., 2008:252, 253).

Furthermore, children with DS struggle with language development. Chapman (1997:307) described the different phases of language development. The first phase in the mental stage (0- to two-years-old), is called the sensorimotor period. Children with DS appear near normal in their first year, but from the second year a delay in language development occurs that increases until the fourth year (Chapman, 1997:307). Development of speech sounds are delayed, early accounts of looking, smiling, touching, pointing, laughing, reaching, showing, giving and communicative routines are less likely to be spontaneous. Children with DS do not reach their milestones at the exact same chronological age as neuro-typical children. The emergence of early words can roughly be the same as for neuro-typical children. Mothers or caregivers should teach children with DS to be more effective communicators and to make use of exclusively signed (using their hands) words, which will decrease when they start to speak (Chapman, 1997:307, 308).

The second phase is the pre-operational stage from two- to seven-years-old. According to Chapman (1997:308), expressive language becomes weaker than receptive language from 24-months old. Receptive language is the ability to understand or comprehend language that is heard or read. It is important for children to be able to learn novel words for nameless objects. All children must be able to 'fast map' the names of novel objects and be able to generalize them. Through repetition this would become easier for children (Chapman, 1997:308; Fidler, 2005:90).

Now that there is an understanding of children with DS's cognitive function and its effects on their language development and the execution of daily tasks, it is also important to be informed about the medical aspects of children with DS, especially when a person work with them on a daily basis.

Medical development

A child with DS needs more medical attention than a neuro-typical child, and therefore, it is very important that parents plan for health and medical services. Extra health care expenditures might arise from operations and hospital costs (Boulet *et al*., 2008:241; Pitetti *et al.*, 2013:48). Medical care does not stop at a certain age; it goes on for a lifetime. Health care costs have increased since the 1980's due to all the different types of therapies children can receive to improve their lifestyle (Molteno *et al*., 1997:428; Boulet *et al*., 2008:241-244).

There are various co-morbid factors that surround children with DS, such as premature mortality. A baby with DS might have a very low birth weight and a 24 times higher risk of dying compared to a normal birth weight. If babies with DS survive the neonatal period, there is still an increased risk for death before the age of one (Kucik *et al*., 2013:27). However, in the US the lifespan of an individual with DS has improved over recent years. A low birth weight, heart defects and ethnicity are factors that are associated with an increased risk of mortality among babies with DS. Recent studies have indicated that the life expectancy of individuals with DS is now estimated at between 50 and 60 years of age (González-Agüero *et al.*, 2010:716; Kucik *et al*., 2013:27-31). Technology has improved rapidly over the past years and there are numerous new technological developments in medicine, especially in cardiac anomalies to lengthen the life expectancy of individuals with DS. A survey in the US that was performed in 1983 indicated a life expectancy of 25 years, which increased to 49 years in 1997. This might be different in other countries (Mik *et al*., 2008:30). A more recent study done by Pitetti *et al.* (2013:48) stated that the survival for individuals with DS have significantly increased over the past decades to a life expectancy of 60 years old due to all the medical and social development (Pitetti *et al.*, 2013:49).

A study performed by Boulet *et al*. (2008:241) concluded that 75% of infants with DS visits a hospital/clinic at least once a year. This implies that their average visits are three to four times higher than neuro-typical children. Drug claims of children with DS are two to three times higher than those of neuro-typical children. Children with DS need medical assistance from an early onset and regular check-ups to make sure that they are reaching their milestones. Medical assistance is necessary with all children, however, children with DS need a multidisciplinary approach across their lifespan. The medical team for an individual with DS includes specialists such as a clinical geneticist, developmental paediatrician,

cardiologist, ophthalmologist, neurosurgeon, orthopaedic surgeon, psychiatrist, physical and occupational therapists, speech-language pathologist, audiologist and a Kinderkinetcist. All of these specialists play different roles as the child with DS goes through different developmental phases (Boulet *et al*., 2008:241-244).

A study by Schieve *et al*. (2011:68), assessed the functional and health status of children with DS from 2005 to 2006. The researchers made use of data from the National Survey of Children with Special Heath Care Needs (NS-CSHCN) in the US. They concluded that children with DS were less likely to have difficulty with breathing/respiration, asthma or allergies and more likely to have problems with swallowing, digestion and metabolism than children that have mental retardation (González-Agüero *et al.*, 2010:716). Due to the unique anatomic features and differences that children with DS possess, they might have problems with hearing loss, chronic middle ear infection, obstructive sleep apnoea and they might have tooth problems. All of these aspects needs attention throughout their lifespan (Schieve *et al*., 2011:68-76).

When it comes to cardiovascular risk factors there is a variety of elements that have a significant effect on all individuals (Pitetti *et al.*, 2013:48). However, individuals with DS have a very unique account of their cardiovascular risk factors. Typical risk factors associated with any individual with DS includes body-mass index, blood pressure, cholesterol, hypertension, insulin resistance and obesity (Draheim, 2006:8). Individuals with DS have very low blood pressure and endocrine abnormalities that lead to cardiovascular diseases. They are also more prone to myocardial infarction or strokes and they develop high levels of body fat, which increases with age (Draheim, 2006:8, 9). According to Berenson *et al*. (1998:1655) it is vital to implement interventions from as early as possible to encourage individuals with DS to take part in physical activities and follow a healthy diet to prevent atherosclerosis (Berenson *et al*., 1998:1655).

However, it is financially demanding for parents and caretakers and not everyone has access to the necessary resources. It is vital to provide the necessary health care for children and adults with DS that have complex conditions. As children with DS get older and move into the adolescent phase, it does not mean that they will have less health problems or that parents do not have to take them for regular medical check-ups. Parents must still be alert and aware of their children's health condition (Van Susan *et al*., 2006:202).

Physical development

Children with DS do not all look the same, but there are classical physical features that are recognizable (Pitetti *et al.*, 2013:47). These are facial appearance, hand abnormalities, hypotonia, short stature, joint hypermobility and ligamentous laxity (Korenberg *et al*., 1994:4997). Children with DS struggle with the following: communication skills; self-care; and gross and fine motor skills. Researchers also found that children and adolescents with DS are more prone to obesity and their prevalence rate for obesity is twice the rate of individuals with an intellectual disability (Rubin *et al*., 1998:176; Pitetti *et al*., 2013:51). The low levels of physical activity in children with DS may increase their prevalence of being overweight and obese (González-Agüero *et al.*, 2010:717).

Hypotonia is known as low muscle tone and involves reduced strength in the muscles (Uyanik & Kayihan, 2010:3, 4). Hypotonia is a feedback mechanism, which helps the body to get a perception and a place in space and it helps to control the voluntary muscles of the body, posture and quality of movements. Low muscle tone has an effect on an individual's balance and coordination (Uyanik & Kayihan, 2010:3, 4).

Most orthopaedic problems that individuals with DS face, comes from low muscle tone and joint laxity. Collagen is a protein that builds and makes up the ligaments, tendons, cartilage and bone in the body. The genes that encode for type VI collagen are called COL6A1 and COL6A2, and they are found on chromosome 21. These genes are responsible for joint laxity. Collagen creates laxity in the whole body and this affects bones and muscles and leads to the development of orthopaedic conditions (Mik *et al*., 2008:30).

Musculoskeletal conditions that might occur are: cervical spine instability; scoliosis; hip disorders; and patellar instability. Approximately 10 to 15% of individuals with DS have upper cervical spine instability, which is a very big concern (Cohen, 2006:146). If this is not diagnosed early enough, it can lead to lifelong spinal-cord damage. The instability of the cervical spine can occur at the atlanto-axial or occipito-cervical joint. The atlanto-axial joint has a transverse ligament that causes abnormal motion between the segments and this leads to instability. On the other hand, the occipito-cervical joint at the atlas makes a cup-shaped articular surface and this is where ligamentous laxity occurs (Cohen, 2006:146).

The atlanto-dental interval (ADI) is the horizontal distance between the anterior arch of the atlas and the axis. In neuro-typical children over eight-years-old, the ADI should be three millimetres or less, and in younger children the ADI should be four millimetres or

less. In the case of children with DS, the ADI are in some cases greater than four millimetres. In the US, it has been reported that 10 to 30% of individuals with DS have atlanto-axial instability (Mik *et al*., 2008:31). Atlanto-axial instability has a few symptoms that can occur: children might have decreased motor skills; a gait disorder; or any form of progressive paralysis (González-Agüero *et al.*, 2010:716). Normally, the first motor symptoms would be discovered in the legs, which can lead to spasticity. Having atlanto-axial instability, it is necessary to make a few adaptions such as: avoid contact sport; diving; gymnastics; and any form of over manipulation, flexion and extension of the neck. If the person is unaware of any atlanto-axial instability it is better to avoid any exercises or activities where the neck can get in direct contact with the ground or over manipulation (Elliott *et al*., 1988:1484, 1485; Mik *et al*., 2008:31).

Scoliosis can occur in individuals with DS. This occurs when the spine develops abnormally rotated and curved sideways. Scoliosis can normally be seen on an X-ray where there is at least a 10-degree deviation of the curve (Milbrandt and Johnston, 2005:2053). A 10-degree deviation would not necessarily show signs and symptoms, but from 20 degrees an individual would notice abnormalities. Milbrandt and Johnston (2005:2053) looked at the records of patients with scoliosis over a period of 50 years. They concluded that 50% of the individuals diagnosed with scoliosis had to undergo cardiac surgery. If the individual had cardiac surgery as a three-year-old, scoliosis would again be present at the age of 10 years. Thus, children that underwent surgery at a very young age are more prone to get scoliosis at a very young age and they need to be carefully monitored to ensure that they do not develop scoliosis (Milbrandt & Johnston, 2005:2053, 2054).

It is quite common for individuals with DS to have hip problems and normally the dislocation or dysplasia of the hip occurs. Hip problems can be related to low muscle tone and they normally present symptoms like hip pain, poor gait or a limp that would occur between two- and 10-years-old (Mik *et al*., 2008:32). Patello-femoral instability is one of the orthopaedic conditions that might arise. The laxity of the connective tissues and hypotonia of the muscles restrain the patella and this leads to subluxation or dislocation. Patello-femoral instability is normally not something that would give a person trouble in the initial stage, but if it happens quite often and is not attended to, it will lead to a decreased range of motion of the knee (Mik *et al*., 2008:32-35).

Some individuals might have foot disorders such as metatarsus primus varus (MPV) that can be described as a foot deformity, and pes planus (flatfoot) on a mild to severe form (González-Agüero *et al.*, 2010:716). When an individual has severe MPV he/she might

struggle with shoe fitting and severe bunions and calluses. Pes planus is due to ligamentous laxity and shoe modifications or inserts will be necessary (Mik *et al*., 2008:32-35; González-Agüero *et al.*, 2010:716).

It is quite common for children with DS to have flat feet due to laxity. Decaro (2012:142) reported that 88% of children with DS have flat feet. It is important that this problem gets screened as early as possible. Under the age of three years' old there is a possibility for flat feet to go away and there are ways to assist children (Decaro, 2012:142). Feet are the foundation of the body and can lead to other foundational destructions such as having difficulty to walk or balance and unsteadiness. Flat feet occur when a person has the inability of the heel bone to come out of eversion. This leads to the arch, ankle and the rest of the body to be dragged down and this is why children with DS struggle to maintain good strength when they sit and stand (Decaro, 2012:142).

GROSS MOTOR SKILLS

The development of a child's gross motor skills (GMS) begins at birth and develops as the child gets older. GMS are movements that involves the large muscles of the body. It is necessary for children to develop their GMS because these skills are used to engage in physical activities, to play and perform everyday activities (Balic *et al.*, 2000:310). Examples of GMS are running, jumping, throwing and catching. It is advised that children partake in physical activities at least 120 minutes per day, where 60 minutes consist of structured activities and 60 minutes of free play. Children with well-developed GMS tend to be more physically active than children with less developed GMS. Therefore, it is important that children with DS strife to develop their GMS to improve their functioning (Williams *et al*., 2008:1421). It is suggested that physical activity could potentially improve and enhance the quality life on an individual with DS (González-Agüero *et al.*, 2010:717).

Looking at the holistic development of a child with DS, the milestones are slightly delayed in comparison with a neuro-typical child (Pitetti *et al.*, 2013:52). Their motor milestones are possibly delayed because of laxity ligaments in their joints, decreased strength and hypotonia. Children with DS have postural problems, which leads to poor posture and balance problems, which has an effect on a child's stability. In a study by Shumway-Cook and Woollacott (1985), cited in Jobling (1998:290), it was found that balance problems can also relate to the presence of the monosynaptic reflex during the first 12 months after birth and not necessarily hypotonia. In the same study the researchers observed that as

children with DS get older, they struggle with hand-eye coordination, laterality and visual-motor control (Connolly *et al*., 1993:171).

The development of proficient motor skills is very important and it involves simple movements such as: moving around; standing; reaching; and manipulating objects (Jobling, 1998:283). The delay of motor development can have an influence on a child with DS' educational and recreational setting, leading to a big impact on their ability to become self-assured and independent. It is known that children with DS have many obstacles such as health, anatomical and perceptual characteristics that may handicap their motor development (Jobling, 1998:283, 284).

All areas of development are equally important. The first few months after birth are crucial because this is where physical development sets the underlying foundation for future progress (Pitetti *et al.*, 2013:52). A baby learns through the environment and the interaction that they have with those around them. Babies must have the ability to move around freely and purposefully, touching and grasping objects, turning their heads, following a toy, rolling over and starting to crawl. Being able to do all of the above-mentioned, the baby needs to rely on his or her gross and fine motor skills development (Lotan, 2007:9, 10).

Children with DS follow the same pattern of development as neuro-typcial children, just at a slower rate. From birth to six months the motor skills of a child with DS will develop very much the same as a neuro-typical child. At 12 months some changes or delays might be observed. Their development can be four to five months behind that of a neuro-typical child. It is important for parents to be aware that children with DS develop much slower. At the age of five, it is possible that a child with DS' motor skill development can be two years behind (Connolly & Michael, 1986:344, 345).

Looking in more detail at the milestone development of children with DS, walking is one of the primarily milestones that is delayed (Pitetti *et al.*, 2013:52). Children with DS begin to walk as early as 15 months and as late as 74 months. Researchers also looked at the mean age for children with DS to roll over, sit, and crawl on hands and knees. The reported average age for rolling over is between five to 6.4 months, sitting between 8.5 to 11.7 months and crawling between 12.2 to 17.3 months (Palisano *et al*., 2001:494).

Children with DS have a few deficits when it comes to the GMS development. They tend to struggle with hand-eye coordination, laterality, visual motor control and reaction time. They have poor balance and this has an effect on a variety of conditions/deficits. These

include poor muscle tone, awkwardness in movements, flabby hands and short fingers. All of these aspects have a very big influence on their lifestyle and their daily movements. These deficits are also a reason why their motor skill development are delayed (Connolly & Michael, 1986:345).

GMS also includes fundamental movement skills (FMS), for example, throwing, catching and kicking. It is important for a child to develop and master FMS as they are the building blocks for sport specific skills and this is necessary if children want to partake in sport (Schott *et al*., 2014:3300). Children with DS who participated in a hippotherapy intervention improved their fundamental GMS (Champagne & Dugas, 2010:564). Cremers *et al*. (1993:514) assessed children with DS with atlanto-axial instability and without, while playing sport. They found that there was no effect on the increased atlanto-axial distance in the children and there was no reason to stop children from partaking in certain sports and activities with their peers. For children with DS to be able to partake in sport they need to develop their FMS because this would promote their physical activeness and improve their health (Cremers *et al*., 1993:514). The study of Pitetti *et al.* (2013:54) suggested that motor skill development may possibly improve long term physical activity in children with DS (Pitetti *et al.*, 2013:54).

A study was done by Boer (2010:105) to investigate the functional fitness capacity of adults with DS in South Africa by determining their balance, coordination, flexibility, muscular strength and endurance, agility and cardiovascular endurance. These are similar factors that the current study's interventions focused on. During the study, Boer evaluated 371 adults with DS with four different test batteries, the BOT-2 being one of them. Boer concluded that because of all the health problems, individuals with DS are born with, they tend to lead a sedentary lifestyle. Therefore, the establishment of functional activities and programs can be an advantage for individuals with DS (Balic *et al.*, 2000:319; Boer, 2010:105).

CO-MORBID CONDITIONS

Mental health and behavioural problems such as attention deficit hyperactivity disorder, obsessive-compulsive disorder, self-injurious behaviour, depression, Alzheimer's disease and signs of later-onset dementia affect a large portion of individuals with DS (Määttä *et al*., 2006:37). Furthermore, depression in an individual with DS is rarely verbalized and commonly seen as crying, depressed appearance and emotional dysregulation. Depression has been mainly recognised in individuals with DS with mild to moderate

intellectual disabilities. Individuals with DS that have better cognitive abilities might be living with less support and experience less stress (Kent *et al.*, 1999:153; Määttä *et al*., 2006:37, 41, 42).

By observing all of the above-mentioned emotional and behavioural problems, it was thought many years ago that children with DS exhibited autistic behaviours because of some correlating factors. Until recently it was commonly believed that the two conditions, namely DS and Autism Spectrum Disorder (ASD), could not exist together (Ghosh *et al*., 2008:685). A study that was done by the World Health Organization (WHO) in 1993 reported that some of the participants with DS met the full DSM-criteria (*Diagnostic and Statistical Manual of Mental Disorders)* for ASD. The DSM criteria was designed for clinicians, patients, families and researchers to have a clear understanding of each mental disorder, as well as what it exactly entails (APA, 2013:5).

The commonly described areas of concern for children with DS is qualitative impairment in social skills, communication skills and restricted repetitive and stereotyped patterns of behaviours, interest and activities. There are a few differences between children with DS and ASD. Children with DS have physical features that ASD children do not have (Ghosh *et al*., 2008:686). Children with DS find it easier to interact with people on a social level and mix very easily with other children. They take interested in their surroundings. ASD children lack some interactive playing. A delay in language development is seen in both groups, however, children with DS can develop some form of communication and follow instructions. Ghosh *et al*. (2008:686) concluded that ASD is overlooked or considered inappropriate for a child with DS because of cognitive impairment. On the basis of their findings Ghosh and co-workers were able to conclude that not all children with DS are good natured, sociable and outgoing, but have an additional diagnosis of ASD (Kent *et al.*, 1999:153; *Ghosh et al*., 2008:686, 687).

As mentioned previously, individuals with a developmental disability struggle with things such as: coping in an environment; cognitive abilities; communication skills; and adaptive abilities. Their environment and genetic factors also play a role. It is difficult for them to concentrate, especially children that are very hyperactive. They also have impulsive behaviours. This leads to a question, can a child with DS be diagnosed with ADHD (Ekstein *et al*., 2011:1290)?

The prevalence of ADHD with DS among children aged five to 16 years was 43.9% according to the DSM-IV-TR criteria of 2011 (Ekstein *et al*., 2011:1293). According to Polanczyk and Rohde (2007:387), the prevalence of ADHD amongst neuro-typical developing children is about 5.29% and with adults it is 4.4%. A National Health Interview Survey was done in the US between 2011 and 2013 and the researchers concluded that 9.5% of children between four- to 17-years-old have been diagnosed with ADHD. The symptoms of ADHD should be at a place where it is inconsistent on a developmental level and do not occur exclusively during the course of other mental disorders such as mood, anxiety, dissociative or personality disorders. Looking more at the cognitive side of children with DS, they have different degrees of mental impairment, ranging from mild (IQ: 50 to 70), moderate (IQ: 35 to 50) and occasionally to severe (IQ: 20 to 35) (Polanczyk & Rohde, 2007:387). Medical problems that children with DS have can impair their attention and behaviour. One specific aspect regarding the medical conditions are the sensory deficits. A person's lateral pre-frontal cortex plays a vital role in vision, auditory and somatosensory cortices and this helps with directing attention and responses to specific tasks. Abnormalities in the sensorimotor region of the brain can be associated with ADHD. Children with DS are at an increased risk for ADHD, with a prevalence as high as 43.9% (Polanczyk & Rohde, 2007:387; Ekstein *et al*., 2011:1293).

EARLY INTERVENTION

Early intervention (EI) is extremely important for a child with DS (Pitetti *et al.*, 2013:52). A program called Responsive Teaching (RT) was designed by Mahoney and MacDonald (2006:18) to help and assist parents or caregivers who spend long periods of time playing and interacting with children with DS. This program can be implemented in any type of environment. RT helps to make the most of the time spent with the child, as well as to maximize the potential of each routine interaction and to support and enhance children's development and wellbeing (Mahoney *et al*., 2006:19). RT promotes three developmental areas, namely: cognition; communication; and social-emotional functioning. Cognition is necessary for a child to be able to think, learn new things, solve problems and build relationships. Communication is necessary so that one can respond and express feelings in a non-verbal, symbolic or verbal way. And finally, there is social-emotional functioning. Children need to be able to engage with their families and friends and they also need to be able to comply with reasonable rules and expectations (Mahoney *et al*., 2006:19; Karaaslan & Mahoney, 2015:287).

In RT programs, parents or caregivers encourages children to develop their pivotal behaviours. Pivotal behaviours are the foundation for developmental learning such as: social skills; social play and initiation of activities; problem solving skills; trust; and cooperation (Ingersoll & Dvortcsak, 2006:81; Mahoney *et al*., 2006:18).

RT uses strategies so that parents or caregivers can base their actions on 'active learning'. This strategy enables individuals to engage with a child in a responsive interaction before there is a specific routine. When parents or caregivers begin to use these strategies, they get to see how responsiveness has an impact on the child's reactions, engagement and participation (Mahoney *et al*., 2006:21). The ideal is for a parent to implement RT strategies on a spontaneous level. RT interventions can take place in individual settings or in group settings depending on the needs. Each session focusses on one or two pivotal behaviours depending on the needs of the child. The sessions do not need to have a fixed sequence (Mahoney *et al*., 2006:21, 22; Karaaslan & Mahoney, 2015:296).

Currently there is no other developmental intervention that addresses all three of the developmental domains, namely: cognition; physical; and social-emotional. Parents always request what they can do at home to help or how to support and enhance the development of their child (Mahoney *et al*., 2006:26, 27).

EI can be of great benefit for the child and the parents. Early intervention programs (EIP) focus on the child's stimulation of developmental skills, as well as the interaction between the child and the parents. It sets a very good foundation and have long lasting results (Connolly *et al*., 1993:171; Lotan, 2007:10).

INTERVENTIONS

Various characteristics of individuals with DS will have an impact on training interventions and a specific training environment. The following sections will have a look at the advantages of physical activities on land and in aquatic environments, as well as previous interventions. Advantages of physical activities of both land and aquatic based environments will be discussed. It will be followed by a discussion of various other interventions.

Land and aquatic advantages

Children with disabilities are less active than children without disabilities. They often have decreased strength, endurance and flexibility because of their disability or others factor that limits their movements (Fragala-Pinkham *et al*., 2010:162, 163).

It is important in today's era to ensure that children are physically active and fit. Advantages in doing physical activities for children includes: increased muscle strength and bone density, and improvement in self-esteem (Shields *et al*., 2009:308; Pitetti *et al.*, 2013:51). They also tend to have less stress and anxiety. Recommendations for the health promotion of children is at least 60 minutes of moderate to vigorous physical activity, it does not need to be continuous, it can be performed in intervals on most days of the week (Janssen & LeBlanc, 2010:12, 13; Pitetti *et al.*, 2013:51). Another recommendation is that the activities need to be fun and interesting for children (Fragala-Pinkham *et al*., 2010:162).

Children mostly perform their physical activities in a land-based environment as it is quick and easy for teachers and mothers to present and oversee, because it can be done at school or at home in a safe environment (Fragala-Pinkham *et al*., 2010:162). However, most children partake in land-based physical activities, the current study explored the possibility to determine whether an aquatic intervention, with its advantages, will have an enhancing effect on the GMS of children with DS.

However, there is a vast number of ways how a child with DS can be assisted with their GMS for them to learn, grow and reach their full potential. Water is a therapeutic environment in which individuals with DS can exercise. There is something unique about an aquatic environment that almost every child enjoys. Not only does a child's body move through the water and get wet, but the child is also playing and having fun. According to Hutzler *et al*. (1998:218), aquatic activities are beneficial for children with motor deficiencies and the positive characteristics of water are buoyancy, hydrostatic pressure, viscosity, muscle strengthening and improvement of gross motor function (Getz *et al*., 2007:218).

During physical fitness, cardiorespiratory endurance is used and children with DS have limited cardiorespiratory endurance, which limits them to participate in sport and physical activities and this puts them at risk for secondary health problems. Exercises in an aquatic environment can possibly be more beneficial than land-based exercises to improve cardiorespiratory endurance and strength, because there is more resistance in the water and more protection for the joints. Aquatic exercise is a form of low-impact exercise where joint loading forces are less in comparison with land-based exercises. Water provides resistance that increases muscle strength and aerobic capacity (Fragala-Pinkham *et al*.,

2008:822). In an aquatic environment a person's motor skills can potentially develop better and it also increases confidence (Gorter & Currie, 2011:1). Doing physical activities can possible improve health in individuals with DS (Pitetti *et al.*, 2013:51).

The physiological effects of aquatic therapy can be classified into two categories namely: thermal; and mechanical effects. The mechanical effects would include hydrostatic pressure, hydrodynamic force and buoyancy. The reason why children find it easier to do activities in water is because of the buoyancy that decreases the effect of gravity (Lai *et al*., 2014:200). Thermal effects are a wonderful aspect that increases soft-tissue elasticity and children do not experience much pain. Doing exercises with children in an aquatic environment reduces the influence of gravity, joint loading and impact, improves postural support, aerobic and muscular strength. This is the reason why it is a desirable environment (Lai *et al*., 2014:200, 201).

The aquatic environment creates a medium where individuals of any age can take part in recreational and therapeutic activities by having fun. There are also psycho-social benefits of an aquatic program that help individuals with their well-being (Naučni *et al*., 2012:53). Through doing aquatic exercises or swimming, children can partake in vigorous physical activities in a fun environment. When children do the exercises in a group it might also increase their socialisation and self-confidence (Fragala-Pinkham *et al*., 2010:162, 163).

The focus will now be on land and aquatic interventions that are beneficial for individuals with DS and that could possibly enhance their GMS.

Land intervention

The first and biggest milestone for a baby to reach, is being able to walk. The study of Bjornhage *et al*. (1990:163), cited in Lotan (2007:10) included an experimental group of 14 children with DS and a control group of six children with DS. The program began when the babies with DS were three months old and went on until they were all able to walk. During the study they focused on the ability to increase low muscle tone, to reduce incorrect patterns of movement and to stimulate trunk rotation. At the end, the children with DS in the experimental group improved more in four areas than the control group, namely: gross and fine motor skills; kinaesthetic; and tactile perception (Lotan, 2007:10). Children with DS develop their milestones later and walking has been found to develop much later

than with neuro-typical children. Lotan (2007:10) developed a special program on a treadmill for infants between eight to 11 months to improve walking. It was concluded that a treadmill training program could improve walking of children with DS (Lotan, 2007:10).

A study performed by Connolly *et al*. (1993:3311) on children with DS and neuro-typical children between seven- to 11-years-old, the researchers used the BOTMP (Bruininks-Oseretsky Test of Motor Proficiency), to assess the children. The results indicated that children with DS had significantly lower scores in running speed, balance, strength and visual motor control. Henderson *et al*. (1981:416), cited in Connolly *et al*. (1993:3311), studied children with DS between the ages of seven- to 14-years-old and found that they scored very low on agility and balance tasks. Looking at the same age category, Shea *et al*. (1991), cited in Jobling (1998:289), performed a study by using the Peabody Developmental Motor Scales on children with DS and found that static balance was the greatest difficulty for these children (Jobling, 1998:289).

Furthermore, Jobling (1998:289) addressed parameters of the motor development of children with DS. The participants in the study were between 10- to 16-years-old. The study revealed that children with DS continued to develop their motor skills, but certain children progressed much slower than others. It does not matter what age a child is, he/she can still continue to partake in physical activities and see improvement. Jobling and Connolly also used the BOTMP to assess the children and found that their balance was consistently low for their chronological age and showed the least progress. These results showed that Connolly *et al*. (1993:175), Henderson *et al*. (1981:416), cited in Connolly *et al*. (1993:3311), and Jobling (1998:285) came to the same conclusion about the low balance scores of children with DS. Jobling (1998:289) purports that balance is a complex activity that involves the integration of perceptual and motor systems; they claim that if children with DS practise balance, it can improve. Shumway-Cook and Woollacott (1985) noted that the level of proficiency in balance is a big concern because it influences other motor tasks of children (Jobling, 1998:285-289).

Connolly *et al*. (1993:175) compared individuals with DS who had EI with individuals who did not. Balance was definitely an aspect that children with DS struggled with, but researchers also found that neuropathology may be related to this problem. In this situation, neuropathology can refer to a delayed cerebellar maturation and a relatively small brainstem and cerebellum. According to Connolly and co-workers, children with DS have deficits in their hand-eye coordination, balance, laterality, visual-motor activities and reaction

time and their data showed that children who partook in EI did better in these deficits (Connolly *et al*., 1993:175, 176).

Connolly and colleagues suspected that children with DS might have problems with their somatosensory and vestibular systems because of the specific deficits that was identified. These systems are important because they help with a person's overall movements, development and functioning (Connolly *et al*., 1993:176). Techniques that involve proprioceptive, vestibular and visual input would be very beneficial to children with DS, especially if it is incorporated with EI programs. Children that took part in an EI program showed improvements in their gross and fine motor movements. Children should never stop to partake in any form of physical therapy or physical fitness programs, because it would always help them to improve their gross and fine motor skills, as well as their functioning in everyday tasks (Connolly *et al*., 1993:176-178).

Various researchers have investigated the GMS of children with DS to assess in what specific areas they need improvement. Schott *et al*. (2014:3300) used two different scientific assessments to evaluate 36 children, 18 children with DS and 18 neuro-typical children between seven- to 11-years-old. The test battery called Test of Gross Motor Development (TGMD-2), was used to evaluate the motor performance of children between the ages of three- to 10-years-old. This test consists of 12, GMS that children acquire in preschool and early grades. The 12 motor skills are divided up into two skill areas, namely: locomotor (running, jumping, galloping, sliding, hopping and leaping); and object control (striking, dribbling, catching, throwing, kicking and rolling). The higher the score, the better the movements (Schott *et al*., 2014:3300). The Movement Assessment Battery-Checklist (MABC) was used as an informal assessment for motor performance and to screen children for any movement difficulties. The main reason for the checklist was to comprehend how a child manages his/her everyday tasks at home or school. The results showed that children with DS scored significantly lower on all the test items in the TGMD and according to the checklist they had more behaviour problems than neuro-typical children (Schott *et al*., 2014:3300-3305).

However, it is very clear that children with DS struggle with their GMS and that they tend to lead a sedentary lifestyle. Individuals with DS and intellectual disabilities experience poor health and this leads to more health problems. Lotan (2007:9) recommended that an appropriate intervention program focusing on the physical fitness levels of an individual might improve their physical condition. Other psychological benefits include: reducing anxiety and depression; and promoting healthy sleep patterns. Being physically active is

a very big obstacle for many people. Thus, getting children as active as possible can prevent sedentary lifestyles. The following risk factors might be prevented; low motivation, physiological barriers, lack of coordination and efficiency leading to a high risk of developing obesity, coronary arterial diseases and heart attacks (Lotan, 2007:7-9).

The enhancing effect that physical fitness has on individuals led to the reason why Lotan (2007:9) implemented different kinds of interventions. It needs to be highlighted that these interventions were performed on adults with DS. Lotan (2007:9) implemented the following activities in the interventions: stair climbing; walking-running-stretching-aerobic exercises; a mile run using a rowing machine; weight lifting or bicycle training; treadmill training; and walking (Lotan, 2007:9).

These interventions are examples that Lotan (2007:11) implemented and that could be a guideline for investigators to use and implement. Interventions can take place over different time periods. Programs can range from 10 weeks to six months with two to three activity sessions per week. The following intervention programs were recommended because most of the adults with DS have very low levels of cardiovascular fitness. It was suggested that they begin on a low intensity for five to 10 minutes, one to two times per week until their heart rate reaches 30 to 50% of their calculated maximum heart rate (MHR). In the following week they could increase their intensity. The general population, is supposed to train at an intensity of 60 to 80% of his/her MHR, three to five days a week for 20 to 60 minutes. Individuals with DS have poor levels of muscular strength, and therefore, their training intensity has to be 70 to 80% of their MHR, with three sets of eight to 12 repetitions. Programs can also focus on balance training where participants walk on a straight line, on a beam, jumping or standing on one leg. Flexibility exercises are not recommended for individuals with DS because of their hypermobility and joint laxity (Lotan, 2007:11, 12).

In the study of Lotan (2007:12) two group of researchers performed a jog/walking intervention program with adults with DS over a 10-week period. They reported that the adults improved their aerobic capacity. Carmeli *et al*. (2002:106), cited in Lotan (2007:12), implemented two treadmill training interventions, one for young adults with DS and another one for older adults with DS over a 12-week to a six-month period. Carmeli and co-workers found improvement in muscle strength and dynamic balance (Lotan, 2007:12).

Furthermore, Li *et al*. (2013:189) implemented a set of exercise interventions for adults with DS. This study included eight types of interventions: a treadmill program; a bicycle

program; a rowing ergometer intervention; a progressive resistance training program; a combined program with game-like exercises; a cardiovascular and strength program; and a weight-bearing program. The mean duration for the intervention programs were 11.9 weeks, with two to three 10 to 80 minute sessions per week. Li and co-workers concluded that individuals with DS benefited from these interventions, especially the weight-bearing exercises, treadmill walking and balance exercises (Li *et al*., 2013:189,194).

After observing the above-mentioned studies various physical interventions, based on land, it might have positive effects and implications on the overall development of individuals with DS. Aquatic interventions programs and their effects follow.

Aquatic intervention

Individuals with mental problems participated in an on-going program of Connolly and co-workers (1993:177), named the Special Olympics swimming program. The intervention took place over a 10-week period and the children that participated showed a significant improvement in self-concept and cardiovascular endurance. The children also had a tremendous improvement in their GMS (Connolly *et al*., 1993:177).

Fragala-Pinkham *et al*. (2008:822) implemented a study with 20 disabled children. The purpose of the study was to evaluate the effectiveness and safety of a group aquatic aerobic exercise program, as well as to assess the effects of the program on muscle strength and motor skills. This intervention took place over 14 weeks where the children took part in two sessions per week. The program consisted of a warm up of three to five minutes, aerobic exercises of 20 to 30 minutes, strength training of five to 10 minutes and a cool down and stretching of three to five minutes. They came to the conclusion that a fun alternative can be group aquatic exercises to improve children's cardiorespiratory endurance. Doing sessions in the water creates a safe environment for the children and it is a form of low-impact exercise (Fragala-Pinkham *et al*., 2008:822-826).

There are advantages in both types of environments and the above-mentioned studies showed significant improvements. However, one would like to know what the best possible intervention for children with DS would be and in what type of environment they will improve the most. During previous interventions on land and in aquatic environments children struggled with balance, strength and coordination. The aquatic environment provides factors such as buoyancy and resistance that the land intervention does not provide, which might have an influence on the results. The land interventions provide a very

stable and comfortable environment for children, which most of them are used to, whereas the aquatic environment is new and different.

THE INTERVENTION OF THE CURRENT STUDY

The intervention used in the current study is based on the sequence of prevention of Willem van Mechelen. The sequence will be discussed in depth in Chapter three. Being able to do research about a specific and unique individual with DS, and planning an intervention program to improve their GMS, a person needs to look at various factors. These factors include medical background, medical conditions and their ability to execute movements, language and communication. The most important aspect of the whole program was that it is a multidimensional program that includes endurance, strength, balance and coordination that is optimal for development and a healthy lifestyle. Another factor that played a very big role was the fun factor of the program. The children looked forward to the sessions and was excited to partake in the activities (Lotan, 2007:14).

CHAPTER THREE

METHODOLOGY

INTRODUCTION

Developmental disabilities and impairments have a big impact on children with DS's gross and fine motor skills development as discussed in the previous chapter. Individuals with DS struggle especially with hand-eye coordination, laterality, visual motor control, reaction time, strength and balance (Connolly *et al*., 1993:171).

After a thorough investigation on children with DS, and the struggles that they face with GMS, the main aim of the current study was to explore the effect of land and aquatic interventions over a 9 week period in children with DS between seven – 16 years old to improve their GMS. Land and aquatic intervention programs with a duration of seven weeks each were implemented. There were four different groups, two groups participated in the land-based and two groups in the aquatic-based intervention. The main focus of each program were on strength, balance, coordination and cardiovascular endurance (Jobling, 1998:285).

A scientific test battery, the Bruininks-Oseretsky Test of Motor Profiency (2nd Edition) (Bruininks & Bruininks, 2005), was used to evaluate the children's proficiency in four motor area composites, namely: fine manual control; manual coordination; body coordination; and strength and agility. These composites were core focusses of both intervention programs.

The data was used to determine the children with DS's, GMS and to compare the results of the land and aquatic based interventions. The data was analysed to indicate whether their post-test scores had improved.

RESEARCH DESIGN

This current study made use of a quantitative research strategy, making use of an experimental design to collect the data. An experimental design was selected to allow the researcher to manipulate or determine the influence of the variables. There are five types of experimental study designs, namely: true experimental; quasi-experimental; pre-experimental; ex post facto; and factorial design research (Joubert *et al*., 2016:274). In a true experimental research design participants are randomly selected to partake in an experimental or control group. In a pre-experimental study design respondents are not randomly selected and only a hypothesis gets formulated that needs to be followed up with controlled studies. Ex post facto-designs are non-experimental research and factorial designs look at the influence of two or more variables with different randomly selected groups. The current study is a quasi-experimental research design because the participants were a sample of convenience, and therefore, the researcher could not control the influence of the uncontrollable variables. Quasi-experimental designs sometimes lack the element of a treatment or control group. As the participants were not randomly selected there were no guarantees that the different groups were more or less on the same level before the intervention programs began or that the groups will be comparable at baseline. The pre-test assessment gave an indication on what level the participants were, as well as if the independent variables were the same (Grimshaw *et al.,* 2000:11; Joubert *et al*., 2016:274-275).

This study's research design is also based on a Comparative Effectiveness Research (CER) design (Hirsch *et al*., 2014:1677). CER was designed to address health-care decisions by providing evidence-based research on the effectiveness, benefits, harms and different treatments of research studies and products. It looks at the relative effectiveness of different options and ways of treating a specific condition in a selected population (Concato *et al*., 2010:764). The purpose of CER is to make an informed decision about the health care management of an individual. The evidence can be collected via two different ways: Researchers can look at different available studies and evidence that are already available through doing a systematic review; or a research review. In the second option the researchers can conduct new studies and generate new evidence of comparative effectiveness by means of a test or treatment (Hirsch *et al*., 2014:1677).

The current study was based on the second option where the researcher conducted a new study. When conducting CER the researcher needs to be able to develop, expand

or use a variety of resources and methods that takes enough time to deliver good research that can be advised to others (Hirsch *et al*., 2014:1677). The following seven core steps need to be followed when CER is performed to ensure that it is sustainable and shows continued development. These steps were adapted for the current study as follows:

1. The study identified new interventions in the field.
2. The researcher reviewed current research.
3. The researcher identified possible gaps in the field.
4. Interventions were designed and implemented.
5. Assistants were trained.
6. The research findings will be shared with schools and parents that have children with DS.
7. The researcher will publish articles in international peer reviewed journals worldwide.

CER differs from experimental study designs that have a control group. Most CER studies implement a "single group study". This refers to a single intervention that does not include control groups. These type of studies evaluate the outcomes of their own interventions. The current study is based on this research design and therefore does not include a control group (Paulus *et al.,* 2014:152).

PARTICIPANTS

The participants were selected from four different schools in the Stellenbosch, Somerset West, Mitchell's Plain and Bellville regions. The specific schools were chosen for logistical reasons and immediately showed interest in the intervention programs. Each of the schools had at least five or more children with DS. The two schools that participated in the aquatic intervention had to be closer to Stellenbosch University due to the fact that the researcher made use of the Department of Sport Science's swimming pool. These schools did not have swimming pools on their premises and municipality swimming pools were too deep and too cold to utilize.

The total number of participants (N=31) in this study were divided into a land (n=13) and an aquatic group (n=18) according to the amount of children that were willing to participate in each school. The aquatic group had more participants because these schools had more children with DS and the schools wanted the researcher to use all the participants that met the inclusion criteria. The reason for the small sample size was due to logistical and practical implications. Out of the 31 participants, six children were non-

verbal. Table 3.1 shows the participants from each school. Three out of the four schools were for children with special needs and one school was a mainstream school with a class that included children with DS. See Addendum A for a detailed outline of the ages and gender of the participants from each school.

TABLE 3.1. **TOTAL PARTICIPANTS**

School	**Program**	**Boys**	**Girls**	**Total**
School GB	Land	3	2	5
School D	Aquatic	5	4	9
School BP	Land	3	5	8
School B	Aquatic	4	5	9
TOTAL		15	16	31

The inclusion and exclusion criteria of the study were as follow:

Inclusion criteria:

1. The participants had to be between the ages of seven to 16 years old.
2. The participants had to live within a 50km radius from Stellenbosch.
3. The participants had to be medically diagnosed with Down Syndrome.
4. The participants' parents had to complete the medical form prior to the pre-test.
5. The parents had to provide informed consent.
6. The participants had to sign an assent form.

Exclusion criteria:

1. Any child with hearing or sight impairment was excluded.
2. Unwillingness to participate in the intervention program activities.
3. Participants with severe medical conditions, for example, heart defect, ear and mobility problems.
4. Participants that were unable to run or jump.
5. Participants with Atlantoaxial Joint Instability.
6. Participants that missed more than 30% or four of the 14 sessions.

RESEARCH ASSISTANTS

The researcher had five assistants who helped voluntarily and committed themselves from the beginning to the end of the study. The assistants were Kinderkinetics honours students from the Department of Sport Science at Stellenbosch University, who were registered at SAPIK (South African Professional Institute of Kinderkinetics). The assistants have all done a First Aid level 1 course and have undergone police clearance. The study, as well as expectations, were explained to them in detail.

The students assisted with the testing of the participants in the presence of the researcher. All of the assistants are trained with the BOT-2 test battery. The researcher trained the assistants before data collection to confirm that they knew what was expected of them ethically, as well as to ensure that there was constant reliability and validity during the assessments. The assistants helped to present the intervention programs and they were responsible to get the equipment to the specific locations. Programs were sent to the assistants via email beforehand in order for them to prepare. The assistants attended all the sessions.

ASSESSMENTS

Pre- and post-tests took place at the different schools. The pre-test took place a week before the interventions began and the post-test a week after the interventions. A classroom or hall was allocated for the duration of the assessments. One child at a time was assessed in order for the researcher to be present during each assessment and notes were taken during the assessments about the children's behaviour, how they worked together and anything that stood out about the child. For reliability and validity purposes, the same assistant assessed the child every time. This helped the researcher to prepare for the interventions. See Addendum B and C for the times and dates when the pre- and post-tests took place.

TEST BATTERY

Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) (2nd Edition) (Bruininks & Bruininks, 2005).

The BOT-2 assesses proficiency in four motor-area composites, namely: fine manual control; manual coordination; body coordination; and strength and agility. These four composites each comprise of eight subtests. The BOT-2 short form consist of 14 items. These items represent all eight subtests and they have reliable scores. This test takes

approximately 20 to 30 minutes to complete and it is easy to administer. The reliability coefficients are extremely high for the subtests on manual coordination, body coordination and strength and agility composites, with coefficients ranging between 0.98 and 0.99. The Fine Manual composite coefficient is also very high at 0.92. This suggests that the overall reliability of this test is very consistent (Bruininks & Bruininks, 2005:51).

The original BOTMP was published in 1978 and since then it has been used by occupational and physical therapists, psychologists and educators because it provides information over a broad spectrum regarding motor skills. Researchers use the BOTMP because it provides for a standard of criterion-validation and through this test researchers are able to determine whether children have any motor skill deficits (Bruininks & Bruininks, 2005:1).

Various researchers have used the BOT-2 in their studies on children with special needs (Connolly *et al*., 1993:174; Wang & Ju, 2002:445; Lewis & Fragala-Pinkham, 2005:32; Gupta *et al.,* 2010:426; Boer & Moss, 2015:177). The BOT-2 provides evidence for the validity in identifying motor performance in individuals with DCD, mild to moderate mental retardation and autism. The criteria for mild to moderate mental retardation are the following: An IQ below 70 and significant limitations in life skills (Bruininks & Bruininks, 2005:64).

The researcher used the BOT-2 short form to assess the participants. The short form was used because it is quick and easy to administer (Bruininks & Bruininks, 2005:4). The researcher verbally explained and demonstrated every test item to the participants, as well as what was expected of them. The short form consists of the following subtest: fine motor precision; fine motor integration; manual dexterity; bilateral coordination; balance; running speed and agility; and strength. A detailed outline of the activities under each subtest can be found in Addendum D.

INTERVENTION PROGRAMS

A land- and an aquatic-based intervention program was implemented, and the results compared, to determine in what kind of environment children with DS were more likely to improve their GMS. The aquatic environment provides a therapy medium for a child or adult to exercise in. The aquatic environment is beneficial for children with motor deficiencies (Getz *et al*., 2007:218).

The intervention programs were self-designed after an in-depth literature study was done. The programs were based on the principle of the ‘sequence of prevention’ of Van

Mechelen. Figure 3.1 presents a flow diagram that indicates the four steps of the sequence of prevention (Van Mechelen, 1997:164).

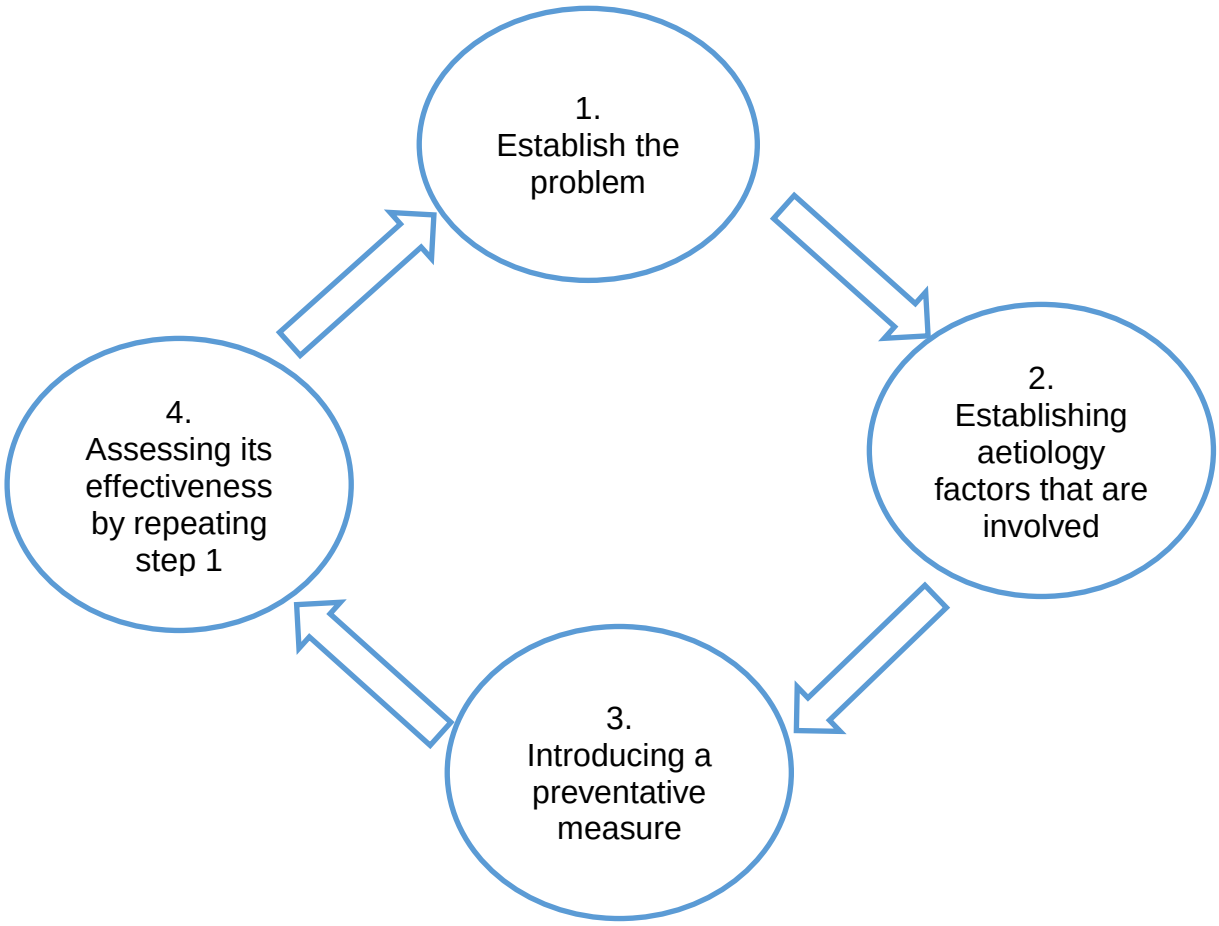

Figure 3.1. **SEQUENCE OF PREVENTION** (Van Mechelen, 1997:164)

SEQUENCE OF PREVENTION

By observing the above principles and applying it to the current study, the first step was to establish the scope of the problem. The researcher asked specific questions such as how serious was the problem, how would the problem be improved, how would it take place and for how long? Thereafter, the aims was broken up into more specific aims. The second step was to look at the factors that lead to the change. For example, the type of program that was implemented, as well as the aims/objectives of the program. The third step was to implement the program. Lastly, the effectiveness of the program was determined by assessing the program and the children to see if there was any improvements.

The intervention programs took place over seven weeks, with two, 40 minute sessions per week. The duration of each session was based on the findings of previous studies (McManus & Kotelchuck, 2007:276). The sessions were planned to ensure that there was no holiday in the middle of the seven-week cycle ensuring that the program took place continuously. The Western Cape school terms are approximately nine to 10 weeks long, and therefore, the interventions were only seven weeks in duration because the pre- and post-tests had to be during the nine-week period. See addendum E for the days and times that interventions took place at each school.

The researcher had to be consistent throughout the study and each intervention at a school had to be exactly the same, therefore, there were no individualised exercise programs (IEP) implemented.

The land- and aquatic-based interventions were based on the exact same outcomes. The programs consisted of a warm-up, four activities and a cool down. See Table 3.2 for the outcome of each activity.

TABLE 3.2. **OUTLINE OF THE PROGRAM'S OUTCOMES**

Activities	**Focusses for land & aquatic programs**	**Duration**	**Repetitions**
Warm-up	• Cardiovascular	5 minutes	2-3
Activity 1	• Static & dynamic balance • Hand – eye coordination	10 minutes	2-3
Activity 2	• Cardiovascular endurance • Static balance	8 minutes	2-3
Activity 3	• Dynamic balance • Hand – eye coordination • Upper & lower body Strength	10 minutes	2-3
Activity 4	• Static & dynamic balance	8 minutes	2
Cool down	• Visual motor integration • Coordination • Upper & lower body Strength	5 minutes	2-3

The programs were prepared and planned every week according to the outline shown in Table 3.2. Each activity had a progression and the participants were allowed to progress if they were able to perform the activity well. This was determined by the knowledge and experience of the researcher as a Kinderkineticist. After each session, the researcher

reflected on the lesson to see if the activities worked or not and whether the children were able to perform the activities. Only after the reflection of the first session of each week, lessons were planned for the second session of the week. The lessons built on each other, and therefore, it was vital for the participants to attend 70% of the sessions. There had to be continuous consistency throughout the programs between all four school's interventions to be valid and reliable.

At two specific schools, the children had to be divided into junior and senior groups because of the big age differences. The older participants were able to do more difficult activities than the younger participants. The duration of each session at the schools were not exactly the same because some participants took a bit longer to do the activities and it took a while to get the participants in and out the swimming pool.

ETHICS

Ethical clearance was obtained from the Research Ethics Committee of Stellenbosch University (Ethics number – SU-HSD-001763), and thereafter, permission from the Western Cape Education Department (WCED) was granted to be able to approach the specific schools. The principals at the schools gave permission to conduct the study, as well as the parent's/legal guardians before the researcher approached the children. Each participant's parent/legal guardian was asked for their informed consent, and thereafter, each participant had to sign an assent form. See Addendum F for the consent form and Addendum G for the assent form. The assent form and the procedures were explained to each individual verbally in a language that they understood. Pictures on the assent form were there for non-verbal children to show if they want to participate. If the individual did not want to partake in the program they were not forced to do so.

A medical form for personal information was designed for parents to complete (see Addendum H). The form asked specific questions such as the birth process, medical and health history or conditions, medication, milestone development and behaviour. The medical form brought awareness about the participants, as well as identifying whether they met the inclusion criteria. Transportation permission (see Addendum I) was obtained and an assistant from the schools accompanied the children at all times. The testing and intervention programs took place in a safe environment and the participants felt comfortable going into the water. The researcher is a qualified Kinderkineticist registered with SAPIK (01/014/06/1415/005). The researcher is also a Learn to Swim instructor, and therefore, sufficiently qualified to present the aquatic intervention program. All the data

that was collected from the study was saved on a password protected computer in an office that was locked at all times. Only the researcher, study leader and statistician had access to the computer and the office, and therefore, the results of the participants were kept confidential at all times.

STATISTICAL ANALYSIS

The statistical analysis was done by Professor Martin Kidd of the Centre of Statistical Consultation at Stellenbosch University. After the pre- and post-tests, the data were scored according to the BOT-2 manual. The final points scored of each category was placed on an excel spreadsheet. Mixed model repeated measures ANOVA were used with group and time as fixed effects and participants as random effects. The group*time interaction was the primary focus for determining whether differences in the measurements over time was detected between the groups. Fisher least significant difference (LSD) testing was used for post hoc analysis. Summary statistics were reported as means and standard deviations. A 5% significance level ($p<0.05$) was used as guideline for determining significant effects. Cohen's D effect sizes were calculated to assist and interpret the pre- and post-test differences between the aquatic and land groups to see whether there were any practical differences between the groups.

SHORT SUMMARY

In this chapter, the researcher explained what type of research design was implemented and gave more information about the experimental design. An in depth explanation was given about the participants that took part in this study. Outlines were given about the procedures of the project, as well as information about the test battery, pre- and post-tests and the intervention programs. Ethical aspects and the statistical analysis were also explained.

CHAPTER FOUR

DISCUSSION OF RESULTS

INTRODUCTION

Children with DS have a variety of features that are caused by trisomy named chromosome 21. With the uniqueness of children with DS, regular engagement in physical activities is essential for their development and lifestyle. By not partaking in physical activity it might lead to possible lifelong sedentary problems that are already a high risk factor for children with DS. The delay in their motor skills has an influence on the efficiency and execution of their movements and may be the reason why they do not often participate in physical activities. As discussed in Chapter two, participation in physical activities have several advantages on land and in aquatic environments (Shields *et al*., 2009:307, 308).

The aim of current study was to explore the effect of land and aquatic interventions on GMS of selected children with DS. The objective was to determine the effect of a land and aquatic environment on selected motor skills of the children with DS. The current study focused on improving the children's balance, coordination and strength and provides comparisons between the pre- and post-tests of both groups and the subtests scores.

The results will be discussed in the sections below.

DISCUSSION OF RESULTS

Pre-test level of GMS of children with DS

The baseline level of the GMS levels of children with DS was determined by assessing them with the BOT-2. The pre-test scores guided the difficulty level of the interventions and gave a clear description of this population. Table 4.1 and 4.2 summarizes the mean, standard deviation (SD) and range of the land and aquatic based participants. The land group's mean final score was 38.31 and the SD was 10.32, while the aquatic group's mean final score was 18.78 and the SD was 14.96. The children's ages ranged from seven to 16 years and the statistics of the land and aquatic groups are provided separately in Tables 4.1 and 4.2 below.

TABLE 4.1. **DESCRIPTIVE STATISTICS: PRE-TEST OF LAND-BASED PARTICIPANTS**

Subtests and Final score	Mean	SD	Range
Balance	5.15	1.68	2-8
Bilateral Coordination	5.84	1.41	2-7
Fine Motor Integration	4.00	2.64	0-9
Fine Motor Precision	5.31	2.53	0-9
Manual Dexterity	1.46	1.13	0-4
Running speed & agility	3.38	2.63	0-8
Strength	3.77	1.96	0-8
Upper-limb coordination	9.00	2.24	4-12
Final score	38.31	10.32	11-54

TABLE 4.2. **DESCRIPTIVE STATISTICS: PRE-TEST OF AQUATIC-BASED PARTICIPANTS**

Subtest and Final score	Mean	SD	Range
Balance	3.72	2.30	0-7
Bilateral Coordination	1.94	2.23	0-7
Fine Motor Integration	1.20	2.38	0-8
Fine Motor Precision	2.44	3.57	0-12
Manual Dexterity	0.89	0.96	0-2
Running speed & agility	2.11	2.17	0-6
Strength	1.61	1.91	0-7
Upper-limb coordination	4.89	4.13	0-12
Final score	18.78	14.96	0-52

Table 4.3 summarizes the lowest to highest scores that a participant, in all age categories, could receive in each subtest of the BOT-2. This provides a better understanding of how the scoring of the BOT-2 works.

TABLE 4.3. **SCORING OF THE BOT-2**

Subtest	**Lowest to highest score**
Fine Motor Precision	0-14
Fine Motor Integration	0-10
Manual Dexterity	0-9
Bilateral Coordination	0-7
Balance	0-8
Running speed and agility	0-10
Upper-limb coordination	0-12
Strength	0-18
Total score	0-88

There was a variation in the final mean scores at the pre-test between the land and aquatic groups. The land group had a higher mean score of 38.31 and the aquatic group had a score of 18.78. It is evident that the land group performed better in their pre-test scores and started on a higher level than the aquatic group. By studying the range of the final scores between the two groups, the land group's maximum range score was 54, whereas the aquatic group's was 52, which is relatively close to each other. However, the land group's minimum score was 11 and that of the aquatic group was 0. This indicates that some of the aquatic group's participants received a very low score during the pre-test and that none of the children in the land group received a score lower than 11. Therefore, it can be speculated that the aquatic group's level of GMS was lower and that they struggled with the activities during the assessments (Table 4.1, 4.2).

Looking at the subtests, the mean scores for balance between the two groups were relatively close to each other and the range of both groups were between 0 to 8.

Table 4.4 contains the descriptive statistics for the BOT-2 balance subtest from previous studies that were performed with children with DS. Although the children in the current study were not exactly the same ages, the mean scores of the aquatic and land groups were higher than the mean scores obtained by Wang and Ju (2002:446). The range of the scores found by Gupta *et al*. (2011:430), fall in the same range as the results of the

aquatic and land groups of the current study. Both of these studies' results are very close to the results of the current study.

TABLE 4.4. **DESCRIPTIVE STATISTICS: BALANCE SUBTEST FROM PREVIOUS INTERVENTIONS**

Balance	Mean	SD	Range	Participants	Age	Author
Walking forward on a line	2.00	1.94	N.A.	N=20	3-6	Wang & Ju (2002)
N.A.	N.A.	N.A.	3.0-3.0	N=28	7-15	Gupta *et al*. (2011)
Standing with one-leg on a beam	0.47	0.69	N.A.	N=20	3-6	Wang & Ju (2002)
N.A.	N.A.	N.A.	1.0-2.0	N=28	7-15	Gupta *et al*. (2011)

Observing the current study's participant's descriptive statistics, the mean score for bilateral coordination differed more between the two groups. The land group had a mean score of 5.84 and the aquatic group a mean score of 1.94. The mean fine motor integration score of the land group was 4.00 and that of the aquatic group was 1.20. The aquatic group struggled to understand what was expected of them during the pre-test and the researcher/assistants experienced that overall, the children could not perform many fine motor activities. The non-verbal children showed a lack of interest in the fine-motor integration. The manual dexterity scores were comparable for both of the groups (Table 4.1, 4.2).

In the running speed and agility subtests the land group's mean score was higher than that of the aquatic group. The land group had a mean score of 3.38 and the aquatic group a mean score of 2.11. The land group also had a higher maximum range score (0-8) than the aquatic group (0-6). The aquatic group found this subtest difficult as they struggled with endurance during the pre-test assessment. They got tired very quickly and wanted to stop. Strength was a focus of the intervention and there were minimal differences between the groups. The land group understood the techniques on how to do a push-up or a sit-up better than the aquatic group. Lastly, upper-limb coordination, another focus of the intervention, indicated a big difference between the two groups. The land group had a mean score of 9.00 and the aquatic group a score of 4.89. The land group's

minimum range for this subtest was only 4 and that of the aquatic group was 0 (Table 4.1, 4.2).

Now that the descriptive statistics of the participants have been discussed, Table 4.5 summarizes the norms (mean and SD) of boys and girls from four to 21 years' old that were assessed with the BOT-2. The norms in Table 4.5 are from the BOT-2 manual and can help to give a clear indication of what a good, average or below average mean and SD is. It is always good to have a lower SD, which indicates that the data were clustered closer to the mean. These norms are, however, of neuro-typical children. Through these norms one would also be able to see how the scores of children with DS differed from neuro-typical children and on what developmental level children with DS were (Bruininks & Bruininks, 2005:60).

TABLE 4.5. **DESCRIPTIVE STATISTICS: GIRLS AND BOYS FROM 4 TO 21 YEARS OLD**

Subtest and Final score	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
	4-7 years		**8-11 years**		**12-21 years**	
Balance	15.0	4.9	15.1	4.7	14.7	4.7
Bilateral Coordination	15.0	4.9	15.1	4.6	14.9	4.1
Fine Motor Integration	15.0	4.8	15.1	4.6	15.1	4.6
Fine Motor Precision	15.0	4.9	14.9	4.8	14.9	4.5
Manual Dexterity	15.0	4.8	15.0	4.8	15.0	4.8
Running speed & agility	15.0	4.8	15.0	4.7	14.8	4.9
Strength	15.0	4.9	14.9	4.8	15.0	5.0
Upper-limb coordination	14.9	4.8	15.1	4.7	15.0	4.8
Final score	50.1	10.0	50.0	9.9	50.0	9.8

It is difficult to give an indication of what is a good or average mean and SD, and therefore, the norms are there to compare it with the results of the current study. By comparing the norms above with participant's scores in the current study, it is evident that their final mean scores were much lower and their SD were slightly higher especially in the case of the aquatic group. The participants in the current study recorded very low means and SD scores. After the pre-test it was clear that balance, coordination, running speed and agility

and strength were most children's weaknesses. Through the results of their weaknesses the specific aims and objectives of the current intervention programs were established.

The researcher determined whether an aquatic or land intervention program would improve the GMS of the children by reviewing their post-test results. Therefore, the aims for both programs were exactly the same, even though the children in the land group had a higher pre-test score. The overall scores will be discussed below, as well as which environment improved the GMS of the children the most at each subtest. The statistical significant difference was set at $p<0.05$. Therefore, if the p value was smaller than 0.05, it showed a statistical significant difference. The Cohen's effect sizes were based on the following (Cohen, 1992:98):

- <0.15= Negligible
- <0.4= Small
- <0.4-0.75= Medium
- <0.75-1.1= Large
- <1.1-1.45= Very large
- >1.45= Huge

All the tables of the Cohen's effect sizes are provided in Addendum L. The results of a small effect size indicate that there was a very small practical improvement, whereas a medium effect size and larger effect size shows that there was a better practical improvement. The a, b and c on the figures indicate the following: a-a indicates that there was no statistical significant improvement, c-b indicates that there was a statistical significant improvement. Normality plots was inspected by an expert and found to be normally distributed.

COMPARISON OF THE LAND- VERSUS AQUATIC-BASED INTERVENTION RESULTS (OVERALL FINAL SCORE)

Figure 4.1 shows the overall final score between the land and aquatic groups (pre- and post-test).

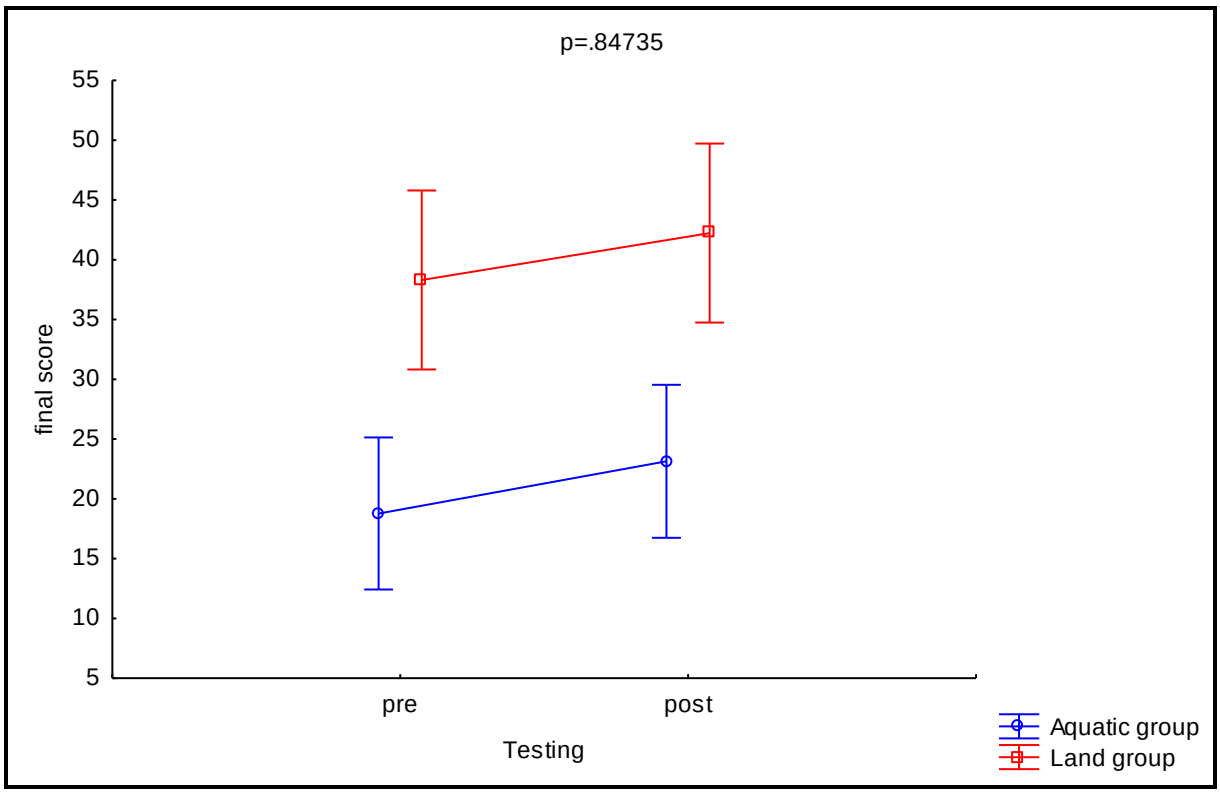

Figure 4.1. **FINAL SCORE BETWEEN THE LAND AND AQUATIC GROUPS (PRE- AND POST-TEST)**

The aquatic group had a total pre-test score of 19 and a post-test score of 23. The land group had a total pre-test score of 38 and a post-test score of 42. Both the land and aquatic environment improved the GMS of the children as each group improved with four points from the pre- to post-test. The intervention had the same outcome for both groups (Figure 4.1).

Dimitrijević *et al*. (2012:172) found a statistically significant difference (p=0.01) in the motor function of children with CP in their study. Their results indicate that an aquatic intervention was a good form of physical therapy for the children and that it provides a good foundation for the development of motor skills, functional abilities and quality of life. Another aquatic intervention was done by Naučni *et al*. (2012:58), with exactly the same aim as Dimitrijević *et al*. (2012). After the intervention period there was a statistically significant difference (p=0.02) in the children's overall gross motor function (Naučni *et al*., 2012:58). By studying the latter two studies it became clear that the aquatic environment had a positive effect on the children's GMS.

Getz *et al*. (2007:219) compared an aquatic and land-based intervention program on children with CP. The aim and type of activities were slightly different from the current study, and the aquatic and land groups did not participate in the same programs. Getz *et*

al. (2007:225) concluded that there was a statistically significant difference (p=0.003) in the aquatic group between the pre- and post-test, but no significant differences between the two groups in their physical competence after the intervention period (Getz *et al*., 2007:223).

However, Hutzler *et al*. (1998:179) also performed an aquatic versus land-based intervention in their studies and both studies concluded that a combined aquatic and land training program showed significant improvements instead of just doing a land-based program. The children were able to gain more improvement in the aquatic environment and they acquired aquatic skills (Hutzler *et al*., 1998:179). In the current study there was an improvement in both groups, but not adequately enough to state that one group performed better than the other, because both groups improved their overall score with the same scores.

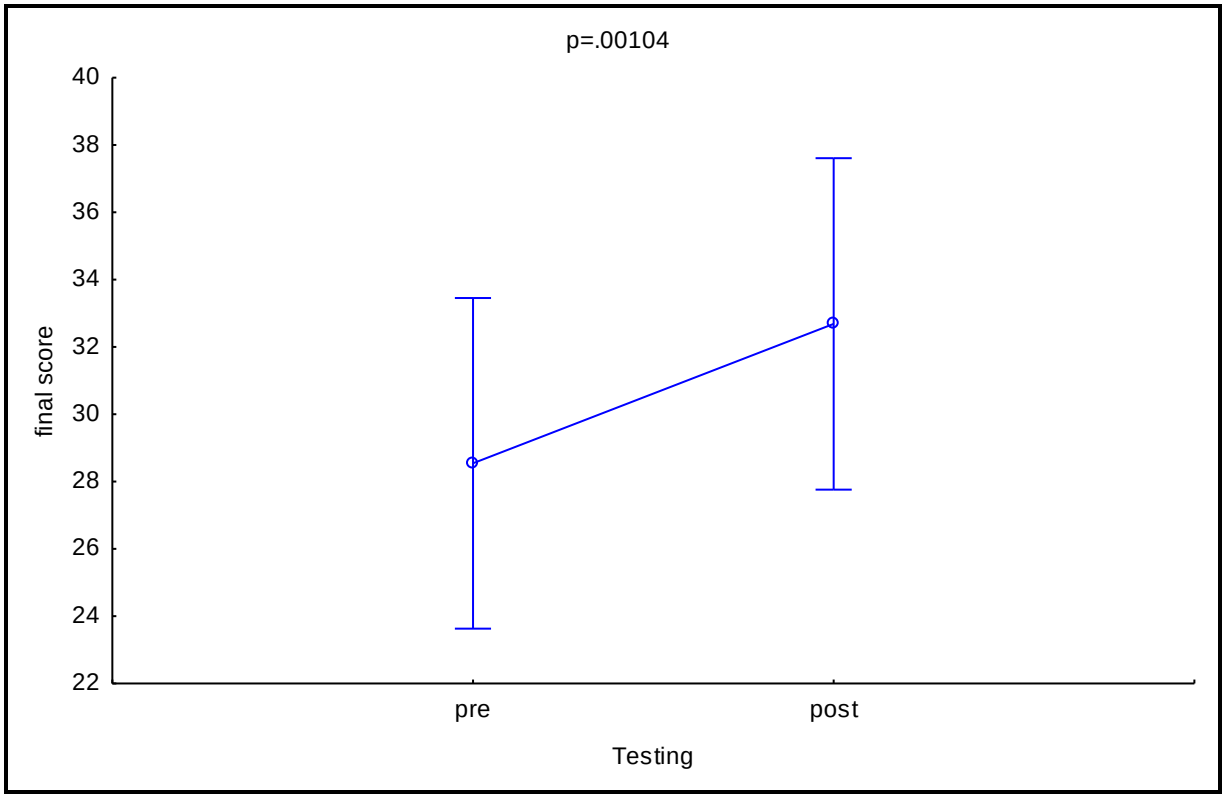

Figure 4.2. **TIME EFFECT MEAN OF THE TOTAL SCORE (AQUATIC AND LAND)**

There was a statistical significant difference (p=0.001) in the time effect of both groups between the pre- and post-test, which indicate that there was a possibility that the groups improved their GMS during the interventions (Figure 4.2). It can, therefore, be considered that both the aquatic and land intervention groups improved their GMS. The Cohen's D effect sizes were calculated for the overall scores of both groups. The aquatic group had

a score of 0.33, which is small and the land group a score of 0.41, which is medium. The land group improved slightly more than the aquatic group. The results do not show a very strong trend because the final scores of the two groups were not statistically significant.

It can be speculated that the time effect results of certain statistically significant subtests in the current study could resulted from the fact that the aquatic and land groups data were combined. As a result, the number of participants were more than in other instances where the aquatic and land groups' data were separated.

In the current study two interventions (land- and aquatic-based), of seven weeks in duration, with two sessions per week, for 40 minutes were performed. Naučni *et al*. (2012:56) concluded that aquatic interventions between six to 12 weeks with two to three, 45 minute sessions per week, had a positive enhancing effect on children with DS' GMS. They analyzed improvements in walking, running and jumping skills. By doing activities in an aquatic environment improved the children's movements and balance on land, which helped them with their everyday tasks. In this study, the aquatic group showed improvements in balance, as well as overall motor skills, which might have helped them with their daily activities on land.

McManus and Kotelchuck (2007:277) completed an aquatic intervention on children with developmental disabilities. They implemented a 30-minute aquatic sessions on a weekly basis. Based on the research of Hutzler *et al*. (1998:177), 30 minutes is an appropriate duration for an intervention session, because it gives adequate time to positively affect children's functional mobility without fatiguing them. McManus and Kotelchuck (2007:281) concluded that the children in their study's functional ability mean score increased from 2.6 to 9.3.

Fragala-Pinkham *et al*. (2010:163) developed an aquatic intervention program of 14 weeks after reviewing and investigating previous literature for children with different kinds of disabilities. The intervention consisted of two, 45 minute sessions per week. The participants showed a statistical significant difference (p=0.001) in their swimming skill levels and a majority of the parents reported improvements in balance, gross motor skills, endurance and self-esteem. After six months, the parents stated that their children were participating in physical activities more than previously, at least 60 minutes of moderate to vigorous activities five times per week (Fragala-Pinkham *et al*., 2010:167).

The outline and duration of each session of this study was exactly the same as Fragala-Pinkham *et al*. (2010:167), but the type of testing measurements were different. At the

end of the 14-week intervention of Fragala-Pinkham's *et al*. (2010:167) study, the participants showed improvements in swimming skills and cardiorespiratory endurance with a statistical significant difference (p=0.001) in their cardiopulmonary endurance.

Fragala-Pinkham *et al*. (2008:825) found similar results as Lochbaum (2003:228) in a land-based program with the same aim. During this specific group aquatic program, both researchers found no statistical significant differences in strength and motor skills. Better improvements were seen in the motor skills of the land-based program participants, although the land-based programs focused on more task-specific skills. However, the aquatic program incorporated task-specific skills and GMS, but the amount of time that was spent on the activities were minimal. The current study's activities were mostly task-specific and each session had specific outcomes that was followed throughout the whole aquatic and land intervention.

Lai *et al*. (2014:201) performed an aquatic intervention with CP children. The intervention took place over 12 weeks and there were two hourly sessions per week. This program intended to improve the children's motor function. For children who struggle to move on land the aquatic environment is a safe and effective alternative therapy. The aquatic therapy group improved at the Gross Motor Classification system with a statistical significant difference (p=0.011) (Lai *et al*., 2014:204).

Jankowicz-Szymanska *et al*. (2012:676) implemented a 12-week land-based intervention for children with DS, focusing on static balance, in 45 minute sessions, twice per week. There was a statistical significant difference (p=0.001) in the activities that were done with eyes open (Jankowicz-Szymanska *et al*., 2012:676).

Because of all the advantages an aquatic environment has compared to interventions on land to improve the GMS of children with disabilities researchers have been performing more studies in the aquatic environment. All the studies mentioned above, showed statistical significant improvements. As mentioned, in the current study the children's overall scores between the two groups improved with four points, and therefore, both programs had a possible positive effects on the GMS of the children, and therefore, one could speculate that children would benefit from both programs.

As mentioned in Chapter 3, the BOT-2 short form consists out of 8 subtests. The results of the subtests will now be discussed, as well as in which environment the children improved the most at each subtest.

BALANCE

Figure 4.3 below contains the results of the balance subtest for the land and aquatic groups. There was no statistical significant difference (p=0.46) between the pre- and post-test of both groups. Both the land and aquatic environments improved the balance of the participants, but there was a slight trend that the aquatic group improved more than the land group. The aquatic group had a pre-test score of 3.7 and a post-test score of 4.7, while the land group had a pre-test score of 5.2 and a post-test score of 5.8 (Figure 4.3).

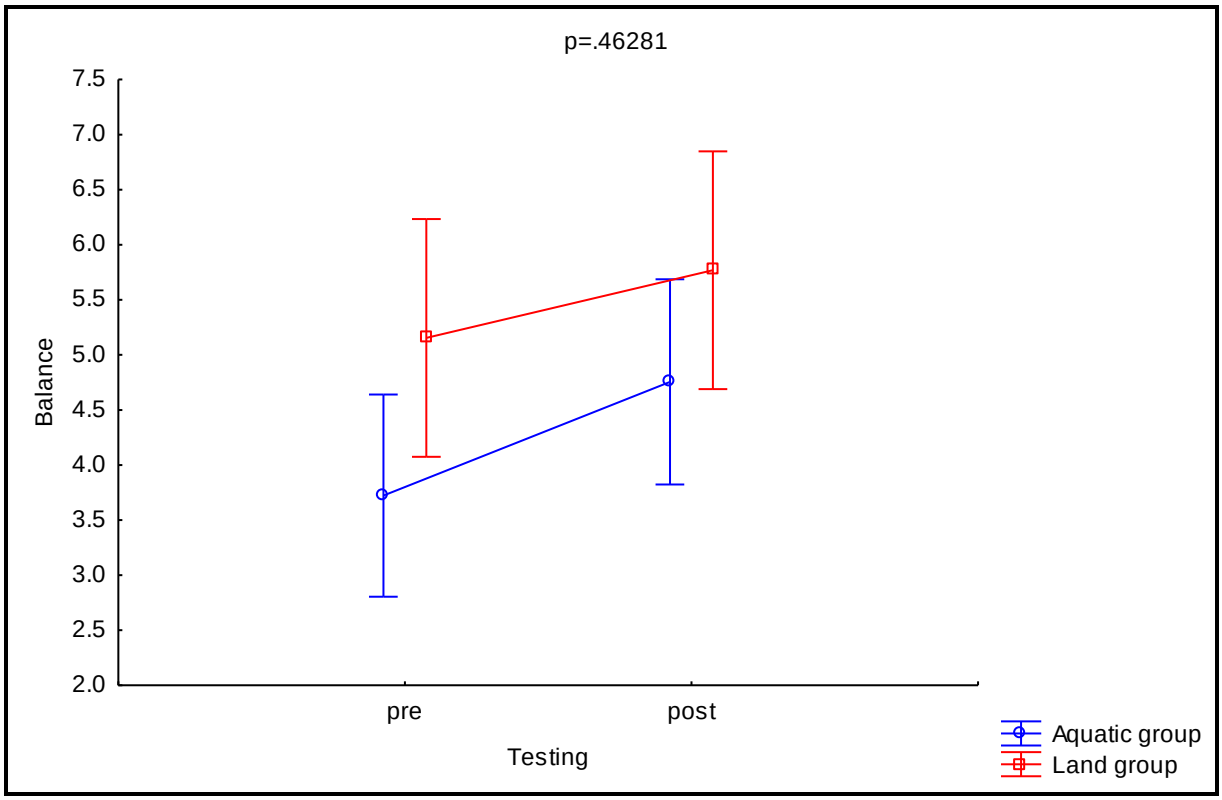

Figure 4.3. **OVERALL RESULTS OF BALANCE SUBTEST (BOTH GROUPS)**

In a study by Wang and Ju (2002:447), children with DS participated in a six-week jumping intervention. The participants showed a statistical significant difference in their motor performance. Wang and Ju (2002:447), speculated that the improvements in balance resulted from the intervention and not from normal developmental growth. Wang and Ju (2002) focused on vertical and horizontal jumping in a group and individualised setting, whereas the current study focused more on improving static and dynamic balance. Wang and Ju (2002) focused on postural control in the jumping intervention and speculated that it had an influence on the outcome of their study.

Lewis and Fragala-Pinkham (2005:33) employed a case study intervention with a child with DS for six weeks. The overall score on the Gross Motor Scale of the BOTMP

improved from two to 19 and the balance subtest improved. Their intervention focused on activities such as walking heel-to-toe on a line and on a balance beam, unilateral stance with eyes open and closed on and off a balance beam and jumping up and down. These activities were very similar to the activities used in the current study. Additionally, the current study also incorporated hopping and standing on one leg and making use of unstable surfaces to attempt to improve balance. Jankowicz-Szymanska *et al*. (2012:676) concluded that doing exercises on unstable surfaces improved the static balance of children with DS. In the current study the aquatic group improved slightly more than the land group in the balance subtest. Fragala-Pinkham *et al*. (2008:826) asserts that doing activities in an aquatic environment might be easier for children with balance problems due to the water support and buoyancy.

Figure 4.4 shows the time effect for the overall mean balance scores between the pre- and post-test for both groups.

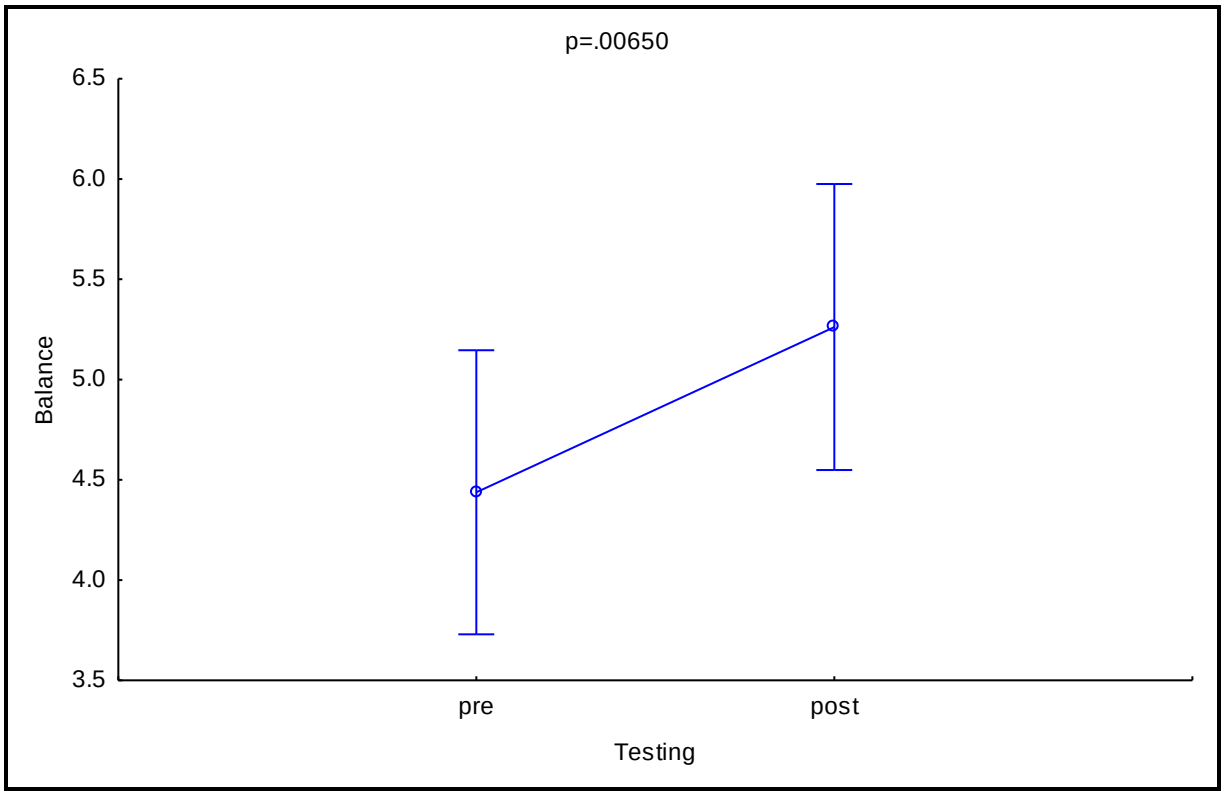

Figure 4.4. **TIME EFFECT ON BALANCE FOR PRE- AND POST-TEST (BOTH GROUPS)**

The Cohen's effect sizes for the aquatic group was 0.54 (medium) and for the land group it was 0.4 (small), indicating that the aquatic group improved more than the land group. However, there was no statistical significant improvement, and the effect size of the land group ranged between small and medium, suggesting a weak improvement. It can be

speculated that the interventions might have had a practical effect on the groups, but more so on the aquatic group.

Gupta *et al*. (2011:427, 429) assessed children with DS with the BOTMP long form and found that the total score increased from 10.50 to 19.50. The study of Gupta *et al*. (2011:429) concluded that a six-week intervention program improved the overall balance of the experimental group significantly (p=0.007) compared to the control group. In the current study, the participants partook in similar exercises and the above-mentioned study, as well as the current study focused on a variety of static and dynamic balance activities. Participants in the Gupta *et al*. (2011:427) intervention began with 10 repetitions per activity, which was later increased by five. However, in the current study balance was not the only focus of the programs, and therefore, the participants only did three repetitions per activity. It can be speculated that if the children in the current study did more repetitions their scores might have increased more. Gupta *et al*. (2011:429) proclaims that in a shorter intervention program the changes in muscle strength can be improved by neural recruitment rather than changes in increased muscle fibres, which might occur in a 12-week program. Lewis and Fragala-Pinkham (2005) conducted a six-week intervention and came to the same conclusion as Gupta *et al*. (2011:426), regarding muscle strength and neural recruitment. According to Lewis and Fragala-Pinkham (2005:35), young children do not show changes in their muscle fibres.

Connolly and Michael (1986:346) found that balance scores were significantly different between a group of children with DS and without DS. Children with DS had lower scores. Connolly *et al*. (1984:1518) conducted a study with children with DS who partook in an Early Intervention Program (EIP), and also found that the children had poor balance deficits Connolly *et al*. (1993) led a longitudinal study with adolescence with DS who participated in EIP as infants and found that the lowest scores were on the balance subtest just like the previous study of Connolly *et al*. (1984). Balance was definitely an obstacle for individuals with DS even though they participated in an EIP.

In the study of Jobling (1998:289), the participants were only assessed and did not participate in an intervention, very low scores in the balance subtest were found. Jobling (1998:289) claims that the balance subtest is the most difficult subtest for children with DS and from 10 years up to adolescence, the balance skills of individuals with DS begin to stabilize at a low level of proficiency. This is a big concern as balance is important for the execution of most other motor tasks. In the current study, there were participants older

than 10 years of age and it is speculated that even at the age of 16 children with DS still struggle tremendously with balance activities.

Most of the above interventions were performed in a land environment and the children with DS showed improvements. In the current study the aquatic group improved more than the land group, and therefore, it can be speculated that the aquatic environment provided more advantages than the land environment. It is also important to keep in mind what the abilities of the participants were that took part in the current study.

BILATERAL COORDINATION

Figure 4.5 shows the results for the bilateral coordination subtest between the land and aquatic groups.

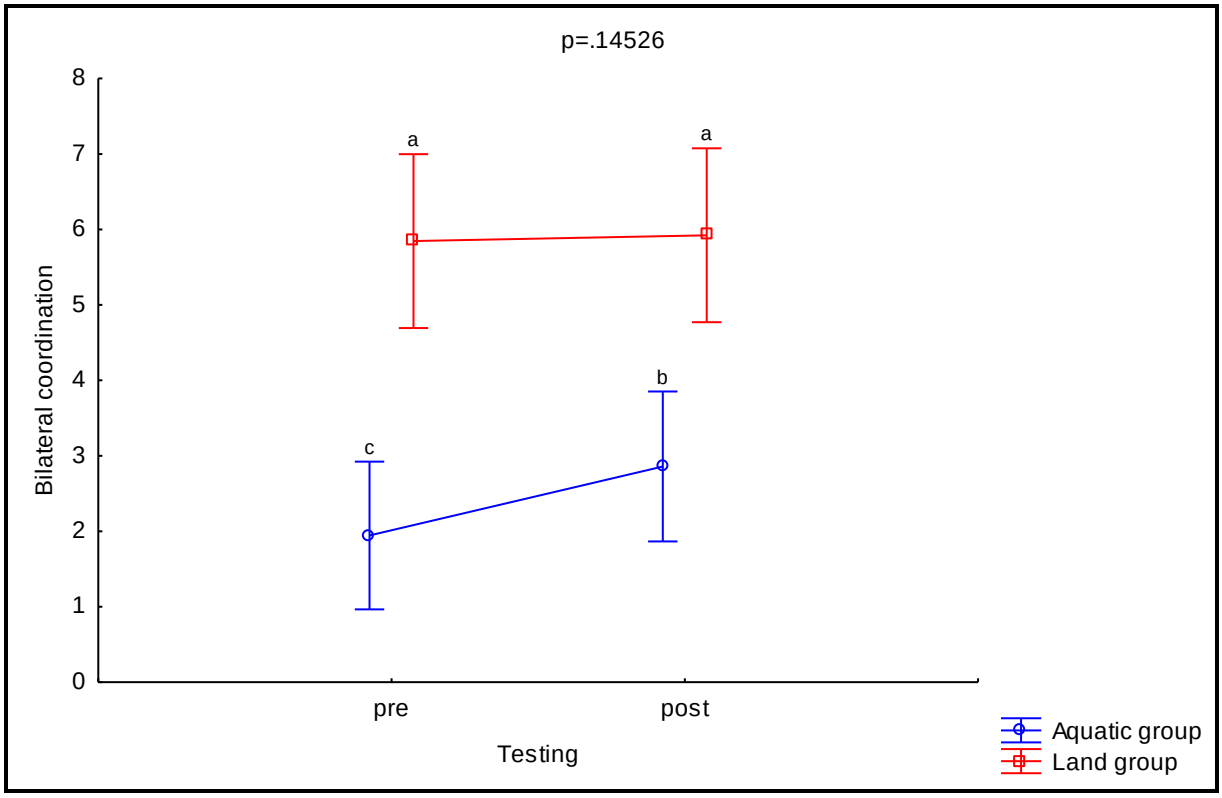

Figure 4.5. **THE OVERALL RESULTS OF BILATERAL COORDINATION (BOTH GROUPS**)

The overall score showed no statistical significant difference (p=0.14). By looking at the results of this subtest the aquatic environment improved bilateral coordination more than the land environment. There was a slight improvement in the aquatic group, and therefore, it can be speculated that the program had an effect, if only slightly, on the aquatic group's bilateral coordination. The aquatic group had a mean pre-test score of 2 and a post-test score of 2.9. The land group had a mean pre-test score of 5.9 and a post-

test score of 5.9, indicating a possible ceiling effect. The land group had a higher post-test score than the aquatic group, and therefore, it can be anticipated that the program had no positive effect on the results of the land group. However, the aquatic group was not on the same level as the land group.

The time effect showed no statistical significant difference (p=0.08) between the pre- and post-test of both groups (Figure 4.6).

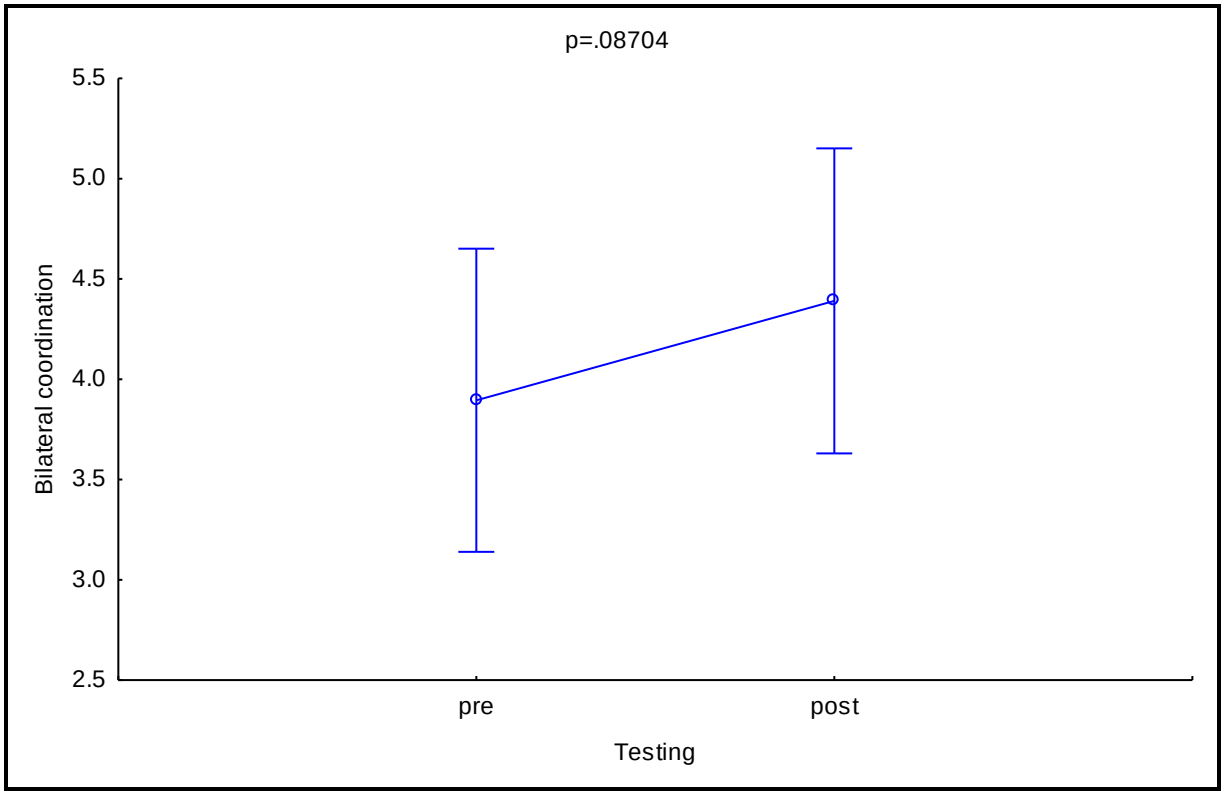

Figure 4.6. **THE TIME EFFECT FOR BILATERAL COORDINATION FOR PRE- AND POST-TEST (BOTH GROUPS)**

The Cohen's effect sizes for the aquatic group was 0.43 (medium) and for the land group it was 0.06 (negligible). This indicates that the land group showed no improvement, but that there was a practical improvement in the aquatic group even though no statistical significance was found.

In the case study intervention of Lewis and Fragala-Pinkham (2005:34), improvements in coordination skills were found. Although the focus of their intervention was on aerobic conditioning and strength, the participant's coordination skills improved. In the current study the land group started off with a higher pre-test score as provided above, than the aquatic group, and therefore, it might be that the type of activities did not really have an impact on land group. The aquatic group showed improvements in their scores. However,

it was experienced that the children with DS struggled to understand the activities and how to execute them, especially a jumping jack.

FINE MOTOR INTEGRATION

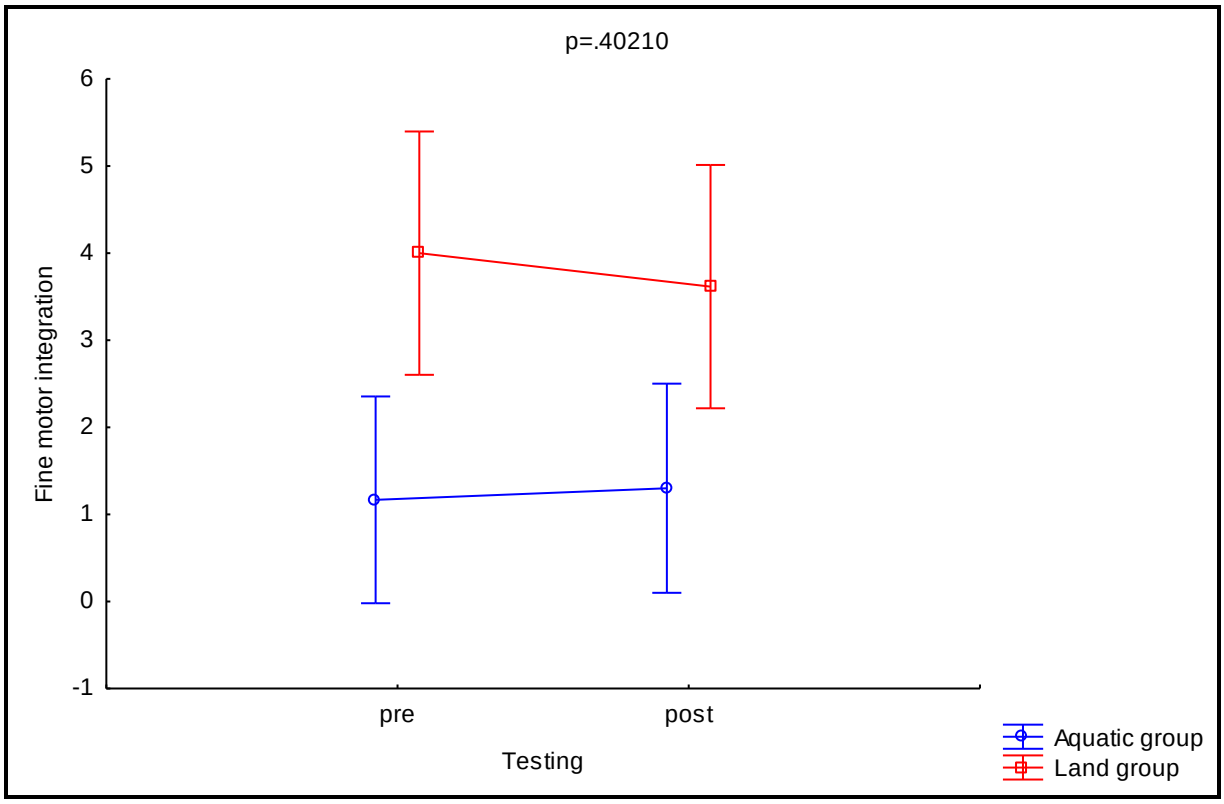

Figure 4.7. **THE OVERALL RESULTS FOR FINE MOTOR INTEGRATION FOR BOTH GROUPS**

The fine motor integration subtest did not show a statistical significant difference (p=0.40) between both groups. The aquatic environment had a minor effect on the fine motor integration skills of the participants and the land environment showed no enhancing effects. The land groups pre-test score was 4 and the post-test score was 3.6. The aquatic group's pre-test score was 1.1 and the post-test score was 1.3. It is visible that there was a slight decrease from the pre- to post-test of the land group. By comparing the two groups, the aquatic group improved more than the land group.

The time effect showed no statistical significant difference (p=0.68) between the pre- and post-tests of both groups (Figure 4.8).

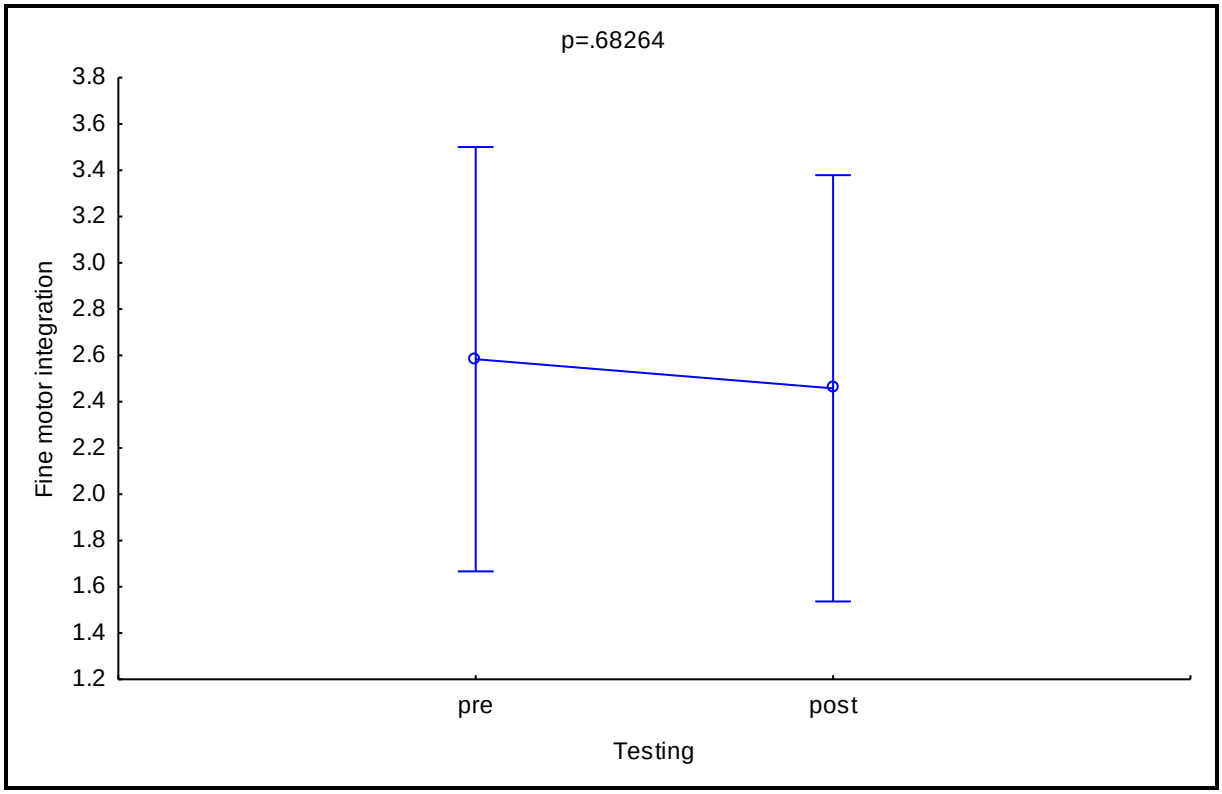

Figure 4.8. **TIME EFFECT FOR FINE MOTOR INTEGRATION FOR PRE- AND POST-TESTS (BOTH GROUPS)**

The Cohen's effect size for the aquatic group was 0.08 (negligible) and 0.15 (small) for the land group. These scores are very weak and did not show any trend. The land group, however, improved slightly more than the aquatic group.

The current study did not focus on the improvement of the children's fine motor skills. According to Jobling (1998:291), a possible reason for the low scoring results of the fine motor tasks in their study could be the result of the low level of arm and shoulder strength in the participants, which could have affected their writing.

FINE MOTOR PRECISION

The results of fine motor precision between the aquatic and land groups are showed in Figure 4.9.

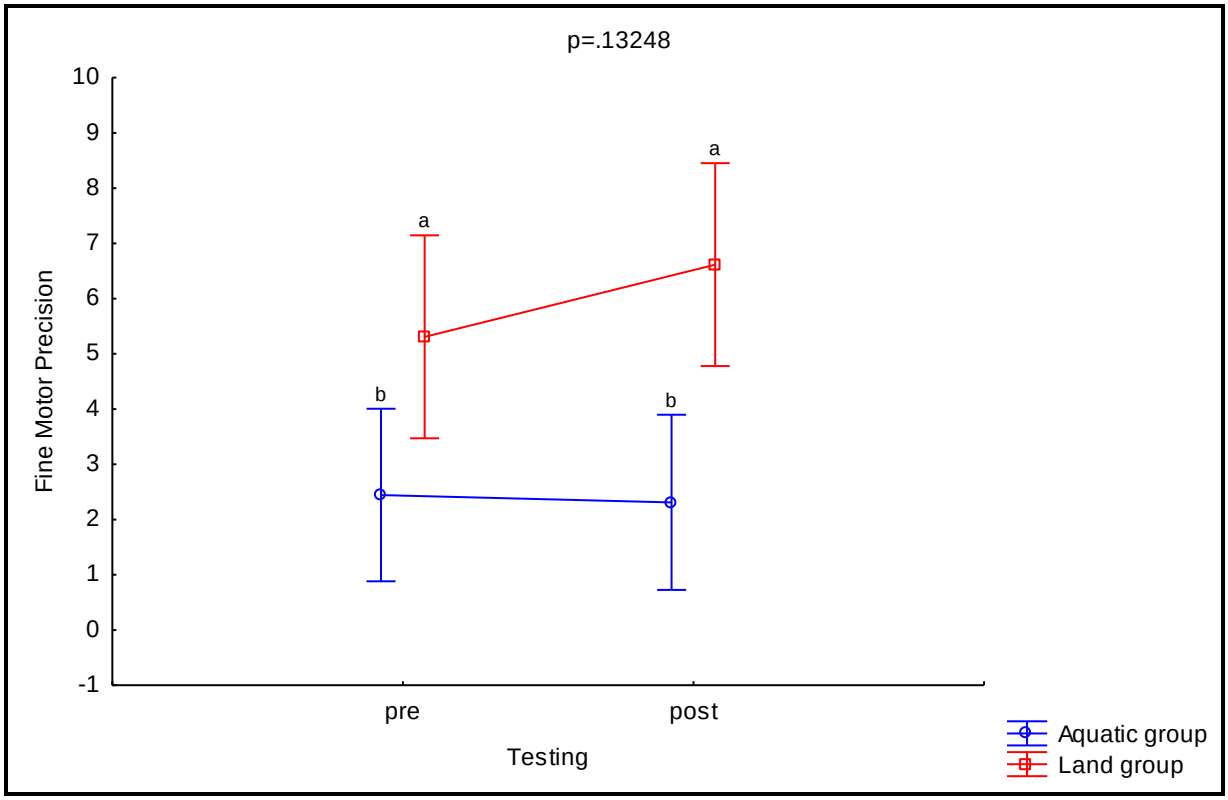

Figure 4.9. **THE OVERALL RESULTS FOR FINE MOTOR PRECISION (BOTH GROUPS)**

This subtest showed no statistical significant difference (p=0.13) between the aquatic and land groups. By studying Figure 4.9 it is clear that the aquatic environment did not improve fine motor precision, but the score of the land group improved. The land group had a mean pre-test score of 5.2 and a post-test score of 6.8. By comparing the two groups, a slight improvement in the land group in comparison with the aquatic group can be observed.

The time effect showed no statistical significant difference (p=0.21) between the pre- and post-tests of both groups (Figure 4.10).

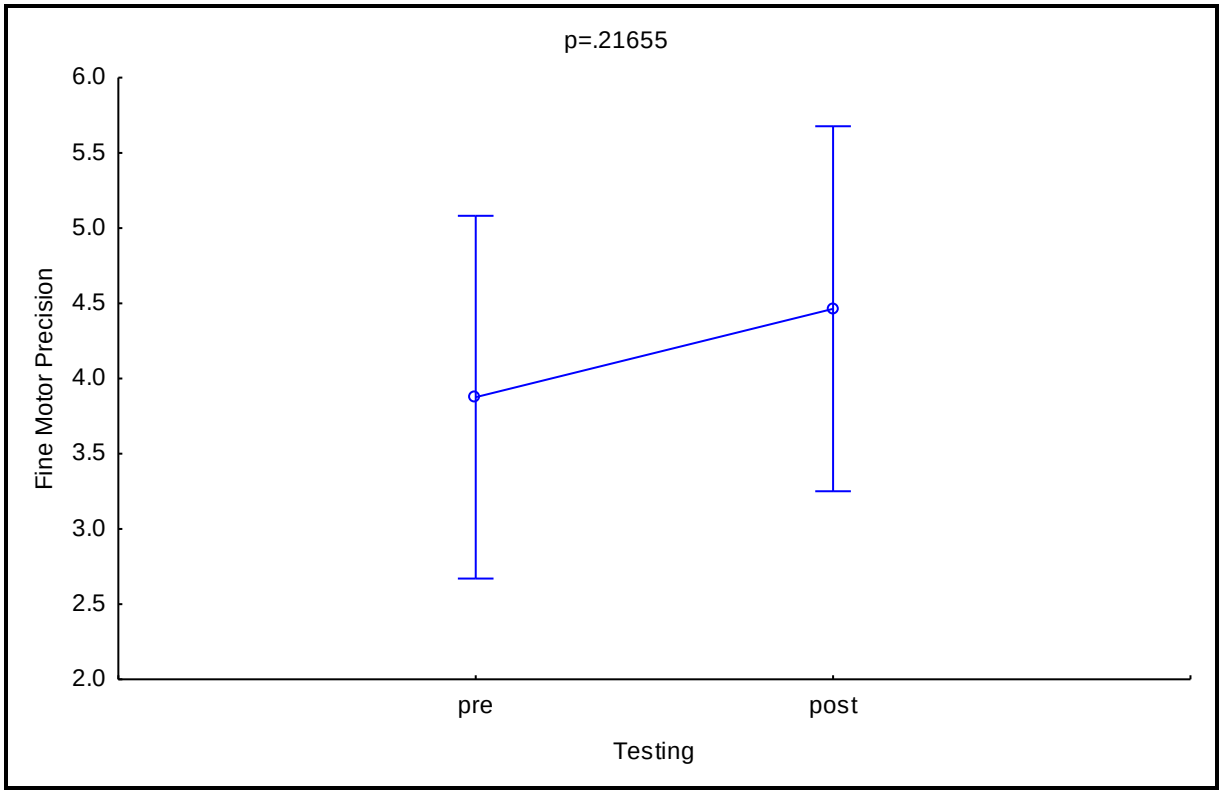

Figure 4.10. **THE TIME EFFECT FOR FINE MOTOR PRECISION FOR PRE- AND POST-TEST (BOTH GROUPS)**

The Cohen's effect size of the aquatic group was 0.01 (negligible) and 0.49 (medium) for the land group. The practical effect size of the land group was relatively bigger than the aquatic group, indicating that there was a big difference in the results between the two groups.

Connolly *et al*. (1993:177), observed in their study that the children were extremely precise and accurate during the assessments. In the current study it was observed that the participants took their time and were very precise. The intervention programs of the current study did not aim to improve fine motor skills although it can be assumed that the land group benefitted from the program and showed quite a big improvement. The cool down activities focused partially on visual-motor integration and this might have had an effect on the land group's post-test scores.

MANUAL DEXTERITY

The overall results of manual dexterity for both groups are found in Figure 4.11.

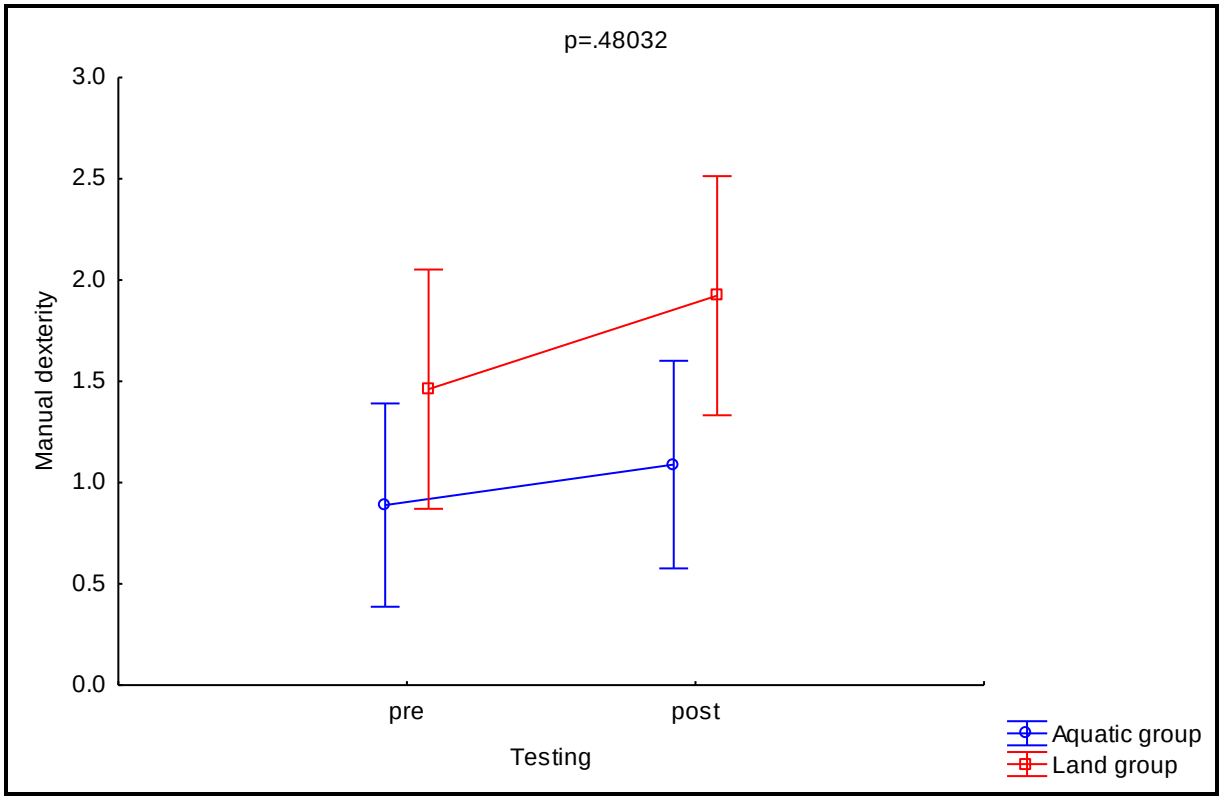

Figure 4.11. **THE OVERALL RESULTS FOR MANUAL DEXTERITY (BOTH GROUPS)**

It seemed as if the land group increased slightly more than the aquatic group in manual dexterity, indicating that the land environment improved manual dexterity more than the aquatic environment. The aquatic group had a mean pre-test score of 0.9 and post-test score of 1.1. An improvement of just 0.2, whereas the land group had a mean pre-test score of 1.4 and a post-test score of 1.85. Implying an improvement of 0.65 (Figure 4.11).

The time effect (Figure 4.12) indicates no statistical significant difference (p=0.08) between the aquatic and land groups.

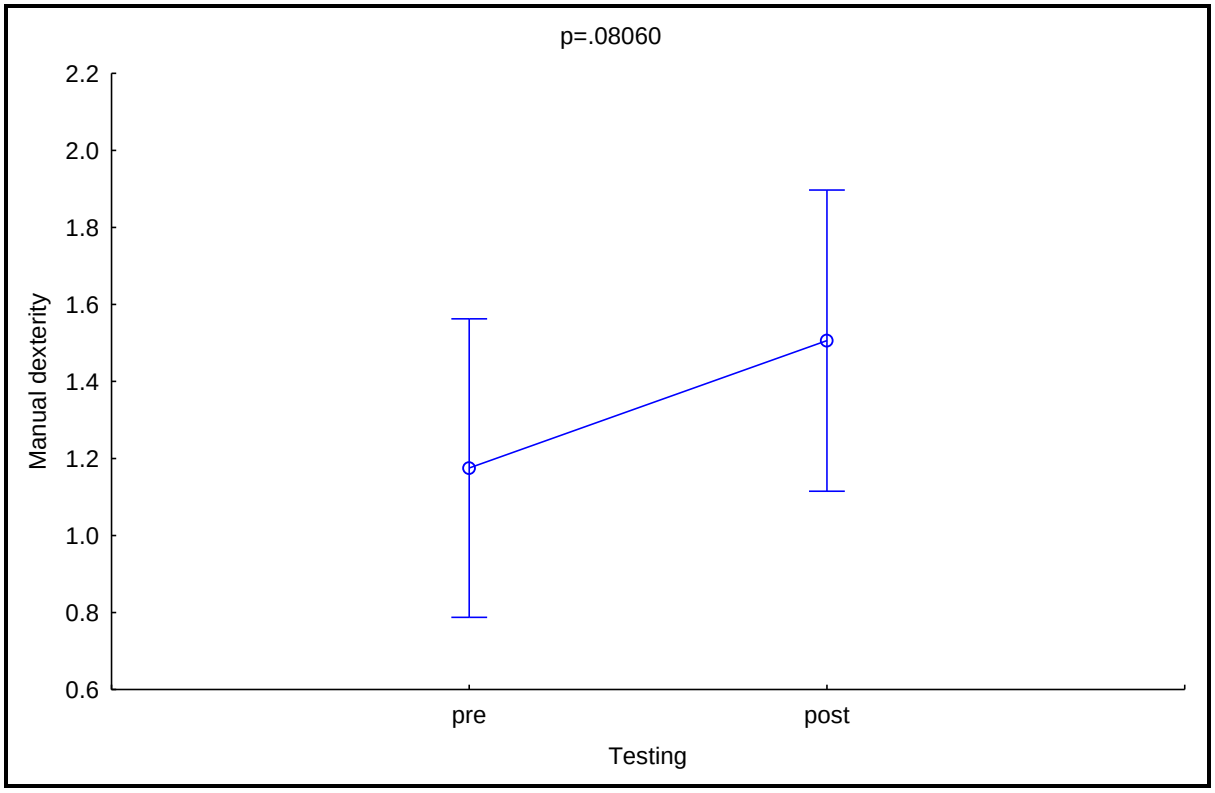

Figure 4.12. **THE TIME EFFECT FOR MANUAL DEXTERITY FOR PRE- AND POST-TEST (BOTH GROUPS)**

The Cohen's effect size of the aquatic group was 0.24 (small) and the land group was 0.43 (medium). To some extent the land group improved more than the aquatic group by looking at the Cohen's effect sizes. The trend is not very strong due to no statistical significant improvement and that the effect size of the land group was relatively small. The intervention programs did not aim to improve the children's manual dexterity. According to the researcher's knowledge, no research has been conducted on the manual dexterity subtest on children with DS.

RUNNING SPEED AND AGILITY

Figure 4.13 displays the overall results of running speed and agility of the aquatic and land groups.

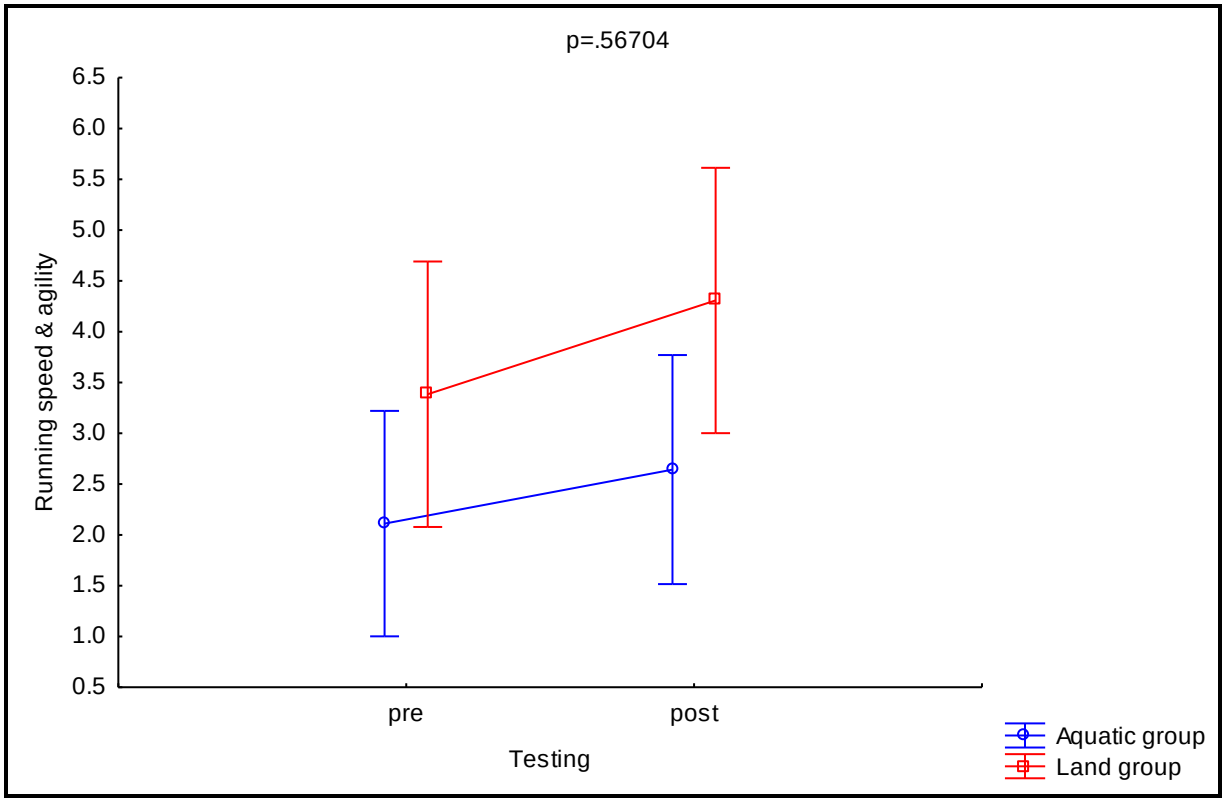

Figure 4.13. **THE OVERALL RESULTS FOR RUNNING SPEED AND AGILITY (BOTH GROUPS)**

Although no statistically significant results was found there was a definite improvement in both groups, with the land group showing a greater improvement. It can be contemplated that the land intervention had a greater effect on running speed and agility than the aquatic intervention. The land group had a mean pre-test score of 3.4 and a post-test score of 4.3, while the aquatic group had a mean pre-test score of 2.1 and a post-test score of 2.6. The land group improved with a mean score of 0.9 and the aquatic group with a mean score of 0.6. It can be speculated that both environments had a positive effect on the running speed and agility because both groups improved from pre- to post test.

One of the objectives of the current study was to improve dynamic and static balance. It is, therefore, speculated that this objective might have improved running speed and agility. Connolly *et al*. (1993:175) concluded in their study that children with DS performed poorly in running speed without even participating in any intervention. According to Connolly *et al*. (1984:1518), hypotonia plays a very big role in the functioning of children with DS, which contributes to low scores in running speed. Adolescents, who participated in an EIP, scored the lowest in running speed (Connolly *et al*., 1993:171). In comparison with other studies that Connolly *et al*. (1993:175) conducted previously, the results were

very similar (Connolly *et al*., 1984:1518). The researchers of these studies hypothesized that a possible reason for the low scores in balance and running speed may be related to the neuropathological foundations in the brain (Connolly *et al*., 1993:171).

The time effect for running speed and agility between the pre- and post-test for both groups showed a statistical significant difference (p=0.04) (Figure 4.14).

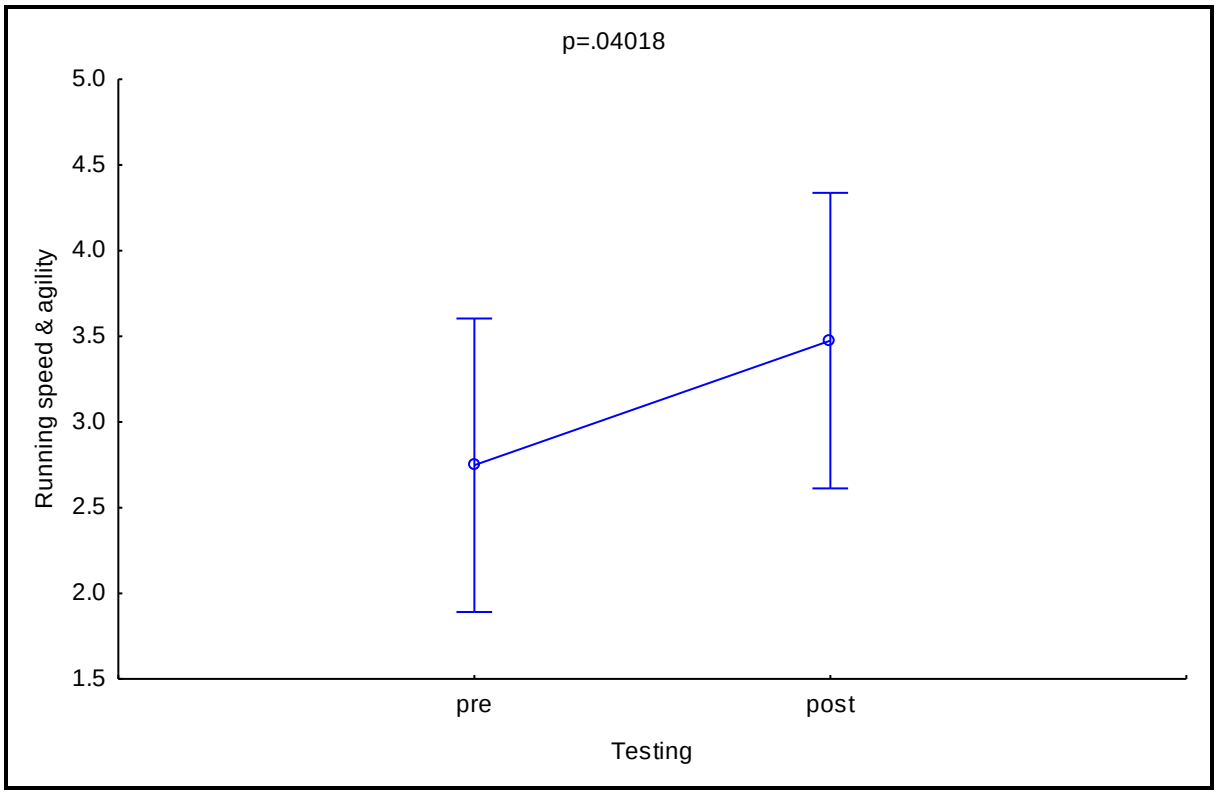

Figure 4.14. **TIME EFFECT FOR RUNNING SPEED AND AGILITY FOR PRE- AND POST-TEST (BOTH GROUPS)**

The Cohen's effect sizes for the aquatic group was 0.26 (small) and for the land group it was 0.38 (small). These result did not show a very strong trend and the practical improvement of both groups were minimal although the land group was very close to a medium effect size of 0.4.

Jobling (1998) assessed children with DS and found that some of the children recorded higher scores than their chronological age category in the running speed and agility subtest, which showed that some children with DS are capable of executing these movements correctly and that they could even perform better. These results are similar to the results of the current study. In the current study it can be assumed that the land group found the activities a bit easier than the aquatic group, and therefore, they were able to execute the activities correctly. In some cases, the land group participants

attempted to perform the progressions, whereas the aquatic group struggled with the activities and did not always understand what to do. Only the older children in the aquatic group were able to do some progressions.

STRENGTH

The results of the strength subtest for both groups are indicated in Figure 4.15.

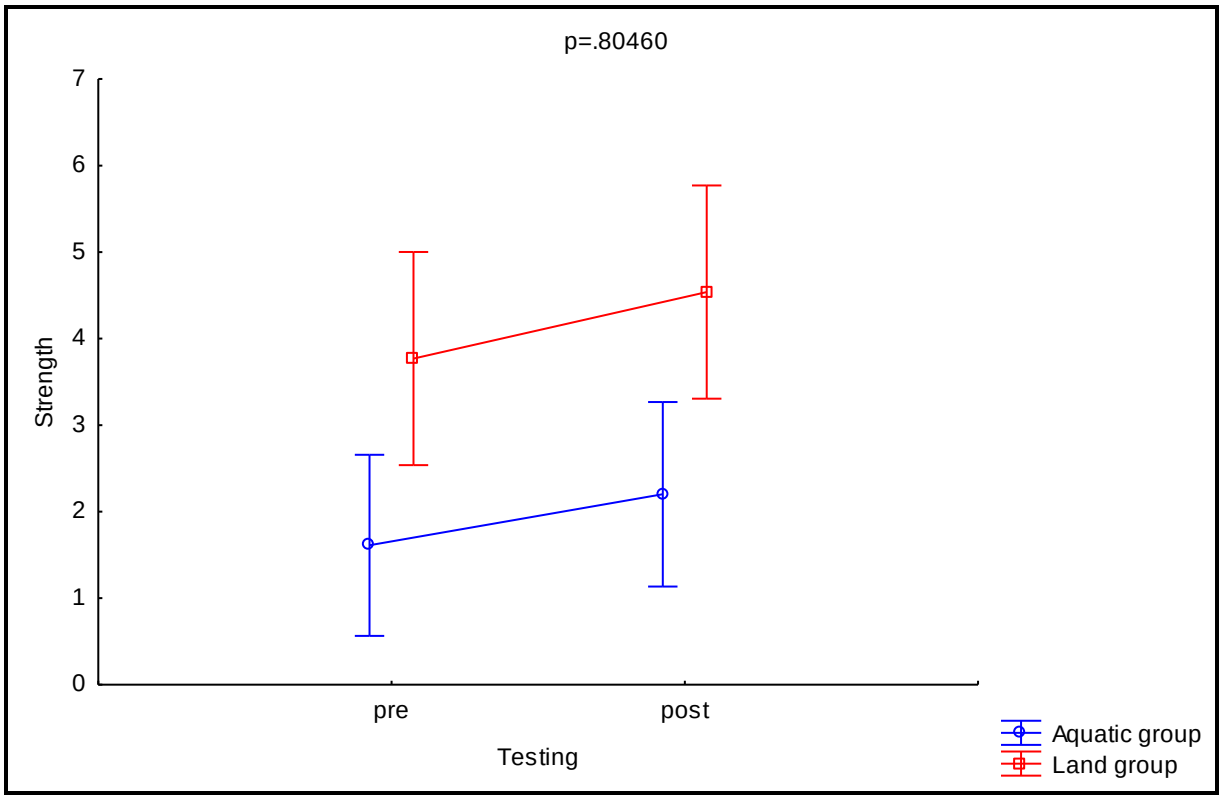

Figure 4.15. **THE OVERALL RESULTS FOR STRENGTH (BOTH GROUPS)**

There was a slight improvement in both groups (Figure 4.15). It seemed as if the land and aquatic environments had the same effect on the results of both groups. The aquatic group had a mean pre-test score of 1.6 and a post-test score of 2.2. The land group had a mean pre-test score of 3.8 and post-test score of 4.5. Fragala-Pinkham *et al*. (2008:826) found that performing activities in an aquatic environment might be easier for children with balance problems due to the water support and buoyancy. The reason for no significant differences in strength in the current study might also be because the programs did not spend enough time during each session on the strength component, and that in the aquatic program the water did not provide enough resistance. During the sessions the children were asked to increase their pace, but it was observed that they did not really comply.

In the case study of Lewis and Fragala-Pinkham (2005:33), the participants showed significant improvements in upper and lower body strength. The improvements can be attributed to the strength training program in which the participant started off with two sessions per week, which increased to three by the third week. Another aspect that played a big role in this case study is the home program that the participants participated in on the other days. Improvements in participant's GMS can be due the increased number of repetitions for each activity (Wang, 2004:40).

The time effect showed no statistical significant difference (p=0.06) (Figure 4.16).

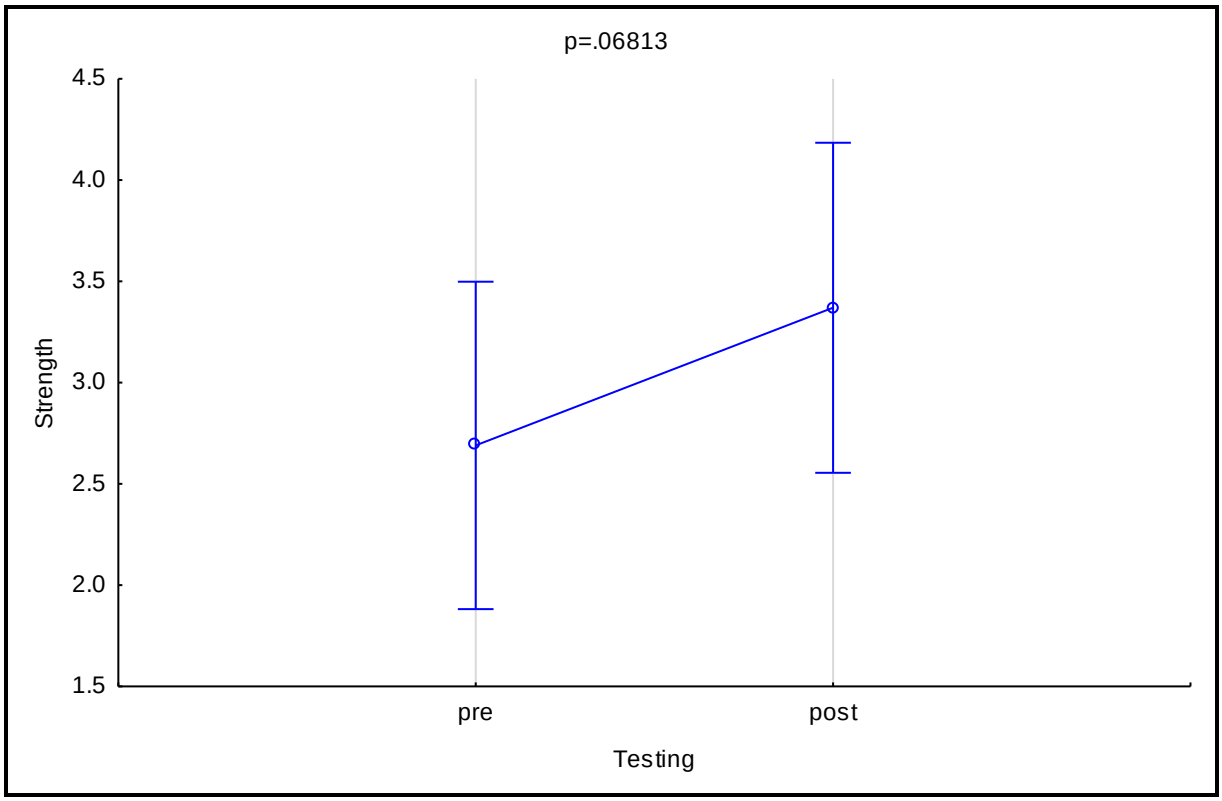

Figure 4.16. **THE TIME EFFECT FOR STRENGTH FOR PRE- AND POST-TEST (BOTH GROUPS)**

The Cohen's effect sizes of the aquatic group were 0.23 (small) and 0.39 (small) for the land group. As mentioned above, the aquatic and land groups improved with same amount of points from the pre- to post-test, but according to Cohen's effect sizes the practical improvement of the land group was higher than that of the aquatic group.

Connolly *et al*. (1993:171) found that children with DS, performed poorly in the strength subtest. In the study of Jobling (1998:291), children with DS struggled with the correct execution and a lack in skill in the strength subtest. As seen in Appendix D, the children in the current had to do sit- and push-ups for this subtest. The push-up could be done on

the knees or a full push-up. Only five out of 99 children with DS in Jobling (1998) study were able to maintain a full push-up. In the current study the children with DS also struggled with this subtest during testing, as well as performing the correct technique.

Connolly *et al*. (1984:1516) found that the strength subtest had the highest scores overall, which is contrary to Connolly's *et al*. (1993:171) and Jobling's (1998:291) study results. The fact that the children in the Connolly *et al*. (1984) study participated in an EIP previously, and that the program focused on a variety of strength activities could perhaps have led to these results. Connolly *et al*. (1984:1518) concluded that the children who participated in EIP showed better results and improved their functioning. They recommend EIP for children with DS because the program provides a solid foundation. In the current study none of the children with DS had any exposure to EIP and most of the activities were fairly new to them. The researcher and assistants had to demonstrate each activity and correct them as the children executed the activities.

UPPER-LIMB COORDINATION

In Figure 4.17 the results of upper-limb coordination for both groups are displayed.

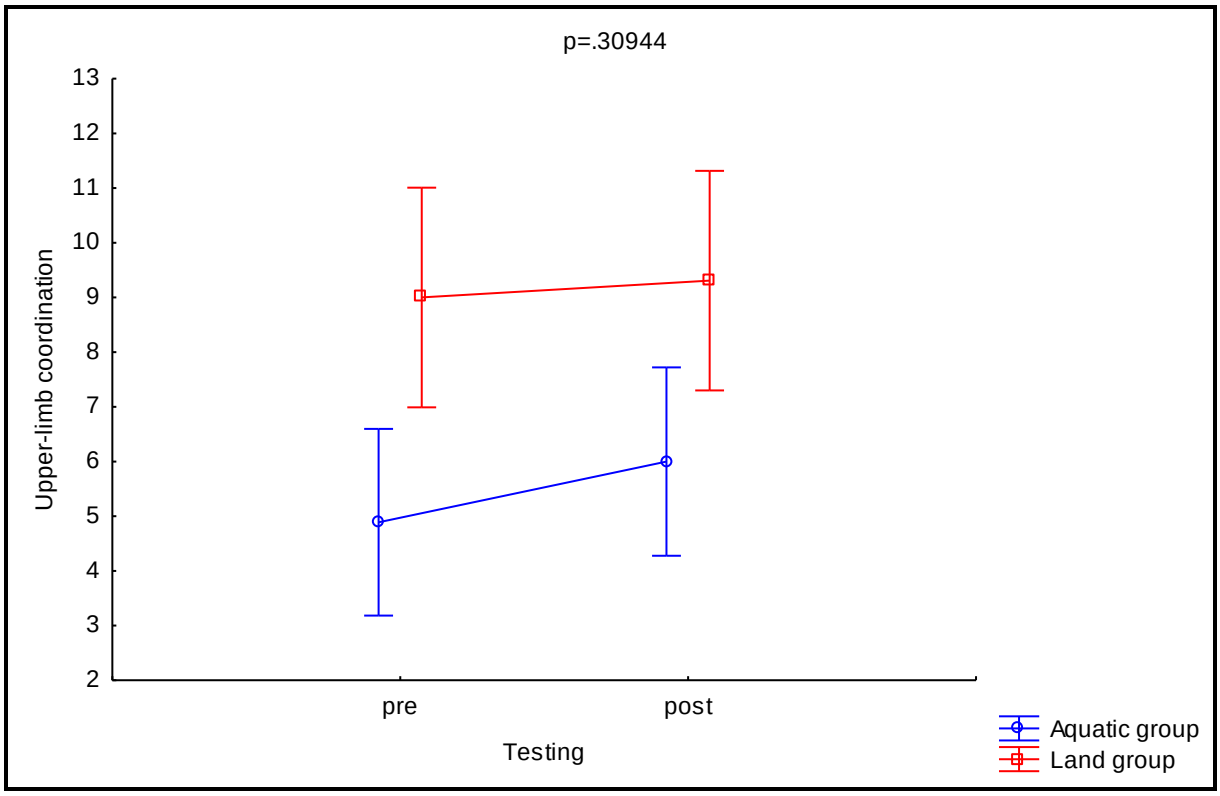

Figure 4.17. **THE OVERALL RESULTS OF UPPER-LIMB COORDINATION (BOTH GROUPS**

In the upper-limb coordination subtest there was a tendency of slight improvement in the aquatic group and a minor improvement in the land group. The aquatic group had a mean pre-test score of 4.95 and a post-test score of 6 and improved with a score of 1.05. The land group began very high, which could also be regarded as a possible ceiling effect. By studying the results, the aquatic intervention had a more positive effect in this subtest than the land intervention. Even though the children in the aquatic group showed such a big improvement, they were below the land group's pre-test score. It can be speculated that perhaps if the land group was in the aquatic environment their results would have improved more in this subtest. Connolly and Michael (1986:347) found similar results than the current study. In the upper-limb coordination subtest they found no statistical significant differences between children with and without DS.

The time effect indicated in Figure 4.18 showed no statistical significant difference (p=0.07).

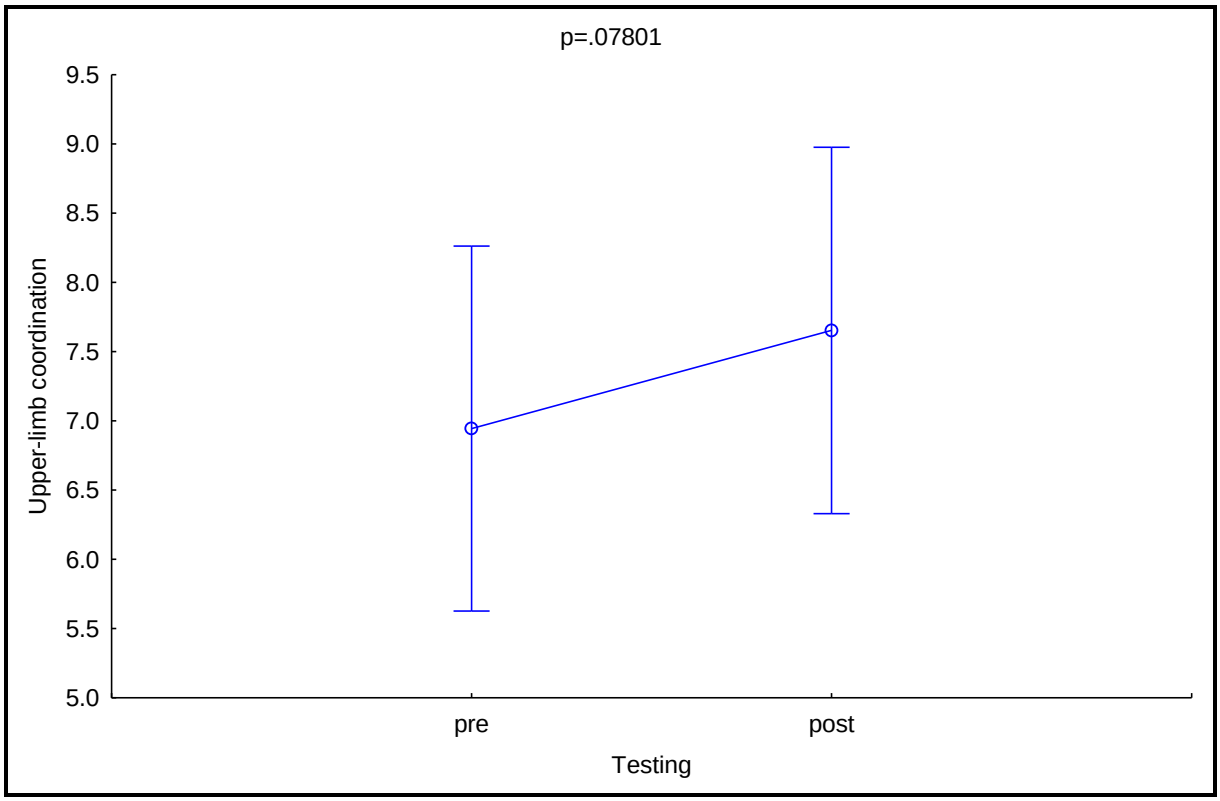

Figure 4.18. **TIME EFFECT FOR UPPER-LIMB COORDINATION FOR PRE- AND POST-TEST (BOTH GROUPS)**

The Cohen's effect sizes for the aquatic group was 0.33 (small) and for the land group it was 0.14 (negligible). These results indicate that there was a small practical improvement in the aquatic group, but none in the land group.

The study by Jobling (1998), looked at different parameters of motor development in children with DS and found that they showed significant higher scores in upper-limb coordination subtest, especially between the ages of 10- to 12-years. Several boys had higher scores than their chronological age, which revealed they could reach higher levels of proficiency. Connolly *et al*. (1984) assessed children with DS' long-term functioning after they participated in an EIP and compared the results with children that did not participate in an EIP. After they assessed the children the highest scores were on the upper-limb subtest, thus indicating that the intervention they partook in showed enhancing results in upper-limb coordination.

To summarize, the aquatic group improved more than the land group in the following subtests: balance; bilateral coordination; fine motor integration; and upper-limb coordination. The land group improved more than the aquatic group in the following subtests: fine motor precision; manual dexterity; and running speed and agility. Both groups improved with the same score in the strength subtest.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

INTRODUCTION

In this chapter conclusions about the descriptive statistics, overall score and each subtest of the BOT-2 will follow. Limitations of the study and relevant recommendations will be discussed, as well as advice for future intervention programs and research in this field. The conclusions will be based on the results of the specific intervention program and post-test.

GROSS MOTOR SKILL LEVELS (DESCRIPTIVE STATISTICS)

After the pre-test, it was clear that both groups struggled with balance, running speed and agility, strength and upper-limb coordination. Even though the aquatic and land groups were not on the same level when the interventions began, the outcomes of the programs were similar.

In the sections that follows, the overall scores and scores of each subtest will be discussed, followed by a conclusion of each subtest stating which environment enhanced the GMS the most.

OVERALL SCORE

During the interventions, the researcher can assume that both the land and aquatic group improved their GMS. The post-test results indicated that both groups improved with the same amount of points from the pre-test. Therefore, it can be speculated that the practical differences between the groups were the same. Cohen's effect sizes indicated that there was a practical difference between the two groups, with the land group exhibiting a more prominent and significant practical difference than the aquatic group. Thus, even though their final score improved with the same amount, the interventions had a different practical effect on the groups.

It can be concluded that the results of the current study were similar to what other studies have found. Furthermore, by implementing an intervention that focuses on balance, coordination and strength will have significant and positive effects on children with DS, whether or not it is an aquatic- or a land-based program. Although other studies focused on different motor skills and the duration of the intervention programs were slightly longer, they found similar results.

BALANCE

Post intervention, the aquatic group improved more than the land group in the balance subtest. Cohen's effect sizes indicated a practical difference between the two groups. It can, therefore, be concluded that the land group had a small practical difference, which was not significant, while the aquatic group had a medium effect size. The aquatic group's improvement might be ascribed to their low starting score. The results correspond to other studies who also found that children with DS improved their balance scores in an aquatic environment. However, other studies also found that children with DS improved in a land-based environment as well.

Taking everything into consideration, it can be speculated that the support of the water, the extra kinesthetic feedback that the aquatic environment provides, and taking the fear of getting hurt when falling away, could have contributed to a greater improvement in balance for the aquatic group.

BILATERAL COORDINATION

The land group showed no statistical improvement between the pre- and post-test, although they began with a high pre-test score, therefore, it can be concluded that the intervention had no effect on bilateral coordination. The aquatic group improved their score and the Cohen's effect sizes showed that they had a medium practical improvement, which indicated that either way during the intervention their bilateral coordination improved. It is speculated that the natural viscosity and soothing effect that the aquatic environment offers could have led to the improvement of the aquatic group.

FINE MOTOR INTEGRATION

The land group showed a slight decrease in their score and the Cohen's effect sizes showed that there was a small practical improvement in their results. The aquatic group improved slightly, but not enough to show significant improvement and there was no practical improvement in their scores. It can, therefore, concluded that there was no practical difference in the impact of the choice of environment on the outcome of fine motor integration after the intervention. This was not a focus of the current intervention.

FINE MOTOR PRECISION

It can be concluded that the land group improved their score post the intervention period and had a medium practical improvement according to the Cohen's effect sizes. Whereas, the aquatic group had contrasting result with the land group and showed no improvement. This was not a focus of the current intervention.

MANUAL DEXTERITY

For this subtest it can be concluded that the land group improved slightly more than the aquatic group because their practical difference was greater than the aquatic group. The land group had a medium practical improvement and the aquatic group a small practical improvement according to the Cohen's effect sizes. This was not a focus of the current intervention.

RUNNING SPEED AND AGILITY

It can be concluded that the land group showed a greater improvement in their running speed and agility skills than the aquatic group. The Cohen's effect sizes of both groups indicated that there was a small practical improvement at the post-test. The minor improvements of the aquatic group, could suggest that the intervention program did not have a large effect on the results.

STRENGTH

For the strength subtest it can be concluded that the land and aquatic group improved with exactly the same amount of points post intervention. However, the land group had a more prominent practical improvement than the aquatic group. Both groups had small Cohen's effect sizes, but the land group's score was slightly higher, on the borderline of reaching a medium effect size. Although their scores were the same it is speculated that the intervention program might have had a bigger impact on land than in the aquatic environment.

UPPER-LIMB COORDINATION

It can be concluded that the aquatic group improved their mean score and Cohen's effect sizes, indicating a small practical improvement. However, the land group's mean score did not improve at the post-test and no practical improvement was found in their results. Therefore, it seemed as if the program did not have an effect on the land group's upper-limb coordination, but it had an effect on the aquatic group. Consequently, it might be stated that the land activities were not effective because it showed no improvement in the results.

SUMMARY

The land and aquatic based intervention programs had different impact levels. It was hypothesized that the aquatic program would have a greater impact, but the results of the intervention program is not supportive of this hypothesis. Thus, the H1 was rejected.

Table 5.1 below provides a summary of the findings from the various environments. The findings were based on the Cohen's D effect sizes. The suggested environment is highlighted in yellow.

TABLE 5.1. **SUMMARY OF THE VARIOUS ENVIRONMENTS**

Subtests	**Aquatic Environment**	**Land Environment**
Overall Score	Small Improvement	Medium Improvement
Balance	Medium Improvement	Small Improvement
Bilateral Coordination	Medium Improvement	Negligible Improvement
Fine Motor Integration	Negligible Improvement	Small Improvement
Fine Motor Precision	Negligible Improvement	Medium Improvement
Manual Dexterity	Small Improvement	Medium Improvement
Running Speed and Agility	Small Improvement	Small Improvement
Strength	Small Improvement	Small-medium Improvement
Upper limb coordination	Small Improvement	Negligible Improvement

From the summary above it can be speculated that the overall scores did not indicate any improvement. However, it is clear that the two environments did have an impact on the scores of the different subtests. It is, therefore, concluded that it is important to consider the needs of a child with DS before choosing an environment for the intervention.

LIMITATIONS

The following limitations with reference to: intervention setting; participants; general and the program will be discussed.

Intervention setting:

- ***A combination of setting and group* size:** The group setting made individual attention impossible. It was difficult to give extra attention to children that struggled with specific activities, as well as to ensure that they completed all the repetitions.
- ***Age*:** The younger children were more challenging and needed constant attention. The ideal setting would be one-on-one sessions, but unfortunately during the current study it would have taken up too much time and less children would have been part of the study. There was a wide age range which made the intervention more challenging. The reason for the large age gap between the children in such

a small sample size was because this was a sample of convenience and the researcher took all the children at each school that met the inclusion criteria.

- ***New environment*:** The first week of the aquatic intervention was challenging. It was a new environment for the aquatic group and most of the participants were not habitually exposed to a swimming pool, and therefore, the majority just wanted to play around and consequently struggled to follow instructions. The second session during the first week was more productive.

Participants:

- ***Concentration*:** In the group setting, the children began to play with the other children, showed off or threw tantrums. All of the activities had two or three repetitions and during the last repetition some of them began to lose concentration.
- ***Duration of exercise*:** Children in the aquatic group did not always complete the activities properly. The aquatic groups would begin to throw and catch a ball and after 10 seconds they would turn around and walk away. Therefore, the duration of the activities was not too long, but they lost complete concentration and interest.
- ***Endurance*:** The children fatigued quickly and lacked endurance.
- ***Sample size*:** The sample size was too small. The reason for the small sample size was due to logistical and transportation factors.
- ***Mood swings*:** The children's mood swings had a possible effect on the outcome of each session. Sometimes the children arrived at a session and they would refuse to participate and give their cooperation. There were only 14 sessions during the intervention, each session was very valuable and if the children had a bad day this affected their improvement, as well as the amount of sessions that they partook in.
- ***Absenteeism*:** During the winter, some children got sick regularly and because of the logistical circumstances of getting to school, some missed a session or two. More participants were absent in the aquatic group than the land group. The researcher kept record each week of who showed up at the intervention or who missed a session. The researcher can therefore speculate that this could have influenced the aquatic group's results.
- ***Progressions*:** Only the older children were able to progress, however, they struggled with endurance during the sessions.
- ***Aquatic group:*** It was observed that the aquatic group's children were less exposed to physical activities in their daily routine and tended to lead a more

sedentary lifestyle than neuro-typical children. This is pure speculation. Due to the fact that the aquatic group had lower baseline values than the land group, physiologically they would improve more than a group with higher baseline values.

- ***Testing:*** Some children struggled to complete the pre- and post-testing and received very low scores, due to non-randomization there was no control on the abilities of the children.

General:

- ***Control group*:** Although the research question was to compare the effect of an aquatic with a land-based intervention program, the incorporation of a control group would have enriched the study. Due to resources and time made it was impossible to recruit more children with DS to participate in a control group. There is research that supports studies with no control groups, seeing that it is better for children to participate in physical activities than to do nothing.
- ***Results:*** The researcher can only speculate that the children improved from a learning effect or due to the intervention as there was no control group.
- ***Body composition*:** The majority of the aquatic group's children were overweight, and therefore, struggled to pick up the pace during endurance activities when they needed to.
- ***Language*:** Language was a barrier with some of the groups. The majority of two land group's home language were Afrikaans or English, which was not a problem, but most of the aquatic groups children were Xhosa. Although they understood English, they did not always respond immediately and an instruction had to be repeated a few times.
- ***Environment*:** The land group had an advantage because their sessions took place at their schools, which was a familiar and comfortable environment for them. The aquatic group's children have never been at a swimming pool before and it was new and different for them.
- ***Logistical*:** The transport and logistics to the swimming pool and back was very challenging and took a lot of valuable time.
- ***BOT-2*:** There is no evidence regarding the reliability and validity that the BOT-2 test battery is specifically the best test battery for children with DS. Although, numerous studies have used the BOT-2 on children with DS and the specific focuses and outcomes of the intervention, the BOT-2 was the best test battery in this study.

The program:

- ***Aquatic group:*** It was difficult to see if the children executed the activities correctly as well as to assist them because their lower extremities were under water.
- ***Balance:***

  - Both groups found the static and dynamic balance (hopping on one leg) activities quite difficult, and therefore, needed assistance, especially the younger children.

  -The children got very confused between their dominant and non-dominant leg.
- ***Coordination:***

  -The children were able to understand the activities, but they struggled to combine upper and lower body movements. Some children were very rigid and tense and struggled to do the activities in a comfortable manner.

  -Some children in the aquatic group struggled to have fluent and flexible movements during the activities, which led to uncoordinated movements.

  - During hand-eye coordination activities it was observed that the children did not use enough strength to successfully complete the activities.
- ***Strength:*** The land group were able to use heavier objects, whereas the aquatic group struggled to use a 3kg medicine ball.

RECOMMENDATIONS

The following recommendations are proposed for future studies and intervention programs:

General:

- ***Intervention period*****:** Most studies recommend a 10- to 12-week intervention. A three to four-week longer intervention might show better improvements and if children are absent or sick, they will have more time to gain improvements.
- ***Current intervention*****:** Although the current intervention was shorter than most other interventions, there was still statistical significant improvements, and therefore, a shorter intervention can be recommended.
- ***GMS*****:** When comparing a land and aquatic program with each other it is recommended that the groups GMS levels are more or less on the same level according to the results of the pre-test. Improvements would be clearer, as well as which environment improves their GMS more.

- ***Methods:*** This was a sample of convenience, participants were not randomly selected. Randomization would have been better, unfortunately due to practical constraints it was not possible. In future studies the researcher would like to do this.
- ***Participants:*** To have a larger sample size with smaller age differences.
- ***Aquatic group*****:** It is recommended that perhaps the aquatic group would benefit more out of a land intervention, firstly to ensure that they understand and execute the activities correctly, and thereafter, to only undergo an aquatic intervention.
- ***Equipment*****:** Be creative with the equipment during the sessions to make it fun for the children.
- ***Alternatives*****:** Instead of using a medicine ball the whole time, make use of alternatives.
- ***BOT-2*****:** In the future test-retest reliability can be done on children with DS with the BOT-2.
- ***Future studies:*** In the future to determine the GMS of children with DS at baseline (descriptive research) a very large sample size (100-150 participants) would be needed.
- ***Play:*** It is recommended that the children must play more during the day, this will perhaps get them more active and they would fatigue less.
- ***IQ Levels:*** In future it would be interesting to get access to the children's IQ levels.
- ***Medical History:*** It would be recommended in the medical form for parents to indicate if their child have trisomy 21 or mosaic DS.
- ***Collaborative studies:*** It the future it would be recommended to perhaps collaborate with other provinces to do a larger study.

The program:

The main focuses of the current interventions were static and dynamic balance, hand-eye- coordination and upper and lower body strength activities. For future programs the following areas needs to be revised and assessed:

- ***Balance*****:** Perhaps combine static and dynamic balance in each activity.
- ***Coordination activities*****:** To ensure that the land group also show improvement revise the coordination activities.

- ***Strength*:** Combining upper body strength activities with hand-eye coordination in the intervention program can be an advantage for children with DS.
- ***Movements*:** Focus more on coordination, rhythm and fluent movements of the children when they are executing the activities.
- ***Strength*:** A better combination between upper and lower body strength activities and more own body weight activities (example: push-ups, wheel-barrow walk).
- ***Cardiovascular*:** Incorporate cardiovascular endurance activities to increase the children's fitness levels in order for them to fatigue less and to be able to increase their pace during activities.
- ***Balancing equipment*:** During balance activities unstable surfaces were used as an equipment medium. It is recommended that this should be done away with because the children were unable to balance by themselves. Most of the children transferred their weight onto the object that they were holding on for assistance and not onto the leg that they were balancing on.
- ***Individual attention*:** During future programs more individual care need to be given to children that struggle more. This way the children would receive more individual attention and it will ensure that the activities are performed correctly. Older children with higher cognitive levels are able to understand instructions better and can be placed in bigger groups.

Although the aquatic and land group's GMS levels differed and they did not begin the program on the same level, they still showed significant improvements in specific subtests. The improvements sometimes varied between the environments. The aim of the program was to compare a land-based intervention program with an aquatic-based intervention program to determine which environment will enhance the GMS of children with DS the most. Based on the results that were obtained in the present study, an aquatic and land intervention program can be performed on children with DS and both environments would likely improve their GMS. The current outcome of the study can be seen as an advantage, especially for schools that do not have access to an aquatic environment. This program can be done on land and it would still have the same outcomes.

SUMMARY

It can be concluded that it is possible to implement a nine-week intervention with testing incorporated, and have a positive impact on the GMS development of children with DS. Therefore, a nine-week intervention that fits into a South African school term, can be recommended to improve the GMS of children with DS. A longer intervention can, however, be even more beneficial. It is, therefore, strongly recommended to focus on balance, strength and coordination in the intervention though it is necessary to make a few adaptions for future intervention similar to the one used in the current study. The current study's interventions will give children with DS the opportunity to participate in a recreational setting and to improve their everyday functioning by participating more comfortable in activities and to play more. It gives them a safe space to have the courage to try out activities and to realize that they are capable of performing the activities. This could encourage children with DS to keep on participating in an intervention like this study's one or a similar intervention.

"When you judge someone based on a diagnoses, you miss out on their abilities, beauty and uniqueness."

~Seventy

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ADDENDUM

ADDENDUM A

Table A.1. OUTLINE OF AGES AND GENDER OF PARTICIPANTS

School	Program	Boy	Girl	Age
School GB	Land		√	9
	Land	√		16
	Land	√		16
	Land		√	8
	Land	√		16
School BP	Land	√		12
	Land		√	10
	Land	√		10
	Land		√	14
	Land		√	10
	Land	√		13
	Land		√	14
	Land		√	16
School D	Aquatic		√	8
	Aquatic	√		9
	Aquatic	√		9
	Aquatic	√		14
	Aquatic	√		13
	Aquatic	√		16
	Aquatic		√	16
	Aquatic		√	16
	Aquatic		√	14
School B	Aquatic		√	7
	Aquatic	√		9
	Aquatic	√		12
	Aquatic	√		14
	Aquatic		√	16
	Aquatic	√		10
	Aquatic		√	11
	Aquatic		√	12
	Aquatic		√	8

ADDENDUM B

Table B.1. **OUTLINE OF TIMES AND DATES OF PRE-TESTING**

School	Program	Dates	Times
School GB	Land	11/04/2016	09:30-11:00
		14/04/2016	09:30-10:30
School BP	Land	20/07/2016	11:00-12:30
		22/07/2016	08:30-10:30
School D	Aquatic	15/04/2016	08:30-10:00
		20/04/2016	09:00-11:00
School B	Aquatic	11/10/2016	08:30-10:00
		14/10/2016	09:00-11:00

ADDENDUM C

Table C.1. **OUTLINE OF DATES AND TIMES OF POST-TESTING**

School	Program	Dates	Times
School GB	Land	7/06/2016	09:30-11:00
		9/06/2016	09:30-10:30
School BP	Land	14/09/2016	11:00-12:30
		16/09/2016	08:30-10:30
School D	Aquatic	20/06/2016	08:30-10:00
		22/06/2016	09:00-11:00
School B	Aquatic	1/12/2016	08:30-10:00
		2/12/2016	09:00-11:00

ADDENDUM D

Subtest 1 – Fine motor precision

Activity 1

- Procedure: Place a paper with the crooked path in front of the participant, as well as a pencil. The participant holds the pencil in his/her preferred hand. The participant may stop and restart, the participant was not allowed to turn the paper more than 45 degrees while drawing.
- Aim: Not to go out of the lines.
- Trials: The participant did not get any practice trials and only had one formal trial.
- Time: The participant had the opportunity to take as much time as needed.

Activity 2

- Procedure: Place the folding paper form in the booklet in front of the participant. The participant needed to fold the corners of the page as well as folding the page in the middle.
- Aim: The participant needed to fold the paper as close as possible on the line.
- Trials: The participant did not get any practice trials and only had one formal trial.
- Time: The participant had the opportunity to take as much time as needed.

Subtest 2 – Fine motor integration

Activity 1

- Procedure: Place the paper in front of the participant that has the circle and square on. The participant received a pencil. The participant used his/her preferred hand. The researcher explained verbally to the child what he/she had to do.
- Aim: To copy the square exactly as it is in the example.
- Trials: The participant did not get any practice trials and only had one formal trial.
- Time: The participant had the opportunity to take as much time as needed.

Activity 2

- Procedure: Place the paper in front of the participant that has the star and overlapping pencils on. The participant received a pencil. The participant used his/her preferred hand. The researcher explained verbally to the child what he/she had to do.
- Aim: To copy the star exactly as it is in the example.
- Trials: The participant did not get any practice trials and only had one formal trial.
- Time: The participant had the opportunity to take as much time as needed.

Subtest 3 – Manual dexterity

Activity 1

- Procedure: The researcher placed the two pieces of the penny pad together so that it formed a large rectangle. There are marks allocated where the pennies and the box should be placed. The penny pad was placed in front of the participant with the pennies on the preferred side of the child. The researcher first demonstrated the test-item to the participant. The researcher picked up a penny with the preferred hand, transferred the penny to the non-preferred hand and placed the penny in the box. The pennies were allowed to be picked up in any order. The researcher reminded the participant not to throw the pennies in the box.
- Aim: To transfer one penny at a time, starting with the preferred hand and then transferring it to the non-preferred hand.
- Trials: The participant had a quick practice round with 2 to 3 pennies and after that 2 formal trials.
- Time: The participant received 15 seconds per trial to get as many pennies as possible in the box.

Subtest 4 – Bilateral Coordination

Activity 1

- Procedure: The participant needed to stand with the preferred leg and arm on the same side forward and the non-preferred leg and arm at the back. The participant had to jump by bringing the non-preferred side to the front.

- Aim: To move the preferred side together and then being able to alternate jumps without stopping.
- Trials: The participant received a quick practice round and after that one formal trial.
- Time: There was no allocated time given, it had to be continuous.

Activity 2

- Procedure: The participant sat at a table, index fingers were placed on the table and the other fingers had to be tucked in. The participant had to simultaneously tap his/her foot and index finger on the same side at the same time.
- Aim: To move the preferred side together and then being able to alternate the taps without stopping or giving a pause.
- Trials: The participant received a quick practice round and after that one formal trial.
- Time: There was no allocated time given, it had to be continuous.

Subtest 5 – Balance

Activity 1

- Procedure: The participant stood with their feet next to each other, his/her preferred foot parallel on the line with hands on the- hips. The participant had to walk forward in a natural stride on the line.
- Aim: To keep walking on the line for consecutive steps and not to fall off the line.
- Trials: Recorded the number of correct steps, if he/she failed in the first trial, a second trial was conducted.
- Time: There was no allocated time given, it had to be continuous.

Activity 2

- Procedure: The participant stood with his/her preferred foot on the balance beam with the- non-preferred foot on the floor. The participant's hands needed to be on his/her hips. The participant had to raise his/her non-preferred foot up to 90 degrees and hold the position.

- Aim: To keep the non-preferred leg off the ground and balance for as long as possible until the examinee said stop.
- Trials: The participant received 2 trials.
- Time: The participant had to balance for 10 seconds.

Subtest 6 – Running Speed and Agility

Activity 1

- Procedure: The participant stood with his/her preferred foot on the end of the line with hands was on the- hips. The participant needed to raise his/her non-preferred leg up to 90 degrees (bent) to the floor.
- Aim: To keep the non-preferred leg off the ground and to hop up and down with the preferred foot lifting off the ground.
- Trials: The participant received 2 trials.
- Time: The participant had to hop on the preferred leg for 15 seconds.

Subtest 7 – Upper-limb coordination

Activity 1

- Procedure: The participant held a tennis ball in both hands and extended his/her arms forward in front of the body. The participant had to drop the ball and after it bounced on the ground once it had to be caught with both hands.
- Aim: To drop the ball, and not to throw it, and to catch it with both hands for 5 correct catches.
- Trials: The participant received 2 trials, but it was only necessary to conduct a second trial if he/she failed the first one.
- Time: There was no allocated time given.

Activity 2

- Procedure: The participant held a tennis ball in the preferred hand and extended the preferred arm forward in front of the body. The participant had to drop the ball and then alternate hands with each dribble.

- Aim: To drop the ball, to do 10 alternating dribbles.
- Trials: The participant received 2 trials, but it was only necessary to conduct a second trial if they failed in the first one.
- Time: There was no allocated time given.

Subtest 8 – Strength

Activity 1

- Procedure: The participant kneeled down on the knee pad and had to lean forward, his/her hands had to be placed on the floor shoulder width apart. The hands had to be directly underneath his/her shoulders. The participant's ankles had to be crossed and his/her feet had to be off the ground. The participant had to lower him-/herself down to the ground without the stomach touching the mat and come back up.
- Aim: He/she had to try and do as many push-ups possible in 30 seconds.
- Trials: The participant only received 1 trial.
- Time: 30 seconds

Activity 2

- Procedure: The participant had to lie on his/her back on the floor, palms on the floor next to his/her body. The participant had to raise his/her head, shoulder and neck to perform a sit-up.
- Aim: To try and do as many sit-ups as they could in 30 seconds.
- Trials: The participant received 1 trial.
- Time: 30 seconds.

Scoring:

Please see the manual online for information if interested.

https://www.pearsonclinical.com/therapy/products/100000648/bruininks-oseretsky-test-of-motor-proficiency-second-edition-bot-2.html

ADDENDUM E

Table E.1. **OUTLINE OF DATES AND TIMES OF INTERVENTION PROGRAM**

School	**Program**	**Starting date**	**End date**	**Day & Time (1st session of the week)**	**Day & Time (2nd session of the week)**
School GB	Land	19/04/2016	2/06/2016	Tuesday 09:00-10:30	Thursday 09:30-11:00
School BP	Land	27/07/2016	09/11/2016	Wednesday 11:15-12:00	Friday 08:30-09:15
School D	Aquatic	29/04/2016	15/06/2016	Wednesday 09:30-11:00	Friday 09:30-11:00
School B	Aquatic	18/10/2016	30/11/2016	Tuesday 09:45-10:30	Thursday 09:45-10:30

ADDENDUM F

Consent form

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

STELLENBOSCH UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

Parent/Legal guardian

The effect of an aquatic intervention compared to a land-based programme on gross motor skills for children with Down Syndrome.

You are kindly requested to consent that your child may participate in an experimental research study conducted by Dr Africa and Odelia Roodt from the Department of Sport Science, Stellenbosch University. The results will contribute to a Master's degree. Your child has been identified as a possible participant in this study because he/she is Down syndrome (DS) and falls in the age criteria of 7- to 16-years-old.

1. PURPOSE OF THE STUDY

The primary aim of this study was to explore the effect of land and aquatic interventions over a 9 week period in children with DS between seven – 16 years old to improve their GMS.

2. PROCEDURES

If your child volunteers to participate in this study, we would ask him/her to do the following things:

The children will be assessed (pre-test) with a test battery before the intervention begins as well as after (post-test) the intervention. The children will partake in a land or aquatic intervention. The sessions will consist of a variety of big movements that will enhance physical activity and that will possibly improve their balance, strength and coordination. All the exercises are based on a Kinderkinetics program. The intervention program will be 7 weeks long.

The total length of this study will be nine weeks, the researcher will see the children at their school and at the Department of Sport Science twice a week in the morning (during school) and a session will be 40 to 45 minutes long.

3. POTENTIAL RISKS AND DISCOMFORTS

There are no serious risks involved in the study. One group of children will do their exercises in the water. There will be honours students assisting the researcher during the sessions to make sure they are safe in the pool. The researcher is trained in First Aid and is a qualified Learn to Swim instructor. The pool is very shallow and there is a rail on the side for safety. If your child is not comfortable to go into the water it is not a problem, your child can participate in the exercises with the land group. Your child may be uncomfortable during the higher intensity activities. He/she may also experience muscle soreness and sweatiness after the exercise sessions. The researcher will be aware of specific risk factors that the parent/legal guardian will state in the medical form and extra care will be given to the child. The researcher will be very sensitive towards the children and if they feel uncomfortable in any way she will let them stop.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

The benefits that the aquatic (water) and land group may get from this study are that they will get positive feedback on their physical well-being and their everyday functioning. They might show improvements in gross motor skills, balance, strength and coordination, as well as improve their concentration for academic purposes. The group that will partake in the aquatic environment will also be able to improve their water confidence.

5. PAYMENT FOR PARTICIPATION

Your child will not receive any payment; this is a free voluntarily participation for a Master's degree.

6. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can either identify your child or you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of safeguarding data and the test subjects will remain anonymous throughout the study. The data will be kept safe on the researcher's laptop, which only the researcher will have access to and this would be password protected. This laptop will be safely stored in a locked cabinet in an office that will be locked at all times at the Department of Sport Science. When the final

data and article of this study is handed in, the data will be safeguarded at the Department of Sport Science at Stellenbosch University.

The researcher will publish an article at the end, but all participants will be kept anonymous.

7. PARTICIPATION AND WITHDRAWAL

Your child can choose whether to be in this study or not. If your child volunteers to be in this study, he/she child may withdraw at any time without consequences for him/her. Your child may also refuse to answer any questions you do not want to answer and still remain in the study. The investigator may withdraw your child from this research if circumstances arise, which warrants us or if the researcher feels the child does not want to take part, but struggles to communicate it.

IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact Dr E Africa and her team at 021 808 4591. Her email address is: africa@sun.ac.za. She can be reached daily at the Department of Sport Science at Stellenbosch University.

8. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622], at the Division for Research Development.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to [_____*]* by Odelia Roodt in [_____*]* and [_____*]* in command of this language or it was satisfactorily translated to [_____]. [_____*]* was given the opportunity to ask questions and these questions were answered to *[*_____*]* satisfaction.

*[*_____] I have been given a copy of this form.

_____

Name of Subject/Participant

_____

Name of Legal Representative (if applicable)

_____ _____

Signature of Subject/Participant or Legal Representative **Date**

SIGNATURE OF INVESTIGATOR

I declare that I explained the information given in this document to _____ [_____*]* and/or [_____] representative _____ [_____*]. [*_____] was encouraged and given ample time to ask me any questions. This conversation was conducted in [_____] and [_____ _____ by _____].

_____ _____

Signature of Investigator **Date**

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
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UNIVERSITEIT STELLENBOSCH
INWILLIGING OM DEEL TE NEEM AAN NAVORSING

Ouers/Wettige voog

Die effek van ’n water intervensieprogram in vergelyking met ’n land-gebaseerde program op groot motoriese vaardighede van kinders met Down Sindroom.

U word vriendelik versoek om in te stem dat u kind aan ’n eksperimentele navorsingstudie, wat deur Dr E Africa en Odelia Roodt van die Departement Sportwetenskap aan Stellenbosch Universiteit uitgevoer gaan word, deel te neem. Die resultate sal bydrae tot ’n Meestersgraad. U kind is as ’n moontlike deelnemer op grond van sy/haar Down Sindroom (DS) status geïdentifiseer en omdat hy/sy in die ouderdomskategorie van 4 tot 16 jaar val.

1. **DOEL VAN DIE STUDIE**

Die primêre doel van die studie was om te kyk wat die effek van land en water intervensies oor ’n periode van 9 weke in kinders met DS tussen sewe-16 jaar oud sal wees om hulle groot motoriese vaardighede te verbeter.

2. PROSEDURES

Indien u inwillig dat u kind aan die studie deelneem, sal die volgende van hom/haar verwag word:

Die deelnemers sal vir ’n periode van 1 week voordat die sessies begin (voor-toets) geassesseer word met ’n wetenskaplike toetsbattery asook vir 1 week na afloop van die intervensies (na-toets). Die kinders sal vir 7 weke aan ’n land gebaseerde of ’n water gebaseerde intervensie deelneem. Die sessies sal hoofsaaklik bestaan uit ’n verskeidenheid van groot bewegings wat die deelnemers se fisieke aktiwiteit sal verhoog en verbeter. Al die oefeninge is gebaseer op ’n Kinderkinetika program.

Die hele studie sal 9 weke duur. Die sessies sal gedurende skool ure of by die Departement Sportwetenskap, 2 keer per week, vir 40 tot 45 minute lank, aangebied word.

3. MOONTLIKE RISIKO'S EN ONGEMAKLIKHEID

Die studie hou geen ernstige risiko's vir die deelnemers in nie. Honneurs studente sal ten alle tye die navorser gedurende die sessies met die kinders behulpsaam wees om seker te maak hulle is veilig. Die navorser is in Noodhulp opgelei en is ook 'n gekwalifiseerde *Learn to Swim* instrukteur. Die swembad waar die sessies gaan plaasvind, is baie vlak en daar is reëlings om aan vas te hou vir veiligheid. Die navorser sal bewus wees van spesifieke risikofaktore wat die ouer/wettige voog in die mediese vorm aandui. Die navorser sal baie bedagsaam/sensitief teenoor die kinders wees. Indien hulle ongemaklik voel, kan hulle ophou om deel te neem.

4. MOONTLIKE VOORDELE VIR PROEFPERSONE EN/OF VIR DIE SAMELEWING

Die voordele wat hierdie studie vir u kind mag inhou is as volg:

- hulle sal positiewe terugvoer kry oor hulle fisieke welstand en alledaagse funksionering;
- hulle mag heel moontlik verbeteringe in hulle groot motoriese vaardighede toon: balans, krag en koördinasie, sowel as om hulle konsentrasie vir akademiese doeleindes te verbeter; en
- die groep wat aan die water program gaan deelneem, sal ook hulle watervertroue verbeter.

5. VERGOEDING VIR DEELNAME

Die proefpersone sal geen vergoeding vir deelname aan hierdie studie ontvang nie.

6. VERTROULIKHEID

Enige inligting wat deur middel van die navorsing verkry word, sal vertroulik bly en slegs met u toestemming bekend gemaak word of soos deur die wet vereis. Vertroulikheid sal gehandhaaf word deur middel van die beveiliging van die data en die deelnemers sal anoniem tydens die studie hanteer word. Die data sal op die navorser se skootrekenaar wat 'n wagwoord het, bewaar word. Die skootrekenaar sal veilig in 'n geslote kabinet in 'n kantoor wat tenalle tye gesluit word, binne die Departement Sportwetenskap bewaar word. Wanneer die finale tesis en artikel oor die studie ingehandig word, sal dit veilig by die Departement Sportwetenskap bewaar word.

Die navorser sal aan die einde van die studie 'n artikel publiseer en alle deelnemers sal anoniem hanteer word.

7. DEELNAME EN ONTTREKKING

U kan self besluit of u kind aan die studie gaan deelneem of nie. Indien u kind inwillig om aan die studie deel te neem, kan u kind ter enige tyd hom-/haarself daaraan onttrek sonder enige nadelige gevolge. U kind kan ook weier om op bepaalde vrae te antwoord, maar steeds aan die studie deelneem. Die navorser kan u kind aan die studie onttrek indien omstandighede dit noodsaak of as die navorser voel die kind wil nie deelneem nie, maar sukkel om te kommunikeer.

8. IDENTIFIKASIE VAN ONDERSOEKERS

Indien u of u kind enige vrae of besorgdheid omtrent die navorsing het, staan dit u vry om in verbinding te tree met Dr E Africa (021 808 4591) of Odelia Roodt, epos adresse: africa@sun.ac.za / o.roodt@lantic.net. Hulle kan bedags bereik word by die Departement Sportwetenskap, Stellenbosch Universiteit.

9. REGTE VAN PROEFPERSONE

U kan enige tyd u toestemming onttrek en u kind se deelname beëindig sonder enige nadelige gevolge. Deur deel te neem aan die navorsing doen u geensins afstand van enige wetlike regte, eise of regsmiddel nie. Indien u vrae het oor u regte as proefpersoon by navorsing, skakel met Me Maléne Fouché [mfouche@sun.ac.za; 021 808 4622], van die Afdeling Navorsingsontwikkeling, Universiteit Stellenbosch.

VERKLARING DEUR PROEFPERSOON OF SY/HAAR REGSVERTEENWOORDIGER

Die bostaande inligting is aan my, [_____], gegee en verduidelik deur Odelia Roodt in [Afrikaans*]* en ek [_____] is dié taal magtig of dit is bevredigend vir [_____] vertaal. Ek [_____] is die geleentheid gebied om vrae te stel en my/sy/haar vrae is tot my/sy/haar bevrediging beantwoord.

Ek gee hiermee my toestemming dat die proefpersoon/deelnemer aan die studie mag deelneem.]

_____

Naam van proefpersoon/deelnemer

_____

Naam van regsverteenwoordiger (indien van toepassing)

_____

_____

Handtekening van proefpersoon/deelnemer of regsverteenwoordiger **Datum**

VERKLARING DEUR ONDERSOEKER

Ek verklaar dat ek die inligting in hierdie dokument vervat verduidelik het aan [_____] en/of sy/haar regsverteenwoordiger [_____]. Hy/sy is aangemoedig en oorgenoeg tyd gegee om vrae aan my te stel. Dié gesprek is in [*Afrikaans*] gevoer

_____ _____

Handtekening van ondersoeker **Datum**

ADDENDUM G

Assent form

	STELLENBOSCH UNIVERSITY

PARTICIPANT INFORMATION LEAFLET AND ASSENT FORM

TITLE OF THE RESEARCH PROJECT: The effect of an aquatic intervention compared to a land-based program on gross motor skills of children with Down Syndrome.

RESEARCHERS NAME(S): Dr Africa and Odelia Roodt

ADDRESS: Department of Sport Science, Stellenbosch University

CONTACT NUMBER: 021 808 4591 / 0721238448

***What is research*?**

Research is something we do to obtain **NEW KNOWLEDGE** about the way things (and people) work. We use research projects to help us find out more about children and the things that affect their lives and their health. We do this to try and make the world a better place!

What is this research project all about?

This research project is about exercises that we are going to do with you in the water and on land at the school and at the Department of Sport Science, Stellenbosch University, to improve your balance, strength and coordination, as well as your big muscle movements.

Why Have I been invited to take part in this research project?

I would like to work with children in the age group 7- to16-years-old and you are one of them.

Who is doing the research?

This teacher sitting in front of you is from the Stellenbosch University, a Kinderkineticist that works with children through playful and fun activities on land and in the water. I am going to do research on all of the friends that are here with you and we are going to play and have fun together.

What will happen to me in this study?

The one group will be doing fun activities in the water and the other group will do fun activities on land. All of these exercises will improve the way you feel on a daily basis.

Can anything bad happen to me?

Nothing bad can happen to you. You may just be a little out of breath while doing the exercises and your muscles may be a bit stiff of all the fun and games. You may also sweat during the activities.

Can anything good happen to me?

You are going to have a fun session with us, you are going to play with your friends and we are going to work on getting you stronger and improve your strength, coordination and balance.

Will anyone know I am in the study?

Your name and details will be confidential and no one will know.

Who can I talk to about the study?

When you have any questions you are more than welcome to contact Dr. E Africa (021 808 4591) or Odelia Roodt (0721238448) at the Department of Sport Science,Stellenbosch University.

What if I do not want to do this?

If you don't want to take part in this research and play you do not have to. Whenever you feel like you do not want to participate you can just tell us, you will not get into trouble and no one would be mad at you.

Do you understand this research study and are you willing to take part in it?

YES NO

Has the researcher answered all your questions?

YES NO

Do you understand that you can pull out of the study at any time?

YES NO

_____ _____

Signature of Child Date

	UNIVERSITEIT STELLENBOSCH

INLIGTINGSTUK EN INWILLIGINGSVORM VIR DEELNEMERS

TITEL VAN NAVORSINGSPROJEK:

Die effek van ’n water intervensieprogram in vergelyking met ’n land-gebaseerde program op groot motoriese vaardighede van kinders met Down Sindroom.

NAVORSER(S): Dr Africa en Odelia Roodt

ADRES: Departement Sportwetenskap, Stellenbosch Universiteit.

KONTAKNOMMER: 021 808 4591/ 0721238448

Wat is navorsing?

Deur navorsing leer ons hoe dinge (en mense) werk. Ons gebruik navorsingsprojekte of studies om meer uit te vind oor kinders se gesondheid.

Waaroor gaan hierdie navorsingsprojek?

Hierdie navorsingsprojek gaan oor oefeninge in die water en op land wat ons graag met jou wil doen, by jou skool en die Departement Sportwetenskap, Stellenbosch Universiteit. Die doel is om jou balans, krag en koördinasie te probeer verbeter.

Hoekom vra julle my om aan hierdie navorsingsprojek deel te neem?

Ek wil graag met kinders tussen 7 tot 16 jaar oud werk en jy val in hierdie groep.

Wie doen die navorsing?

Ek, Odelia Roodt, van Stellenbosch Universiteit wil graag met jou en al die ander maatjies speel.

Wat sal in hierdie studie met my gebeur?

Een groep gaan baie lekker aktiwiteite in die water doen en die ander groep gaan baie lekker aktiwiteite op land doen. Al hierdie aktiwiteite gaan jou elke dag beter laat voel.

Kan enigiets fout gaan?

Jy gaan glad nie seerkry tydens die sessies nie. Jy mag dalk uitasem raak en jou spiere kan seer voel na afloop van die aktiwiteite. Jy gaan dalk ook sweet nadat ons gespeel het.

Watter goeie dinge kan in die studie met my gebeur?

Jy gaan ’n baie lekker sessie saam met ons hê. Jy gaan lekker speel saam met jou maatjies en ons gaan daaraan werk om jou spiere sterker te maak.

Met wie kan ek oor die studie praat?

Indien jy enige vrae het, kan jy Dr. E Africa (021 808 4591) of Odelia Roodt (0721238448) by die Departement Sportwetenskap kontak.

Wat gebeur as ek nie wil deelneem nie?

As jy nie wil deelneem nie, hoef jy nie. Jy kan ook enige tyd vir ons sê as jy nie meer wil saamspeel nie. Jy sal nie in die moeilikheid kom as jy nie meer wil deelneem nie, niemand sal vir jou kwaad wees nie.

Verstaan jy hierdie navorsingstudie, en wil jy daaraan deelneem?



JA NEE

Het die navorser ál jou vrae beantwoord?


JA NEE

Verstaan jy dat jy kan ophou deelneem net wanneer jy wil?


JA NEE

_____ _____

Naam van Kind/Handtekening Datum

ADDENDUM H

Medical form

☐ _____

For office use

EVALUATION PERSONAL INFORMATION:

Name of child
_____

Initials and surname of parent/s / legal guardian
_____

Address
_____

_____

Telephone (H) _____Cell_____ (W)
_____

E-mail address
_____

Test date _____

Date of birth
_____

Age_____ Sex_____

School _____ Grade _____

MEDICAL HISTORY

HEALTH HISTORY: ***Check any conditions that apply to your child or run in your family. Please indicate by making a cross under child/family.***

	Child	**Family**
Allergies		
Asthma		
Respiratory disease		
Cancer		
Diabetes		
Thyriod		
Heart problems		
High blood pressure		
Head trauma		
Migraine/headache		
Colour “blind”		

Medication_____

MEDICAL/NEUROLOGICAL BACKGROUND:

Check any conditions that apply to your child or run in your family. Please indicate by making a cross under child/family.

	Child	**Family**
ADD/ADHD		
Auditory Processing Disorder		
Autism Spectrum Disorder		
Difficulties		
Cerebral Palsy		
Low muscle tone		
DCD		
Sensory Related		
Down Syndrome		

*List any illnesses or developmental/genetic diagnoses not specified:

_____

MILESTONE DEVELOPMENT (Please indicate by making a cross)

Activity	Ave Age	Early	Late	Normal	Unable to do
Gross Motor Development:					
Head Control	3 mths				
Rolled Over	3.5 mths				
Sits w/o Support	6.5 mths				
Crawl(Stomach on Floor)	7 mths				
Creep (Stomach off floor)	8 mths				
Pulls self to Stand	9 mths				
Walks with support	12 mths				
Walks Unaided/alone	13 mths				
Walks up steps with help	18 mths				
Runs without falling often	20 mths				
Kicks a ball	22 mths				
Toilet Trained	24 mths				
Walks tiptoe with Demonstration	25 mths				
Put on some clothing alone	3 yrs				
Rides Tricycle	3 yrs				
Jumping Jacks	4 yrs				
Skipping	5 yrs				
Stands on one foot 2-4 seconds	38 mths				
Fine Motor Development:					
Eye control 180 degrees	3 mths				
Reaches/Grasp for object	4 mths				
Neat pincer grasp	11 mths				
Scribbles Spontaneously	15 mths				
2 Cube Tower	16 mths				
Turns pages 2-3 at a time	17 mths				
Stacks/Piles blocks	18 mths				
4 Cube Tower	19 mths				
Strings 3 one inch objects	22 mths				
Eats with a fork/spoon	24 mths				
Turn pages one at a time	24 mths				
Completes simple puzzle	26 mths				
Builds 8 cube tower	30 mths				
Puts on shoes and socks	31 mths				
Copies Circle	3 yrs				
Language Development:					
Smiles Spontaneously	1 mths				
Responds to words/names	5 mths				
Says single words	12 mths				
4-6 Word vocabulary Refers to self by name	14 mths 18 mths				
Combines 2 different words	18 mths				
Says 2 word sentences	24 mths				
10 Words in vocabulary	28 mths				
Repeats 2 digits sequences	29 mths				
Knows last name and sex	32 mths				
Knows full name	3 yrs				
Repeats 3 digit sequence	39 mths				

Note: mths = months and yrs = years

EDUCATION (Please indicate by making a cross)

	Yes	No
Is your child in preschool?		
Does your child draw?		
Does your child like to read/or be read to?		
Has your child been for the following testing:		
Educational		
Neurological		
Psychological		
Occupational		
Speech Auditory		
Physical		

If yes, please list all previous evaluations done on your child:

_____
_____
_____

Check the appropriate spaces if you have any concerns about the following behaviour(s) in your child:

	Yes	No
Lack of curiosity		
Thumb sucking		
Nervous Has difficulty separating away from parents		
Glum, sulky, moody		
Bad temper		
Passive		
Irritable, easily upset		
Restlessness		
Sleeplessness		
Lethargic, Low energy		
Aggressive		

Other (please explain):

_____

BIRTH TRAUMA:

PREGNANCY AND BIRTH HISTORY: Please circle the correct one

Length of pregnancy:	**Full term**	**Pre-Mature**
During pregnancy which of the following occurred:	Severe Illness	Trauma
	Smoking	Prescribed Medication
	Use of drugs	Use of Alcohol
	Injury by fall	
Type of Delivery:	Natural	Caesarian
	Forceps/Vacuum	Anesthesia
	Other	
Were there any problems during delivery:	Yes	No

AFTER BIRTH:

Immediately after birth my child was Circle the correct one

Given oxygen	Doing well, requiring no medical treatment
Allergic	Placed in an incubator
Running a fever	Placed in Neonatal ICU
Jaundiced	Having breathing/feeding problems
Birth weight:	
Circumference of head:	
Apgar score:	

ANY OTHER RELEVANT INFORMATION:

(e.g. mentally retarded, auditory/visual disabilities, emotional problems, hyperactivity, learning disability, loss of perceptual ability, psychological adaptability, physical abnormalities (postural problems, flat feet, abnormal curvature of the spine, etc.), spasticity, syndromes).

Medication: _____

Does your child have the following or struggles with:

	Yes	**No**
Physical Activity (run around & jump)		
To get in the pool and move around		
Atlantoaxial Instability of C1 and C2		

PERMISSION LETTER

During the sessions I would like to take photos of the children to keep track of their progression and also for me to keep it on record. At the end I can give you the photos so that you can see what the children did during the time I worked with them.

I parent/ legal guardian……. hereby give permission to take photos of

…….... during the sessions.

…….. ……..

Signature (parent / legal guardian) Date

MEDIESE VORM

EVALUASIE PERSOONLIKE INLIGTING:

Naam van u kind
_____

Voorletters en van (ouer/s/wettig voog)
_____

Adres_____

_____

Telefoon (H) _____Sel_____ (W)
_____

Epos adres
_____

Toetsdatum
_____

Geboortedatum
_____

Ouderdom_____ Geslag _____

Skool _____ Graad _____

MEDIESE GESKIEDENIS

GESONDHEID GESKIEDENIS: ***Kyk of enige toestande op u kind van toepassing is of in u familie voorkom. Merk met 'n kruis onder kind/familie.***

	Kind	**Familie**
Allergieë		
Asma		
Respiratoriese siektes		
Kanker		
Diabetes		
Skildklier		
Hart probleme		
Hoe bloeddruk		
Kop trauma		
Migraine/hoofpyn		
Kleurblind		

Medikasie_____

MEDIESE/NEUROLOGIESE AGTERGROND:

Is enige toestand op u kind van toepassing of kom dit in u familie voor. Merk met 'n kruis onder kind/familie.

	Kind	**Familie**
ADD/ADHD		
Ouditiewe Prosessering wanorde		
Outisme		
Serebrale Gestremdheid		
Sensoriese verwante probleme		
Lae Spiertonus		
DCD		
Down Syndrome		

*Noem asb. enige siektes of ontwikkelings-/genetiese diagnose wat nie hierbo gespesifiseer is nie: _____

MYLPAAL ONTWIKKELING (Dui aan met 'n kruis wat van toepassing is)

Aktiwiteit	Gemiddelde ouderdom	Vroeg	Laat	Normaal	Onmoontlik om te doen
Groot Motoriese Ontwikkeling:					
Kop Beheer	3 mde				
Rol oor	3.5 mde				
Sit sonder ondersteuning	6.5 mde				
Kruip (Maag op die vloer)	7 mde				
Kruip (Maag weg van die vloer)	8 mde				
Trek jouself op om te staan	9 mde				
Loop met ondersteuning	12 mde				
Loop sonder ondersteuning	13 mde				
Loop op met die trappe met hulp	18 mde				
Hardloop sonder om te val	20 mde				
Skop 'n bal	22 mde				
Toilet gereedheid	24 mde				
Loop op tone met demonstrasie	25 mde				
Trek sekere kledingstukke aan sonder hulp	3 jr				
Ry 'n driewiel fiets	3 jr				
Skêrspronge	4 jr				
Huppel	5 jr				
Staan op een been vir 2-4 sekondes	38 mde				
Fyn motoriese ontwikkeling:					
Oog beheer 180 grade	3 mde				
Strek vir objek	4 mde				
Netjiese potloodgreep	11 mde				
Krabbel spontaan	15 mde				
2 Blokkies Toring bou	16 mde				
Blaai 'n boek (2-3 bladsye op 'n slag)	17 mde				
Pak blokkies op mekaar	18 mde				
Met 4 blokkies 'n toring bou	19 mde				
Ryg 3 klein voorwerpe in	22 mde				
Eet met 'n vurk/lepel	24 mde				
Blaai bladsye een op 'n slag	24 mde				
Voltooi 'n eenvoudige legkaart	26 mde				
Bou 'n 8 blokkie toring	30 mde				
Trek self 'n sokkie en skoen aan	31 mde				
Kopieer 'n sirkel	3 jr				
Taal Ontwikkeling:					
Glimlag spontaan	1 md				
Reageer op woorde/name	5 mde				
Sê enkele woorde	12 mde				
4-6 Woordeskat Verwys na jouself deur jou eie naam	14 mde 18 mde				
Kombineer twee verskillende woorde	18 mde				
Sê twee woord sinne	24 mde				
10 woorde in 'n sin	28 mde				
Herhaal 2 getal patrone	29 mde				
Ken laaste naam en geslag	32 mde				
Ken volle name	3 jr				
Herhaal 3 getal patrone	39 mde				

Nota: mde = maande en jr = jaar

OPVOEDING (Merk met ‘n kruis)

	Ja	**Nee**
Is jou kind in ‘n voorskoolse klas?		
Teken jou kind?		
Hou jou kind daarvan om te lees en/of hou hulle daarvan as iemand vir hulle lees?		
Het u kind enige van die volgende toetse/behandeling ondergaan?		
Opvoedkundige		
Neurologiese		
Psigologiese		
Arbeidsterapie		
Spraak/ Oudiologie		
Fisieke		

Indien ja, lys asb. al die vorige toetse/evaluasies wat op u kind gedoen is:

_____
_____
_____

Merk asb. indien u enige van die onderstaande gedragspatrone by u kind kan identifiseer:

	Ja	**Nee**
Gebrek aan belangstelling		
Geïrriteerd en raak maklik ontsteld		
Duimsuig		
Rusteloos		
Senuweeagtig, Moeilik om weg te gaan van ouers		
Nors en ‘moody’		
Slapeloosheid		
Slegte humeur		
Traag en lae energie		
Passief		
Aggressief		

Enige ander (verduidelik):

_____

GEBOORTE TRAUMA:

SWANGERSKAP EN GEBOORTE GESIEDENIS (Omkring wat van toepassing is)

Lengte van swangerskap:	**Vol termyn**	**Vroeg gebore**
Gedurende swangerskap, het daar enige van die volgende plaasgevind:	Ernstige siekte	Truama
	Rook	Voorgeskrewe Medikasie
	Gebruik van dwelms	Gebruik van Alkohol
Tipe geboorte:	Natuurlik	Keisersnee
	Instrument (Forceps/Vakuum)	Narkose
	Ander	
Was daar enige probleme tydens die geboorte?	Ja	Nee

Verduidelik_____

Onmiddellik na geboorte was my kind: Omkring die korrekte een

Suurstof gegee	Goed gegaan, geen mediese behandeling was nodig nie
Allergies	Geplaas in broeikas
Koorsig	Geplaas in die Neonatale ICU
Geelsig	Asemhaling/voeding probleme gehad
Geboortegewig	
Omvang van kop	
Apgar telling:	

ENIGE ANDER RELEVANTE INFORMASIE:
(bv. Verstandelik gestrem, ouditiewe/visuele gestremdhede, emosionele probleme, hiperaktief, leer probleme, verlies in perseptuele vermoë, psigologiese aanpasbaarheid, fisieke gestremdhede [posturale probleme, platvoete, abnormale rugkurwes/werwel, ens.], spastisiteit, sindrome).

Medikasie: _____

Het u kind enige van die volgende probleme of sukkel daarmee: Maak kruis onder die korrekte een.

	Ja	**Nee**
Fisieke aktiwiteit (om om te rond, te kan hardloop of spring)		
Om in ’n swembad in te gaan en rond te beweeg		
Atlanto-aksiale onstabiliteit van C1 en C2		

TOESTEMMINGSBRIEF

Gedurende die sessies wil ek graag foto's neem van die kinders om rekord te hou van hulle vordering. Aan die einde van die sessies kan ek vir julle al die foto's gee sodat julle kan sien wat die kinders gedurende die sessies gedoen het.

Ek ouer/ wettige voog…….gee hiermee toestemming om foto's van …….. gedurende die sessies te neem.

…….. .....

Handtekening (ouer/wettige voog) Datum

ADDENDUM I

Transport consent

TOESTEMMINGSVORM VIR VERVOER:

Ek ouer/ wettige voog _____ gee hiermee toestemming aan Odelia Roodt om my kind van die skool (_____) te vervoer na die Departement Sportwetenskap by Stellenbosch Universiteit vir ’n watersessie en weer veilig terug te besorg aan die skool. U kind sal ten alle tye baie veilig wees. Sessies sal plaasvind op ’n Maandag en Woensdag oggend.

Handtekening: _____

Datum: _____

Sportwetenskap
Sport Science
STELLENBOSCH

TRANSPORTATION CONSENT:

I parent/legal guardian_____ hereby give permission to Odelia Roodt to transport my child from the school (_____) to the Sport Science Department at Stellenbosch University for an aquatic session and to bring my child safely back to the school. Your child will be safe at all times. Sessions will take place on a Monday and Wednesday.

Signature: _____

Date: _____

Sportwetenskap
Sport Science
STELLENBOSCH

ADDENDUM J

Research Ethics Committee: Human Research Approval

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Approval Notice
Progress Report

28-Mar-2017
Africa, Eileen EK

Proposal #: SU-HSD-001763

Title: A 12-week aquatic intervention program compared to a land programme for selected 4 to16 year old Down syndrome children

Dear Dr Eileen Africa,

Your **Progress Report** received on **22-Feb-2017**, was reviewed by members of the **Research Ethics Committee: Human Research (Humanities)** via Expedited review procedures on **23-Mar-2017** and was approved.

Please note the following information about your approved research proposal:

Proposal Approval Period: **23-Mar-2017** -**22-Mar-2018**
Please take note of the general Investigator Responsibilities attached to this letter. You may commence with your research after complying fully with these guidelines.

Please remember to use your **proposal number** (**SU-HSD-001763**) on any documents or correspondence with the REC concerning your research proposal.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

Also note that a progress report should be submitted to the Committee before the approval period has expired if a continuation is required. The Committee will then consider the continuation of the project for a further year (if necessary).

This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki and the Guidelines for Ethical

Research: Principles Structures and Processes 2004 (Department of Health). Annually a number of projects may be selected randomly for an external audit.
National Health Research Ethics Committee (NHREC) registration number REC-050411-032.

We wish you the best as you conduct your research.

If you have any questions or need further help, please contact the REC office at 218089183.

Sincerely,
Clarissa Graham
REC Coordinator
Research Ethics Committee: Human Research (Humanities)

ADDENDUM K

Approval from the Western Cape Education Department

REFERENCE: 20160114-6520

ENQUIRIES: Dr AT Wyngaard

Ms Odelia Roodt
PO Box 12615
Die Boord
7613

Dear Ms Odelia Roodt

RESEARCH PROPOSAL: A TWELVE WEEK AQUATIC INTERVENTION PROGRAMME COMPARED TO A LAND PROGRAMME FOR SELECTED 4 – 12YEAR OLD-DOWN SYNDROME CHILDREN

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **01 February 2016 till 30 September 2016**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Research Services
Western Cape Education Department
Private Bag X9114
CAPE TOWN
8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 14 January 2016

ADDENDUM L

COHEN'S D EFFECT SIZES TABLES

Table 4.1. **EFFECT SIZES FOR THE OVERALL SCORE**

	1 group	2 time	3 {1}	4 {2}	5 {3}	6 {4}
1	Water group	pre		0.33(small)	1.53(huge)	1.87(huge)
2	Water group	post	0.33(small)		1.12(very large)	1.46(huge)
3	Land group	pre	1.53(huge)	1.12(very large)		0.41(medium)
4	Land group	post	1.87(huge)	1.46(huge)	0.41(medium)	

Table 4.2. **EFFECT SIZES FOR THE BALANCE SCORE FOR BOTH GROUPS**

	1 group	2 time	3 {1}	4 {2}	5 {3}	6 {4}
1	Water group	pre		0.54(medium)	0.72(medium)	1.05(large)
2	Water group	post	0.54(medium)		0.19(small)	0.57(medium)
3	Land group	pre	0.72(medium)	0.19(small)		0.4(small)
4	Land group	post	1.05(large)	0.57(medium)	0.4(small)	

Table 4.3. **EFFECT SIZES FOR THE BILATERAL COORDINATION SCORE FOR BOTH GROUPS**

	1 group	2 time	3 {1}	4 {2}	5 {3}	6 {4}
1	Water group	pre		0.43(medium)	2.08(huge)	2.15(huge)
2	Water group	post	0.43(medium)		1.4(very large)	1.46(huge)
3	Land group	pre	2.08(huge)	1.4(very large)		0.06(negligible)
4	Land group	post	2.15(huge)	1.46(huge)	0.06(negligible)	

Table 4.4. **EFFECT SIZES FOR THE FINE MOTOR INTEGRATION SCORE FOR BOTH GROUPS**

	1 group	2 time	3 {1}	4 {2}	5 {3}	6 {4}
1	Water group	pre		0.08(negligible)	1.17(very large)	1.03(large)
2	Water group	post	0.08(negligible)		1.1(large)	0.96(large)
3	Land group	pre	1.17(very large)	1.1(large)		0.15(small)
4	Land group	post	1.03(large)	0.96(large)	0.15(small)	

Table 4.5. **EFFECT SIZES FOR THE FINE MOTOR PRECISION SCORE FOR BOTH GROUPS**

	1 group	2 time	3 {1}	4 {2}	5 {3}	6 {4}
1	Water group	pre		0.01(negligible)	0.93(large)	1.3(very large)
2	Water group	post	0.01(negligible)		0.95(large)	1.32(very large)
3	Land group	pre	0.93(large)	0.95(large)		0.49(medium)
4	Land group	post	1.3(very large)	1.32(very large)	0.49(medium)	

Table 4.6. **EFFECT SIZES FOR THE MANUAL DEXTERITY SCORE FOR BOTH GROUPS**

	1 group	2 time	3 {1}	4 {2}	5 {3}	6 {4}
1	Water group	pre		0.24(small)	0.57(medium)	1.04(large)
2	Water group	post	0.24(small)		0.34(small)	0.8(large)
3	Land group	pre	0.57(medium)	0.34(small)		0.43(medium)
4	Land group	post	1.04(large)	0.8(large)	0.43(medium)	

Table 4.7. **EFFECT SIZES FOR THE RUNNING SPEED & AGILITY SCORE FOR BOTH GROUPS**

	1 group	2 time	3 {1}	4 {2}	5 {3}	6 {4}
1	Water group	pre		0.26(small)	0.56(medium)	1.(large)
2	Water group	post	0.26(small)		0.32(small)	0.77(large)
3	Land group	pre	0.56(medium)	0.32(small)		0.38(small)
4	Land group	post	1.(large)	0.77(large)	0.38(small)	

Table 4.8. **EFFECT SIZES FOR THE STRENGTH SCORE FOR BOTH GROUPS**

	1 group	2 time	3 {1}	4 {2}	5 {3}	6 {4}
1	Water group	pre		0.23(small)	1.15(very large)	1.52(huge)
2	Water group	post	0.23(small)		0.73(medium)	1.05(large)
3	Land group	pre	1.15(very large)	0.73(medium)		0.39(small)
4	Land group	post	1.52(huge)	1.05(large)	0.39(small)	

Table 4.9. **EFFECT SIZES FOR THE UPPER-LIMB COORDINATION SCORE FOR BOTH GROUPS**

	1 group	2 time	3 {1}	4 {2}	5 {3}	6 {4}
1	Water group	pre		0.33(small)	1.22(very large)	1.31(very large)
2	Water group	post	0.33(small)		0.81(large)	0.89(large)
3	Land group	pre	1.22(very large)	0.81(large)		0.14(negligible)
4	Land group	post	1.31(very large)	0.89(large)	0.14(negligible)	

ADDENDUM M

Language editing

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jou kennisvennoot·your knowledge partner

17 August 2017

TO WHOM IT MAY CONCERN

I, Prof Karel J. van Deventer, hereby declare that I conducted the language and technical editing of the Master's thesis titled, *The effect of an aquatic intervention compared to a land-based programme on gross motor skills of children with Down Syndrome* authored by Me Odelia Roodt.

Yours sincerely

KJ van Deventer

(Emeritus Associate Professor [Retired])

Sportwetenskap
Sport Science
STELLENBOSCH

Departement Sportwetenskap ◆ Department of Sport Science

Privaat Sak/Private Bag X1 ◆ Matieland 7602 ◆ Suid-Afrika/South Africa

Tel: +27 21 808 4915 ◆ Faks/Fax: +27 21 808 4817

ADDENDUM N

Aquatic Intervention

All the activities took place in the swimming pool. The activities were executed across the width of the pool, from the one side to the other. Width of the pool = 10m.

The following equipment were used during the intervention as well as the measurements:

Equipment	Measurements
Small plastic colourful balls	10cm x 10cm
Plastics baskets	40cm x 40cm
Plastic hula hoops	70cm x 70cm
Big plastic cones	30cm x 10cm
Circle shape (Plastic)	34cm x 34cm
Triangle shape (Plastic)	34cm x 34cm
Square shape (Plastic)	43cm x 43cm
Pool noodles (sponge)	1.5m
Small plastic cones	6cm x 10cm
Medicine balls	1kg = 10cm x 10cm, 2kg = 20cm x 20cm & 3kg = 30cm x 30cm
Plastic yellow balls	20cm x 20cm

Environment: Aquatic

Time: 40 min

Age: Junior (7-11 years) and Senior (12-16 years)

Warm-up:

Focus: Cardiovascular endurance and listening skills.

Repetitions: x4 (5 minutes)

- Spread the balls in the shallow side of the pool.
- Children have to run randomly through the water, pick up a ball and throw it in a basket. Place the basket on the side of the pool.
- Continue until all the balls are in the basket.

Activity 1:

Focus: Coordination, dynamic balance, hand-eye coordination.

Repetitions: x3 (8 minutes)

- Teach the children how to walk like a monkey on the side of the swimming pool by holding onto the rail and moving sideways through the water with their feet against the wall.
- Place a hula hoop on the side of the pool in the deep side with small balls inside.
- Children will walk like a monkey from the shallow to the deep side where the hula hoop is, take a ball and hop like a bunny through the water to the other side of the pool.
- On the other side, place a big cone with a circle on top of it. Children will throw the balls through the circle.
- **PROGRESSION:** Move the cone further away.

Activity 2:

Focus: Cardiovascular and static balance.

Repetition: x3 (5 minute)

- Spread the balls in the water in the shallow side of the pool.
- Let the children run around randomly in the shallow side, when the whistle blows they need to grab a ball and balance on one leg for 2-4 seconds. (If they struggle they are allowed to hold onto the rail).
- After they balanced on one leg, they need to throw the ball in the basket. The basket will be on the side of the pool.
- **PROGRESSION:** Before the child throws the ball in the basket, perform 5 jumping jacks.

Activity 3:

Focus: Dynamic balance, coordination and cardiovascular endurance.

Repetitions: x3 (8 minutes)

- Give each child a swimming pool noodle.
- Children hop from one side of the pool to the other side on the noodle.
- Pack small cones out on the other side on the deck of the pool with a number under each cone.

- Children will lift the cone up and do that amount of jumping jacks. (Break the jumping jack up if they struggle).
- Run back to the start on the other side.
- **PROGRESSION:** Multiply the jumping jacks.

Activity 4:

Focus: Dynamic balance, hand-eye coordination and upper-body strength.

Repetitions: x3 (5 minutes)

- Children hop like a frog in the shallow side of the pool from one point to another.
- After they hopped like a frog, they need to throw and catch a 1kg ball x5. If they struggle use a normal ball.
- After that, the children will lie on their stomachs and sail back like a crocodile to the starting point.
- **PROGRESSION:** x10 catches

Cool down:

Repetitions: x2 (1 minute)

Ring-a-rosie

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

- Focus: Cardiovascular endurance and listening skills.

Repetitions: x4 (5 minutes)

- Spread the balls in the shallow side of the pool.
- Children have to run randomly through the water, pick up a ball and throw it in a basket. Place the basket on the side of the pool.
- Continue until all the balls are in the basket.

Activity 1:

Focus: Coordination, dynamic balance and hand-eye coordination.

Repetitions: x3 (8 minutes)

- Teach the children how to walk like a monkey on the side of the swimming pool by holding onto the rail and moving sideways through the water with their feet against the wall.
- Place a hula hoop on the side of the pool at the deep side with small balls inside.
- Children will walk like a monkey through the water from the shallow to the deep side where the hula hoop is, take a ball and hop like a bunny through the water to the other side of the pool.

- On the other side, place a big cone with a circle on top of it on the deck. Children will throw the ball through the circle.
- **PROGRESSION:** Move the cone further away.

Activity 2:

Focus: Cardiovascular and static balance

Repetitions: x3 (5 minutes)

- Take a ball in the basket (place the basket on the side of the pool) and run through the water to the other side of the pool.
- Hold onto the side/rail and balance on one leg for 2-4 seconds.
- Older children- Try balance without support.
- Throw the ball in the basket on the deck.

  PROGRESSION: Hold a medicine ball while balancing on one leg.

Activity 3:

Focus: Dynamic balance, coordination and cardiovascular endurance.

Repetition: x3 (8 minutes)

- Give each child a pool noodle.
- Children hop through the water to the other side of the pool on the noodle.
- Place small cones on the deck on the other side of the pool with a number under each cone.
- When the children get to the other side of the pool they need to lift the cone up and do that amount of jumping jacks in the water. (Break the jumping jack up if they struggle).
- Go back to the start by running there through the water.
- Older children can go back to the start by lying on their stomachs and kicking.
- **PROGRESSION:** Multiply the jumping jacks.

Activity 4:

Focus: Dynamic balance, hand-eye coordination and upper-body strength.

Repetitions: x3 (5 minutes)

- Children hop like a frog in the shallow side of the pool from one point to another point.
- After the children hopped like a frog, they need to throw and catch a 1kg ball x5 in the water. If they struggle use a normal ball.
- Then the children will lie on their stomachs and sail back like a crocodile to the starting point.
- **PROGRESSION:** x10 catches

Cool down:

Repetitions: x2 (1 minute)

Ring-a-rosie

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetition: x4 (5 minutes)

- Place swimming pool rings on the side of the pool in the shallow side. The swimming pool rings can be any object that can sink down to the bottom of the pool.
- Children need to take one ring, run through the water to the other side and place it in the basket.
- They need to run back to the starting point to get another ring and repeat the activity.

Activity 1:

Focus: Dynamic and static balance and hand-eye coordination.

Repetitions: x2 (8 minutes)

- Teach the children how to walk like a monkey on the side of the swimming pool by holding onto the rail and moving sideways through the water with their feet against the wall.
- Place a hula hoop at the end of the pool in the deep side with small balls inside.
- Children will walk like a monkey through the water from the shallow to the deep side where the hula hoop is, take a ball and hop like a bunny through the water to the other side of the pool.
- Older children have to hop on one leg to the other side.
- On the other side, place a big cone with a circle on top of it on the deck of the pool. Children will throw the ball through the circle x3.
- **PROGRESSION**: Move the cone further away.

Activity 2:

Focus: Cardiovascular and static balance.

Repetitions: x3 (5 minutes)

- Place rings/any object that can sink to the bottom of the pool in the shallow side.
- Children must run around in the water at the shallow side, when the whistle blows they must stop and pick up a ring.
- They must walk to the side of the pool and place the rings/object on their heads and balance on one leg for 5 seconds.
- Older children- try not to hold on the side.
- **PROGRESSION**: Balance on the other leg (non-dominant).

Activity 3:

Focus: Dynamic balance, hand-eye coordination and strength.

Repetitions: x3 (8 minutes)

- Give each child a pool noodle.
- Children must hop from the one side to the other in the pool.
- When they get to the other side, they must get off the noodle and throw and catch a normal plastic ball x5.
- Give each child a 1/2kg medicine ball, they have to walk back to the starting point by holding the ball with straight arms above their head.
- **PROGRESSION:** Throw and catch the ball x10.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes)

- Children hop like a frog in the shallow side of the pool from one side to the other.
- When they get to the other side they will throw and catch the 1kg ball x5.
- Junior children- can use a normal ball if the medicine ball is too heavy.
- After the throw and catch exercise, the children will lie on their stomachs and sail back like a crocodile to the starting point.
- **PROGRESSION:** Hop further.

Cool down:

Repetitions: x2 (1 minute)

- Place different shapes on the side of the pool (big plastic shapes).
- Children must walk like a bear from the one side to the shapes.
- They must now identify and imitate the shapes.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetitions: x4 (5 minutes).

- Place swimming pool rings in the shallow side of the pool. The swimming pool rings can be any object that can sink down to the bottom of the pool.
- Children need to take one ring, run through the water to the other side and place it in the basket.
- They need to run back through the water to the starting point to get another ring and repeat the activity.

Activity 1:

Focus: Dynamic and Static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Teach the children how to walk like a monkey on the side of the swimming pool by holding onto the rail and moving sideways through the water with their feet against the wall.
- Place a hula hoop in the deep side of the pool with small balls inside.
- Children will walk through the water like a monkey from the shallow side to the deep side where the hula hoop is, take a ball and hop like a bunny through the water to the other side of the pool.
- Older children have to hop on one leg to the other side.
- On the other side, place a big cone with a circle on top of it on the pool deck. Children will throw the ball through the circle x3.

PROGRESSION: Move the cone further away.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes)

- Place the rings on the bottom of the pool at the shallow side.
- Children must bend down and pick up a ring.
- Run through the water to the other side of the pool.
- Place the ring down and balance with support on one leg between 1-5 seconds.
- Older children - balance on their own.
- **PROGRESSION:** Balance between 4-7 seconds on one leg or balance on your non-dominant leg.

Activity 3:

Focus: Dynamic balance, hand- eye coordination and strength.

Repetitions: x3 (8 minutes).

- Give each child a pool noodle.
- Children hop from the shallow to the deep side on the noodle.
- They must then get off the noodle and take a plastic ball that will be placed on the side of the pool and throw and catch a ball x7.
- Afterwards, give each child a 1/2kg medicine ball, they have to walk back to the other side by holding the ball with straight arms above their heads.
- **PROGRESSION:** Throw and catch a ball x10.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Children need to hop like a frog in the shallow side of the pool from the one side to the other.

- When they get to the other side they will throw and catch a 1kg ball x5.
- Junior children can use a normal plastic ball if the medicine ball is too heavy.
- After the throw and catch item, the children will lie on their stomachs and sail back like a crocodile to the starting point.
- **PROGRESSION**: Throw and catch the ball x10.

Cool down:

Repetitions: x2 (1 minute).

- Place different shapes on the side of the pool (big plastic shapes).
- Children must walk like a bear from the one side to the shapes.
- They must now identify and imitate the shapes.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetitions: x3 (5 minutes).

- Children hold onto the rail on the side of the pool, while lying on their stomachs and then they must kick x10.
- After the first set of kicks, they must stop and blow bubbles and then kick x 10 again.

Activity 1:

Focus: Dynamic and static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Pack small cones and balls on the deck at the shallow side of the pool.
- Each child must take a cone and place a ball in the cone.
- The children must hop like a bunny through the water to the deep side, take the ball out and place it in the correct colour basket. Place the baskets in the deep side on the deck.
- While placing the ball in the basket they must balance on one leg.

- Junior children do not have to balance on one leg while placing the ball in the basket. They can balance on one leg after they have placed the ball in the basket.
- **PROGRESSION**: Children must try and balance on their own.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- In the shallow side, place a noodle around each child in order for them to lie on their backs. They must hold onto the noodle.
- They must now kick while lying on their backs to the deep side, support them so that they feel safe.
- When they get to the deep side, put the noodle down.
- Balance on a foam block for 1-5 seconds.
- After they balanced, they must run back through the water to the starting point.
- **PROGRESSION:** Balance on your non-dominant leg on the foam block.

Activity 3:

Focus: Dynamic balance, hand-eye coordination and strength.

Repetitions: x3 (8 minutes).

- Give each child a noodle.
- Hop to the deep side of the pool on the noodle.
- Children must get off the noodle at the deep side and catch and throw a plastic ball x7. Place the balls on the deck of the pool.
- Give each child a 1/2kg medicine ball, they have to walk through the pool back to the starting point by holding the ball with straight arms above their head.

PROGRESSION: Throw and catch the plastic ball x10.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Take a ring and balance it on your head while walking from the one side to the other of the pool. The ring must not fall off.
- Pack small cones in a line with a number under each cone on the deck of the pool at the deep side.
- Participant needs to choose a cone and identify the number.
- Jump up and down (the amount would be the number chosen).
- Run back and do it again.
- **PROGRESSION:** Multiply the number.

Cool down:

Repetitions: x2 (1 minute)

- Place different shapes on the side of the pool (big plastic shapes).Children must walk like a bear from the one side to the shapes. They must now identify and imitate the shapes.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetitions: x3 (5 minutes).

- Children hold onto the rail on the side of the pool, while lying on their stomachs and then they must kick x10.
- After the first set of kicks, they must stop and blow bubbles and then kick x10 again.

Activity 1:

Focus: Dynamic and static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Pack small cones and balls on the deck of the pool at the shallow side.
- Each child must take a cone and place a ball in the cone.
- The children must hop like a bunny to the deep side, take the ball out and place it in the correct colour basket. Place the baskets on the deck of the pool.
- While placing the ball in the basket they must balance on one leg.
- Junior children do not have to balance on one leg while placing the ball in the basket. They can balance on one leg after they have placed the ball in the basket. If they struggle assist them.
- **PROGRESSION:** Junior children must try and balance on their own and senior children must balance on their non-dominant leg.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- Place a noodle around each child in order for them to lie on their backs in the shallow side. They must hold onto the noodle.
- They must now kick while lying on their backs to the deep side, support them so that they feel safe.
- When they get to the deep side, put the noodle down.
- Balance on a foam block for 1-5 seconds.
- After they balanced, they must run through the water back to the starting point.
- **PROGRESSION:** Balance on your non-dominant leg on the foam block.

Activity 3:

Focus: Dynamic balance, hand-eye coordination and strength.

Repetitions: x3 (8 minutes).

- Give each child a noodle.

- The need to hop to the other side on the noodle.
- Children must get off the noodle at the other side and throw and catch a plastic ball x7 with the presenter. Place the balls on the deck of the pool.
- Give each child a 1/2kg medicine ball, they have to walk back through the water to the starting point by holding the ball with straight arms above their head.
- **PROGRESSION:** Throw and catch the plastic ball x10 with the presenter.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Take a ring and balance it on your head while walking from the one side to the other. The ring must not fall off.
- Pack small cones in a line with a number under each cone at the side of the pool on the other side.
- Chose a cone and identify the number.
- Jump up and down (the amount would be the number chosen).
- Run to the other side and do it again.
- **PROGRESSION:** Multiply the number.

Cool down:

Repetitions: x2 (1 minute)

- Place different shapes on the side of the pool (big plastic shapes).
- Children must walk like a bear from the one side to the shapes.
- They must now identify and imitate the shapes.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetitions: x3 (5 minutes).

- Give each child a ring to hold onto or any object that is small, do different movements with them in the shallow side. For example, jump, run, turn around, walk on your toes.

Activity 1:

Focus: Dynamic and static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Pack yellow plastic balls on the deck of the pool at the shallow side. Each child must take a ball.

- Walk to the deep side, while walking they must throw and catch the ball to themselves.
- When they get to the deep side, they must throw the ball in the basket and balance on one leg for as long as they can. Place the basket on the side of the pool.
- Hop back like a bunny to the start.
- **PROGRESSION:** Put the basket further away.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- Place small colourful balls on the deck of the pool at the side.
- Children must take a ball and run to the other side and put the ball in the correct colour basket.
- Afterwards they must balance on one leg for 4-7 seconds.
- **PROGRESSION:** Balance on one leg with a 1/2kg ball.

Activity 3:

Focus: Dynamic balance, hand- eye coordination and strength.

Repetitions: x3 (8 minutes).

- Give each child a yellow plastic ball, they must push the ball from the one side to the other side of the pool with their head/hands.
- When they get to the other side they must throw and catch the ball x10 with the presenter.
- Give the child a 1/2kg medicine ball and they have to hop on both legs to the other side of the pool with the ball above their heads.
- **PROGRESSION:** Stand further away when you catch & throw.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Give the children a kicking board, they must balance it on their heads and walk to the other side of the pool.
- Place small cones on the side of the pool with numbers underneath.
- They have to choose a cone, jump up and down for that amount that was chosen.
- After the jumping, they must lie on their stomach/back in the pool and kick to the other side. They can make use of a noodle or kicking board to assist them.
- **PROGRESSION:** Multiply the number that was under the cone.

Cool down:

Repetitions: x2 (1 minute).

- If you are happy, you clap your hands, stomp your feet and turn around.

- Children must now walk to the shapes.
- Pack 3 shapes out on the side (circle, square and triangle).
- When the child gets to the shapes, ask the child what each shape is. Thereafter, they have to take their finger and follow the lines of the shape.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetitions: x3 (5 minutes).

- Give each child a ring to hold onto or any object that is small, do different movements with them in the shallow side. For example, jump, run, turn around, walk on your toes.

Activity 1:

Focus: Dynamic and static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Pack yellow plastic balls on the deck of the pool at the shallow side. Each child must take a ball.
- Walk to the deep side, while walking they must throw and catch the ball to themselves.
- When they get to the deep side, they must throw the ball in the basket and balance on one leg for as long as they can. Place the basket on the side of the pool.
- Hop back like a bunny to the start.
- **PROGRESSION:** Put the basket further away.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- Place small colourful balls on the deck of the pool at the side.
- Children must take a ball and run to the other side and put the ball in the correct colour basket.
- Afterwards they must balance on one leg for 4-7 seconds.
- **PROGRESSION:** Balance on one leg with a 1/2kg ball.

Activity 3:

Focus: Dynamic balance, hand- eye coordination and strength.

Repetitions: x3 (8 minutes).

- Give each child a yellow plastic ball, they must push the ball from the one side to the other side of the pool with their head/hands.
- When they get to the other side they must throw and catch the ball x10 with the presenter.

- Give the child a 1/2kg medicine ball and they have to hop on both legs to the other side of the pool with the ball above their heads.
- **PROGRESSION:** Stand further away when you catch & throw.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Give the children a kicking board, they must balance it on their heads and walk to the other side of the pool.
- Place small cones on the side of the pool with numbers underneath.
- They have to choose a cone, jump up and down for that amount that was chosen.
- After the jumping, they must lie on their stomach/back in the pool and kick to the other side. They can make use of a noodle or kicking board to assist them.
- **PROGRESSION:** Multiply the number that was under the cone.

Cool down:

Repetitions: x2 (1 minute).

- If you are happy, you clap your hands, stomp your feet and turn around.
- Children must now walk to the shapes.
- Pack 3 shapes out on the side (circle, square and triangle).
- When the child gets to the shapes, ask the child what each shape is. Thereafter, they have to take their finger and follow the lines of the shape.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance and listening skills.

Repetitions: x4 (5 minutes).

- Spread balls on the deck at the shallow side of the pool.
- Children have to run randomly through the water, pick a ball up and throw it in a basket. Place the balls on the deck of the pool.
- Continue until all the balls are in the basket.

Activity 1:

Focus: Dynamic and Static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Place tennis balls on the deck of the pool, each child must take a ball.
- Assist them to hop on one leg with the tennis ball to the other side of the pool.
- Older children must hop on their own.

- A target is placed against the wall at the deep side, when the children get to the deep side they must aim and throw at the target.
- After the throw they must balance on their toes for 4-7 seconds.
- Older children can hop back to the shallow side on their other leg and younger children can hop on both legs with the tennis ball.
- **PROGRESSION**: Hop back with a medicine ball.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- Each child takes a ring that will lying on the deck at the side of the pool.
- They must balance the ring on their heads. Hold onto the side of the pool and balance on one leg for 5 seconds.
- Older children must try not to hold onto the side.
- They must take the ring off, hold it in their hands and run through the water to the other side of pool and do the same as above with the other leg.
- Put the ring down and run backwards through the water to the other side.
- **PROGRESSION:** Hold a medicine ball while balancing on one leg on both sides.

Activity 3:

Focus: Dynamic balance, hand- eye coordination and strength.

Repetitions: x3 (8 minutes).

- Each child takes a medicine ball and hops through the water to the other side of the pool.
- When they get to the other side, they must throw and catch the ball x5 with the presenter.
- After each throw, the child must do 3 shoulder presses with hands on the side of the pool.
- Run back to the other side by holding the ball above their heads.
- Older children can run with a 3kg medicine ball.
- **PROGRESSION:** Stand further apart when throwing the ball.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Give each child a noodle, hop to the other side of the pool on the noodle.
- When the children get to the other side they must try to stand on the noodle by holding onto the sides and standing on the middle of the noodle. Balance for 1-5 seconds.
- Run back through the water to the starting point.

- **PROGRESSION:** Children must kick with the noodle to the starting point on their stomach instead of running.

Cool down:

Repetitions: x2 (1 minute)

- Walk like a bear from the shallow side to the deep side of the pool.
- Pack 3 shapes out on the deck of the deep side of the pool (circle, square & triangle).
- When the child gets to the shapes, ask the child what each shape is. Thereafter, they have to take their finger and follow the lines of the shape.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance and listening skills.

Repetitions: x4 (5 minutes).

- Spread balls on the deck at the shallow side of the pool.
- Children have to run randomly through the water, pick a ball up and throw it in a basket. Place the balls on the deck of the pool.
- Continue until all the balls are in the basket.

Activity 1:

Focus: Dynamic and Static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Place tennis balls on the deck of the pool, each child must take a ball.
- Assist them to hop on one leg with the tennis ball to the other side of the pool.
- Older children must hop on their own.
- A target is placed against the wall at the deep side, when the children get to the deep side they must aim and throw at the target.
- After the throw they must balance on their toes for 4-7 seconds.
- Older children can hop back to the shallow side on their other leg and younger children can hop on both legs with the tennis ball.
- **PROGRESSION**: Hop back with a medicine ball.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- Each child takes a ring that will lying on the deck at the side of the pool.
- They must balance the ring on their heads. Hold onto the side of the pool and balance on one leg for 5 seconds.

- Older children must try not to hold onto the side.
- They must take the ring off, hold it in their hands and run through the water to the other side of pool and do the same as above with the other leg.
- Put the ring down and run backwards through the water to the other side.
- **PROGRESSION:** Hold a medicine ball while balancing on one leg on both sides.

Activity 3:

Focus: Dynamic balance, hand- eye coordination and strength.

Repetitions: x3 (8 minutes).

- Each child takes a medicine ball and hops through the water to the other side of the pool.
- When they get to the other side, they must throw and catch the ball x5 with the presenter.
- After each throw, the child must do 3 shoulder presses with hands on the side of the pool.
- Run back to the other side by holding the ball above their heads.
- Older children can run with a 3kg medicine ball.
- **PROGRESSION:** Stand further apart when throwing the ball.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Give each child a noodle, hop to the other side of the pool on the noodle.
- When the children get to the other side they must try to stand on the noodle by holding onto the sides and standing on the middle of the noodle. Balance for 1-5 seconds.
- Run back through the water to the starting point.
- **PROGRESSION:** Children must kick with the noodle to the starting point on their stomach instead of running.

Cool down:

Repetitions: x2 (1 minute)

- Walk like a bear from the shallow side to the deep side of the pool.
- Pack 3 shapes out on the deck of the deep side of the pool (circle, square & triangle).
- When the child gets to the shapes, ask the child what each shape is. Thereafter, they have to take their finger and follow the lines of the shape.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetitions: x4 (5 minutes).

- Place the swimming pool rings on the deck of the pool at the shallow side.
- Children need to take one ring, run to the other side of the pool and place it in the basket. Place the baskets on the side of the pool.
- Encourage the children to do it faster.

Activity 1:

Focus: Dynamic and static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Hop on both legs to the other side of the pool.
- Place one leg on the rail on the side, hold your balance for 3 seconds.
- Take a yellow plastic ball on the side of the pool, the child and the assistant must throw the ball to each other, while walking back to the shallow side.
- **PROGRESSION:** Hop back with a medicine ball.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- Put a noodle around the child, children must pull each other to the other side of the pool as fast as possible.
- At the other side, put the noodle down and stand heel-to-toe for 7 seconds.
- Children must swop around and pull the other one back to the other side.
- **PROGRESSION:** While standing heel-to-toe hold a medicine ball in front of your body.

Activity 3:

Focus: Dynamic balance, hand- eye coordination and strength.

Repetitions: x3 (8 minutes).

- Take a noodle on the side of the pool. Hop on the noodle from the one side to the other.
- Each child must take 2 rings, put it around their arms and walk through the water like a monkey on the side of the pool by holding onto the rail back to the starting point other side.
- Older children must cross their midline with their hands (presenter will show) while walking like a monkey.
- **PROGRESSION:** Place four 4 rings on the arms.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Take a noodle on the side, children must kick on their stomachs, while using their arms (Doggy swim) to the other side.
- At the other side, put the noodle down stand on one leg for as long as possible.
- Run backwards through the water to the starting point.
- **PROGRESSION:** Hop back on one leg instead of running.

Cool down:

Repetitions: x2 (1 minute)

- Walk like a bear from the shallow side to the deep side of the pool.
- Pack 3 shapes out on the deck of the deep side of the pool (circle, square & triangle).
- When the child gets to the shapes, ask the child what each shape is. Thereafter, they have to take their finger and follow the lines of the shape.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetitions: x4 (5 minutes).

- Place the swimming pool rings on the deck of the pool at the shallow side.
- Children need to take one ring, run to the other side of the pool and place it in the basket. Place the baskets on the side of the pool.
- Encourage the children to do it faster.

Activity 1:

Focus: Dynamic and static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Hop on both legs to the other side of the pool.
- Place one leg on the rail on the side, hold your balance for 3 seconds.
- Take a yellow plastic ball on the side of the pool, the child and the assistant must throw the ball to each other, while walking back to the shallow side.

  PROGRESSION: Hop back with a medicine ball.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- Put a noodle around the child, children must pull each other to the other side of the pool as fast as possible.
- At the other side, put the noodle down and stand heel-to-toe for 7 seconds.
- Children must swop around and pull the other one back to the other side.
- **PROGRESSION:** While standing heel-to-toe hold a medicine ball in front of your body.

Activity 3:

Focus: Dynamic balance, hand- eye coordination and strength.

Repetitions: x3 (8 minutes).

- Take a noodle on the side of the pool. Hop on the noodle from the one side to the other.
- Each child must take 2 rings, put it around their arms and walk through the water like a monkey on the side of the pool by holding onto the rail back to the starting point other side.
- Older children must cross their midline with their hands (presenter will show) while walking like a monkey.
- **PROGRESSION:** Place four 4 rings on the arms.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Take a noodle on the side, children must kick on their stomachs, while using their arms (Doggy swim) to the other side.
- At the other side, put the noodle down stand on one leg for as long as possible.
- Run backwards through the water to the starting point.
- **PROGRESSION:** Hop back on one leg instead of running.

Cool down:

Repetitions: x2 (1 minute)

- Walk like a bear from the shallow side to the deep side of the pool.
- Pack 3 shapes out on the deck of the deep side of the pool (circle, square & triangle).
- When the child gets to the shapes, ask the child what each shape is. Thereafter, they have to take their finger and follow the lines of the shape.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetitions: x4 (5 minutes).

- Everyone holds hands and stand in a circle. Hop around in the circle x3 in the shallow side.
- Spread balls in the shallow side of the pool, children must pick one ball up and place it in the basket. Place the basket on the side of the pool.
- Do this until all the balls are in the basket.

Activity 1:

Focus: Dynamic and static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Take a yellow ball on the deck of the pool, hold it above your head and walk to the other side of the pool.
- When the children get to the other side they have to throw the ball through a hoop X5. The presenter will hold a hoop 3-5m from the child.
- Hop back to the other side on one leg through the water with the ball in your hands.

PROGRESSION: Hop with a medicine ball.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- The child must pull another child with the noodle from the deep to the shallow side. They must put the noodle down and stand on all fours in the shallow side.
- Lift one limb up and hold it in the air for 10 seconds.
- **PROGRESSION:** Lift two limbs up and hold it for 10 seconds.

Activity 3:

Focus: Dynamic balance, hand- eye coordination and strength.

Repetitions: x3 (8 minutes).

- Hop with the medicine ball to the other side of the pool.
- Put the medicine ball down and the children must perform 5 star jumps in the water.
- Take the medicine ball, hold it in front of your body and run back through the water to the starting point.
- **PROGRESSION:** Hop with the medicine ball above your head back through the water to the start.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Children lie with their stomachs on noodles and they must kick to the other side.
- At the other side, put the noodle down. Lift a cone up and look at the number, stand for that number on one leg.
- Younger children may be assisted, but older children must do it on their own.
- Place two rings on the bottom of the pool, place feet on the rings and slide on the rings back to the start.
- **PROGRESSION:** Multiply the number that was found under the cone.

Cool down:

Repetitions: x2 (1 minute)

- Walk like a bear from the shallow side to the deep side of the pool.
- Pack 3 shapes out on the deck of the deep side of the pool (circle, square & triangle).
- When the child gets to the shapes, ask the child what each shape is. Thereafter, they have to take their finger and follow the lines of the shape.

Environment: Aquatic

Time: 40 min

Age: Junior and Senior

Warm-up:

Focus: Cardiovascular endurance.

Repetitions: x4 (5 minutes).

- Everyone holds hands and stand in a circle. Hop around in the circle x3 in the shallow side.
- Spread balls in the shallow side of the pool, children must pick one ball up and place it in the basket. Place the basket on the side of the pool.
- Do this until all the balls are in the basket.

Activity 1:

Focus: Dynamic and static balance and hand-eye coordination.

Repetitions: x2 (8 minutes).

- Take a yellow ball on the deck of the pool, hold it above your head and walk to the other side of the pool.
- When the children get to the other side they have to throw the ball through a hoop X5. The presenter will hold a hoop 3-5m from the child.
- Hop back to the other side on one leg through the water with the ball in your hands.

- **PROGRESSION:** Hop with a medicine ball.

Activity 2:

Focus: Cardiovascular endurance and static balance.

Repetitions: x3 (5 minutes).

- The child must pull another child with the noodle from the deep to the shallow side. They must put the noodle down and stand on all fours in the shallow side.
- Lift one limb up and hold it in the air for 10 seconds.
- **PROGRESSION:** Lift two limbs up and hold it for 10 seconds.

Activity 3:

Focus: Dynamic balance, hand- eye coordination and strength.

Repetitions: x3 (8 minutes).

- Hop with the medicine ball to the other side of the pool.
- Put the medicine ball down and the children must perform 5 star jumps in the water.
- Take the medicine ball, hold it in front of your body and run back through the water to the starting point.
- **PROGRESSION:** Hop with the medicine ball above your head back through the water to the start.

Activity 4:

Focus: Static and dynamic balance.

Repetitions: x3 (5 minutes).

- Children lie with their stomachs on noodles and they must kick to the other side.
- At the other side, put the noodle down. Lift a cone up and look at the number, stand for that number on one leg.
- Younger children may be assisted, but older children must do it on their own.
- Place two rings on the bottom of the pool, place feet on the rings and slide on the rings back to the start.
- **PROGRESSION:** Multiply the number that was found under the cone.

Cool down:

Repetitions: x2 (1 minute)

- Walk like a bear from the shallow side to the deep side of the pool.
- Pack 3 shapes out on the deck of the deep side of the pool (circle, square & triangle).
- When the child gets to the shapes, ask the child what each shape is. Thereafter, they have to take their finger and follow the lines of the shape.

ADDENDUM O

Land Intervention

All the lessons took place in a hall, across the length. Measurements of the hall 18m x 8m. The following equipment were used as well as the measurements:

Equipment	Measurements
Plastic hula hoops	70cm x 70cm
Small plastic colourful balls	10cm x 10cm
Plastic baskets	40cm x 25cm
Bosu ball (Jellyfish)	80cm x 50cm
Small plastic cones	6cm x 10cm
Big plastic cones	30cm x 10cm
Medicine balls	1kg = 10cm x 10cm, 2kg = 20cm x 20cm & 3kg = 30cm x 30cm
Triangle shape (Plastic)	34cm x 34cm
Circle shape (Plastic)	34cm x 34cm
Square shape (Plastic)	43cm x 43cm
Scooter board	40cm x 40cm
Wooden puzzle	10 pieces
Plastic hopscotch blocks	40cm x 40cm
Plastic ten pin bowling pins	20cm x 10cm
Rope	5m x 10m
Shape dice	15cm x 15cm
Trampoline	96cm x 96cm
Beanbags	10cm x 10cm
Plastic tunnel	2m x 60cm
Small plastic blocks	30cm x 20cm
Plastic bar	100cm x 5cm
Rocks	30cm x 20cm
Ladder	Blocks 40cm x 40 cm and length 5m
Plastic beacons	20cm x 20cm
Sponge foam blocks	30cm x 30cm
Yellow plastic balls	20cm x 20cm
Rubber tactile hand and feet	10cm x 20cm
Hurdles	50cm x 30cm
Plastic stilts	15cm x 15cm
Tilt board	50cm x 50cm

Environment: Land

Time: 40 min

Age: Junior (7-11 years) and Senior (12-16 years)

Warm-up:

Repetition: x3 (7 minutes).

Focus: Cardiovascular endurance

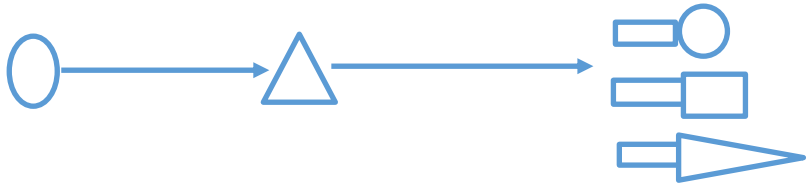
- Spread different colour hoops randomly on the ground.
- Children have to move between the hoops while the music is playing. When the music stops the children have to go and stand in a hoop.
- Different movements have to be performed between the hoops: Run, jump like a frog and walk like a bear.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Children stand and balances on the jelly fish (flat bosu ball) – while balancing they have to bend down and pick up a colour bean bag. (Place green, yellow, blue and red bean bags in front of the jelly fish).
- Climb down the jelly fish and hop like a rabbit with the bean bag towards the cone.
- Place 3-5m from the jelly fish a cone, and place 3-5m from the cone the large colourful cones with the circle, triangle and square on the cone.
- Children have to stand next to the cone and throw the bean bag into one of the shapes. (Presenter will indicate which shape)



- **PROGRESSION:** Close eyes when holding the bean bag and move hoops further away.

Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Spread colourful balls randomly on the grass/surface.
- The children have to run around and pick up the balls. When the presenter blows the whistle the children have to stand and balance on one leg (3-5 sec).
- Thereafter, place the balls in the basket. Place the basket in the middle of the hall.
- **PROGRESSION:** Before the child place the balls in the basket, make a straight line and walk heel-toe towards the basket.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination

- Spread pieces of a puzzle over an area in the hall.
- Hold onto the child's legs and do the wheel barrow walk to the puzzle.
- Junior children - If the wheel barrow walk is too difficult let the children lie on their stomachs on a scooter board and push them.
- After the wheelbarrow walk - Do 5 jumping jacks.
- Go back and collect more puzzle pieces.
- **PROGRESSION:** 10 jumping jacks

Activity 4:

Repetitions: x3 (7-8 minutes)

Focus: Static and dynamic balance and strength

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their dominant leg.
- Place pins in a ten pin bowling format after the hopscotch. Give them a 1kg medicine ball, they must roll the ball and see how many pins they can knock over X3.

PROGRESSION: When they jump with one leg into the hop-scotch block, try and hold it for 2-4 sec.

Cool down:

- Children get turns to throw the shape dice, then they have to use a rope to form the shape on the dice thrown, after the pre-senter performed the first one.
- When the shape is made the children have to walk on all fours around the shape.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (7 minutes).

Focus: Cardiovascular endurance.

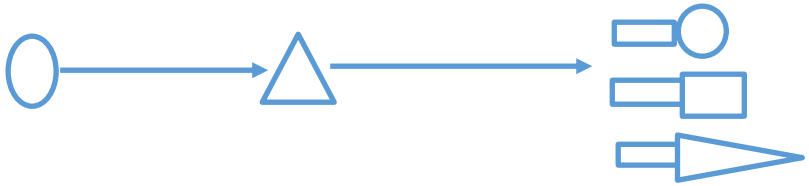
- Spread different colour hoops randomly on the ground.
- Children have to move between the hoops, while the music is playing. When the music stops the children have to go and stand in a hoop.
- Different movements must be performed between the hoops: Run, jump like a frog and walk like a bear.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Children have to jump 10 times on the trampoline, after the last jump the children need to pick up a colourful beanbag. (Place green, yellow, blue and red beanbags in front of the trampoline).
- Climb off the trampoline and jump like a rabbit to the cone (the cone would be 5m away from the trampoline) – focus on how children jump (bend knees, show children if they battle).
- Older children can hop on one leg.
- Place 3-5m from the cone, large colourful cones with the circle, triangle and square on the cone.
- Children have to stand next to the cone and throw the beanbag in one of the shapes. (Presenter will indicate the shape)



- **PROGRESSION:** Close eyes when holding the bean bag and move hoops further away.

Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Place cones randomly around in the hall with numbers under the cones. (Numbers from 1-5).
- Children have to run around and when the presenter blows the whistle the children have to run to the nearest cone and look at the number under the cone.
- Children must then stand on one leg for the time (seconds) equivalent to the number.
- Afterwards, run towards the rope, then walk heel-toe on the rope and place the number in the basket. (Distance of the rope is 5m, place the basket at the end of the rope).
- **PROGRESSION:** Take a medicine ball in both hands and walk with the ball on the rope.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and Coordination.

- Let the children lie on a scooter board on their stomach, they have to pull themselves forward or wheel barrow walk (older children) for 10meters.
- After that they have to get up and throw and catch a medicine ball with the presenter (x 10).

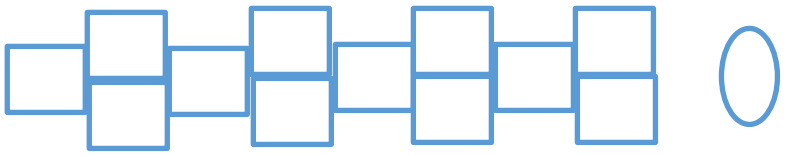
- Do 5 jumping jacks and jump like a frog (for 5-7m) back to the beginning.
- **PROGRESSION:** 10 jumping jacks instead of 5.

Activity 4:

Repetitions: x3 (7-8 minutes).

Focus: Static and dynamic balance and strength.

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their dominant leg.
- When the children finished the hopscotch they have to balance on the jelly fish (flat bosu ball) for 5-10 sec. Place the jellyfish right after the hopscotch.



- **PROGRESSION:** Hold a medicine ball (1kg) while standing on the jellyfish.

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made the children have to walk on all fours on the shape.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (7 minutes).

Focus: Cardiovascular endurance.

- Spread colourful balls randomly in the hall.
- Children must run/ jump around and pick up one ball at a time and place it in the basket. Place the basket in the middle of the hall.

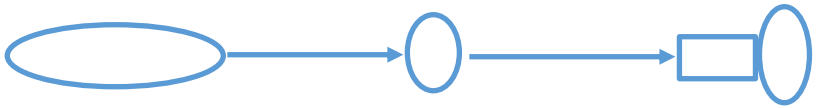
Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Children have to crawl through a tunnel, and as they exit they have to pick up a colourful ball. Place the balls in a basket.
- Older children - put up a low level rope (80cm) for them to crawl under in place of the tunnel.
- They have to take the ball and hop on one leg towards the jelly fish.
- Place one cone with circle, 3-5m from the jelly fish.
- Stand on the jellyfish and throw the ball through the circle.

- Get off the jellyfish and run back to the starting point (10m).



- **PROGRESSION:** Move circle 2m further away.

Activity 2:

Repetition: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Place a rope (5m) on the ground. Children have to walk heel-to-toe on the rope.
- After walking on the rope the children have to run to the small block that is 7-8m away and balance with one leg on the block.
- Place a number in front of the block - balance for that amount of time (seconds).
- **PROGRESSION:** Walk backwards on the rope.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Place 2 big cones with a bar in the middle. The bar is a meter. Then a meter after that another 2 cones with a bar in the middle.
- Let the children walk on all fours up to the first bar. They have to go underneath the bar by just using their hands to pull them through, do the same with the seconds one.
- When they are finished with that they have to hop on one leg to the trampoline (4-5m to hop).
- They have to do 5 jumping jacks on the trampoline.

- **PROGRESSION:** 10 jumping jacks on the trampoline.

Activity 4:

Repetitions: x3 (7-8 minutes).

Focus: Static and dynamic balance and strength.

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their dominant leg.
- Afterwards - throw and catch a medicine ball (x 10) with the presenter.
- **PROGRESSION:** Throw a heavier medicine ball (x 5)

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made the children have to walk on all fours around the shape.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (7 minutes).

Focus: Cardiovascular endurance.

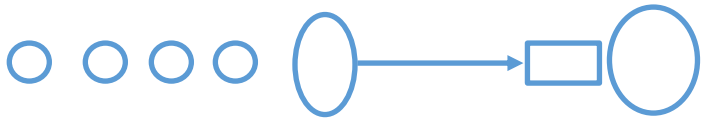
- Spread colourful balls randomly in the hall.
- Children must run/ jump around and pick up one ball at a time and place it in the basket.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Pack the rocks in a vertical line so that the children can jump on and off them. There must be a 30cm space open between the rocks.
- Children have to jump over the rocks towards the jellyfish.
- Place one cone with a circle, 3-5m from the jellyfish.
- Children have to stand on the jellyfish and throw a ball through the circle x 3. Balls would be placed in front of the jellyfish.
- Run back to the starting point (10m).



- **PROGRESSION**: Move circle 2m further away.

Activity 2:

Repetition: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Place big cones 3m from each other in a vertical line. The line is 10m long.
- Place a beanbag on every cone.
- Children begin by running to every cone to pick up the beanbag.
- On the other side there must be a number the children have to balance on one leg for that amount of time (seconds).
- **PROGRESSION:** Children have to close their eyes while they balance on one leg.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Place 2 big cones with a bar in the middle. The bar is a meter. Then a meter after that another 2 cones with a bar in the middle.
- Let the children walk on all fours up to the first bar. They have to go underneath the bar by just using their hands to pull them through, do the same with the seconds one.
- When they are finished with that they have to hop on one leg to the trampoline (4-5m to hop).
- They have to do 5 jumping jacks on the trampoline.
- **PROGRESSION:** 10 jumping jacks on the trampoline.

Activity 4:

Repetitions: x3 (7-8 minutes).

Focus: Static and dynamic balance and strength.

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their dominant leg.
- Afterwards - throw and catch a medicine ball (x 10) with the presenter.
- **PROGRESSION:** Throw a heavier medicine ball (x 5)

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made the children have to walk on all fours around the shape.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (3 minutes).

Focus: Cardiovascular endurance.

- Place a ladder (5m long) on the floor. Children must run as fast as possible through the ladder straight to the basket with the colourful balls.
- Place a basket 5m away from the ladder.
- Children must take a ball out of the basket and run to place it in the right colour block. Place the colour blocks about 10m from the basket with the balls in.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Place 5 beacons, 1-2m away from each other in a vertical line. The line is 10m long.
- Children must hop like a rabbit through the beacons.
- Place a big cone 3-5m after the last beacon. Give the children a yellow ball that they have to use to roll the cone over. Afterwards they have to balance for 4-8 seconds on their dominant leg.

- **PROGRESSION:** Roll the cone over with a medicine ball and stand on non-dominant leg.

Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Place 5 rocks in a vertical line. There must be a 30cm space open between the rocks and the vertical line is 8m long.
- Children must balance on one leg on a rock for 3-5 seconds and then jump off and run to the next one.
- At the end they have to do 3 sit-ups.
- **PROGRESSION:** Use foam blocks instead of rocks.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Give the children a yellow ball to throw up and catch with 2 hands from one cone to another while walking.
- The children then have to throw the ball into a basket that is 2-3m away from the cone where they stopped.
- Give the children a 3kg medicine ball, they have to roll it back to the starting point (10m) (they have to go down and bend their knees while they roll the ball).
- **PROGRESSION:** Bear walk while they roll the ball.

Activity 4:

Repetitions: x3 (7 minutes).

Focus: Static and dynamic balance and strength.

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their dominant leg.
- Afterwards - throw and catch a medicine ball (x 10) with the presenter.
- **PROGRESSION:** Throw a heavier medicine ball (x 5).

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made they have to walk like a worm on the shape.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (3 minutes).

Focus: Cardiovascular endurance.

- Place a ladder (5m long) on the floor. Children must run as fast as possible through the ladder straight to the basket with the colourful balls.
- Place a basket 5m away from the ladder.
- Children must take a ball out of the basket and run to place it in the right colour block. Place the colour blocks about 10m from the basket with the balls in.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Place 5 beacons, 1-2m away from each other in a vertical line. The line is 10m long.
- Children must hop like a rabbit through the beacons.
- Place a big cone 3-5m after the last beacon. Give the children a yellow ball that they have to use to roll the cone over. Afterwards they have to balance for 4-8 seconds on their dominant leg.
- **PROGRESSION:** Roll the cone over with a medicine ball and stand on non-dominant leg.

Activity 2:

Repetition: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Place 5 rocks in a vertical line. There must be a 30cm space open between the rocks and the vertical line is 8m long.
- Children must balance on one leg on a rock for 3-5 seconds and then jump off and run to the next one.
- At the end they have to do 3 sit-ups.
- **PROGRESSION:** Use foam blocks instead of rocks.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Give the children a yellow ball to throw up and catch with 2 hands from one cone to another while walking.

- The children then have to throw the ball into a basket that is 2-3m away from the cone where they stopped.
- Give the children a 3kg medicine ball, they have to roll it back to the starting point (10m) (they have to go down and bend their knees while they roll the ball).
- **PROGRESSION:** Bear walk while they roll the ball.

Activity 4:

Repetitions: x3 (7 minutes).

Focus: Static and dynamic balance and strength.

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their dominant leg.
- Afterwards - throw and catch a medicine ball (x 10) with the presenter.
- **PROGRESSION:** Throw a heavier medicine ball (x 5).

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made they have to walk like a worm on the shape.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (3 minutes).

Focus: Cardiovascular endurance.

- Give each child an A4 paper. They must hold the paper against their stomach. They must run around and try and keep the paper against their stomachs without using their hands.
- When the whistle blows they must hold the paper, pick up a beanbag, go, and throw it in a basket. Place the basket in the centre of the hall and scatter the beanbags all around the basket.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Children must balance on the rock on one leg. Place small cones around the rock with numbers underneath. They must now choose a cone and kick the cone with their dominant leg.
- Look at the number under the cone, jump of the rock and hop like a bunny to the other side. Distance from the rock to the other side of the hall= 5m.

- Now they must balance in the heel-to-toe position for the amount that was under the cone.
- Run back to the starting point = 10m.
- **PROGRESSION:** Balance on the foam block instead of the rock.

Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

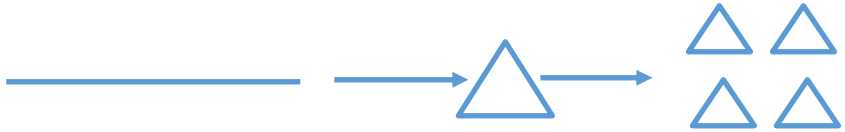
- Place 9 (amount of children) sets of rubber tactile hands and feet on the ground.
- Children must run around, when the whistle blows the children must each go to a pair of hands and feet.
- They must place their hands on the hands and the same with their feet. The presenter will say - lift up your left leg and then they must keep that limb in the air for 5 seconds.
- **PROGRESSION:** Hold a limb in the air for 10 seconds.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Children must walk heel-to-toe on a rope (5m).
- After the rope they must pick a ball up, while walking to the cone they must throw and catch the ball by themselves. Distance from the rope to cone = 5m.
- When they reach the cone they must roll the ball and knock over the pins. Place the pins 5m from the cone.
- **PROGRESSION:** Use a medicine ball to roll with.



Activity 4:

Repetitions: x3 (7 minutes).

Focus: Static and dynamic balance and strength.

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their non-dominant leg
- When the children hop in the block with one leg - balance for 3 seconds before continuing.
- **PROGRESSION:** Balance for 5 seconds.

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made they have to walk like a worm on the shape.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (3 minutes).

Focus: Cardiovascular endurance.

- Give each child an A4 paper. They must hold the paper against their stomach. They must run around and try and keep the paper against their stomachs without using their hands.
- When the whistle blows they must hold the paper, pick up a bean bag and go and throw it in a basket. Place the basket in the centre of the hall and scatter the bean bags all around the basket.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Children must balance on the rock on one leg. Place small cones around the rock with numbers underneath. They must now choose a cone and kick the cone with their dominant leg.
- Look at the number under the cone, jump of the rock and hop like a bunny to the other side. Distance from the rock to the other side of the hall= 5m.
- Now they must balance in the heel-to-toe position for the amount that was under the cone.
- Run back to the starting point = 10m.
- **PROGRESSION:** Balance on the foam block instead of the rock.

Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Place 9 (amount of children) sets of rubber tactile hands and feet on the ground.
- Children must run around, when the whistle blows the children must each go to a pair of hands and feet.
- They must place their hands on the hands and the same with their feet. The presenter will say - lift up your left leg and then they must keep that limb in the air for 5 seconds.
- **PROGRESSION:** Hold a limb in the air for 10 seconds.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Children must walk heel-to-toe on a rope (5m).
- After the rope they must pick a ball up, while walking to the cone they must throw and catch the ball by themselves. Distance from the rope to cone = 5m.
- When they reach the cone they must roll the ball and knock over the pins. Place the pins 5m from the cone.
- **PROGRESSION:** Use a medicine ball to roll with.

Activity 4:

Repetition: x3 (7 minutes).

Focus: Static and dynamic balance and strength.

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their non-dominant leg
- When the children hop in the block with one leg - balance for 3 seconds before continuing.
- **PROGRESSION:** Balance for 5 seconds.

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made they have to walk like a worm on the shape.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (3 minutes).

Focus: Cardiovascular endurance.

- Pack a big square out with cones (10m x10m). Children must run around the square.
- If the whistle blows the children must do 2 jumping jacks inside the big square.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Place a long rope on the ground. At least 8m-10m. On the sides of the rope, place beanbags.

- Children have to walk heel-to-toe on the rope. When they see a bean bag they must stop, bend down and pick the bean bag up, then they must put the bean bag in their other hand and drop the bean bag on the other side of the rope.
- At the end of the rope they must balance on the ground for 5 seconds on one leg.
- **PROGRESSION:** Place the rope in an S shape, and children have to balance on one leg on a foam block.

Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Place 4 bean bags in a vertical line, 4m apart. On the furthest point place a rock and about 2m from the rock a basket.
- Children will run to the 1st bean bag, pick it up and run to the rock. Children have to get on the rock and they must balance and throw the bean bag in the basket. They must do this with the other bean bags as well.
- **PROGRESSION:** Side shuffle instead of run.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Children must jump over 2 hurdles (height = 30cm). The hurdles must be 1m apart from each other.
- They must then walk like a crab to a cone (5m to the cone).
- When they reach the cone, they will catch and throw a ball to a friend x 5. (Place the plastic balls at the cone).
- **PROGRESSION:** Dribble the ball in a stationary position instead of throw and catch.

Activity 4:

Repetitions: x3 (7 minutes).

Focus: Static and dynamic balance and strength.

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their non-dominant leg
- When the children hop in the block with one leg - balance for 3 seconds before continuing.
- **PROGRESSION:** Balance for 5 seconds.

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made they have to walk like a worm on the shape.
- Progression: Pack a set of rubber hands and feet out, do the worm on the hands and feet.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (3 minutes).

Focus: Cardiovascular endurance.

- Pack a big square out with cones (10m x10m). Children must run around the square.
- If the whistle blows the children must do 2 jumping jacks inside the big square.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Place a long rope on the ground. At least 8m-10m. On the sides of the rope, place beanbags.
- Children have to walk heel-to-toe on the rope. When they see a bean bag they must stop, bend down and pick the bean bag up, then they must put the bean bag in their other hand and drop the bean bag on the other side of the rope.
- At the end of the rope they must balance on the ground for 5 seconds on one leg.
- **PROGRESSION:** Place the rope in an S shape, and children have to balance on one leg on a foam block.

Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Place 4 bean bags in a vertical line, 4m apart. On the furthest point place a rock and about 2m from the rock a basket.
- Children will run to the 1st bean bag, pick it up and run to the rock. Children have to get on the rock and they must balance and throw the bean bag in the basket. They must do this with the other bean bags as well.
- **PROGRESSION:** Side shuffle instead of run.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Children must jump over 2 hurdles (height = 30cm). The hurdles must be 1m apart from each other.
- They must then walk like a crab to a cone (5m to the cone).
- When they reach the cone, they will catch and throw a ball to a friend x 5. (Place the plastic balls at the cone).
- **PROGRESSION:** Dribble the ball in a stationary position instead of throw and catch.

Activity 4:

Repetitions: x3 (7 minutes).

Focus: Static and dynamic balance and strength.

- Pack a hopscotch (at least 12 blocks).
- Children have to hop through the hopscotch on their non-dominant leg
- When the children hop in the block with one leg - balance for 3 seconds before continuing.
- **PROGRESSION:** Balance for 5 seconds.

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made they have to walk like a worm on the shape.
- **PROGRESSION:** Pack a set of rubber hands and feet out, do the worm on the hands and feet.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (3 minutes).

Focus: Cardiovascular endurance.

- Pack a big square out with cones (square= 10m x10m). Children must run around the square.
- If the whistle blows the children must do 3 frog jumps in the square.

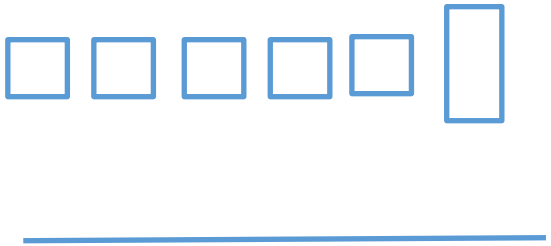
Activity1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Pack out 5 rubber feet in a vertical line. The line is 3 meters long.
- Children will hop on one leg on the rubber feet to the end. At the end there will be a foam block. Balance on it for 5 seconds.
- Younger children may be assisted.
- Place a long rope next to the feet. The rope must be 5 meters long. They must now move back to the begging in the push-up position.

- **PROGRESSION:** Hop on the non-dominant leg on the rubber feet.



Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Make 2 stations (divide children up into 2 groups). The children will now race against each other. The distance that they will be running = 10 meters.
- The child in front needs to pick up a bean bag, run to the other marked place and put the bean bag down. Then the next child in the line can go.
- The aim is to see how many bean bags the children can get to the other side. After 1 minute a whistle will blow and the children must stop.
- At the end they must all balance on their fours and lift a limb up.
- **PROGRESSION:** Lift 2 limbs up.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Throw and catch a ball to themselves to the 1st cone while walking. Distance = 5 meters.
- Put the ball down and take a medicine ball (1 or 2kg). Hop like a bunny with the medicine ball to the 2nd cone. Distance = 5 meters.
- Put the ball down and do 3 sit-ups.
- **PROGRESSION:** Put the cones at least 2/3 meters further away from each other.

Activity 4:

Repetition: x3 (7 minutes).

Focus: Static and dynamic balance and strength.

- Pack hopscotch in a circle (at least 12 blocks).
- Children have to hop through the hopscotch on their non-dominant leg

- When the children hop in the block with one leg - balance for 3 seconds before continuing. PROGRESSION: Throw a yellow medicine ball (1 or 2kg) to each other (x 5).
- When they are finished they must take a medicine ball (1 or 2kg) and see how far they can throw it.
- **PROGRESSION:** Balance for 5 seconds in the hopscotch block on one leg.

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made they have to walk like a worm on the shape.
- **PROGRESSION**: Pack sets of rubber hands and feet out, do the worm on the hands and feet.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (3 minutes).

Focus: Cardiovascular endurance.

- Pack a big square out with cones (square= 10m x10m). Children must run around the square.
- If the whistle blows the children must do 3 frog jumps in the square.

Activity1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Pack out 5 rubber feet in a vertical line. The line is 3 meters long.
- Children will hop on one leg on the rubber feet to the end. At the end there will be a foam block. Balance on it for 5 seconds.
- Younger children may be assisted.
- Place a long rope next to the feet. The rope must be 5 meters long. They must now move back to the begging in the push-up position.

- **PROGRESSION:** Hop on the non-dominant leg on the rubber feet.

Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Make 2 stations (divide children up into 2 groups). The children will now race against each other. The distance that they will be running = 10 meters.
- The child in front needs to pick up a bean bag, run to the other marked place and put the bean bag down. Then the next child in the line can go.
- The aim is to see how many bean bags the children can get to the other side. After 1 minute a whistle will blow and the children must stop.
- At the end they must all balance on their fours and lift a limb up.
- **PROGRESSION:** Lift 2 limbs up.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Throw and catch a ball to themselves to the 1st cone while walking. Distance = 5 meters.
- Put the ball down and take a medicine ball (1 or 2kg). Hop like a bunny with the medicine ball to the 2nd cone. Distance = 5 meters.
- Put the ball down and do 3 sit-ups.
- **PROGRESSION:** Put the cones at least 2/3 meters further away from each other.

Activity 4:

Repetition: x3 (7 minutes).

Focus: Static and dynamic balance and strength.

- Pack hopscotch in a circle (at least 12 blocks).
- Children have to hop through the hopscotch on their non-dominant leg
- When the children hop in the block with one leg - balance for 3 seconds before continuing. PROGRESSION: Throw a yellow medicine ball (1 or 2kg) to each other (x 5).
- When they are finished they must take a medicine ball (1 or 2kg) and see how far they can throw it.
- **PROGRESSION:** Balance for 5 seconds in the hopscotch block on one leg.

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.

- When the shape is made they have to walk like a worm on the shape.
- **PROGRESSION**: Pack sets of rubber hands and feet out, do the worm on the hands and feet.

Environment: Land

Time: 40 min

Age: Junior and Senior

Warm-up:

Repetitions: x3 (3 minutes).

Focus: Cardiovascular endurance.

- Pack a big square out with cones (10m x 10m). Children must run around the square.
- If the whistle blows the children must go in the crab position and hold it for 10 seconds.

Activity 1:

Repetitions: x 3 (7-8 minutes).

Focus: Static and dynamic balance and hand-eye coordination.

- Pack rocks and foam blocks in a vertical line. The objects must be 30cm apart from each other on an 8m vertical line. Children must hop over the objects.
- At the end of the rocks and foam blocks they must jump off and take a tennis ball. They have to throw the ball at the target against the wall. The target – 30cm x 30cm.
- Bear walk back to the starting point (5m).
- **PROGRESSION:** Hop on dominant leg over the objects.

Activity 2:

Repetitions: x3 (7-8 minutes).

Focus: Cardiovascular endurance and static balance.

- Make a square with cones, they have to side shuffle all around the square. (10m x 10m)
- At the end they must lie on a swiss ball and then they have to lift a limb up for 10 seconds.
- **PROGRESSION:** Lift 2 limbs up for 10 seconds.

Activity 3:

Repetitions: x3 (7-8 minutes).

Focus: Strength and coordination.

- Walk on the stilts to the 1st cone. Distance = 5m.
- Participants get off the stilts, throw and catch a medicine ball (1 or 2kg) x5 with the presenter. After each throw and catch they must do 1 chest press.
- After the catch and throw they must push themselves back to the start by lying on their stomachs on the scooter board. Distance = 5meters.
- **PROGRESSION:** Take a heavier medicine ball (2 or 3 kg).

Activity 4:

Repetitions: x3 (7 minutes).

Focus: Static and dynamic balance and strength.

- Place 3 squares in a vertical line next to each other, then 2 circles, 3 squares then 2 circles.
- In the square they have to hop with both legs and in the circle with one leg.
- Then the participant will sit on a tilt board and the instructor will move the child from side to side, while they have to keep their balance.
- **PROGRESSION:** Stand on one leg for 3 seconds in the circle.

Cool down:

- Children get turns to throw the shape dice and then use a rope to form the shape on the dice thrown, after the presenter performed the first one.
- When the shape is made they have to walk like a worm on the shape.
- **PROGRESSION:** Pack sets of rubber hands and feet out, do the worm on the hands and feet.

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