Efficacy of a Physical Exercise Programme on the Stereotypic Behaviour and Response Amongst Autistic Children at the Nairobi Autism Unit, Kenya

By

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156/5659/03

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the School of Applied Human Sciences of Kenyatta University

June 2008

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DECLARATION

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DEDICATION

This thesis is dedicated to Autism Society of Kenya. Adequate knowledge on the specific intervention needs and problems of people with autism is very indispensable. Your call to attention and emphases for an in depth knowledge on autism as a specific disorder in Kenya shall shed light at the end of the tunnel to these very deserving persons.
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LIST OF ABBREVIATIONS

ATEC...........................................Autism Treatment Evaluation Checklist

SPSS...........................................Statistical Package of Social Sciences

TEACCH......................................Treatment and Education of Autistic and Related
                                      Communication Handicapped Children

HFA..........................................High Functioning Autistics

LFA...........................................Low Functioning Autistics

DSM-IV.......................................Diagnostic and Statistical Manual for Mental Disorders

CARS.........................................Childhood Autism Rating Scale

GARS.........................................Gilliam Autism Rating Scale

ABC...........................................Autism Behaviour Checklist
ABSTRACT

Autism is a developmental disorder, which is typically characterized by an inability to develop normal social relationships, compulsive and ritualistic behaviour and failure to develop normal intelligence. A characteristic feature commonly seen among people with autism is the abnormal stereotype behaviours. These behaviours engaged in at various times also inhibit the ability to learn or take part in activities appropriately. This study analysed the efficacy of using structured physical exercises as an intervention for managing stereotype behaviours in autism. The Nairobi Autism Unit for individuals with autism was purposively selected. All the 34 autistic children at the unit constituted the sample of the study. Quasi-experimental research using a single-group pre-test and post-test design was used with the experimental group (autistic children) being given treatment using structured physical exercises for a period of eleven weeks. The physical exercise circuit included warm up, flexibility, cardiovascular and endurance, muscle-strengthening and cool down activities. The adaptive exercise routine used structured teaching principles explained by Hong (2001) and Schopler, et al., (1995). The Autism Treatment Evaluation Checklist was used as the main tool for collecting data. A pre-test was done during the first week of the school term to establish the children’s behaviour levels in the different domains. This was followed by subsequent tests periodically, at 3 weeks and 4 weeks intervals up to a final test after the eleventh week. The dependent variables comprised those behaviours found in the ATEC evaluation checklist and included: Speech/ Language/ Communication, Sensory/ Cognitive awareness, Sociability and Health/ Physical behaviours. Age, gender and level of autism were the independent variables. The raw data was summarized using descriptive statistics. To test the hypotheses, dependent t-test was used where hypotheses were either rejected or not rejected at 0.05 alpha level. The results of the study were then presented in tables and charts. The results indicated that the structured physical exercises had a positive significant impact on all the four behaviour domains of children at the Nairobi Autism Unit. With regard to gender, age group and level of autism, the males, aged 8-12 and 13-17 years as well as those children with mild level autism did not improve significantly in speech/ language/ communication. The improvement of children aged 18 years and above was not significant in any of the behaviour variables. Structured physical exercise is thus recommended as a means to manage the challenging behaviour and enhance better health and wellness amongst individuals with autism. Creative methods for including physical exercises in the daily schedule for autistic individuals could be very beneficial. There is also a major task for curriculum planners to develop an appropriate Physical Education syllabus. Studies need to be carried out to establish the physical fitness levels of individuals with autism for the establishment of more specific programmes. Different populations with behavioral challenges should also be used as samples in physical exercise intervention other than individuals with autism.
CHAPTER ONE

INTRODUCTION

1.1 Background to the Problem

Despite the voluminous amount of research that has been published in the field of exercise science over the past decades, there remains a paucity of information on the activity patterns and physiological responses to exercise in persons with disability (Rimmer et al., 1996). In an era when physical activity has grown to new heights in terms of importance in promoting health and preventing disease, many questions pertaining to how it affects the lives of individuals with specific physical and mental disabilities remain unanswered. This renders the establishment of guidelines for increasing physical activity on condition – specific basis rather difficult (Rimmer et al., 1996).

In Kenya, autism is one of the disabilities that require urgent attention. This is a pervasive developmental disorder, which affects the whole personality and lasts throughout life. Autism also typically appears during the first three years of life (Shirley, 1998). This is as a result of a neurological disorder that affects the brain and its associated behaviour has been estimated to occur in as many as 1 in 500 individuals as noted by Grandin (1995). Autism is manifested through impairments in communication, social relationships and flexible organisation of behaviour and interest. According to Quill (1995), the spectrum of autism is quite wide: it includes persons with multiple handicaps, who have practically no contact with the environment, as well as persons with occasionally excellent intelligence, who have mild autism and just may seem
strange and lonesome. Grandin (1995), further reports that autism is four times more prevalent in boys than in girls (usually the first born). It affects people equally regardless of ethnicity, intelligence, geographical location or socioeconomic background all around the world. It has become more prevalent in both developing and developed countries.

In Kenya today, cases of children diagnosed with this disorder have been reported. Over 400 cases have been identified around Nairobi’s environs between the year 2000 and 2005 as the awareness continues to grow. It is believed there are even more cases (Autism Society of Kenya, 2006). Despite having been 68 years since autism was first diagnosed, Kenyan parents with afflicted children are only just beginning to seek professional help. They have had to wait for decades to get direction from the health authorities as the government grappled with how to handle this neurological disorder (Kithaka, 2006). This is due to lumping autistic children with other mental cases with little regard to their care and treatment (Autism Society of Kenya, 2006).

Due to its complexity, the educational and treatment needs of all individuals with autism, have some shared features. The highest possible degree of autonomy and social integration in individuals with autism can only be obtained with intensive developmental programmes aimed at enhancing communicative, social and cognitive skills (Schopler and Mesibov, 1994). Therefore, on the basis of these shared needs, this population has to be handled in an integrated way. Through unified therapeutic principles, a number of interventions are required in order to help the child to live a normal life (Schopler and Mesibov, 1994).
Various therapeutic modalities have been used to manage behaviour in autism. Some of these modalities are but not limited to; speech therapy, occupational therapy, physical therapy, nutritional intervention and biomedical treatment. Among these treatments, is the inclusion of physical exercises in the child’s lifestyle (Berkely and Zittel, 1998). While treatments for autism do exist, it is widely considered that cure is impossible because autism involves aspects of the brain structure that are determined very early in a child’s development. However, people with autism can and do get better. They can live happily and have more productive lives when appropriate treatment is started early (Shirley, 1998).

Recognizing that difficulties faced by individuals with autism have significant impact on their ability to be integrated into educational, social and vocational settings, some studies have investigated methods of reducing the maladaptive, stereotypic behaviour associated with autism (Schopler and Mesibov, 1994). Studies that focused on the influence of physical exercise have consistently been congruent in their results among different populations. These include decreases in motor stereotypic behaviour and hyperactivity amongst autistic individuals after participating in physical exercises (Elliott et al., 1994). In addition, improvements have been shown in increased attention span after the exercise programme.

Currently, experimental literature indicates that physical exercise positively influences the characteristic inappropriate behaviour in individuals with autism. Some of the studies in this area have investigated whether specific types of exercise such as mild
versus vigorous, would differentially affect subsequent self-stimulatory behaviour (Watters and Watters, 1980 and Kern et al., 1984). According to these authors, vigorous exercise (jogging) systematically produced decreases in the stereotypic responding. The study by Watters and Watters (1980), also found that there is lesser motor self-stimulating behaviour or a 32.7% decrease on the average following periods of 8 -10 minutes of jogging. Bumin et al., (2004) also found that hydrotherapy had an effect of reducing the maladaptive behaviour in a child with autism after a session of swimming.

However, hardly has any research been done to establish whether engaging in different modes of physical exercise using a structured environment suitable for individuals with autism enhances positive responses and decreases the use of stereotypic behaviour which in turn affects other aspects of learning. According to the Autism Society of Kenya (2006), the number of reported cases of autism has increased dramatically in the country. This is attributed to increased public awareness through the Autism Society of Kenya and improvement in diagnostic methods. As such, more people are becoming aware of the disorder and the medical professionals are doing a better job with regard to it (Kithaka, 2006). In view of a growing population of children with autism in Kenya, it is important that research focuses on ways of helping these children to live productive lives.

Most studies conducted on autism and physical exercise have been in developed countries. Currently in Kenya, studies have been done on adapted physical education. These include, Gathua (1990) who examined problems in curriculum instruction in
Kenyan special schools and Nkatha (2002) who investigated the effect of a physical education programme on deaf children in Kenya. There is hardly any available data on adapted physical education or activity patterns and physiological responses to exercise in children with this specific developmental disorder in Kenya.

The Autism Society of Kenya has no guidelines on the use of physical exercises as a possible behavioral intervention for children with autism in Kenya. This study served as a step towards using this effective yet affordable means. It is notable that there are very few studies, if any, relating to autism and physical exercise therapy in Kenya. This study therefore was designed to bridge the gap by providing the positive effects of structured physical exercises on the challenging behaviour among children with autism at the Autism Unit situated in City Primary School in Nairobi.

1.2 Statement of the Problem

The therapeutic strategies involving physical exercise that have been used in several studies such as Watters and Watters (1980), Elliot et al., (1994), Kern et al., (1984) and Rosenthal and Mitchell (1997), have been effective in reducing the frequency of a variety of maladaptive behaviour in autism. The exercise therapy has been shown to increase the frequency of substitute appropriate behaviour in autistic individuals. This includes enhancing positive on-task response in terms of reduced motor stereotypic behaviour like rocking, hand flapping or hand biting, among other stereotypes. This is because the autistic person becomes more organized and less anxious with increased physical activity (O’Connor et al., 2000).
In Kenya, many parents of individuals with autism find it a challenge to deal with them because they demand a lot of care, attention and hard work (Kithaka, 2006). This is, among other reasons, due to their maladaptive stereotypic behaviour. A child with autism exhibits impulsive behaviour that is related to anxiety, emotional excitement or agitation. Such a defining characteristic of autism often interferes with the child's learning and socialization, which could even be hazardous to the child or others. For this reason, reducing inappropriate behaviour is usually one of the highest challenges and priorities for parents and care givers and is often the first target of different behavioral intervention programmes.

It is in light of this that the current study focused on investigating the effects of a variety of physical exercises as a possible intervention in dealing with the stereotypic behaviour of children at the Nairobi Autism Unit. This was with a view to finding out whether various exercises done over a given period of time would contribute to reduction of stereotypic behaviour in autistic children. The study also sought to find out the effects of the physical exercises on interactive responses amongst autistic individuals.

1.3 Purpose of the Study

The purpose of this study was to investigate the effects of a structured physical exercise programme on the stereotypic behaviour and responses in various behaviour domains amongst individuals in Nairobi Autism Unit.

1.4 Objectives of the Study

The objectives of this study were:
i) To establish the efficacy of using a structured physical exercise programme as an intervention for the stereotypic behaviour and response by comparing the overall outcome before and after the treatment amongst children at the Nairobi Autism Unit.

ii) To establish the effect of a structured physical exercise programme on the stereotypic behaviour and response with regard to gender amongst children at the Nairobi Autism Unit.

iii) To determine the effect of the physical exercise programme on the stereotypic behaviour and response of children of different age groups at the Nairobi Autism Unit.

iv) To determine the effect of a structured physical exercise programme on the stereotypic behaviour and response of children with regard to their level of autism at the Nairobi Autism Unit.

v) To examine the effect of a structured physical exercise programme on the children’s behaviour and responses in the specific areas of: Speech/ Language/ Communication, Sociability, Sensory/ Cognitive Awareness and Health/ Physical behaviour at the Nairobi Autism Unit.

1.5 Research Hypotheses

The study set out to test the following null hypotheses:

H₀₁ There would be no significant difference in stereotypic behaviour and response before and after the exercise programme on the overall behaviour score (total score) amongst children at the Nairobi Autism Unit.
There would be no significant difference in stereotypic behaviour and response after the exercise programme between male and female children at the Nairobi Autism Unit.

There would be no significance difference in stereotypic behaviour and response after the exercise programme amongst children of different age groups at the Nairobi Autism Unit.

There would be no significant difference in stereotypic behaviour and response in children with mild and severe levels of autism after the exercise programme.

There would be no significant difference in stereotypic behaviour and response in the various domains (Speech/ Language/ Communication, Sociability, Sensory/ Cognitive Awareness and Health/ Physical behaviour) after the exercise programme amongst children at the Nairobi Autism Unit.

1.6 Theoretical Framework

The theoretical base of sensory integration guides the use of the structured physical exercise programme as an intervention for the maladaptive behaviour in autism. This theory was developed and refined by occupational and physical therapists in the 1950s and 1960s (Kranowitz, 1998). It attempts to explain the relationship between behaviour and neural functioning with regards to sensory processing or integration. This theory predicts specific relationships among neural functioning, sensorimotor behaviour, and learning (Di Matties and Quirk, 2004).
Figure 1.1 shows the contribution of physical exercises to the sensory integration process in all individuals as they promote experience in sensations of tactile, vestibular and proprioceptive systems. Sensory integration according to Mc Inner and Treffry (1997) is an innate neurobiological process that refers to the interpretation of sensory stimulation from the environment by the brain. They assert further that in contrast, sensory dysfunction is a disorder in which sensory input is not integrated or organized appropriately in the brain and may produce varying degrees of problems in development, information processing and behaviour.
This theoretical base postulates that learning is dependent on the ability of normal individuals to take in sensory information derived from the environment and from movement of their bodies. It is also used to process and integrate these sensory inputs within the central nervous system (CNS), as well as use this sensory information to plan and organize behaviour (Di Matties and Quirk, 2004). Sensory integration provides the child with sensory information that helps to organize the central nervous system, assists in inhibiting or modulating sensory information hence contributes to learning and finally assists in processing a more organized response to stimuli (Kranowitz, 1998).

In most children, sensory integration develops in the course of ordinary childhood activities. However, for others, sensory integration does not develop as efficiently as it should (Di Matties and Quirk, 2004). With a disorder in this process, a number of problems in learning, development, or behaviour may become evident to families and professionals. According to Kranowitz (1998), the sensory integration dysfunction may affect 12% to 17% of children and throws some of them "out of sync" emotionally, socially, and behaviorally.

Foss et al., (2003) point out that children and adults with autism as well as those with other developmental disabilities may have a dysfunctional sensory system. This renders them unable to interact with their environment or have difficulties adjusting to new situations. They may react with frustration, aggression or withdrawal, and as a result, self-stimulation occurs to overcome the situation. Wilbarger (1995) indicates that this is because attention, emotional stability and self-esteem are related to sensory integration.
Physical exercises provide these needed opportunities for sensory integration by autistics.

According to Kranowitz (1998), sensory integration focuses primarily on three basic senses. These are the tactile, vestibular and proprioceptive. These senses allow individuals to experience, interpret and respond to different stimuli in the environment. Wilbarger (1995) asserts that, several principles of sensory integration are used in drawing out different physical activities and deciding which ones are appropriate for each autistic child. The author further reports that engaging in the activities appropriately promotes effective processing of tactile, proprioceptive and vestibular sensations that in turn contribute to appropriate processing of visual and auditory sensations, acquisition of language and academic skills, and emotional adjustment.

In light of the problems that may develop due to sensory integration dysfunction, it is then not a wonder that individuals with autism may lack emotional stability and social skills. The way a child behaves or interacts influences how individuals will interact with them. A child with sensory integration dysfunction may feel insecure in completing daily tasks because of his/her uncertainty of the environment. Disorders in the sensory integration domain greatly influence the ability to function, but also can be so subtle that they easily go unrecognized (Mc Inner and Treffry, 1997).

Through the use of various physical exercises drawn from the principles of sensory integration in this study, the approach seeks to encourage the nervous system to process and integrate sensory input in an organized and meaningful way. According to a study by Levinson and Reid (1993), the maladaptive behaviours were managed by the sensory
feedback produced that may be eliminated or replaced by physical activities that produced similar sensory consequences on the individuals, and hence the use of different physical exercises in a structured environment as an intervention as the case in this study.

1.7 Significance of the Study

Physical exercise is a useful therapeutic tool in individuals with autism. The specific way of life characterising most individuals with this disorder is that, they spend relatively little time in activities involving physical exercise and they have difficulties in organising their spare time in a useful and valuable way. Physical exercise in itself, is of course not a cure for autism, but can significantly improve the functional abilities of these individuals. Physical exercise can be applied even in those severely impaired individuals, who are impossible to involve and develop efficiently by other, more traditional methods (Weber and Thorpe, 1992). There can be an initial habituation period with many difficulties, following the physical exercise programme. However, even individuals with little intrinsic motivation and those with serious behavioural problems become more interested and involved while participating in the various physical activities. According to Quill (1995), an elementary level of communication may emerge in a previously completely isolated individual, as a contact is getting established with the environment, and behavioural problems begin to decrease both in quantity and quality.
An intensive physical education programme offers a variety of benefits for individuals with autism. Due to their inability to cope with the variety of auditory, visual and tactile stimuli in wide-open spaces, autistic children often demonstrate the stereotypic behaviours. Any exercise programme for these children should be developed with the aim of not only enhancing overall physical fitness, but also conditioning inappropriate behaviour by promoting interaction with the environment as asserted by O'Connor et al., (2000). Despite the literature on importance of physical exercises in maintaining a healthy lifestyle, and the fact that knowledge on autism is increasing in Kenya (Autism Society of Kenya, 2006), there is hardly any research done on this disorder with regard to physical exercise.

The findings of this study are useful in establishing the effectiveness of different physical exercises done in a structured setting to improve the behaviour of children with autism. The use of these exercises helped in comparing the results of this research with other research that has been done using a single type of physical exercise (jogging, ball playing and swimming). The results were found similar and this led to a variety of structured physical exercises being advocated with a view of decreasing the maladaptive behaviour and to enhance better response in communication, cognitive awareness, sociability and the physical behaviour in individuals with autism. The effects on gender, age and level of autism are highlighted in the study whose results show that any child with autism can benefit from participating in physical exercises.
The study contributes to awareness of autism and knowledge on why autistic children in Kenya should participate more in physical exercises that are structured. This is by providing a framework on the importance of inclusion of exercise programmes as an integral part of autistic children’s lifestyle. Physical exercises provide an alternative way to regulate them, interacting with the environment as well as helping them to acquire some essential motor skills necessary for daily functioning (Reid et al., 1991).

The research findings are useful for policy formulation by the Ministry of Education where curriculum planners can emphasize on incorporation of Physical Education as a core subject in the autism syllabus. For practical application, this study gives a methodological guideline for adapted physical educators and parents. There is need for them to design appropriate programmes of physical exercises that cater for the sensory needs in autism. In addition, the research findings raise the morale of children who are generally classified as dormant (Hart, 1993) as they participate in the various activities giving them a reason to be active which also enhances their physical fitness.

Findings of this study also provide a reference point from which future research in the field of autism and Physical Education in Kenya can be done. This is because other parameters related to physical activity can be assessed in order to maintain the well being of this population. The study also heralds other studies on autism in Kenya in relation to any other discipline. The information obtained on the behaviour change is beneficial for scholarly purposes as there can be interdisciplinary comparisons of disabilities. It has been shown that many parents with autistic children in Kenya have
had difficulties in managing the stereotypic behaviour associated with this disorder (Kithaka, 2006).

1.8 Limitations of the Study

The study was conducted under the following constraints:

i) Paucity on physical exercise and autism related literature in Kenya.

ii) The study did not consider the participants’ previous period of exposure to physical exercises and sports.

iii) The researcher had no control over the attitude or motivational level of students towards performance of the exercises in the programme due to their characteristic individual differences.

1.9 Delimitations of the Study

The study was delimited to:

i) The use of all the students in one institution, the Nairobi Autism Unit, at the City Primary School, Nairobi for it is the only one in Kenya.

ii) A period of eleven weeks of the third term in the school’s academic year.

iii) The use of Autism Treatment Evaluation Checklist (ATEC) as the main instrument for data collection.

iv) The study was confined to assessing the behaviour domains that have been identified in the Autism Treatment Evaluation Checklist as they include various aspects of the characteristic autistic behaviour. These are: speech/
language/ communication, sensory/ cognitive awareness, sociability and health/ physical behaviour.

1.10 Assumptions of the Study

The study was based on the assumptions that:

i) All the students included in the study would be present in school for the treatment period of eleven weeks.

ii) The respondents would be exposed to the same activities and would respond to the physical exercise programme adequately.

iii) Information given by the teachers on the autistic pupils would be correct.

1.11 Operational Definition of Terms


Autism: A pervasive brain disorder that hinders the development of normal social relationships, leads to development of compulsive ritualistic behaviour as well as failure in the development of normal intelligence as explained in the Diagnostic Criteria for Autistic Disorder (Appendix C). A diagnosis is made when observable aspects using criteria given in categories A, B and C are all met.
Autistic children: These are the male and female children at the Nairobi Autism Unit who participated in the study. Their ages ranged between 3 and 19 years.

Behavioral Domains: Speech/ language/ communication, sensory/ cognitive awareness, sociability and health/ physical behaviour of autistic children at the Nairobi Autism Unit.

Health/ Physical behaviour: This indicates the child’s behaviour in relation to physical actions such as motor movement patterns (hand-flapping, body-rocking, spinning or flipping of objects), imposition of unusual routines upon themselves and other individuals, formation of attachments to specific objects and self- injurious habits (head banging, biting or scratching).

Internet scoring: Procedure for feeding data obtained from the ATEC checklist into the computer system on the Internet, which then displays a set of numerical values that indicate the status of the person in each of the four separate areas affected in autism.

Level of autism: This is an indication showing how mild or severe the disorder is in an individual diagnosed with autism. It is derived from the total ATEC score which is then extracted in a score distribution chart (Appendix E).

Nairobi Autism Unit: A special center set up to cater for the needs of people with autism by the Autism Society of Kenya at City Primary School in Nairobi.

Pervasive Developmental Disorders: This is a group of disabilities that begin in infancy or early childhood and lasts for the rest of an individual’s life. They are characterized by delays in the development of socialization and communication skills for example Autism, Asperger’s Syndrome, Childhood Disintegrative Disorder and Rett’s Syndrome.
Physical exercises: Physical activities that involve movement of the body which result in energy expenditure and increase in the kinesthetic sense organized for the autistic children during the eleven week period of data collection that include jumping, running, stretching and rolling.

Response: Any action observed after a given task during the physical exercise intervention period of eleven weeks such as concentration in activities, performing a skill, accomplishing prescribed academic work, observed behaviour or answering questions appropriately.

Sensory Integration: The neurobiological process necessary for integration of information provided by the senses. The nervous system receives and organizes information in order to respond enabling individuals to interact with the environment.

Sensory/ Cognitive awareness: How the child responds in aspects requiring the brain’s function. This may include; frequent engagement in apparently non- purposeful, repetitive sequences of fixed actions and thoughts such as staring at one object or direction endlessly.

Sociability: How the autistic child responds when in a group setup with other children such as obsessive-compulsive behaviours, aloofness, major anger and distress.

Speech/ Language/ Communication: How the child responds in terms of interactive communication with significant others.

Stereotypic behaviour: Observable distinguishing features in most children with autism. This is viewed in terms of the child’s behaviour in four aspects: Communication, Sociability, Sensory/ Cognitive Awareness and Health/ Physical Behaviour.

Structured setting: This includes physical structure, visual structure and individual schemes or work systems. Physical structure helps the autistic children to understand
boundaries of their environment during physical exercise; visual structure is used to capitalize on visual strengths and to minimize problems with auditory processing. Individual schemes or work systems are used to enable the individual know what to do, how much is to be done, concept of finishing the activity and what happens next.

**Structured Physical Exercise Programme:** Activities in form of games that were offered in structured settings suitable for the pupils at Nairobi Autism Unit.
CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.1 Introduction
Presented in this chapter is the information pertaining to autism as a spectrum of disorders, sensory integration, stereotyped behaviour, motor performance of autistics, efficacy studies on the effect of physical exercise in autism, structured teaching and physical exercises for individuals with autism.

2.2 Autism as a Spectrum of Disorders
The National Research Council (2001) observes that major advancements in the sciences of early identification and treatment of Autism Spectrum Disorders have increased public awareness and focused more attention on this class of neurodevelopment disorders. It has been clearly demonstrated that autism is identifiable and relatively stable in very young children (Koegel et al., 1996). Intervention at earlier stages in the child’s development may have a greater chance of reducing the short-term and long-term negative consequences of these disorders. Lord and Rutter (1994) reckon that there is no single way that autism is first identified in young children. This will vary somewhat depending on the individual child. In addition the sequence in which components of the assessment process are done may vary.

The causes of child autism and many other Autism Spectrum Disorders are still unknown. Scientists believe that there are certain genetic factors responsible for the development of autism, but the genes that cause autism have not yet been identified.
Autism has a pronounced hereditary character. Parents with an autistic child in the family are most likely to have another child with the same disorder. An interesting aspect of child autism is the larger numbers of boys affected by the disorder, compared to the numbers of girls with autism (Hart, 1993).

2.2.1 Classification in Autism

According to Quill (1995), diagnosis of autism and classification of severity is based on behavioral characteristics. Social interactions and communication skills are areas of the brain most affected in autistic patients. It is common for autistics to be viewed as socially withdrawn or unwilling to appropriately interact with people or events surrounding them. In addition, persons with autism exhibit repeated body movements, unusual responses to people or attachments to objects (Hart, 1993).

Shirley (1998) observes that autism prevalence rate makes it one of the most common developmental disabilities yet most of the public including many professionals in the medical, educational and vocational fields are still unaware of how it affects people and how they can effectively work with autistic individuals. According to Grandin (1997), autism is not just one disorder with a well-defined set of symptoms, but a broad spectrum of disorders that range from mild to severe. This range varies from those who are nearly dysfunctional and apparently mentally retarded to those whose symptoms are mild or remedied enough to appear unexceptional (normal) to the public. In terms of therapy, Elliot (1990) notes that autistic individuals are often divided into low-functioning autism (LFA) and high functioning autism (HFA). Low and high
functioning are generally applied to how well an individual can accomplish activities of daily living, rather than to their intelligence levels. The mild cases are termed as high functioning while those who are severe are the low functioning autistics.

Koegel et al., (1996) explain that while Autism may co-exist with a range of measured ability levels, the majority of autistics have some learning difficulties. Among the cases with severe learning difficulties, there is unlikely to develop meaningful speech, and there will be a high probability of disturbed behaviours such as self-injury. Where ability is within the mild range, outcomes are more unpredictable. Lord and Rutter (1994) agree that in many cases, there will be an improvement with age as awareness of and adaptation to the difficulties become greater. In other cases, problems will increase with age. Grandin (1995) also points out that with time, the patterns of a child’s development is influenced by the degree of cognitive impairment.

2.2.2 Diagnosis of Autism

The diagnostic labels and diagnostic criteria for autism and similar disorders have changed several times since autism was first defined. The diagnostic criteria for autism that are currently most accepted are those specified in the Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) as revealed by National Research Council (2001).

A diagnosis of autistic disorder is made when an individual displays six or more of 12 symptoms listed across the three major categories in the Diagnostic and Statistical
Manual for Mental Disorders (National Research Council, 2001). The child should display qualitative impairments in social interaction, communication, repetitive patterns of behaviour, interest and activities. Delays or abnormal functioning of the child prior to 3 years of age could also indicate presence of this developmental disorder. This is illustrated in Appendix C (American Psychiatric Association, 2000).

2.3 Dysfunctional Sensory Integration

A lack of sensory integration can interfere with normal development and there is need for intervention. Careful assessment is necessary in order to determine which parts of the sensory integration process needs to be addressed in autistic individuals. Dysfunction in sensory integration is the inability to modulate, discriminate, coordinate or organize sensation adaptively (Foss et al., 2003). When the process of sensory integration is disordered, a number of problems in planning and producing behaviour occur that interfere with development in behaviour, conceptual and motor learning (Kranowitz, 1998).

Sensory systems can be viewed in terms of tactile, vestibular and proprioceptive systems. The tactile system includes the nerves under the skin’s surface that sends information to the brain including touch, light, pain and pressure. It has the ability to distinguish various objects through touch and pressure. A dysfunctional tactile system may lead to a misperception of touch and/or pain and may lead to self imposed isolation, general irritability, distractibility and hyperactivity (Hutchinson, 1993).
The vestibular system refers to the balance system in the brain and is the master system that controls all other senses. Howlin (1998) notes that dysfunctions within this system manifest in two ways; some individuals may be hypersensitive and have fearful reactions to ordinary movement activities. They result in apprehensive walking or crawling on uneven and stable surfaces. On the other extreme, in a hypo-reactive vestibular system, the child may actively seek very intense sensory experiences such as excessive body whirling, jumping or spinning as they are trying to continuously stimulate their vestibular system (Hutchinson, 1993). Having a child to perform balance exercises that combine multiple senses improves the ability of the child to receive more accurate and complete information about the outside world as indicated by Wilbarger (1995).

The proprioceptive system refers to components of muscles, joints and tendons that provide a person with subconscious awareness of body position. Signs of proprioceptive dysfunction are lack of awareness of body position in space, clumsiness, a tendency to fall, odd body posturing, difficult in manipulating small objects and resistance to new motor movement activities (Howlin, 1998).

Lord and Rutter (1994) confer that dysfunction within these three systems manifests itself in many ways. A child may be over or under responsive to sensory input; activity level may be usually high or unusually low or a child may be in constant motion or fatigue easily. Gross and/or fine motor coordination problems are also common when these three systems are dysfunctional and may result in speech language delays and in
academic under-achievement. Some children may also have difficulty adjusting to new situations and may react with frustration, aggression, or withdrawal as explained by Lord and Rutter (1994).

### 2.3.1 Sensory Integration Activities

According to Campbell et al., (1996), the general goals for this intervention are; to provide the child with sensory information which helps organize the central nervous system, to assist the child in inhibiting and/ or modulating sensory information and also to assist the child in processing a more organized response to sensory stimuli. The activities afford a variety of opportunities to experience tactile, vestibular, and proprioceptive input in a way that provides the right challenge for the child to promote increasingly more complex adaptive responses to environmental challenges. The result is improved performance of skills that relate to daily roles (Bundy et al., 2002). Sensory activities are usually quite simple to perform after giving instructions. Activities relating to the three primary sensory systems are suggested to promote the enhancement of sensory integration and usually conducted in the form of games (Lieberman and Cowart, 1996).

Campbell et al., (1996) suggest that for the sense of touch, activities may include rolling down on a sloppy area, pretending to swim on a mat or rug, catching various objects such as beanbags and also hanging on pull-up bars. To work on the sense of gravity activities may include; rolling, swinging, using the seesaw, merry-go-round, rocking chair, wiggling a rope on the floor and jumping over it and singing and rocking in a
circle-back, forward, and sideways. The senses provided from muscles and joints can be integrated by running, jogging, cycling, stair climbing, pushing on walls, pulling a rope, jumping on a trampoline, hopping on flat surfaces, tumbling activities (forward, backward and log rolls), wheelbarrow walks, clapping games and throwing and catching balls (Lieberman and Cowart, 1996).

According to Campbell et al., (1996), motor planning requires integrated input from all the senses in order to organize and execute movement. Activities suggested to aid the child in spontaneous motor planning include: animal walks (crab, duck, frog or kangaroo), rope jumping, hopping, crawling, statue game (quick change of positions), obstacle running courses, swimming, water play and kicking balloons or balls. Campbell et al., (1996) and Lieberman and Cowart (1996) caution that, although some children will crave for these activities, some will show no reaction while others display adverse reactions to these activities. They also note that the children must be carefully monitored and assisted while performing the activities.

2.4 Stereotyped Behaviours in Autism

One of the distinguishing features of many children with autism is their frequent engagement in apparently non-functional behaviours. These have historically been referred to as stereotypic behaviours (Kern et al., 1984). According to Daversa (2001), behaviour analysts and others, recognize the inappropriate behaviours in autism as directed at producing self-sensory stimulation and have broadened the area of concern to include all of these self-stimulatory behaviours, some of which are subtler to detect than...
traditionally defined stereotypes. Self-stimulatory behaviours can be socially stigmatizing, thereby precluding significant inclusion in natural social, occupational and educational environments. These behaviours pose significant obstacles to learning and if left untreated they can easily become the dominant behaviour in later years of life (Howlin, 1998).

2.4.1 Types of Stereotyped Behaviours in Autism

Cuvo (1997) states that all autistics persons have extreme difficulty in coping with the demands of a changing environment. Once they have found a comforting and pleasurable experience they will tend to repeat it endlessly. This makes their interests to appear narrow and their behaviour to lack variation. Where they cannot readily make their needs known, and where there is no internalized system for dealing with stress, the children with autism may well react by displaying retaliatory behaviours, marked withdrawal and a reliance upon routine and rituals (Edelson, 1995).

Various motor stereotypes are commonly seen among people with autism. Some of the most common are body rocking, hand and limb flapping, running in circles, head-banging and spinning. There could also be oral stereotypes like humming or incessant questioning accompanying the motor stereotypes. Miller et al., (1999) suggest that these might be engaged in at various times: when agitated, aroused or active, excited, angry and even when simply comfortable and relaxed. The physical sensation of some stereotypes may also be pleasurable or interesting. The authors further reckon that motor
stereotypes do not cause any harm in themselves, unless they cause damage to self or other people, or they inhibit the ability to learn or take part in activities.

Self-injurious behaviour often refers to any behaviour that can cause tissue damage, such as bruises, redness, and open wounds (Schopler and Mesibov, 1994). The most common forms of these behaviors include head banging, hand biting, and excessive scratching or rubbing. Cuvo (1997) points out that some individuals engage in self-injurious behaviours to obtain attention from other people and that some individuals exhibit self-injury to escape or avoid a task.

Another observed aspect in behaviour is obsession and rituals (Miller et al., 1999). These authors observe that repetitive or ritualistic behaviour for a child with autism can provide some protection against anxiety and a sense of control over what might otherwise seem a very unpredictable world. Therefore, rapid attempts to restrict such behaviour may lead to more stress and the greater entrenchment of the behaviour. Children with autism may seem to be incomprehensibly obsessed with some non-functional object (Iwata et al., 2000). Edelson (1995) emphasizes that these make education and daily living very difficult.

Tantrums are another example of challenging behaviour and one of the most common problems in young children with autism as stated by Howlin (1998). Tantrums are normal behaviour for most children and there is no reason why children with autism
should by-pass this stage of development. The problem seems to be that it is more difficult for parents to prevent tantrums in children with autism and the episodes usually last a longer time than usual (Howlin, 1998). Similar episodes of panic, anxiety, rage or even aggression might be seen throughout childhood, adolescence and even adulthood.

According to Schopler and Mesibov (1994), extensions of these behaviours are also physically seen in the unusually high or low activity level of the children. The children may be constantly on the move or slow to get going, have coordination problems and fatigue easily. The child as a result appears clumsy, has delayed academic achievement or in activities of daily living. Poor self concept also makes the child appear lazy, bored, or unmotivated and as a result may avoid tasks and appear troublesome as explained by Schopler and Mesibov (1994).

2.4.2 Functions of Autism Behaviours

It is important to recognize the importance of autism behaviours as they play a vital role in the daily lives of autistic people. Schopler and Mesibov (1994) note that the specific pattern of behaviour, social interaction and understanding in autism can help explain the challenging behaviours. To begin with, stereotypic and other self-stimulatory activities serve to provide and regulate sensory input from the environment. Kennedy et al., (2000) indicate that these behaviours are operant responses that serve as effective block during times of excessive or aversive environmental stimulation and can provide sensory input during periods of under-stimulation.
According to Iwata et al., (2000) studies have identified the function of stereotype behaviour as a method of social interaction. This is meant to influence the behaviour of others in order to either access or escape stimulation or instructional requests. Simple social interaction can be very tiring and cognitively draining to the autistic people (Cuvo, 1997). It is perhaps inevitable that when these obsessions and rituals are disrupted the response may be apparently extreme and disproportionate, especially where there is no clearly understood reason for interference.

For those autistics with profound difficulties in communication, it is hardly surprising for frustration, anger and anxiety to build up. It is also quite likely that the challenging behaviours will directly serve as a form of communication (Kennedy et al., 2000). Natural tantrums for example, would occur in response to changes in routine or requests to do something that the individual does not want to do.

Kennedy et al., (2000) observe that people with autism often rely on ritual and structure. Structure is a method that these individuals use to define the world in terms of rigid rules and explanations that help them to function most effectively. Most children with autism find their own methods of imposing structure and maintaining consistency. They need this structure because the world is confusing. Other people are complex and almost impossible to understand. Therefore, when some form of structure or routine is disrupted the world becomes confusing and overwhelming again. Rhythmical motions are good ways of imposing order and control on one’s self and the environment. This order is something most people with autism seem to both desire and need (Cuvo, 1997).
2.4.3 Stereotyped Behaviours and Learning

Skill acquisition can be enhanced through a reduction of stereotyped behaviours as stated by Campbell et al., (1996). According to Kern et al., (1982), some children can spontaneously reduce self-stimulatory behaviour without external suppression, and skill acquisition in such cases is possible. For others, external suppression of stereotyped behaviours is a prerequisite for learning new skills. Regression to base stereotypic rate returns when suppression is discontinued. Therefore, this process must be performed on regular intervals. There are various ways to reduce or eliminate stereotypic behaviour such as providing a person with alternate more socially appropriate forms of stimulation. Physical exercise has a positive effect on this. Drugs are also used to reduce these behaviours. However drugs do it indirectly by slowing down one’s overall motor movement (Berkely and Zittel, 1998).

2.5. Motor Performance of People with Autism

It is documented that physical activity in individuals significantly decreases with age and varies according to day of week and time of day (Pan and Frey, 2005). The authors further caution that this data cannot be generalized to individuals with autism because the social and behavioral deficits associated with the condition may limit opportunities to engage in physical activity. There were no consistent patterns in physical activity patterns of youths with autism as found in a study that examined age-related physical activity patterns in youths with autism (Pan and Frey, 2005).
Many children with autism have been observed to have a physical delay in motor development and co-ordination skills. Berkeley et al., (2001) conducted a study to compare children with autism to the national scores on the test of Gross Motor Development. The authors found that 73% of the participants were delayed in the fundamental motor skills placing them in the poor and very poor categories of ability. In a study done by Reid et al., (1983) it was revealed that autistic children had lower scores compared to non autistic subjects on the following fitness measures; body fat, grip strength, abdominal strength and flexibility, especially on trunk flexion. They were below chronological age level on tasks requiring physical integration skills, imitation tasks (dynamic and static movements) and on qualitative motor skill performances. Reid et al., (1983) further observe that minimum differences in performance on most tasks were found when comparing older and younger groups of autistic individuals.

Morin and Reid (1985) also did a study in which they analysed a group of boys who were categorized as either having autism or mental retardation. They indicated that despite clumsiness in gait and in gross motor performances, it was evident that children with autism were slower, more controlled and very skillful in all their movements when compared to the mentally retarded ones. Individuals with autism have difficulties in dealing with complex co-ordination motor tasks even in the high functioning ones seeming to indicate central nervous system dysfunction.

In a study that compared the motor skill performance of high, middle and low functioning people with autism to individuals with mild retardation, those with autism
had lower scores except for stair tasks such as climbing and descending (De Myer, 1980). The study further revealed that the middle functioning group had the best performance. Morin and Reid (1985) suggested further that impairment might be a misnomer for what is really poor perceptual processing compounded by the fact that this population tends to have lower levels of interest or motivation to participate in games.

2.6 Efficacy Studies on Physical Exercise and Individuals with Autism

Past research supports the use of physical exercise to reduce maladaptive behaviour in autism. In a study by Watters and Watters (1980), 5 autistic boys were observed to find out if it was the physical exercise itself or a change in environment that decreased stereotyped behaviours. A session of television watching was added as a control group. There were three settings observed: an academic setting, television watching for 10-15 minutes and jogging for a 5-10 minute period. It was found that the lowest levels of stereotypic behaviour was in the physical exercise group which averaged to about 37%. This was considered by both the researchers and teachers to be a significant change. There were no differences in the levels exhibited by the individual following television watching and academics. However in the study, levels of correct question answering were not affected by all of the three different periods. The study suggested that it was definitely the physical exercise and not the physical setting that resulted in the decrease in the motor stereotyped behaviour.

Kern et al., (1982) observed a group of 7 children with autism after performing a brief session (5-10 minutes) of jogging as a possible method of increasing subsequent
appropriate response as well as decreasing the characteristic motor self-regulation behaviour. They found out that the reduction of self-stimulatory behaviour resulted in meaningful play and more general ratings in school tasks following the jogging sessions. These changes after jogging were evident in three different experimental settings: during academic tasks, during ball playing session in an outside play area and while in a quiet room, while no other activity was going on.

Kern et al. (1984) investigated whether the specific type of exercise would differentially affect subsequent autistic behaviour. The programme used 15 minutes of ball playing (mild exercise) versus jogging (vigorous exercise) and found that the 15 minutes of mild exercise had little or no influence on the child's subsequent stereotyped responding while 15 minutes of continuous jogging was always followed by reductions on stereotyped behaviours.

A review by Quill (1989) was carried out on a Japanese model for educating children with autism known as Daily Life Therapy - The Higashi Method to examine the fundamental principles. The objective of the method was to develop the self-esteem of the children and help them establish security in their emotions. Daily Life Therapy availed to boys and girls with autism a systematic education involving a wide variety of activities in many different areas including physical exercises. The Higashi method focused on developing harmony in all aspects of life for children with autism, both in and out of school. Problem behaviours were dealt with through encouraging more adaptive and appropriate behaviours. Research conducted at the Boston Higashi School
in Massachusetts revealed the effectiveness of physical activities in alleviating some of the problems experienced by people with autism such as hyperactivity, and off-task behaviour. Its use of intensive physical exercise was a unique approach not found in other traditional methods. Peer interaction and social development was emphasized. Quill (1989) goes on to state that the practitioners found out that through exercise, students learnt to control their body and hence learnt to control their behaviour as well.

Elliot et al. (1994) examined effects of antecedent exercise conditions on maladaptive behaviour in 6 adults with both autism and moderate to profound mental retardation. The behaviours were observed before and after two exercise and one non-exercise conditions. From the original group of 6 participants, 2 were selected to participate in aerobic exercise immediately before performing a community-integrated vocational task. Only antecedent aerobic exercise significantly reduced the maladaptive behaviours. Neither of the less vigorous antecedent conditions did. It was also revealed that when aerobic exercise preceded the vocational task, similar reductions were observed. There were though individual differences in response to antecedent physical exercise. Use of antecedent aerobic exercise to reduce stereotyped behaviours of adults with both autism and mental retardation was supported.

Levinson and Reid (1993) examined the effects of exercise using two different programmes of different intensities on 3 subjects. The mild exercise programme involved 15 minutes of walking and the vigorous programme involved 15 minutes of jogging. They found out that there was a significant mean reduction of stereotypic
behaviour of 17.5% as a function of the vigorous exercise condition (jogging). The mild exercise condition had little effect. However, the reduction of the behaviour was noted to last for 60 minutes after exercising. The stereotypic behaviours of subjects were broken down into three categories: motor, vocal/oral and other. The category that was most common was the motor behaviours which also happened to be the only specific area that was affected significantly by jogging. The mild exercise condition had little effect on the motor component. The jogging led to a mean reduction of 17%.

Allison et al., (1995) conducted a review and meta-analysis of 42 group and single-case studies evaluating antecedence exercise as a means of reducing maladaptive behaviour on different populations. Out of 16 group studies, 12 produced positive results and 4 produced negative results. Of the 26 single-case studies 22 produced positive results, 1 produced no results and 3 produced negative results. Information was reviewed suggesting that antecedent exercise is socially accepted, can be implemented with treatment integrity and has a benign side effect profile.

Celiberti et al., (1997) examined the effects of two levels of exercise (walking and jogging) in suppressing the self-stimulatory behaviour of a 5 year old boy with autism. The exercise conditions were applied immediately before periods of academic programming. Motor self stimulation (hand flapping) and “out of seat” behaviour was identified and tracked. Examination of temporal effects indicated a decrease in targeted behaviours, but only for the jogging condition. In addition, high reductions in these
behaviours were observed immediately following the jogging intervention and gradually increased but did not return to baseline levels over a 40 minute period.

To expand on the previous research that demonstrated the effectiveness of exercise on reducing negative behaviours in special populations, a study was carried out by Rosenthal and Mitchell (1997) involving 5 adolescent males. Each child completed either an exercise session or an academic session on a given school day for a total of 20 sessions. The exercise consisted of stretching then jogging for 20 minutes. The academic session consisted of a variety of typical subjects used during the regular school day. The child then went to either a regular classroom period or to a community workshop. The researchers found that jogging for 20 minutes daily increased correct responses in the classroom, and increased the amount of work produced at the workshop. They recommended the inclusion of physical exercise programmes for adolescent students with autism.

Bumin et al., (2004) investigated the effects of hydrotherapy on an 11-year-old girl who had autism. This was done in a swimming pool twice a week for 8 weeks. The tests included analysis of physical fitness, movements such as functional hand use, hand skills, gait and balance, hyperactive behaviour, communication and social interaction. After the period of hydrotherapy, cardio respiratory, flexibility, walking balance, agility, and strength increased markedly. Feeding activities, hand skills, and interaction with the environment also increased and hyperactive behaviour and anxiety decreased. The
researchers recommended that more subjects needed to be used to determine whether hydrotherapy really has a positive effect on the stereotyped behaviours in autism.

2.7 Role of Physical Exercises in Individuals with Autism

Physical exercise is vital for a healthy lifestyle for children with and without disabilities (Huettig and O'Connor, 1999). Most individuals with autism spend relatively little time in activities involving physical exercise because they have difficulties in organising their spare time in a useful and valuable way. Huettig and O'Connor (1999) caution that physical exercise in itself, is of course not a cure for autism, but can significantly improve the functional abilities of these individuals. According to the available research, physical exercise in individuals with autism can be an intervention in the following ways: general health-related physical fitness, increasing motor skills, reduction in motor stereotyped behaviour, reduction in inappropriate play and disruptive behaviour, enhancing functioning of the brain and social interaction.

a) General Health-related Physical Fitness

Children with autism have been found to have lower levels of physical fitness compared to children without autism as suggested by Reid et al., (1983). This can be compounded by the fact that this population tends to have lack of interest and motivation to participate in games and other activities as asserted by Auxter et al., (1997). Therefore, the child needs to be in a structured environment where he/she is encouraged to participate (O’Connor et al., 2000).
Physiological benefits that can be obtained from regular physical exercise involvement among individuals with intellectual disabilities include improved health related fitness as well as an increase in energy levels (O’Connor et al., 2000). In addition, an increase in physical activity promotes weight loss hence prevention of obesity and other health-related conditions. They help prevent injury and are essential for performing day-to-day activities (Sherrill, 1998). Bumin et al., (2004) found that cardio respiratory function, flexibility, coordination, balance, agility, muscle tone and strength increased and stereotypical behaviours decreased after a child with autism participated in a study involving swimming.

b) Increase in Motor Skills

When an appropriate programme is established a child with autism can dramatically acquire and increase their motor skills that are essential for daily functioning according to Reid et al., (1991).

c) Reduction in Motor Stereotyped Behaviour

Berkely and Zittel, (1998) point out that physical exercise helps to decrease self-stimulatory behaviours such as hand flapping and body rocking by providing scope for sensory integration and stimulation. This deals with the high levels of frustration from sensory difficulties. Physical exercise also directs them to do something meaningful.
d) Reduction in Inappropriate Play and Disruptive behaviours

A physical exercise based programme has been shown to be effective in controlling many types of inappropriate behaviours associated with autism and intellectual disabilities. Hyperactive behaviour, which results to the individuals becoming destructive, can be managed by involving in physical exercises (Allison, et al., 1991; Elliot et al., 1994). Participation in exercise programmes of moderate intensity has revealed that there is more interest in learning and an increase in attention span to task relevant information leading to successful responses for adolescents with autism (Rosenthal and Mitchell, 1997). The reductions in disruptive behaviour enables a child with autism focus a little longer and process the information being presented to him or her. Instead of using their energy to try and control their self-stimulation behaviour, the child may direct the energy toward learning.

Allison (1991) emphasizes that this change in physical activity has the potential to change daily behaviour. If children, who are exhibiting the early symptoms of inattention and hyperactivity can be exposed to a high incidence of frequent physical exercises on a regular basis, then the effects of muscle exhaustion and increased body chemistry changes may combine to curb unwanted disruptive behaviour.

e) Enhancing Functioning of the Brain

Participation in exercise regularly improves the brain functions as this can eliminate emotional disorders such as anxiety which is commonly occurring in autism as well as increasing attention span to given tasks (Yanker, 1999; O’Connor et al., 2000).
According to Richardson et al., (1996), signals from the vestibular system also project to the cerebellum. This area of the brain is further critical to an individuals' attention system, since it regulates incoming sensory data. Greenfield (1995) states that autism may be related to cerebellum deficits since brain-imaging studies have shown that autistic children have smaller cerebellums and fewer cerebellum neurons. This deficit is linked with impaired ability to shift attention quickly from one task to another that may result to stereotypic behaviour due to the frustrating situation. The findings strongly implicate the value of physical exercises in boosting cognition, especially playground games that stimulate inner ear motion. This is because the vestibular system that provides the dominant input about movement and orientation in space is situated in the vestibulum in the inner ear. Greenfield (1995) also points out that the part of the brain known to control movement is also involved in learning therefore movement and learning have constant interplay.

In the same way that movement through physical exercise shapes up the muscles, heart, lungs, and bones, it also strengthens the key areas of the brain. Not only does physical exercise fuel the brain with oxygen it also feeds it with neurotropins (high-nutrient food) that enhance growth and greater connections between neurons. This natural substance enhances cognition by boosting the ability of neurons to communicate with one another (Yanker, 1999). Payne and Isaacs (1999) explain that exercise and play during early childhood form a critical period in the neuronal development of the brain. This is when particular sensitivity to environmental stimuli provides vital sensory and physiological
stimulation that leads to nerve connections. In other words, by working out the body, an individual prepares the brain to respond to challenges rapidly.

f) Social Interaction

Tsai (1998) notes that children with autism experience social interaction difficulties because they have deficits in interpersonal relationships, do not seek or readily accept affection, avoid eye contact, do not engage in play or any physical activity and avoid interacting with their families or peers. As a result, they are usually passive, lack interest in their surroundings and have limited interests in new experiences.

According to Berkeley and Zittel (1998) physical exercise intervention can be applied even to those severely impaired individuals, who are impossible to involve and develop efficiently using other, more traditional methods. Individuals with little intrinsic motivation and also those with serious behavioural problems become more interested and involved with other children while performing the exercises in the given programme. Weber and Thorpe (1992) are of the view that physical exercise does not require good cognitive skills and there is less risk of information 'overload' in this context. This, therefore, provides the individuals with autism an opportunity to develop as part of any social group they get involved in without restricting learning in other areas. When children with autism engage in different forms of group physical exercise it helps to diffuse their energy and thus increase their physical stamina, build self-confidence, develop concentration and enables them to be calm and relaxed in social settings.
Furthermore, O'Connor (2000) states that all positive attributes like establishing cooperation and relationships with others, following of instructions and learning of basic rules are achieved when autistics are involved in physical exercise. It also provides an opportunity for children with autism to learn, practice and expand on a variety of communication skills. When appropriate and adequate physical exercise activities are given on a daily routine basis, individuals with autism shed many of their difficulties and strive to reach their fullest potential as members of the community.

2.8 Developmental Framework for Implementing Physical Exercises for Individuals with Autism

Berkeley and Zittel (1998) point out that before one can effectively introduce physical exercises to any child, it is crucial to recognize and respect that children are multi-faceted individuals. Children with autism particularly, often present characteristic uneven learning patterns that are significantly different from their normal developing peers. As a result, Berkeley and Zittel (1998) confer that; acquisition of skills that focus only on age appropriateness would often impede learning for the child with autism. In order for a physical exercise or recreation programme to help a child develop in all areas, parents or teachers must consider factors guided by the uniqueness of autism, the principles of physical exercises and those of sensory integration when designing it so as to meet the needs of the child with autism (Winnick, 2005).
2.8.1 Sensory Considerations

Sensory integration, the process in which the brain organizes and interprets sensory information, is often impaired in individuals with autism (Kranowitz, 1998). The children may have no reaction to sound, lack attention to people, environment or things or even unaware of painful stimuli resulting in bruises. There may also be excessive movement, sensitivity to textures of the equipment being used, and irrational fear of heights, movements, or the playing environment (Baranek, 2002).

Lieberman and Cowart (1996) asserts that individuals whose proprioceptive system is affected may complain of being tired, move slowly and have difficulty participating in physical exercises. Being aware of sensory processing difficulties that an individual may have and incorporating individualized sensory activities into the physical exercise programme can benefit the individual with autism.

2.8.2 Physical Behavioral Considerations

According to Kennedy et al., (2000), individuals with autism who may not be able to communicate in typical ways can often let their needs be known through their behaviour. In order to decrease the likelihood of challenging behaviours, it is important to plan the physical exercise according to the individuals’ developmental levels and to meet their sensory needs as noted by Auxter et al., (1997). Including activities that capitalize on the need to exhibit excessive movement needed to stimulate the body and brain to stay alert and active may enhance this.
It is important to be aware of the potential for restricted, repetitive motor patterns of behaviours as it may require pre-planning for potential issues that may arise (Hueting and O’Connor, 1998). Working with, instead of against, some of these behaviours will benefit all involved. For example, if a child likes throwing objects, involving that child in a game that requires throwing, will redirect the behaviour to functional use. Initially, benefits gained from participating in the programme may be more important than upsetting a child by trying to stop an inappropriate behavior (Berkeley and Zittel, 1998).

2.8.3 Social Considerations

Social communication, both verbal and non-verbal, is impaired in individuals with autism. Therefore, group dynamics and cooperation may be difficult as social skills, and social cues are needed for appropriate interactions (O’Connor, 2000). Non-threatening settings should be provided for the children to practice social interaction skills. Developing social skills and providing opportunities to practice these skills during the physical activity sessions is necessary for lifelong skill attainment. Physical skills taught in one environment transfer well to other environments (Tsai, 1998).

It is very important to teach these social skills during physical education and recreational activities as they provide opportunities for social skill building and interaction. Weber and Thorpe (1992) advise on the inclusion of activities that are enjoyable and encourage interaction.
2.8.4 Cognition Considerations

The child needs to be able to understand the rules of the game as well as understand instructions that are being given to him or her (Schopler and Mesibov, 1995). Persons with autism are often visual learners and greatly benefit from visual instruction (Berkeley and Zittel, 1998). IQ scores for individuals with autism as explained by American Psychiatric Association (2000) may range from high intelligence to severe and profound intellectual disability. As a result, a child with autism during the exercises may; exhibit short attention span, have difficulty in attending to multiple cues, focus too much on details, and have information processing impairments with difficulty in integrating, sequencing, organizing, and transferring of information from one situation to another (Schopler, 1994). This should be dealt with to avoid behavioral consequences.

2.8.5 Communication Considerations

A child with autism may have difficulty expressing needs, initiating and maintaining conversations when engaging in the physical exercise programme. Communication can be verbal or non-verbal, and should include physical movement, facial expressions, body language or gestures. Tests often show that hearing in autism falls within normal limits. However, despite adequate hearing, individuals’ responses to auditory information are frequently poor hindering the instruction procedure (Winnick, 2005).

2.8.6 Neurological (Seizures) Considerations

Betty (2002) cautions that seizures, which are an abnormality in the electric activity in the brain, occur in one of every four children with autism and range in type and severity.
It is important to know if these seizures are controlled through medication since this can have an effect on an individual's physiological response to exercise and activity. In addition, certain activities are not recommended for individuals who have seizures, such as soccer and underwater swimming. Research suggests that monitored exercise, which is performed on a regular basis, has been shown to inhibit seizure activity (Durstine and Moore, 2003).

2.9 Structured Teaching in Planning Physical Exercises for Individuals with Autism

According to Schopler (1997), structured teaching is an attempt to develop teaching strategies while understanding autism. Since individuals with autism have difficulty in organizing and integrating separate ideas, research has been exploring appropriate methods of teaching them (Weber and Thorpe, 1998). In a study to compare systematically the effect of structure on development in children with autism, it was found that children with autism did better in a structured than in an unstructured teaching situation (Schopler, 1997). Structured teaching has become one of the major guiding principles of the TEACCH (Treatment and Education of Autistic and Related Communication Handicapped Children) approach. The basic concepts incorporate the need for physical structure, visual structure, individual schedules and work systems and can be applied in physical education (Hueting and O'Connor, 1998).

a) Physical Structure

To help the child with autism understand his environment during physical exercise, Berkeley and Zittel (1998) are of the view that a clear physical structure should be set up.
that has visual boundaries. Boundaries establish context and segment the environment so that each activity is clearly associated with a physical space. Further noted is that there should also be minimum visual and auditory distractions. This helps the student focus on the main concept and relevant details.

b) Visual Structure

To capitalise on their visual strengths and to minimise problems with auditory processing, visual structure should be employed when planning physical exercises for individuals with autism. Visual structure is a method of incorporating concrete visual cues into the task itself (Schopler, 1997). Visual structure is employed to increase the individual’s ability to work successfully and independently without interaction or intervention by the teacher (Hong, 2001). To ensure that the individual understands what to do, it is critical that the correct types of visual instructions, visual organization and visual clarity are employed in relation to the individuals’ needs (O’Connor et al., 2000). Depending on the individual’s language ability, visual instructions may take the form of written instructions, picture exchange illustration, or materials to define the task (Schopler, 1997).

c) Work Schedules

The work schedules are used to ensure that the individual understands the demands of the task in order to successfully and independently complete the physical exercises. These include what work is to be done, how much is to be done, the concept of finish and what should happen next (Schopler, 1997). Making use of the need for sameness
and structure when setting up a consistent exercise plan or activity routine is important as abrupt changes in routines may precipitate outbursts or regression in skill acquisition (O'Connor et al., 2000).

By using structured teaching and implementing physical exercises with appropriate visual schedules and work systems, an individual with autism can learn to acquire skills in a more systematic and organised fashion.

2.10 Principles of Physical Exercises for Individuals with Autism

Although studies related to autism have shown that physical exercise produces a decrease in stereotype responses and an increase in appropriate behaviours (Elliot et al., 1994; Rosenthal and Mitchell, 1997), it is important for individuals to engage in the other components of health-related physical fitness. An exercise programme according to Yanker (1999) needs to address the four components of fitness, which include cardiovascular endurance, strength, flexibility, and balance.

a) Cardiovascular Fitness

Physiological and behavioral mechanisms appear to be factors influencing the reduction in stereotypical behaviours. Cardiovascular activities can also be instrumental in decreasing anxiety and depression, which individuals with autism are at a greater risk of experiencing (Lavay et al., 2006).
b) Strength Training

Core strength is especially important for individuals with autism, because their trunk muscles are typically weak as observed by Winnick (2005). The author further notes that core muscles have an effect on other activities such as balance and coordination and an important foundation that must be established before working on higher-level skills. Weber and Thorpe (1992) emphasis that when developing a strength training programme, it is important to incorporate activities that focus on repetition of movements in the same order. Since individuals with autism respond best to structured learning, it is important to develop a sequential and consistent strength-training programme.

c) Flexibility

Flexibility is an important component of an overall physical activity programme that is important to address for individuals with autism as they often have low muscle tone (Auxter et al., 1997). Individuals who have low muscle tone may walk on their toes to stimulate their proprioceptive system, which can result in hypertonicity or high tone in their calf muscles (Berkeley and Zittel, 1998). Incorporating flexibility exercises which stretch the legs and feet are helpful.

d) Balance

According to O’Connor et al., (2000), incorporating balance and coordination activities into a physical exercise programme is important for individuals with autism because it utilizes the vestibular system. Balance activities such as using a therapy ball or walking
a line on the floor, can improve balance and coordination. The author goes on to state that individuals with autism may have a poor sense of direction and may need visual cues, such as standing on a carpet square or a mark on the floor to help them know where to stand while performing activities.

e) Frequency, Intensity and Duration

Winnick (2005) observes that to ensure maximum benefit for the individual, it is also important to plan physical exercises with regards to their frequency, intensity and duration. Hong (2001) advises that the length of activities should be well thought out because some children may need frequent changes due to limited attention span, while others, might not. Intensity and duration of the exercise should be increased gradually over time to accommodate the physiological training effects such as improved cardiovascular endurance, strength or flexibility (Hueting and O’Connor, 1998). Hong (2001) also suggests that activities should be presented in progression from simple to activities that are more complex in small increments. The exercises should also be safe activities as individuals may not be aware of the danger.

2.11 Implementing Physical Exercises into the Individual’s Daily Routine

Besides the group physical exercises that children with autism receive in a school set up, it is important for these individuals to do physical exercise in their daily routines most probably at home or in recreation centers (Berkely and Zittel, 1998). The authors go on to state that parental involvement is crucial and often results in improved outcomes in young children with autism as their encouragement can help a child learn a new skill or try a new activity very easily.
To help the individual know what to do during 'exercise time', a work system can be employed. The work system can be placed at the exercise area in the form of sequence charts, flip cards or checklists, which have pictorial or written instructions (Hong, 2001). Since they may often misunderstand verbal instructions, the written ones must be short, clear and unambiguous. Each daily routine physical exercise plan should be tailored to the needs and likes of the individual. For example, one individual may need heavier and active routines incorporated into the mornings and more calming, soothing activities in the afternoons, while another may need calming activities throughout the day (Winnick, 2005). It is vital that any exercise experience be a positive one.

The physical exercise should be incorporated into the individual’s daily routine only after the particular activity has been taught and practiced by the particular individual. When the individual is familiar with what to do when presented with the necessary physical and visual supports, he or she can then be considered ready to carry out the activity independently (Weber and Thorpe, 1992).

Hong (2001) emphasises that facilitators of the physical exercises programme should know how to make appropriate adaptations or modifications for a successful experience. People that children are familiar with help to get the child interested and have confidence in doing various physical exercises (O’Connor et al., 2000).
2.11.1 Motivation and Reinforcement

People with autism may not understand the abstract nature of participating in routine physical exercises as a means of improving their wellness (Winnick 2005). Therefore, it is necessary to incorporate various motivation and reinforcement techniques into plans for physical exercise. Lavay et al., (2006) support matching the exercise to individual interests, preferences, or strengths. Berkeley and Zittel (1998) add that the individual can get more physically involved because of following or embedding rewards into the activity. By valuing and accepting the idea that participation in the activity need not be perfect by the individual can be motivating too (Lavay et al., 2006).

2.12 Summary

A number of studies have been conducted on the effect of physical exercise on stereotypic behaviours, positive response to tasks as well as in the reduction of maladaptive mannerisms in autism (Rosenthal and Mitchell, 1997; Levinson and Reid, 1993; Elliot et al., 1994; Celiberti et al., 1997; Bumin et al., 2004). Other studies also investigated the effects of physical exercise on some health-related fitness components (Bumin et al., 2004). As defined within each study, most dealt with the motor pattern stereotypic behaviour in autism. With regard to type of exercise activity, findings from research indicate that participation in vigorous aerobic activity is more effective in reducing short-term stereotypic responding than is participation in leisure activities (Elliot et al., 1994).
The exercise conditions discussed have been limited to jogging, walking, ball playing and hydrotherapy (swimming) and as such lack the full application of the principles of physical exercise. It is important for individuals with autism to engage in the other components of health-related physical fitness during their exercise sessions, in order to enhance daily functioning. The current study incorporated the role played by the sensory integration using physical exercises unlike the reviewed studies. According to Hong (2001), the physical exercise intervention must address the issue of sensory imbalance which could be a cause of the evident maladaptive behaviour in autism hence the need for a structured programme.

Most previous studies on effects of physical exercises on autism have been conducted in developed countries. Currently, there is hardly any data on the influence of physical exercises on individuals with autism or any other developmental disorders in Kenya. This study therefore utilised activities that are founded on the principles of physical exercises, sensory integration and vestibular stimulation. Routine activities were highly structured and instructional technique that was group oriented. All these were tailored to address the sensory dysfunction in autism. It was thus the concern of this study to find out the effects of a structured physical exercise programme on the stereotyped behaviour viewed in four domains and the response amongst children at the Nairobi Autism Unit situated in City Primary School in Nairobi.
CHAPTER THREE
MATERIALS AND METHODS

3.1 Introduction
This chapter describes the research design, variables, location of study, target population, sampling size and sampling procedure, instrumentation, pilot test, data collection procedures, data analysis and presentation techniques and also logistical and ethical considerations that were taken into account in the study.

3.2 Research Design
Quasi-experimental research design using pre-test and post-test procedure of obtaining data was used in the study. This was because the subjects could not be randomly assigned to the different groups. It also allowed conclusions to be drawn about the causal relationships (Thomas and Nelson, 2001). A single group was used in the study. Here, the phenomenon under investigation, namely the stereotypic behaviour and response was observed periodically. The pre-test was administered to evaluate the dependent variables. Treatment that included exposure to a structured physical exercise programme was carried out for eleven weeks. A post-test was then conducted after eleven weeks to establish the effect of that intervention or treatment on the subjects’ behaviour and on-task response (Thomas and Nelson, 2001).

3.3 Variables
This study focused on the following four variables.
a) Stereotypic Behaviour and Response

Every child with autism at the Unit was evaluated on these dependent variables. A pre-test was done on the day before commencement of the physical exercise programme and a post-test at the end of eleven weeks. Scores from the ATEC (Appendix E) subtests (Speech/ Language/ Communication, Sociability, Sensory/ Cognitive Awareness and Health/ Physical Behaviour) were used to indicate in the characteristic stereotypic behaviour and response. Other tests were carried out after the third and sixth weeks. The results were sent to the Autism Research Institute’s, San Diego, database for purpose of developing norms. The institute is the world headquarters for research and information on autism and related disorders, and the epicenter of a rapidly growing movement that holds that autism can be managed effectively through intensive behaviour modification treatments (Edelson and Rimland, 1999).

b) Age

This independent variable represented the individual subjects’ date of birth. Subjects’ ages were grouped as follows, ages 3-7, 8-12, 13-17 and 18 years and above. These age groups were the available ones in the institution at that time.

c) Gender

This independent variable referred to the individual subjects categorised as either male or female.
d) Level of Autism
This independent variable indicated the severity of the disorder. The level of autism was derived from the school records and had been given by the parents at the autism unit during the children’s admission. To determine the severity, diagnosis had been made on each child by doctors with expertise in pervasive developmental disorders such as pediatric neurologists and developmental pediatricians. The initial ATEC scores were also used to confirm this using the Autism Treatment Evaluation Checklist Score Distribution Chart illustrated in Appendix F. This was done before the treatment. The level of impairment can either be mild or severe.

3.4 Location of the Study
The study was done at the Nairobi Autism Unit located at City Primary School in Nairobi. This is a special unit within the school. The center is unique for being the only place in Kenya where a group of individuals with autism are currently being catered for.

3.5 Target Population
The target population consisted of children from the Nairobi Autism Unit. This group comprised of children whose ages ranged from 3 to 19 years, among them 14 girls and 20 boys. The center was purposively selected due to its unique nature for catering for only autistic children in Kenya.

3.6 Sample size and Sampling Procedure
Due to the small size (n = 34) of the target population, it was not necessary to select a sample. Therefore, consistent with the research guidelines by Mugenda and Mugenda (2003), the whole population in the study was used.
3.7 Instrumentation

The research adopted the Autism Treatment Evaluation Checklist (ATEC) as the main tool to assess changes namely, the condition at the beginning, improvement or regression as the research progressed. Documentary analyses were also used to obtain the severity of autism based on the information obtained from the children’s school records.

The ATEC test sheet was developed by the Autism Research Institute, San Diego (Edelson and Rimland, 1999). The instrument uses simple Internet-based scoring procedure and is a valid means of measuring the effectiveness of various treatments for autism. According to Edelson and Rimland (1999), the checklist (ATEC) was designed for researchers, parents, teachers, or caretakers of autistic individuals. The test was considered ideal for the study because other rating scales such as the Childhood Autism Rating Scale (CARS), the Gilliam Autism Rating Scale (GARS) or the Autism Behaviour Checklist (ABC) were designed to diagnose autism (to tell whether or not a child is autistic) and not to measure treatment effectiveness (Ibid).

The checklist evaluates behaviour in four different areas namely, speech/ language/ communication, sociability, sensory/ cognitive awareness and health/ physical behaviour. Using a simple three or four point rating scale, a respondent who is evaluating an autistic person is required to rate the child’s behaviour and tick on the appropriate space. The checklist has 77 items in the four subtests on behaviour to be evaluated and rated. When this has been done, the data is fed into the computer system.
on the Internet to be transmitted for scoring. The scoring is done instantaneously and results are displayed for each area and for a total score in a set of numerical values. This normative data, which can permit comparison of one individual with others, is then used. This is illustrated in the Autism Treatment Evaluation Checklist Score Distributions Chart (Appendix E). The lower the scores, the less impaired the child is (Edelson and Rimland, 1999).

Since this tool is free and not copyrighted, it can be used several times to evaluate the behaviours present after a particular treatment is tried and then the results can be compared to see which areas of behaviour are improved on one particular treatment in comparison with other treatment methods which have been tried. The primary function of ATEC in this study was to measure the efficacy of the physical exercise intervention. Thus, four evaluations were done on each autistic child. That is, three ATECs were submitted for each individual periodically during the trial of the intervention, subsequent to the initial (baseline) ATEC. Edelson and Rimland (1999) support this procedure.

3.8 Pilot Test

A pilot test was carried out in Kestrel Manor School located in Nairobi region using five autistic children to assess feasibility of the study. This was done after obtaining permission from the school’s administration. This was to give the researcher and the assistants an exposure in filling in the appropriate responses on the checklist as well as entry of data obtained in Internet for scoring by the researcher. It was also to familiarize the research assistants to the treatment procedures in terms of administering the physical
exercise program and the subjects' ability to follow the treatment instructions. The subjects performed the different physical exercises after the teachers did demonstrations. The ATEC scores were filled twice for each subject within a period of one week. This was administered during the physical education lessons. The two sets of data obtained were correlated to establish inter-recorder reliability. A correlation coefficient of \( r = 0.81 \) was achieved.

### 3.9 Validity

For the purpose of this study, specialists in assessing children with autism spectrum disorder from the Autism Society of Kenya were asked to assess the relevance of the content measured by the instrument (ATEC). After judging the appropriateness of the items on the instrument it was found that, the evaluation checklist contained a representative sample of the content being examined in relation to behaviour in autism. The researcher then adopted the ATEC as the main tool to assess changes in the children's behaviour as the research progressed.

Further, on the logical and content validity of ATEC, the various published studies that have used it have shown the evaluation checklist to be sensitive to changes because of a treatment as reported by Betty (2002), Derrick et al., (2002) and also Jorgen and Bigam (2002).

### 3.10 Reliability

The general reliability of the ATEC is quite high. According to Edelson and Rimland (1999), studies at the Autism Research Institute examined the internal consistency of the
ATEC by conducting a split-half reliability test on over 1,300 completed ATECs. The internal consistency reliability was high, that is, 0.942 for the Total score.

3.11 Data Collection Procedures

Throughout the data collection, the researcher worked closely with the center’s teachers and the occupational therapist as research assistants. The occupational therapist was familiarized with the ATEC form by the researcher and was the only one used to complete all the required forms. This was due to having adequate information about the subjects. The procedure included; acquiring a research permit authorization from the Ministry of Education, seeking official permit from the Autism Unit administration, explaining to the teachers performance of the physical exercises, sensitizing them also about the importance of tests and treatment and encouraging the subjects to continue in the testing and physical exercises process throughout the 11 weeks.

A pre-test was done one day before the exercise programme began. This was on the first week of the third academic term. Other tests were carried out periodically after the 3rd, 6th and a final test after the 11th week of the programme. This was to determine the trend of the effect of the intervention over a period of time once the Autism Research Institute does comparison of the 4 different ATEC scores. The results could also be compared with other interventions in later researches. The timing of the testing was determined by the 11-months assessment period where 4 evaluations had to be done in consistence with guidelines by the research institute (Edelson and Rimland, 1999). In this study 2 of the ATEC scores were used. The pre-test evaluation score was taken in order to determine
the stereotypic behaviour and response of the children at the beginning of the school term in September. The post-test evaluation was then done after the eleventh week of the exercise program in order to establish changes in the level of the children’s characteristic behaviour and response resulting from the physical exercise programme.

The treatment included adaptive physical exercises developed as per the structured teaching approach explained by Hong (2001) and Schopler (1997). Exercises were done during the physical education lessons for a maximum of 30 minutes daily as shown in Appendix C and in the physical therapy sessions, which dealt with the children individually unlike in the group activities in physical education classes. The teachers were used as research assistants to help the children accomplish the tasks. The research assistants verbally motivated the children in order to sustain their concentration since they are destructed very easily. The researcher regularly and randomly supervised the programme to ensure effectiveness.

It was ensured that each autistic child started exercising at a comfortable level, progressed gradually towards the intermediate level and beyond. To ensure maximum benefit for the individuals, physical exercises were planned with regards to their frequency, intensity and duration. In the case of strain or stress noted on a particular individual while performing the activities, discontinuity for that particular session was encouraged. All the subjects were tested on all the scheduled evaluation days.
3.12 Data Presentation and Analysis

Data collected from the study were subjected to statistical analysis. The Statistical Package for Social Science (SPSS) was used to tabulate measures like percentages and frequencies. Descriptive statistics namely the mean, mode, median and range were computed to summarize the raw data. To test the hypotheses, Student paired t-test was used to evaluate whether significant change occurred between the initial and final observations, where all hypotheses were accepted or rejected at 0.05 alpha level. The dependent t-test was appropriate in this study because it assumes that there is a relationship, or a correlation between the scores and that a subject’s scores on the post-test is partially dependent on their pre-test score unlike other analysis tools (Thomas and Nelson, 2001). The analyzed data were then presented in tables and graphs.

3.13 Logistical and Ethical Considerations

The researcher acquired official permit to conduct the research (A copy of request letter is shown in Appendix A). The parents were also informed of the research by the school’s administration and were required to give a written consent by signing a letter (A copy of the informed consent letter is shown in Appendix B). To ensure correct performance of activities by the subjects, the reasons as to why individual attention was required on some of the very impaired children were explained to the teachers. The children who were injured or unwell were not subjected to exercises on such days. The exercises were conducted during play sessions and the specific area marked using cones to guide the children on the restricted playing area. Confidentiality on the test results on all participating children was assured to the institution’s management.
CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the data analysis and discusses the findings. The purpose of the study was to establish the effect of a structured physical exercise programme on the stereotypic behaviour and response amongst individuals with autism. The theme of the study was derived from the research objectives that guided the study. The findings are organized according to variables, as they appeared in the evaluation checklist. That is, the respondent’s demographic profiles, and the respondents’ respective stereotypic behaviour scores in the subtest domains of speech/language/communication, sociability, sensory/cognitive awareness and health/physical behaviour. A total population of 34 respondents was included in the pre-test. All the respondents successfully underwent the entire treatment. There were no dropouts. This represents 100% response and success rate.

4.2 Demographic Details of Subjects

A total of 34 autistic children participated in the study. Out of these, 14 (41.2%) were females, while 20 (58.8%) were males. The participants’ ages were grouped in class intervals of 5 years. The age groups are shown in table 4.1.
Table 4.1: Distribution of Age groups of the Participants

<table>
<thead>
<tr>
<th>Age Range (Years)</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-7</td>
<td>14</td>
<td>41.2</td>
</tr>
<tr>
<td>8-12</td>
<td>11</td>
<td>32.4</td>
</tr>
<tr>
<td>13-17</td>
<td>6</td>
<td>17.6</td>
</tr>
<tr>
<td>18 and above</td>
<td>3</td>
<td>8.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>34</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.1 above indicates that the class interval of 3-7 year olds had the majority of participants (14, 41.2%), followed by the 8-12 age group (11, 32.4%), then 13-17 year old category (6, 17.6%) and above 18 years (3, 8.8%) in this order. The mean age for the participants was 9 years and the median, 8 years. The youngest and eldest children were 3 and 19 years respectively giving a range of 17 years. The age distribution of the subjects was further stratified by gender as shown in table 4.2.

Table 4.2: Age and Gender Distribution of the Participants

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Male</th>
<th>%</th>
<th>Females</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td></td>
<td>Number</td>
<td></td>
<td>Number</td>
<td></td>
</tr>
<tr>
<td>3-7</td>
<td>8</td>
<td>23.5</td>
<td>6</td>
<td>17.6</td>
<td>14</td>
<td>41.2</td>
</tr>
<tr>
<td>8-12</td>
<td>6</td>
<td>17.6</td>
<td>5</td>
<td>14.7</td>
<td>11</td>
<td>32.4</td>
</tr>
<tr>
<td>13-17</td>
<td>3</td>
<td>8.8</td>
<td>3</td>
<td>8.8</td>
<td>6</td>
<td>17.6</td>
</tr>
<tr>
<td>18 and above</td>
<td>3</td>
<td>8.8</td>
<td>0</td>
<td>0.0</td>
<td>3</td>
<td>8.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>58.8</strong></td>
<td><strong>14</strong></td>
<td><strong>41.2</strong></td>
<td><strong>34</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The male participants were 20 (58.8%) while the females were 14 (41.2%). Majority of the females were aged between 3-7 years (6, 17.6%) followed by those aged 8-12 years.
and the 13-17 years olds (3, 8.8%) in that order. Conversely, majority of the males were also aged between 3-7 years (8, 23.5%) followed by 8-12 years olds (6, 17.6%), 13-17 year olds (3, 8.8%) while those above 18 years were 3 (8.8%). The males in this study were expected to be more probably due to the fact that autism affects more boys than girls according to Grandin (1995). The high percentage of children in age groups of 3-7 and 8-12 years can be attributed to rising awareness of this disorder and parents starting intervention at early stages of life (Autism Society of Kenya, 2006).

4.3 Level of Autism Distribution

The participants were also grouped as either mild or severe cases of autism. This information was obtained from the individual child’s schools records. The results are presented in table 4.3.

<table>
<thead>
<tr>
<th>Level of Autism</th>
<th>Male</th>
<th>%</th>
<th>Females</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>9</td>
<td>26.5</td>
<td>6</td>
<td>17.6</td>
<td>15</td>
<td>44.1</td>
</tr>
<tr>
<td>Severe</td>
<td>11</td>
<td>32.3</td>
<td>8</td>
<td>23.5</td>
<td>19</td>
<td>55.9</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>58.8</td>
<td>14</td>
<td>41.2</td>
<td>34</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The mild cases comprised 15 participants (44.1%) of whom 9 (26.5%) were males and 6 (17.6%) females. In the severe category, 11 (32.3%) were boys and 8 (23.5%) girls. Majority of the participants (19, 55.9%) were in the severe category. The highest percentage of severity (32.3%) is indicated to be from 11 males compared to the 8 females (23.5%). This higher percentage for the boys is because there were more boys
than girls in the study. This study indicates that the males were more impaired but according to Lord and Rutter (1994), although more boys are affected by autism, it adversely affects the females more.

4.4 Autism Treatment Evaluation Checklist Results

The overview pre-test and post-test results as derived from the Internet scoring procedure are illustrated in tables 4.4 and 4.5, respectively. On these tables the following codes are used: Sex: Female (F) and Male (M)

- Autism Level: Mild (M) and Severe (S)

4.4.1 Autism Treatment Evaluation Checklist Pre-test Scores

Table 4.4 shows the overall pre-test scores of the participants before exposure to the treatment or physical exercise programme for a period of 11 weeks. It also gives details of the participants’ age, gender and level of autism.

The total score obtained for each child in the ATEC evaluation checklist measured the stereotypic behaviour in autism (Edelson and Rimland, 1999). This comprised the observations made from the four major categories, which were scored in the Internet then rated (Ibid). This was used to evaluate how the autistic children responded on various aspects in daily skills and activities given within the treatment period. The level of autism was indicated as either mild or severe.
Table 4.4: Raw Data on ATEC Pre-test Scores (n = 34)

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Sex</th>
<th>Age</th>
<th>Autism Level</th>
<th>Speech/ Language/ Communication</th>
<th>Sociability</th>
<th>Sensory/ Cognitive Awareness</th>
<th>Health/ Physical Behaviour</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>3.5</td>
<td>S</td>
<td>27</td>
<td>34</td>
<td>34</td>
<td>57</td>
<td>152</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>4</td>
<td>S</td>
<td>24</td>
<td>33</td>
<td>33</td>
<td>28</td>
<td>118</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>3</td>
<td>S</td>
<td>27</td>
<td>32</td>
<td>32</td>
<td>28</td>
<td>119</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>8</td>
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From table 4.4, the scores indicate that in all the behaviour domains the higher the child scored the more impaired they were in that category. This also translated in the overall score of the participants. The severe children all had above 100 points in their total score. The mean of the overall score in the pre-test was 116.2. Health/ physical behaviour domain had the highest mean score (35.1), sociability (31.5), sensory/cognitive awareness (27.2) and speech/language/communication (22.4) in that order.

4.4.2 Autism Treatment Evaluation Checklist Post-test Scores (n = 34)

Table 4.5 shows the overall post-test scores of the participants after exposure to the physical exercise programme that lasted for 11 weeks. The table indicates that most of the participants’ scores reduced as compared to the pre-test in all the behaviour domains. The mean for the overall score was 94.9. The highest reduction in the mean was observed in the health/physical behaviour domain (27.4). Speech/language/communication (21.7) had the least mean change of 0.7.
Table 4.5: Raw Data on ATEC Post-test Scores (n = 34)

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<th>Sociability</th>
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4.4.3. Pre-test and Post-test Scores for Speech/ Language/ Communication (n = 34)

The participants’ speech/ language/ communication pre-test and post-test distribution of scores is shown in the line curve in figure 4.1.

![Diagram showing distribution of pre-test speech/language/communication scores](image)

**Figure 4.1: Distribution of Pre-test Speech/ Language/ Communication Scores**

From the diagram, the modal scores were 26 and 27. The mean score was 22.4 and median was 25. The figure above also shows that the range between the highest and lowest score was 19. This indicates that most of the children had very poor scores in this category before the intervention began. The respondents’ post-test distribution of scores is illustrated in the line curve in figure 4.2.
Figure 4.2: Distribution of Post-test Speech/ Language/ Communication Scores

The distribution of the post-test speech/ language/ communication indicates that the points were still negatively skewed. Majority of the respondents (10, 29.4% and 5, 14.7%) scored 26 and 25 respectively. The overall mean score was 21.7 points and a median of 25. The mean changed from 22.4 points in the pre-test to 21.7 points in the post-test. This indicates that the intervention might not have had a big impact on this behaviour domain as most of the children still had poor scores at the end of the 11 weeks.

4.4.4 Pre-test and Post-test Results for Sociability (n = 34)

The participants' sociability pre-test and post-test scores are shown in table 4.6.
Table 4.6: Pre-test and Post-test Sociability Scores

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<th>Sociability Score (Points)</th>
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<th>Post-test</th>
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<td><strong>34</strong></td>
<td><strong>100</strong></td>
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</table>

Table 4.6 above indicates that the highest number of the respondents in the pre-test scored between 36-40 (14, 41.2%) and 31-35 (12, 35.3%). A total of 4 (11.8%) scored between 11-15, 2 (5.9%) between 16-20 and a further 2 (5.9%) between 26-30. None scored between 21-25. The overall mean score of sociability was 31.5. The modal score was 40 points, median 33.5 and the range between the highest and lowest score was 28 points.

The participants’ sociability post-test scores show that 10 (29.4%) respondents scored between 31-35 in sociability. Others scored 26-30 (7, 20.6%), 11-15 (5, 14.6%), 16-20 (4, 11.7%), 21-25 (3, 8.7%), 6-10 (3, 8.8%) and 36-40 (2, 5.9%). The mean score for post-test scores in sociability was 24.5; median was 29 and mode of 32. The range
between the highest and lowest scores was 32. The mean changed from 31.5 points in the pre-test to 24.5 points in the post-test. This was a difference of 7 points.

4.4.5 Pre-test and Post-test Scores for Sensory/Cognitive Awareness

The children’s sensory/cognitive awareness pre-test and post-test distribution of scores is shown in table 4.7.

Table 4.7: Pre-test and Post-test Sensory/Cognitive Awareness Scores

<table>
<thead>
<tr>
<th>SCA Score (Points)</th>
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<th>Post-test</th>
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</thead>
<tbody>
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</tr>
<tr>
<td>6-10</td>
<td>0</td>
<td>0</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>11-15</td>
<td>3</td>
<td>8.8</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>16-20</td>
<td>3</td>
<td>8.8</td>
<td>27.2</td>
<td>7</td>
</tr>
<tr>
<td>21-25</td>
<td>2</td>
<td>5.9</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>26-30</td>
<td>14</td>
<td>41.2</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>31-35</td>
<td>12</td>
<td>35.3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>100</td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>

From the table above the highest number of the respondents in the pre-test scored between 26-30 (14, 41.2%) and 31-35 (12, 35.3%) points. 3 (8.8%) scored between 11-15 and 16-20 and a further 2 (5.9%) between 21-25. The mean score was 27.2 and median of 28. The range between the highest and lowest scores was 21.

The respondents’ post-test scores for sensory/cognitive awareness are also indicated in table 4.7. The results presented reveal that 9 (26.5%) respondents each scored between
21-25 and 26-30 points. Others scored 16-20 (7, 20.6%), 6-10 (2, 5.9%) and 31-35 (1, 2.9%). The mean score for post-test scores was 21.9 and a median of 23. The range between the highest and lowest scores was 23 points. The mean had a difference of 5.9 as it changed from 27.2 points in the pre-test to 21.3 points in the post-test.

4.4.6 Pre-test and Post-test Scores for Health/ Physical Behaviour

The participants’ health/ physical behaviour pre-test and post-test results are shown in table 4.8.

Table 4.8: Pre-test and Post-test Health/ Physical Behaviour Scores

<table>
<thead>
<tr>
<th>Score (Points)</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
</tr>
<tr>
<td>1-5</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>6-10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11-15</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16-20</td>
<td>4</td>
<td>11.8</td>
</tr>
<tr>
<td>21-25</td>
<td>4</td>
<td>11.8</td>
</tr>
<tr>
<td>26-30</td>
<td>7</td>
<td>20.6</td>
</tr>
<tr>
<td>31-35</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>36-40</td>
<td>5</td>
<td>14.6</td>
</tr>
<tr>
<td>41-45</td>
<td>5</td>
<td>14.6</td>
</tr>
<tr>
<td>46-50</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>51-55</td>
<td>3</td>
<td>8.8</td>
</tr>
<tr>
<td>56-60</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>61-65</td>
<td>2</td>
<td>5.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>34</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
In physical/health behaviour domain, a majority of the respondents (7, 20.5%) scored between 26-30, followed by those that scored 36-40 (5, 14.6%), 41-45 (5, 14.6%), 16-20 (4, 11.8%) and 21-25 (4, 11.8%) before the treatment. The mean score for pre-test physical/health behaviour for the entire sample was 35.2. The modal score was 28 and median was 34 points. The highest and lowest scores had a range of 59 points.

The participants’ health/physical behaviour post-test scores as shown in table 4.8 indicate that majority of the respondents (7, 20.6%) scored between 26-30, followed by those that scored 16-20 (5, 14.6%), 11-15 (4, 11.8%), 21-25 (4, 11.8%), 31-35 (4, 11.8%) and 36-40 (4, 11.8%). The highest and lowest scores had a range of 51 points. The mean, median and mode for post-test physical/health behaviour for the entire sample were 27.4, 27 and 28, respectively. The mean reduced from 35.2 points in the pre-test to 27.4 points in the post-test and this indicates a mean difference of 7.7 points.

4.4.7 Pre-test and Post-test Overall Scores Distribution

The participants’ overall total scores for pre-test and post-test evaluation are shown in table 4.9. These scores are derived from the participants’ performance in all four behavioral domains that are summed up and are used to gauge the effectiveness of the intervention as suggested by Edelson and Rimland (1999).

The participants’ overall behaviour pre-test scores as shown in table 4.9 indicate that majority of the respondents (7, 20.6%) scored between 140-149, followed by those that scored 90-99 (4, 11.8%), 100-109 (4, 11.8%) and 120-129 (4, 11.8%). The highest (161)
and lowest (59) scores had a range of 102 points. The mean, median and mode for pre-test total score in behaviour and response for the entire sample was 116.2, 122.5 and 143 respectively.

Table 4.9: Overall Behaviour and Response Scores for Pre-test and Post-test

<table>
<thead>
<tr>
<th>Total Scores (Points)</th>
<th>Pre-test</th>
<th></th>
<th></th>
<th>Post-test</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Mean</td>
<td>Number</td>
<td>%</td>
<td>Mean</td>
</tr>
<tr>
<td>40-49</td>
<td>0</td>
<td>0</td>
<td>116.2</td>
<td>2</td>
<td>5.9</td>
<td>94.9</td>
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<tr>
<td>50-59</td>
<td>1</td>
<td>2.9</td>
<td></td>
<td>3</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>3</td>
<td>8.8</td>
<td></td>
<td>3</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>70-79</td>
<td>1</td>
<td>2.9</td>
<td></td>
<td>2</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>80-89</td>
<td>1</td>
<td>2.9</td>
<td></td>
<td>5</td>
<td>14.7</td>
<td></td>
</tr>
<tr>
<td>90-99</td>
<td>4</td>
<td>11.8</td>
<td></td>
<td>2</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>100-109</td>
<td>4</td>
<td>11.8</td>
<td></td>
<td>4</td>
<td>11.8</td>
<td></td>
</tr>
<tr>
<td>110-119</td>
<td>3</td>
<td>8.8</td>
<td></td>
<td>4</td>
<td>11.8</td>
<td></td>
</tr>
<tr>
<td>120-129</td>
<td>4</td>
<td>11.8</td>
<td></td>
<td>7</td>
<td>20.6</td>
<td></td>
</tr>
<tr>
<td>130-139</td>
<td>3</td>
<td>8.8</td>
<td></td>
<td>1</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>140-149</td>
<td>7</td>
<td>20.6</td>
<td></td>
<td>1</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>150-159</td>
<td>2</td>
<td>5.9</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>160-169</td>
<td>1</td>
<td>2.9</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>100</td>
<td></td>
<td>34</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

In the post-test results, 7 (20.6%) participants scored 120-129 points followed by 5 (14.7%) children with 80-89 points in their total score. The post-test evaluation mean, median and mode were 94.9, 99, and 120 points. The lowest score was 43 and highest 140 indicating a range of 97 points. The mean changed from 116.2 points in the pre-test to 94.9 points in the post-test and this indicates a mean difference of 21.3 points.
4.5 Statistical Analysis of Hypotheses

The study employed comparison of pre-test and post-test descriptive statistic findings of the scores (measures of central tendency). Student dependent t-test was used to evaluate whether the means of different categories were significantly different at 0.05 alpha level as a result of the intervention.

4.5.1 Stereotypic Behaviour and Response of Autistic Children Between Pre-test and Post-test

The first null hypothesis (Ho₁) sought to establish the efficacy of using the structured physical exercise programme as an intervention for behaviour in children at the Nairobi Autism Unit. It sought to find out whether there would be no significant differences in stereotypic behaviour and response on the total behaviour score from the ATEC. To achieve this objective, the total pre-test scores of the respondents were compared with the total post-test scores. To analyse this hypothesis Student t test at probability level of 0.05 was used. The cross-tabulated results are shown in the table below.

<table>
<thead>
<tr>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Mean Change</th>
<th>Correlation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>34</td>
<td>116.26</td>
<td>28.48</td>
<td>21.29</td>
<td>0.94</td>
<td>13.19</td>
<td>0.000</td>
</tr>
<tr>
<td>Post-Test</td>
<td>34</td>
<td>94.97</td>
<td>27.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(t = 13.19, Critical t = 2.021 df = 33; p = 0.000)

Magnitude of decrease - (M decrease/M pre-test x 100) 18.3%
It is evident from table 4.10 that the pre and post evaluations changed from $116.26 \pm 28.4$ to $94.94 \pm 21.97$ in the overall behaviour score. The results of a paired t-test showed that the observed mean difference between pre and post test were significant at 0.05 alpha level. There was also a high correlation (0.94) between the two means. Therefore the structured physical exercise programme had a significant effect on the reduction of stereotyped behaviour and increasing positive response in autistic children at Nairobi Autism Unit. The hypothesis stating that there would be no significant differences in stereotyped behaviour and response after eleven weeks of exposure to physical exercise was consequently rejected at 0.05 alpha level. The study also established a decrease of 18.7\% in negative behaviour amongst the respondents after the physical exercise programme.

The 18.7\% reduction in negative behaviour in this study concurs with Watters and Watters’ (1980), study that found a 32.7\% decrease in motor self-stimulatory behaviour after a jogging session. These results can be attributed to the inverse relationship in the rate of correct responses in all domains to the rate of stereotypy decreasing as revealed in a study by Kern et al., (1982). There was also enhancement in the sensory integration processing amongst the children, which were brought about by the various physical exercises as they dealt with their sensory system on a daily basis. Wilbarger (1995) suggests that performing exercises regularly that combine multiple senses improves the ability of the child to perceive, process, react to and organise information leading to a higher level of brain functioning which then affects behaviour.
However, Rosenthal and Mitchell (1997) caution that any intervention in autism that is seen to have positive influence should be continued. If interrupted, the positive effects regress once the intervention is stopped and the child returns to their original functioning level. Therefore, there is need for caregivers of autistic children to in-cooperate an appropriate physical exercise programme in the children’s daily schedule as explained by Schopler (1997).

4.5.2 Stereotyped Behaviour and Response on Gender

The second null hypothesis (H₀₂) sought to find out whether there would be no significant differences in stereotypic behaviour and response on male and female children at the Nairobi Autism Unit after the physical exercise programme. To achieve this, the behaviour domains and the overall pre-test and post-test mean score of males and females were compared. Student t test at 0.05 alpha level was used to analyse this hypothesis.

Table 4.11 shows the means of the males’ and females’ pre and post-test total scores. Results on the table indicate that males and females improved in their behavioral responses because of exposure to the treatment. This is as observed in a reduction in all the mean scores between pre-test and post-test, which also had high correlations between them. In comparison, the boys showed a higher positive improvement than the girls.
Table 4.11: Pre and Post-test Means for Males and Females

<table>
<thead>
<tr>
<th>Behaviour Domain (Points)</th>
<th>Gender</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Mean Change</th>
<th>Corr</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLC</td>
<td>Male</td>
<td>22.45</td>
<td>5.68</td>
<td>21.9</td>
<td>5.39</td>
<td>0.55</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>22.29</td>
<td>6.86</td>
<td>21.50</td>
<td>6.59</td>
<td>0.78</td>
<td>0.99</td>
</tr>
<tr>
<td>SOC</td>
<td>Male</td>
<td>32.2</td>
<td>7.59</td>
<td>24.15</td>
<td>8.79</td>
<td>8.05</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>30.57</td>
<td>9.68</td>
<td>25.07</td>
<td>10.1</td>
<td>5.5</td>
<td>0.91</td>
</tr>
<tr>
<td>SCA</td>
<td>Male</td>
<td>27.1</td>
<td>6.35</td>
<td>20.45</td>
<td>6.64</td>
<td>6.65</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>27.35</td>
<td>5.49</td>
<td>22.5</td>
<td>6.50</td>
<td>4.86</td>
<td>0.92</td>
</tr>
<tr>
<td>HPB</td>
<td>Male</td>
<td>36.65</td>
<td>13.05</td>
<td>27.6</td>
<td>10.1</td>
<td>9.05</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>33</td>
<td>15.41</td>
<td>27.14</td>
<td>13.3</td>
<td>5.86</td>
<td>0.97</td>
</tr>
<tr>
<td>TS</td>
<td>Male</td>
<td>118.4</td>
<td>28.11</td>
<td>94.1</td>
<td>26.5</td>
<td>24</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>113.2</td>
<td>29.78</td>
<td>96.21</td>
<td>29.1</td>
<td>17</td>
<td>0.98</td>
</tr>
</tbody>
</table>

KEY: SLC-Speech/ Language/ Communication
SOC-Sociability
SCA- Sensory /Cognitive Awareness
HPB- Heath/ Physical Behaviour

The boys performed significantly better than the girls in all the behaviour domains apart from speech/ language/ communication. Although they recorded a lower mean, there was no significant difference between the boys’ pre-test (22.5 ± 5.7) and post-test (21.9 ± 5.39).
± 5.4) results at 0.05 alpha level. The girls had slightly better scores at post-test that were significant.

The highest reduction of the stereotype behaviour between the males and females was portrayed in the health/physical behaviour domain. There was a significant difference between the boys and girls pre-test (36.7±13.1), (33±15.41) and the post-test (27.6±10.1), (27.14 ±13.31) results at 0.05 alpha level respectively. This was followed by sociability, sensory/cognitive awareness then lastly the speech/language/communication domain.

Following the above results, it is evident that there was also a significant difference between the pre-test overall score for both male and female (118.4 ± 28.1), (113.2±29.8) and post-test (94.1 ± 26.5), (96.21 ± 29.1), respectively. The hypothesis stating that there would be no significant difference in behaviour and response between males and females before and after eleven weeks of a structured physical exercise programme was rejected at p< 0.5 alpha level. Therefore, physical exercise had a significant positive effect on the maladaptive behaviour and response of male than female children with autism. The better performance in the males could be attributed to the fact that their values were better even at pre-test and due to their hormonal configuration. Boys possess more muscular strength and endurance than girls and as a result were able to benefit from the physical exercises more. The studies reviewed in this area do not compare performance of male and female as most used males only. This study concurs with the review by Quill (1989) where physical exercise was used to encourage more
adaptive and appropriate behaviour for both boys and girls with autism in a Japanese education model. Bumin et al., (2004) also illustrates that females do also benefit from this intervention.

4.5.3 Stereotyped Behaviour and Response on Different Age groups Amongst the Autistic Children (3-7 years n = 14, 8-12 years n = 11, 13-17 years n = 6 and >18 years n = 3)

The third null hypothesis (H₀₃) sought to find out whether there would be no significant differences in stereotypic behaviour and response of different age groups after the physical exercise programme amongst children at the Nairobi Autism Unit. To achieve this, the pre-test and post-test mean score of the four behaviour domains and the overall score of each age group were compared. Student t test at 0.05 alpha level was used to analyse this hypothesis. Table 4.12 shows the means of pre and post-test results of the children as categorized in different age groups.

As depicted in the table, all the age groups had a reduction in the means in all the behaviour variables as well as the total score after the exercise programme. The results between the pre-test and post-test scores were all highly positively correlated. However, some were not significant at 0.05 alpha level as further illustrated.
Table 4.12: Pre and Post-test Means for Different Age Groups

<table>
<thead>
<tr>
<th>Behaviour Domain (Points)</th>
<th>Age Group (Years)</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Mean Change</th>
<th>Corr</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLC</td>
<td>3-7</td>
<td>23.07</td>
<td>5.17</td>
<td>22.3</td>
<td>5.1</td>
<td>0.78</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>8-12</td>
<td>24.09</td>
<td>5.24</td>
<td>23.45</td>
<td>4.69</td>
<td>0.63</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>13-17</td>
<td>21.5</td>
<td>8.24</td>
<td>21.16</td>
<td>7.96</td>
<td>0.33</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>&gt; 18</td>
<td>14.67</td>
<td>4.72</td>
<td>14.0</td>
<td>3.6</td>
<td>0.67</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOC</td>
<td>3-7</td>
<td>29.4</td>
<td>10.04</td>
<td>23.07</td>
<td>9.66</td>
<td>6.35</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>8-12</td>
<td>35.18</td>
<td>4.68</td>
<td>27.18</td>
<td>8.21</td>
<td>8.0</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>13-17</td>
<td>31.5</td>
<td>9.03</td>
<td>24.0</td>
<td>10.04</td>
<td>7.5</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>&gt; 18</td>
<td>28.0</td>
<td>8.71</td>
<td>22.67</td>
<td>11.85</td>
<td>5.3</td>
<td>0.99</td>
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<tr>
<td>SCA</td>
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<td>27.0</td>
<td>6.8</td>
<td>21.14</td>
<td>5.83</td>
<td>5.85</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>8-12</td>
<td>28.7</td>
<td>4.24</td>
<td>22.82</td>
<td>7.16</td>
<td>5.90</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>13-17</td>
<td>27.3</td>
<td>5.42</td>
<td>20.3</td>
<td>7.63</td>
<td>7.0</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>&gt; 18</td>
<td>22.3</td>
<td>8.14</td>
<td>18.33</td>
<td>7.64</td>
<td>4.0</td>
<td>0.98</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HPB</td>
<td>3-7</td>
<td>39.28</td>
<td>15.03</td>
<td>31.5</td>
<td>12.64</td>
<td>7.78</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>8-12</td>
<td>31.64</td>
<td>14.09</td>
<td>23.91</td>
<td>10.57</td>
<td>7.73</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>13-17</td>
<td>34.67</td>
<td>13.85</td>
<td>26.17</td>
<td>10.67</td>
<td>8.5</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>&gt; 18</td>
<td>29.67</td>
<td>6.51</td>
<td>23.67</td>
<td>5.77</td>
<td>6.0</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TS</td>
<td>3-7</td>
<td>118.8</td>
<td>33.2</td>
<td>98</td>
<td>28.9</td>
<td>20</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>8-12</td>
<td>119.6</td>
<td>21.3</td>
<td>97.4</td>
<td>24.4</td>
<td>22.3</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>13-17</td>
<td>115.0</td>
<td>31.5</td>
<td>91.7</td>
<td>31.8</td>
<td>23.3</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>&gt; 18</td>
<td>94.7</td>
<td>25.8</td>
<td>78.7</td>
<td>26.5</td>
<td>16</td>
<td>0.99</td>
</tr>
</tbody>
</table>

KEY: SLC-Speech/ Language/ Communication   SOC-Sociability
SCA-Sensory /Cognitive Awareness   TS –Total Score
HPB- Health/ Physical Behaviour

The hypothesis (H03) that there would be no significant change in speech/ language/ communication for various ages was rejected for the 3-7 year old children but upheld for the other age groups at 0.05 alpha level. On sociability, sensory /cognitive awareness and physical/ health behaviour, the hypothesis purposing no significant change in the
domains for various ages was rejected for the 3-7, 8-12 and 13-17 year old children but upheld for children above 18 years at 0.05 alpha level.

Children in the 3-7 years age group responded positively and significantly in all the domains and had the highest improvement in their pre-test and post-test with mean scores of 39.3 to 31.5 in the health/physical behaviour domain respectively. This was followed by sociability, sensory/cognitive awareness and the lowest reduction in behaviour results was observed in the speech/language/communication, that had mean scores of 23.1 in pre-test and 22.3 points in post-test. These results can be attributed to the individualized attention this group received from the caregivers. This group needed a lot of individualized attention due to the nature of autism. When an intervention is started early in a child’s life they easily adapt and improve their condition in a better way (Shirley, 1998).

Similarly, children in the 8-12 years age group responded positively and significantly in three of the domains with the highest improvement in their pre-test and post-test with mean scores of 35.2 to 27.2, respectively in the sociability domain. This was followed by health/physical behaviour, and sensory/cognitive awareness. There was no significant difference at 0.05 level in the pre-test (24.1 ± 5.24) and the post-test (23.5 ± 4.69) results in the speech/language/communication variable. From table 4.12 it is evident that children in the 13-17 years age group did not show a significant difference at 0.05 level in the pre-test (21.5 ± 8.24) and the post-test (21.16 ± 7.96) results in the communication variable. However the other behaviour domains had significant
differences between their pre-test and post-test results. The most reduction in the stereotype behaviour in this group was depicted in the health/physical behaviour whose mean score changed from 34.7 in pre-test to 26.2 at post-test. This was followed by sociability then sensory/cognitive awareness.

Although there was a positive response and reduction of maladaptive behaviour in children aged 18 years and above, there was no significant difference between pre-test and post-test results at 0.05 level in all the behaviour domains evaluated. This can be attributed to the fact that they only comprised 3 children. With proper management, individuals with autism in many cases may have improvement with age as awareness of, and adaptation to the difficulties become greater (Lord and Rutter, 1994). This group comprised boys who were, even before the treatment period mostly independent and maintained successful daily activities without much assistance from the teachers or caregivers. However, Grandin (1995) points out that in other cases, problems may increase with age.

In the total score on the behaviour evaluation, all the age groups had reductions in the pre-test and post-test results, which were significantly different at 0.05 alpha level as depicted from the table. The best mean change was in the 13-17 year olds followed by 8-12, 3-7 and finally the 18 and above. The hypothesis stating that there would be no significant difference in behaviour and response amongst children of different age groups before and after eleven weeks of a structured physical exercise programme was rejected at p< 0.5 alpha level. It was observed that from an overview the structured
physical exercise programme had a positive effect in all the age groups found at Nairobi Autism Unit.

4.5.4 Stereotyped Behaviour and Level of Autism

The fourth null hypothesis (H0₄) stated that there would be no significant difference in behaviour and response between mild and severe children after the physical exercise programme at the Nairobi Autistic Unit. To confirm this, the different subtest variables were observed in these two categories. Student t-test at 0.05 level of significance was used to test this hypothesis. Table 4.13 shows the changes on the behaviour domains of the subjects who were either mild or severe in their level of functioning.

From table, subjects who were either mild or severe in autism recorded positive responses and reductions in their mean scores in all the behaviour domains after exposure to eleven weeks of physical exercise. High correlations were observed in the pre-test and post-test results apart from the severe children in sociability (0.49) as well as mild children in the sensory/ cognitive awareness (0.55). There were significant changes in the pre and post-test results in all the behaviour variables in the mild and severe cases apart from the children who were mild in speech/ language/ communication. Thus the hypotheses stating there would be no significant difference in the various levels of autism in this domain was upheld for the mild children at 0.05 significance level.
Table 4.13: Pre and Post-test Means for Mild and Severe Levels of Autism

<table>
<thead>
<tr>
<th>Behaviour Domain (Points)</th>
<th>Level Of Autism</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Mean Change</th>
<th>Corr</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLC</td>
<td>Mild</td>
<td>17.86</td>
<td>6.61</td>
<td>17.46</td>
<td>6.27</td>
<td>0.4</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>25.9</td>
<td>1.95</td>
<td>25.1</td>
<td>2.1</td>
<td>0.84</td>
<td>0.84</td>
</tr>
<tr>
<td>SOC</td>
<td>Mild</td>
<td>25.2</td>
<td>8.99</td>
<td>16.7</td>
<td>7.54</td>
<td>8.46</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>36.52</td>
<td>2.69</td>
<td>30.68</td>
<td>4.51</td>
<td>5.84</td>
<td>0.49</td>
</tr>
<tr>
<td>SCA</td>
<td>Mild</td>
<td>22.7</td>
<td>5.93</td>
<td>15.53</td>
<td>4.08</td>
<td>7.2</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>30.74</td>
<td>2.68</td>
<td>25.84</td>
<td>4.06</td>
<td>4.89</td>
<td>0.64</td>
</tr>
<tr>
<td>HPB</td>
<td>Mild</td>
<td>24.33</td>
<td>9.32</td>
<td>18.46</td>
<td>6.61</td>
<td>5.8</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>43.68</td>
<td>10.75</td>
<td>34.47</td>
<td>9.11</td>
<td>9.21</td>
<td>0.89</td>
</tr>
<tr>
<td>TS</td>
<td>Mild</td>
<td>90.13</td>
<td>20.05</td>
<td>68.2</td>
<td>13.7</td>
<td>21.9</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>138.9</td>
<td>12.50</td>
<td>116.1</td>
<td>11.8</td>
<td>20.78</td>
<td>0.75</td>
</tr>
</tbody>
</table>

KEY: SLC-Speech/Language/Communication  SOC-Sociability
SCA- Sensory/Cognitive Awareness  TS -Total Score
HPB- Health/Physical Behaviour

Children who were mild performed better in sociability and sensory/cognitive awareness than those who were severe cases. This can be attributed to the higher pre-test scores since children in this category are not adversely affected in terms of their cognitive development that also translates to the behaviour patterns. On the other hand, the severe autistic children had better performance in the speech/language/communication and health/physical behaviour domains than children with mild autism. In the total score the mild children recorded better performance with a mean change of
90.13 points at pre-test to 68.2 points at post-test. The hypothesis (H04) stating that there would be no significant difference in behaviour and response before and after eleven weeks of a structured physical exercise programme on children with mild and severe autism was rejected at p< 0.5.alpha level. This indicates that from an overview the structured physical exercise programme had a positive effect for children with both mild and severe autism found at Nairobi Autism Unit.

For the children with severe autism, the reduction in stereotypic behaviour and positive response probably was because of the exercises providing another means for self-stimulation that was socially appropriate. The children were able to deal with the high levels of frustration from sensory difficulties while performing the physical exercises (Levinson and Reid, 1993 and Berkely and Zittel, 1998). Children’s responses also improved because the programme was structured and gave them an opportunity to understand what was expected of them at the same time motivating them to engage in the various activities with more ease (Allison et al., 1991).

4.5.5 Autism Stereotype Behaviour Domains and Physical Exercise

The fifth null hypothesis (H05) sought to find out whether there would be no significant differences in the stereotype behaviour and response in the various domains evaluated in children at the Nairobi Autism Unit after the physical exercise programme. To achieve this, the various behaviour domains’ pre-test and post-test mean scores of all the children were compared. To test this hypothesis Student t-test at 0.05 level of significance was used.
4.5.5.1 Physical Exercise and Speech/ Language/ Communication

Speech/ Language/ Communication was one of the parameters used to assess the stereotyped behaviour and response amongst the autistic participants. This is of concern because a child with autism may have difficulty expressing needs, initiating and maintaining conversation. Since they have poor responses to auditory information, communication should be verbal or non-verbal, including physical movement, facial expressions body language or gestures so as to avoid anxiety, which leads to the characteristic negative behaviour (Shirley, 1998). Table 4.14 shows the changes in this behaviour domain after the treatment period.

Table 4.14: Speech/ Language/ Communication Pre-test and Post-test Results (n = 34)

<table>
<thead>
<tr>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Correlation</th>
<th>Mean Change</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>34</td>
<td>22.38</td>
<td>6.10</td>
<td>0.98</td>
<td>0.59</td>
<td>3.03</td>
<td>0.000</td>
</tr>
<tr>
<td>Post-test</td>
<td>34</td>
<td>21.79</td>
<td>5.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(t = 3.03, critical t=2.02 df=33, p=0.000)

It is evident from table 4.14 that the pre-test and post-test scores changed from 22.38 ± 6.1 to 21.79 ± 5.8 in the speech/ language/ communication domain. This shows an improvement of 0.6. The results of a paired t-test showed that the observed mean differences between pre-test and post-test were significant at 0.05 alpha level. The study established a strong positive correlation between the pre and post-test scores of 0.98.
Therefore, the structured physical exercise programme had a significant effect on the communication domain. The hypothesis stating that there would be no significant difference in speech/ language/ communication before and after eleven weeks exposure to physical exercise was rejected at 0.05 alpha level.

In this study, the decrease in speech/ language/ communication domain scores was indicated by the positive response, as the participants were able to follow the instructions given during the structured physical exercises. This is attributed to the use of communication that suited them and enabled them to perform the activities which was mainly non-verbal and included physical movement. O'Connor (2000) indicates that physical exercises provide an opportunity for children with autism to learn, practice and expand on a variety of communication skills, such as expressing their needs and feelings with others as well as use of language.

4.5.5.2 Physical Exercise and Sociability

Sociability was used to assess the behaviour and response amongst the autistic participants since social interaction skill development is often a significant concern for individuals with autism. A child with autism may prefer to be alone rendering group dynamics and cooperation rather difficult. Table 4.15 shows the changes in this behaviour domain after the treatment period.
Table 4.15: Sociability Pre-test and Post-test Results (n = 34)

<table>
<thead>
<tr>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Correlation</th>
<th>Mean Change</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>34</td>
<td>31.52</td>
<td>8.41</td>
<td>0.86</td>
<td>7.0</td>
<td>8.85</td>
<td>0.000</td>
</tr>
<tr>
<td>Post-test</td>
<td>34</td>
<td>24.52</td>
<td>9.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(t = 8.85, critical t=2.02 df=33, p=0.000)

Results from table 4.15 indicate that there was a difference of 7 points between pre-test and post-test scores. The results of a paired t-test showed that the observed mean differences between pre-test and post-test were significant at 0.05 alpha level. The pre-test and post-test changed from 31.52 ± 8.41 to 24.52 ± 9.19 in the sociability domain. The study established a strong positive correlation (0.86) between the pre and post-test means. Therefore, the structured physical exercise programme had a significant effect on the sociability sub-test. The hypothesis stating that there would be no significant difference in sociability before and after eleven weeks exposure to a structured physical exercise programme was therefore rejected at 0.05 alpha level.

In this study, children with autism were instructed using social cues and interaction skills. Individuals with little intrinsic motivation and even those with serious behavioral problems become more involved and interested while engaging in enjoyable activities that encouraged interaction (Weber and Thorpe, 1992). This is because with time the child establishes familiarity with the environment, develops friendships and social relationships and the behavioral problems begin to decrease both in quantity and quality.
(Berkely and Zittel, 1998). Physical skills taught in this environment can transfer well to other environments of the child. In a study by Schleine, et al., (1988), motor skills improved after a nine-week activity programme, which also translated to improved social skills in a group of children with autism. The results of the current study also concur with Kern et al., (1984) where social play in autistic children improved after a session of jogging.

4.5.5.3 Physical Exercise and Sensory/ Cognitive Awareness

Sensory/ cognitive awareness was also used to assess the behaviour and response amongst the autistic participants since they may experience short attention span, difficulty attending to multiple cues and information processing impairments. Autistic individuals may also have sensory processing difficulties (Schopler et al., 1995). All the above are factors that enhance the maladaptive behaviour and need to be dealt with in autism. The summarized results are presented in table 4.16.

Table 4.16: Sensory/ Cognitive Awareness Pre-test and Post-test (n = 34)

<table>
<thead>
<tr>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Correlation</th>
<th>Mean Change</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>34</td>
<td>27.20</td>
<td>5.92</td>
<td>0.78</td>
<td>5.91</td>
<td>8.30</td>
<td>0.000</td>
</tr>
<tr>
<td>Post-test</td>
<td>34</td>
<td>21.29</td>
<td>27.20</td>
<td>6.56</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(t =8.30, critical t=2.02 df=33,p=0.000)
Table 4.16 indicates that the physical exercise programme elicited a positive response in sensory/cognitive awareness behaviour in the autistic children. The results of a paired t-test showed that the observed mean differences between pre-test and post-test were significant at 0.05 alpha level. The pre-test and post-test scores changed from 31.52 ± 8.41 to 24.52 ± 9.19 in this domain. The study established a positive correlation (0.78) between the pre and post-test means. Therefore, the structured physical exercise programme had a significant effect on the sensory/cognitive awareness behaviour domain. Therefore the hypothesis stating that there would be no significant difference in sensory/cognitive awareness before and after eleven weeks exposure to a structured physical exercise programme was rejected at 0.05 alpha level.

In this study, there was a difference of 5.9 points between pre-test and post-test scores. The reduction in the mean reflects that the physical exercises had a positive effect in this domain with positive responses from the subjects. In a previous study, Rosenthal and Mitchell, (1997) indicate that exercise programmes of moderate intensity increased appropriate play, attention span and interest in learning. This study is in agreement with the Daily Life Therapy, an educational approach for children with autism that believed physical exercise is related to the release of endorphins which are natural inhibitors of anxiety and thus improving how the brain functions (Quill, 1989).

The physical exercises were tailored to boost cognition especially activities stimulating motion within the inner ear such as rolling and jumping (Greenfield, 1995) as they enabled the autistic children to be more connected to their environment. To meet their sensory needs, sensory integration activities requiring motor planning, balance,
flexibility and strength were included in the programme. The positive response in this
domain can be attributed to this as the activities assisted the children in processing a
more organised response to sensory stimuli (Campbell et al., 1996).

4.5.5 4 Physical Exercise and Health/Physical Behaviour

In this domain, challenging behaviours because of unmet needs, delayed ability or lack
of skill were observed. These included but not limited to hyperactivity, motor
stereotypes, self-injury, destructiveness, rigid routines, sleep problems and seizures. The
summarized pre-test and post-test mean scores are presented in table 4.17.

Table 4.17 Health/Physical Behaviour Pre-test and Post-test Results (N=34)

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Correlation</th>
<th>Mean Change</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>34</td>
<td>35.1</td>
<td>13.96</td>
<td>0.95</td>
<td>7.7</td>
<td>7.98</td>
<td>0.000</td>
</tr>
<tr>
<td>Post-test</td>
<td>34</td>
<td>27.4</td>
<td>11.35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(t =7.9, critical t=2.02 df=33,p=0.000)

Using the paired t-test, results showed that the observed mean differences in health/
physical behaviour between pre-test and post-test were significant at 0.05 alpha level.
The pre-test and post-test scores changed from 35.1 ± 13.96 to 27.4 ± 11.35 in this
domain. The study established a high positive correlation (0.95) between the pre and
post-test scores. Thus, the structured physical exercise programme had a significant
effect on the health/physical behaviour domain. The hypothesis stating that there would be no significant difference in health/physical behaviour domain before and after eleven weeks exposure to a structured physical exercise programme was rejected at 0.05 alpha level.

The results of this study indicate that the subjects improved significantly in health/physical behaviour scores. The findings of this study concur with those of Kern et al., (1982), Kern et al., (1984) and Watters and Watters (1980) where jogging reduced self-stimulation mannerisms. Elliot et al., (1994) found in their study that engaging in physical exercise reduced maladaptive behaviour such as hyperactivity and high intensive destructive behaviour. Berkely and Zittel, (1998) point out that physical exercise helps to decrease these self-stimulatory behaviours by providing scope for sensory integration and stimulation. This findings of this study concur with those of Levinson and Reid, (1993) when they indicate that physical exercise is seen as a productive and constructive way of satisfy the need for routine and rhythm in autism.
CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the findings of the study, conclusions and recommendations. The study investigated the effect of a structured physical exercise programme on the stereotypic behaviour and response of children at the Nairobi Autism Unit. The behaviour and response aspects evaluated were communication, sociability, sensory/cognitive awareness and health/physical behaviour as in the Autism Treatment Evaluation Checklist. The study also investigated the effect of the programme on the overall performance, different age groups, gender, and levels of autism amongst the participants.

The study was conducted during the third term of the school year between September and November 2006. It was hypothesized that there would be no significant differences between the pre-test and post-test scores of the stereotype behaviour and response after eleven weeks exposure to physical exercise. A pre-test was administered to the participants at the beginning of the term to determine the status of different domains of behaviour. The subjects were then exposed to the structured physical exercise programme for a period of eleven weeks after which a post-test evaluation was administered. All the children of the unit at that time were used as participants. This comprised a total sample of 34, of whom 14 were girls and 20 boys. Descriptive statistics of mean, mode range, median and standard deviation were used in the analysis.
of data. The Student t-test was used to determine if there were significant differences in the mean scores of participants in the pre-test and post-test at the 0.05 alpha level.

Through a pre and post-test research design, the study set out to test the following null hypotheses:

\( H_0_1 \) There would be no significant difference in stereotypic behaviour and response before and after the structured physical exercise programme on the overall behaviour score amongst children at the Nairobi Autism Unit.

\( H_0_2 \) There would be no significant difference in stereotypic behaviour and response before and after the structured physical exercise programme between male and female children at the Nairobi Autism Unit.

\( H_0_3 \) There would be no significance difference in stereotypic behaviour and response before and after the structured physical exercise programme amongst children of different age groups at the Nairobi Autism Unit.

\( H_0_4 \) There would be no significant difference in stereotypic behaviour and response in the mild and severe levels of autism before and after the structured physical exercise programme amongst children at the Nairobi Autism Unit.

\( H_0_5 \) There would be no significant difference in stereotypic behaviour and response in the various behaviour domains before and after the structured physical exercise programme amongst children at the Nairobi Autism Unit.

### 5.2 Summary of the Findings

The following findings were established:
• There was a significant difference in the overall behaviour and response of the children with autism before and after the exercise period. The total mean score in behaviour at pre-test was 116.3 points and 94.9 points at post-test. This signified an improvement in terms of reduction of maladaptive behaviour, which translates to an increase in positive response. This was indicated by the reduction of the mean score at post-test.

• With regard to gender, the eleven-week structured exercise programme led to a positive response in the females, as there were significant differences in all the behaviour domains experimented. The male recorded significant changes in three behaviour domains except in speech/ language/ communication, which had no significant difference at post-test.

• There was a significant difference in stereotype behaviour and positive response in the age group of 3-7 years in all the behaviour domains. Among children aged 8-12 and 13-17 years, there was significant difference in sociability, sensory/ cognitive awareness and health/ physical behaviour but there was no significant difference in speech/ language /communication domains after the exercise period. Children in the 18 years and above age group did not show any significant difference in any of the behaviour variables before and after the structured physical exercise period although the mean score changed positively between the pre and post test. All the four age groups had significant differences in their total score before and after the exercise exposure.
There was a significant difference in all the stereotype behaviour and response variables in children with severe levels of autism before and after the exercise period. Those with mild autism did not show a significant difference in speech/language/communication but had significant changes in the other domains before and after the exercise programme. Both the mild and severe children had significant differences in stereotype behaviour reduction in the total score before and after the exercise exposure.

The structured physical exercise programme had a positive and significant effect on the behaviour domains evaluated using the Autism Treatment Evaluation Checklist on children at the Nairobi Autism Unit. The hypotheses stating that there would be no significant change on the stereotype behaviour domains of the subjects after eleven weeks of exposure to a structured physical exercise programme was rejected.

5.3 Implications of the Findings

Dysfunction in the sensory integration must involve a reorganization of an individual’s entire functional system causing him/her to behave in a qualitatively different manner in order that he/she may adjust and survive. As part of the educational process, Physical Education and Sports, as a medium of expression and learning through movement, can help children with autism acquire and enhance healthy habits. Auxter et al., (1997) note that, teachers and caregivers can make a major contribution to an autistic child’s education by being sensitive to their individual needs. They should also offer physical
exercises that are appropriate and acceptable in the Physical Education and Sports Programme.

This study noted improved responses in stereotyped behaviour of the autistic children after an eleven-week period of structured physical exercises. Tsai (1998) notes that autistic children have reduced social contacts. This leads to reduced opportunity in participation of various sporting activities. It is suggested that parents and significant others of these children should set aside time each day to play with the children. The child should have access to a rich variety of play materials and clearly instructed on how to utilize them when engaging both in solitary or group play.

Children with autism need individual assessment and programmes that will meet their unique needs. Lord and Rutter (1994) note that dysfunction within the sensory systems manifests itself in many negative ways resulting to frustration, aggression, or withdrawal. Gross and/or fine motor coordination problems are also common and may result in speech language delays and in academic under achievement among many others. Well planned and supervised physical exercise programmes are necessary for children with autism to help in their motor functioning, improve sensory/cognitive awareness as well as health/physical behaviour as revealed in this study.

Through this study it was found that behaviour in speech/language/communication did not have significant changes amongst the males in general, mild cases, 8-12 and 13-17 years age groups. This domain probably requires more attention and time for any
significant changes to occur. Appropriate activities that relate directly to leisure should be selected to help improve the speech/ language/ communication aspect in autism. The physical exercise programme for autistic children should include a variety of activities for well-rounded physical, intellectual, emotional and social development.

Both autistic boys and girls in this study benefited from the structured physical exercises. When compared, the results indicated that the males had better scores than the females. However, girls are less likely to develop autism, and when they do they are more severely impaired. As a result, they may need more time for significant improvements to be noted after an intervention (Skuse, 2000).

5.4 Conclusions

Based on the findings of this study, the following conclusions were made:

- The structured physical exercise programme had a positive impact on the characteristic stereotype behaviour on children with autism at the Nairobi Autism Unit.

- Both boys and girls recorded improvement on the score of all the behaviour domains. However, the males performed better than girls at post-test in sociability, sensory/ cognitive awareness and health/ physical behaviour apart from the speech/ language/ communication where the female recorded significant differences and performed better than the male children.

- All age groups’ recorded significant changes on the overall behaviour score at post-test. On the specific behaviour domains, only children aged between 3 to 7
years recorded significant changes on speech/ language/ communication. Children aged above 18 years did not record significant differences on sociability, sensory/ cognitive awareness and health/ physical behaviour domains unlike children in the other age groups who did.

- Subjects who had mild and severe levels of autism both recorded significant improvements in their overall behaviour results. Children who had mild autism performed better in sociability and sensory/ cognitive awareness while the severely impaired ones recorded better results in speech/ language/ communication and health/ physical behaviour domains. The exercise programme did not significantly affect the mild children’s speech/ language/ communication response.

5.5 Recommendations

Based on the research findings the following recommendations for practice, policy formulation and research are made:

5.5.1 Recommendations for Practice and Policy Formulation

1. From this study it was found out that physical exercise improved the behaviour of children with autism. Therefore children with autism should be encouraged by parents and caregivers to participate in physical exercises that promote successful experiences to increase self-confidence in sociability, sensory/ cognitive awareness and be motivation to further participation.

2. Special/ adapted physical education and sports should be encouraged in schools with children with autism for enhancing their health status. Kenya Institute of
Education should develop a suitable Physical Education syllabus geared towards improving and managing the challenging behaviour in this population.

3. Teachers, parents and caregivers of autistic children should take advantage of physical exercises to curb the destructive behaviour by including a variety of activities that are structured in their daily schedules and ensure that children perform these activities as planned and are carefully supervised for safety purposes.

4. Teachers of Adapted Physical Education should carry out periodical physical fitness assessment to establish the health status for the autistic children under their care in order to understand the areas of strengths and weaknesses in their physical fitness; and provide appropriate remedial fitness programmes besides management maladaptive behaviour.

5.5.2. Recommendations for Further Research

1. A nationwide survey should be carried out to establish a general overview of cases of individuals with autism as well as their status in Kenyan schools with special units to take care of them appropriately.

2. An evaluation of the status of physical fitness levels of children with autism in Kenya should be determined because this affects their performance in physical activities. This can be an insight to designing the best appropriate exercise programmes to meet individual needs of these children.

3. Studies should be conducted to establish how physical exercises can be used in managing children with maladaptive behaviours such as those with developmental disorders other than autism in Kenya.
REFERENCES


APPENDIX A

A SAMPLE LETTER TO REQUEST FOR PUPILS

Kenyatta University,
Department of Exercise,
Recreation and Sport Science.
P.O.Box 43844, Nairobi.
Date 20/05/06.

The Chairman,
Autism Society Of Kenya,
City Primary School,
P.O. Box 176, Nairobi.

Dear Sir,

RE: REQUEST FOR PUPILS TO PARTICIPATE IN A RESEARCH

I am a graduate student taking a Master of Science degree in the Department of Exercise, Recreation and Sport Science at Kenyatta University.

I intend to investigate the influence of physical exercises on stereotypic behaviour and response amongst individuals with autism. Children at the Nairobi Autism Unit will form my sample. I am kindly requesting to use the children from the unit to participate in a structured physical exercise programme designed to suit the children for a period of eleven weeks. It will entail full exercise sessions including warm-up, physical exercises and cooling down. Physical exercises will to be performed for a maximum of 30 minutes duration daily.

I hope to carry out the pre-test during the first week of September 2006 and a post-test eleven weeks later.

The results of this study will purely be for academic purposes and will be treated in confidence, the findings of which will certainly contribute towards improvement in managing and treating autistic children. A copy of the completed Thesis shall be made available to the institution by the researcher. It is my sincere wish that you will allow me carry out the study with your pupils at the institution.

Thank you.

Yours sincerely,

Edna Katiwa Maithya
APPENDIX B

A SAMPLE OF THE PARENTS' INFORMED CONSENT LETTER

Kenyatta University
Department of Exercise, Recreation and Sport Science
P.O.Box 43844, Nairobi.
Date 21/05/06.

Dear Parent/Guardian,

RE: REQUEST FOR YOUR CHILD TO PARTICIPATE IN A RESEARCH

I am a graduate student taking a Master of Science degree in the Department of Exercise, Recreation and Sport Science at Kenyatta University.

I intend to investigate the influence of physical exercises on stereotypic behaviour and response amongst individuals with autism. Children at the Nairobi Autism Unit will form my sample. By this letter, I am kindly requesting for your permission to involve your child from the unit to participate in a physical exercise programme designed to suit the children for a period of eleven weeks. It will entail full exercise sessions including warm-up, physical exercises and cooling down. Exercises will to be performed for a maximum of 30 minutes duration daily. The activities in the research in which your child will be participating will not endanger your child in any way.

The results of this study will purely be for academic purposes and your child’s records ad performance will be treated in confidence. A copy of the completed Thesis shall be made available to the institution by the researcher for your review. It is my sincere wish that you will allow me carry out the study with your child in the institution by signing this consent form. A copy of this form will be given to you.

Thank you.

Yours sincerely,
Edna Katiwa Maithya

I understand that my child ___________________________ has been selected to participate in a research to investigate the influence of physical exercises on stereotypic behaviour and response amongst individuals with autism done by Edna Maithya of Kenyatta University.

I have been informed of the nature, duration, demands, risks and benefits of the study have been explained to me. In signing this form I accept my son/daughter to participate in the programme.

Subject’s signature ___________________________ Date ___________________________
(Father, mother, legal guardian or legally authorized official)
APPENDIX C

DSM-IV Diagnostic Criteria for Autistic Disorder

(American Psychiatric Association, 2000)

A diagnosis of autistic disorder is made when the following criteria from A, B and C are all met.

A. A total of six (or more) items from (1), (2) and (3), with at least two from (1), and one each from (2) and (3):

1. Qualitative impairment in social interaction, as manifested by at least two of the following:
   a) Marked impairment in use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction.
   b) Failure to develop peer relationships appropriate to developmental level.
   c) A lack of spontaneous seeking to share enjoyment, interests or achievements with others (e.g., by lack of showing, bringing, or pointing out objects of interest)
   d) Lack of social or emotional reciprocity

2. Qualitative impairments in communication as manifested by at least one of the following:
   a) Delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative models of communication such as gesture or mime).
   b) In individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others.
   c) Stereotypic and repetitive use of language or idiosyncratic language
   d) Lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level.

3. Restricted, repetitive and stereotyped patterns of behavior, interest, and activities as manifested by at least one of the following:
a) Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.

b) Apparently inflexible adherence to specific, nonfunctional routines or rituals.

c) Stereotyped and repetitive motor mannerisms (e.g. hand or finger flapping or twisting, or complex whole-body movements.

d) Persistent preoccupation with parts of objects.

B. Delays or abnormal functional in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.

C. The disturbance is not better accounted for by Rett’s Disorder or Childhood Disintegrative Disorder.
### APPENDIX D

**DETAILED INTERVENTION OF PHYSICAL EXERCISES USED**  
(Adopted from Schopler et al., 1995)

<table>
<thead>
<tr>
<th>PHASE</th>
<th>DURATION</th>
<th>EXERCISE PERFORMED</th>
<th>NUMBER OF REPETITIONS OF ACTIVITY</th>
<th>APPARATUS USED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-up</td>
<td>3 minutes</td>
<td>Jogging round marked area or jumping on a trampoline</td>
<td>3 times</td>
<td>Area marked with cones Trampoline</td>
</tr>
<tr>
<td>flexibility exercises</td>
<td>8 minutes</td>
<td>Circle arms</td>
<td>4 times</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Side stretch</td>
<td>4 times</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straddle stretch</td>
<td>4 times</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lateral stretch</td>
<td>4 times</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular and endurance</td>
<td>8 minutes</td>
<td>Jump from hoop to hoop</td>
<td>10 times</td>
<td>2 hoops 2 feet apart</td>
</tr>
<tr>
<td>exercises</td>
<td></td>
<td>Jump between rope or bouncing ball</td>
<td>10 times</td>
<td>Skipping rope or a ball</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duck walk from cone to cone</td>
<td>2 times</td>
<td>2 cones 5 feet apart</td>
</tr>
<tr>
<td>Muscle-strengthening exercises</td>
<td>8 minutes</td>
<td>Crab walk from hoop to hoop</td>
<td>2 times</td>
<td>2 Hoops 5 feet apart</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seal walk from cone to cone</td>
<td></td>
<td>Mats</td>
</tr>
<tr>
<td>Cool-down</td>
<td>3 minutes</td>
<td>Deep breathing exercises</td>
<td>4 times</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX E

Autism Treatment Evaluation Checklist (ATEC)
Bernard Rimland, PhD. and Stephen M. Edelson, PhD
Autism Research Institute
4182 Adams Avenue, San Diego, CA 92116
Fax: (616) 563-6840; wwww.autism.com/ari

This form is intended to measure the effects of treatment. Free scoring of this form is available on the Internet at: www.autism.com/atec

<table>
<thead>
<tr>
<th>Name of Child</th>
<th>Male</th>
<th>Age</th>
<th>Last</th>
<th>First</th>
<th>Female</th>
<th>Date</th>
</tr>
</thead>
</table>
formed by: | | | | | | |
| Relationship: | | | | | | |
| Today’s Date: | | | | | | |

| Please circle the letters to indicate how true each phrase is: | | | |
| I Speech / Language/ Communication: | | | |
| NSV1. Knows own name | NSV 6. Can use 3 words at a time (Want more milk) | NSV11. Speech tends to be meaningful, relevant |
| NSV2. Responds to ‘No’or ‘Stop’ | NSV 7. Knows 10 or more words | NSV12. Often uses several successive sentences |
| NSV3. Can follow some commands | NSV 8. Can use sentences with 4 or more words | NSV13. Carries fairly good conversation |
| Commands | | | |
| NSV4. Can use one word at a time | NSV 9. Explains what he/she wants | NSV14. Has normal ability to communicate for his/her age |
| (No! Eat, Water, etc) | | | |
| NSV5. Can use 2 words at a time | NSV10. Asks meaningful questions | |
| (Don’t want, Go home) | | | |

| II Sociability: | | | |
| NSV1. Seems to be in a shell – Cannot reach him/her | NSV 7. Shows no affection | NSV14. Disagreeable/not compliant |
| NSV2. Ignores other people | NSV 8. Fails to greet parents | NSV15. Temper tantrums |
| NSV3. Pays little or no attention when addressed | NSV 9. Avoids contact with others | NSV16. Lacks friends/companions |
| NSV5. No eye contact | NSV11. Dislikes being held/ cuddled | NSV18. Insensitive to |
| NSV6. Prefers to be left alone | NSV12. Does not share or show | NSV19. Indifferent to being liked |
| | NSV13. Does not wave “bye bye” | NSV20. Indifferent if parents(s) leave |

| III Sensory/ Cognitive Awareness: | | | |
| NSV1. Respond to own name | NSV 7. Appropriate facial expression | NSV13. Initiates activities |
| when addressed | NSV10. Aware of environment | NSV16. Venturesome – explores |
| NSV5. No eye contact | | | |
| NSV6. Plays with toys appropriately | NSV12. Shows imagination | NSV18. Looks where other are |

| IV. Health/ Physical Behavior: | | | |
| N MI MO S 3. Soils pants/diapers | N MI MO S 11. Hints or injures self | N MI MO S 20. Shouts or screams |
| N MI MO S 7. Eats too much/ too little | N MI MO S 15. Anxious/fearful | N MI MO S 24. “Hooked” or fixed |
| | N MI MO S 16. Unhappy/crying | certain object/topics |
| | N MI MO S 17. Seizures | | |
| | N MI MO S 18. Repetitive mvnt | (Stimming, rocking etc) |

| N MI MO S 3. Soils pants/diapers | N MI MO S 11. Hints or injures self | N MI MO S 20. Shouts or screams |
| N MI MO S 7. Eats too much/ too little | N MI MO S 15. Anxious/fearful | N MI MO S 24. “Hooked” or fixed |
| | N MI MO S 16. Unhappy/crying | certain object/topics |
| | N MI MO S 17. Seizures | | |
| | N MI MO S 18. Repetitive mvnt | (Stimming, rocking etc) |
## APPENDIX F

### AUTISM TREATMENT EVALUATION CHECKLIST SCORE DISTRIBUTION CHART

<table>
<thead>
<tr>
<th>Centile</th>
<th>Scale I Speech Range: 0-28</th>
<th>Scale II Sociability Range: 0-40</th>
<th>Scale III Sensory/ Cognitive Awareness Range: 0-36</th>
<th>Scale IV Health/ Physical/ Behaviour Range: 0-75</th>
<th>Total Range: 0-180</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild</strong></td>
<td>0-9: 0-2</td>
<td>10-19: 3-5</td>
<td>20-29: 6-7</td>
<td>30-39: 8-10</td>
<td>40-49: 11-12</td>
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<td>8-10</td>
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<td>0-5</td>
<td>6-8</td>
<td>9-11</td>
<td>12-13</td>
<td>14-15</td>
</tr>
<tr>
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<td>0-8</td>
<td>9-12</td>
<td>13-15</td>
<td>16-18</td>
<td>19-21</td>
</tr>
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<td></td>
<td>0-30</td>
<td>31-41</td>
<td>42-50</td>
<td>51-57</td>
<td>58-64</td>
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<td>19-21</td>
<td>22-24</td>
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<td>18-19</td>
<td>20-21</td>
<td>22-25</td>
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<td>40-75</td>
<td>90-103</td>
</tr>
<tr>
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<td>25-28</td>
<td>26-36</td>
<td></td>
<td></td>
<td>104-179</td>
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</tbody>
</table>