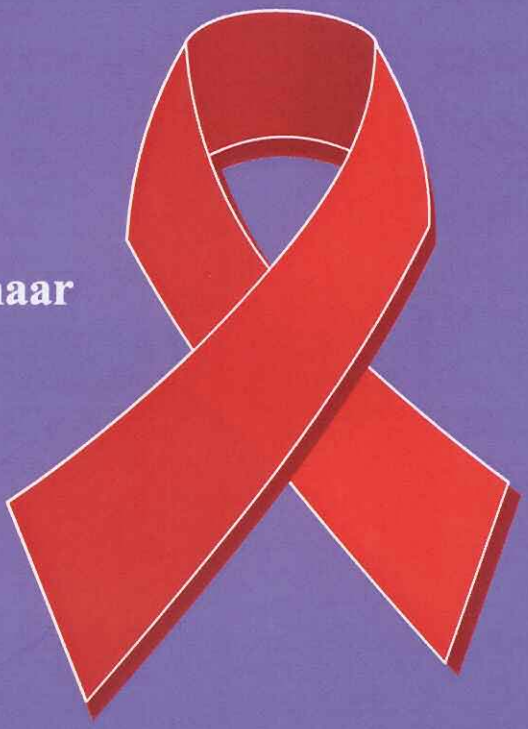
Motor development and growth status of 2 to 6-year old children infected with Human Immunodeficiency Virus (HIV)



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Thesis submitted for the degree Doctor of Philosophy in Human Movement Science at the North-West University

• Getting it right • Re dira sentle • Ons doen dit reg

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FOREWORD

I want to thank:

- God as Father, for being my Provider, my Strength and my Refuge during this period. Jesus for being my Saviour and Friend and the Holy Spirit for being with me, guiding and inspiring me every moment.
- My husband (Faf) for his love, patience, care and giving me perspective, in every situation.
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- My whole family for your prayers, love and support through my life, I really appreciate it.
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"May the Lord smile on you..."

-To the loves of my life-

ABSTRACT

Research indicates that children with Human Immunodeficiency Virus (HIV) / Aquired Immune Deficiency Syndrome (AIDS) display a variety of neuro-developmental, cognitive, motor and nutritional deficiencies (Epstein *et al.*, 1986:678; Davis-McFarland, 2000:20; Blanchette *et al.*, 2001:50). Research also substantiates a need for additional intervention strategies such as improved nutrition and exercise programmes to improve the quality of life for HIV-infected children (Brady, 1994:18; Stein *et al.*, 1995:31; Parks & Danoff, 1999:527). The maintenance of motor skills in above-mentioned children is an important objective for intervention programmes, especially gross motor skills (Parks & Danoff, 1999:525). Literature indicates that growth retardation, exhaustion of fat storage and neuro-developmental deficiencies are related to HIV/AIDS (Aylward *et al.*, 1992:218; Miller & Garg, 1998:368; Davis-McFarland, 2000:20; Miller *et al.*, 2001:1287). The monitoring of growth status is of outmost importance as children with serious stunting and wasting run the risk of early death. Growth retardation can also be an indication of infection or fast disease progression (Bobat *et al*, 2001:209).

The aim of this study was firstly to determine the state of the motor development of 2 to 6-year old children infected with HIV and to compare it with that of affected (in that they are not infected with HIV, but have lost one or both parents to AIDS-related diseases) and non-affected children. Secondly the study aimed to determine the effect of a motor intervention programme for 2 to 6-year old children infected with and affected by HIV. A third aim was to determine the growth status of 2 to 6-year old children infected with HIV and to compare it with that of affected and non-affected children; and the last aim was to monitor the developmental tendencies of body composition and growth of 2 to 6-year old children infected with HIV in the course of nine months and to compare it with that of affected and non-affected children.

The Peabody Developmental Motor Scales-2 (PDMS-2) (Folio & Fewell, 2000), which consist of six subtests, was used to determine the motor development of the children. Regarding the growth status the children were subjected to a series of anthropometric measurements of height, weight, circumference (upper arm - both tonic and relaxed), as well as skin folds (triceps, sub-scapular,

calf), in accordance with standard procedures as prescribed by the International Society of Advanced Kinanthropometry (ISAK).

The data was analysed using Statistica for Windows (StatSoft, Inc S.A., 2001) and SAS (2000-2003). Descriptive statistics were used to determine means (M), standard deviations (SD) and maximum and minimum values. One-way variance of analysis, forward stepwise discriminant analysis, independent T-testing, dependant T-testing and an ANCOVA, repeated measures ANOVA, and Bonferroni post hoc analysis were used to analyze the data in accordance with the above-mentioned aims. The level of statistic significance was set at $p<0,05$. Practical significance of differences (ES) between the testing sessions was calculated by dividing the mean difference (M) between the two testing sessions by the largest standard deviation (SD), as recommended by Cohen (1988) and Steyn (1999). Cohen (1988) set the following guidelines for interpreting practical significance, namely ES = 0,2 (small effect); ES = 0,5 (medium effect) and ES = 0,8 (large effect). Due to the small number of subjects it was considered practically significant if this effect size indicated a medium and larger effect.

From the results of the study it seemed that the HIV-infected children performed the poorest of the groups regarding gross motor, fine motor and total motor skills. This group's gross motor skills showed larger defecits than their fine motor skills, while loco-motor skills contributed the most to the discrimination between the groups. The motor intervention programme led to a statistically significant improvement in loco-motor, fine motor, as well as total motor skills. The infected children showed better improvement compared to the affected children. The infected group displayed the poorest growth status of the three groups compared to the Centre for Disease Control (CDC) growth profiles, although they did not differ significantly from the affected children. The infected children differed significantly regarding height percentile, fat percentage and height-for-age Z-score (HAZ) from non-affected children. The infected group also displayed the least significant effects in the form of growth increases over the nine months monitoring period.

It can be concluded from the results that motor deficiencies and growth impediments are part of the life of HIV infected children. To address these problems, intervention strategies, such as motor intervention and nutrition programmes are needed.

OPSOMMING

Navorsing dui aan dat Menslike Immuniteitsgebrekvirus (MIV)/ Verworwe Immuniteitgebreksindroom (VIGS) gepaardgaan met 'n verskeidenheid neuro-ontwikkelings, kognitiewe, motoriese en voedingsagterstande (Epstein *et al.*, 1986:678; Davis-McFarland, 2000:20; Blanchette *et al.*, 2001:50). Die behoefte aan addisionele intervensie strategieë, verbeterde voeding en oefenprogramme om die kwaliteit van lewe by hierdie kinders te verhoog, blyk duidelik uit die literatuur (Brady, 1994:18; Stein *et al.*, 1995:31; Parks & Danoff, 1999:527). Die instandhouding van motoriese vaardighede is 'n belangrike doelwit vir intervensieprogramme, veral met die klem op groot-motoriese vaardighede (Parks & Danoff, 1999:525). Groei-agterstande, 'n uitputting van vetstore en neuro-ontwikkelingsagterstande word verwant met MIV/VIGS in die literatuur aangedui (Aylward *et al.*, 1992:218; Miller & Garg, 1998:368; Davis-McFarland, 2000:20; Miller *et al.*, 2001:1287). Die monitering van groeistatus is van kardinale belang aangesien 'n ernstige lae lengte-vir-ouderdom asook gewig-vir-lengte die risiko van vroeë sterfte verhoog. 'n Groeivertraging kan ook 'n indikasie wees van infektering of vinnige siekte progressie (Bobat *et* al., 2001:209).

Die doel van hierdie studie was eerstens om die stand van 2 tot 6-jariges wat deur MIV-geïnfekteer is, se motoriese ontwikkeling te bepaal en dit te vergelyk met geaffekteerde (die kinders is self nie geinfekteer nie, maar het een of beide ouers aan MIV-verwante siektes verloor) sowel as ongeaffekteerde kinders. Die tweede doelstelling was om die effek van 'n motoriese intervensieprogram op 2 tot 6-jarige kinders wat deur MIV-geïnfekteer en geaffekteer is, te bepaal. Die derde doelstelling was om die groeistatus van 2 tot 6-jarige kinders wat deur MIV-geïnfekteer is te bepaal en dit met geaffekteerde sowel as ongeaffekteerde kinders te vergelyk. Die laaste doelstelling was om die ontwikkelingstendense van 2 tot 6-jarige kinders wat deur MIV geïnfekteer is se liggaamsamestelling, asook groei oor die verloop van nege maande te monitor en dit met geaffekteerde sowel as ongeaffekteerde kinders te vergelyk.

Die PDMS-2 (Folio & Fewell, 2000) wat bestaan uit ses subtoetse om interafhanklike vermoëns tydens vroeë motoriese ontwikkeling te meet, is gebruik om die stand van die kinders se

motoriese ontwikkeling te bepaal. Al die proefpersone binne die verskillende groepe het 'n reeks antropometriese metings volgens standaardprosedures ondergaan: lengte, massa, omtrekke (bo-arm, beide gespanne/ontspanne), asook velvoue (triceps, subskapulêr, kuit).

Die data is met behulp van die Statistica for Windows (Statsoft, Inc S.A., 2001) asook die SAS (2000-2003) rekenaarprogram verwerk. Beskrywende statistiek is gebruik om rekenkundige gemiddeldes ($\overline{X}$), standaardafwykings (sa) en maksimum en minimum waardes te bepaal. 'n Eenrigtingvariansie-analise, vorentoe stapsgewyse diskriminant analise, onafhanklike en afhanklike T-toetsing, ANKOVA en 'n herhaalde metingsanalise is gebruik om die data met betrekking tot bogenoemde doelwitte te ontleed. 'n P-waarde kleiner as of gelyk aan 0,05 is as betekenisvol aanvaar. Praktiese betekenisvolheid van verskille (EG) tussen die toetsgeleenthede is bereken deur die gemiddelde verskil ($\overline{X}$) tussen die twee toetsgeleenthede te deel deur die grootste standaardafwyking (sa), soos aanbeveel deur Cohen (1988) en Steyn (1999). Cohen (1988) het die volgende riglyne daargestel vir die interpretasie van die praktiese betekenisvolheid, naamlik EG = 0,2 (klein effek); EG = 0,5 (medium effek) en EG = 0,8 (groot effek). Weens die hoeveelheid proefpersone is dit as prakties betekenisvol beskou as dié effekgrootte 'n medium effek en groter aangetoon het.

Uit die resultate van die studie blyk dit dat die MIV-geinfekteerde kinders die swakste van die drie groepe gevaar het in grootmotoriese, fynmotoriese en algeheel motoriese vaardighede. Hierdie groep se grootmotoriese vaardighede was swakker as hul fynmotoriese vaardighede, terwyl lokomotoriese vaardighede die meeste bygedra het tot diskriminasie tussen die groepe. Die motoriese intervensieprogram het tot 'n statisties betekenisvolle verbetering in lokomotoriese, fynmotoriese sowel as algeheel motoriese vaardighede gelei. Die geinfekteerde kinders het meer verbetering getoon tydens die program as die geaffekteerde kinders. Die geinfekteerde groep het die swakste groeistatus van die drie groepe getoon vergeleke met die CDC groeiprofiele, alhoewel hulle nie statisties betekenisvol van die geaffekteerde groep verskil het nie. Die geinfekteerde groep het statisties betekenisvol met betrekking tot die lengte persentiel, vetpersentasie asook lengte-vir-ouderdom se Z-telling verskil. Die geinfekteerde groep het die minste betekenisvolle effekte in die vorm van groeitoenames oor die nege maande getoon.

Uit die resultate kan tot die gevolgtrekking gekom word dat motoriese agterstande en groeibelemmering werklikhede is waarmee MIV geinfekteerde kinders moet saamleef en dat intervensie strategiëe soos motoriese- en voedingsprogramme benodig word om hierdie agterstande aan te spreek.

KEYWORDS

HIV	*MIV*
AIDS	*VIGS*
CHILDREN	*KINDERS*
PEDIATRICS	*PEDIATRIE*
DEVELOPMENT	*ONTWIKKELING*
MOTOR DEVELOPMENT	*MOTORIESE ONTWIKKELING*
INTERVENTION	*INTERVENSIE*
GROWTH	*GROEI*
DEFICIENCIES	*AGTERSTANDE*

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CHAPTER 1

PROBLEM STATEMENT

AND AIMS OF STUDY

CHAPTER 1

Problem statement and aims of study

1.1 Introduction

Human Immunodeficiency Virus (HIV) is a worldwide health danger which also threatens children and adolescents (Brown *et al.*, 2000:81). UNAIDS (2004) reports that 5,3 million South Africans were infected with HIV/AIDS by the end of 2003. The South African Health Review (2002) further indicates that the mortality rate of babies at birth had increased from 45,4 to 59,0 per thousand live births, while life expectancy had decreased from 57 years in 1996 to 52,5 years in 2002. It appeared that the mortality rate for children under five years had increased from 59,4 in 1998 to 100,00 per thousand live births in 2002 and that 90% of children who were born with the virus died before the age of four years. According to Rehle and Shishana (2003:6), the mortality rate increased from 9,1% in 1995 to 17,3% in 2005. This dramatic increase in deaths can be attributed to HIV/AIDS (South African Health Review, 2002).

The cause of most cases of HIV diagnosis in babies and children is transmission from an HIV-infected mother to her baby (Martini *et al.*, 1998a:806; Elmer & Elston, 2004). UNAIDS (2004) reports that HIV/AIDS among pregnant women had increased from 23,1% in 2001 to 24,3% in 2003 and that it had increased in the Free State, Mpumalanga and KwaZulu-Natal by 30%. From this it can be deduced that the health of South African children has degenerated, that infection with HIV still increases and that adults still continue to spread the virus (Loening-Voysey, 2002:103). Children on the Brink (2004) stresses the impact of this growing epidemic on children in South Africa with more than 1 100 000 affected children under the age of 15 years, of whom 740 000 already have lost a mother, 570 000 a father and 290 000 both parents due to this disease. In 2003 alone, 370 000 new cases of children who were left orphaned due to the disease were reported (Children on the Brink, 2004). The increase in children who had been orphaned as a result of AIDS had increased by 400% from 1994 to 1997 and it was predicted that they would form 9-12% of the population in 2010 (UNAIDS, 2004).

1.2 Problem statement

The influence of HIV/AIDS on children is complex and therefore has many implications for the planning of health services for such children (South African Health Review, 2002). It is indicated in literature (Aylward *et al.*, 1992:218; Miller & Garg, 1998:368; Davis-McFarland, 2000:20) that growth retardation, exhaustion of fat storage and neuro-motor difficulties are results of HIV/AIDS. Miller and Garg (1998:368) point out that a decrease in lean body mass occurs in children who are HIV positive before significant differences in weight or fat storage are evident. The lean body mass in the afore-mentioned children is also abnormally low as opposed to that of non-infected children (Polsky *et al.*, 2001:412; Grinspoon & Mulligan, 2003:S69). According to McKinney (1998:417) growth retardation in HIV children takes place in two ways. The most common way is growth retardation in height as well as weight. This phenomenon already appears during the first three to four months of the baby's life. The second way is a relative loss of weight-for-height, which takes place at the end of the HIV-infected child's life. It appears that these children's height-weight-ratio is normal, although they are shorter and lighter than their age group (McKinney, 1998:417).

HIV in children is furthermore characterised by a variety of neuro-development deficiencies (Msellati *et al.*, 1993:843; Davis-McFarland, 2000:20; Blanchette *et al.*, 2001:50). The incidence of neurological deficiencies in infected children is estimated to be between 30 and 90% (Bode & Rudin, 1995:72). The loss of developmental milestones can be seen early in the baby's life and it appears that these problems are aggravated as time progresses (Gay *et al.*, 1995:1078). Progressive motor deficiencies as well as intellectual and behavioural regression often are signs of a loss of developmental milestones (Chamberlain, 1994:176).

Researchers indicate that a need for additional intervention strategies, improved nutrition and exercise programmes exists in order to improve the quality of life and functional ability of children who are HIV positive (Brady, 1994:18; Stein *et al.*, 1995:31). Research proof also indicates that it is essential for children with HIV to receive motor intervention, since it could possibly promote their life expectancy and quality of life (Brady, 1994:18; Wilfert, 1996:438; Parks & Danoff, 1999:527). Wilfert (1996:438) is of the opinion that treatment and an improvement of life-style can cause an increasing number of HIV positive children to survive up

to adolescence and some even to a more advanced age, of whom many may be in a relatively good health condition.

Maintaining motor skills in the afore-mentioned children therefore is an important aim of intervention programmes, because it can enable these children to participate in activities that directly contribute to cognitive growth and social maturation (Parks & Danoff, 1999:525). Without specific attention to gross motor skills, HIV-infected children will not be capable of participating in age appropriate activities such as physical games and sport or to execute self-care tasks such as independently taking a bath, as Parks and Danoff (1999:527) point out. It appears that this disease affects fine motor skills to a lesser degree, consequently the accent of intervention programmes should be on gross motor skills (Parks & Danoff, 1999:527). This finding is attributed to the fact that gross motor skills demand the use of large muscle groups and physical exertion, whereas fine motor skills demand less power (Parks & Danoff, 1999:527). Since HIV is becoming a chronic condition, it is essential to develop and evaluate health promoting interventions such as exercise programs (Wagner *et al.*, 1998:811).

Very little knowledge is available in South Africa pertaining to the health and total well-being of children who live with HIV/AIDS, but also of those who are already affected by the condition (in that they are not infected with HIV, but have lost one or both parents to AIDS-related diseases). After thorough consultation of the literature it has also become clear that a large gap regarding research in this respect exists and especially within the South African context.

The research questions that this study attempts to answer are as follows: Firstly, how does the gross motor and fine motor development of 2 to 6-year old HIV-infected children compare with that of affected and non-affected children. Secondly, the question is posed whether a motor intervention programme will lead to an improvement in the motor as well as physical abilities of the infected and affected children. The third question to be answered is how the growth status of 2 to 6-year old children who are HIV-infected compare with that of affected and non-affected children. The final question that needs to be answered is whether these children will display the same development tendencies as children who are not infected with the virus with regard to body composition and body growth in the course of nine months. Answers that can be obtained to

these questions can make a valuable contribution with respect to the maintenance and improvement of functional abilities of children who are infected with and affected by HIV. These answers can also contribute to the knowledge on the regression of the last-mentioned abilities in the course of time by means of motor intervention.

1.3 Aims

The aims of this research therefore are:

1.3.1 to determine the state of the motor development of 2 to 6-year old children infected with HIV and to compare it with that of affected and non-affected children;

1.3.2 to determine the effect of a motor intervention programme for 2 to 6-year old children infected with and affected by HIV;

1.3.3 to determine the growth status of 2 to 6-year old children infected with HIV and to compare it with that of affected and non-affected children; and

1.3.4 to monitor the developmental tendencies of body composition and body growth of 2 to 6-year old children infected with HIV in the course of nine months and to compare it with that of affected and non-affected children.

1.4 Hypotheses

The hypotheses of this research are as follows:

1.4.1 The gross and fine motor development of 2 to 6-year old children infected with HIV will display significant deficiencies compared to that of affected and non-affected children.

1.4.2 A motor intervention programme will lead to the significant improvement of motor abilities and physical skills in 2 to 6-year old children infected with and affected by HIV.

1.4.3 The body composition and body growth status of 2 to 6-year old children infected with HIV will be poorer compared to that of affected and non-affected children.

1.4.4 The developmental tendencies of body composition and body growth of 2 to 6-year old children infected with HIV will be poorer than that of affected and non-affected children in the course of nine months.

1.5 Structure of the thesis

This thesis is presented in **article format**. The structure of the thesis is as follows:

1.5.1 Chapter 1 contains the problem statement and objectives of the study. Source references that appear in this chapter follow directly after Chapter 2 in the form of a combined reference list for Chapters 1 and 2 and are presented in accordance with the Harvard directions, as required by the North-West University (NWU).

1.5.2 Chapter 2 presents a literature overview, and not a complete literature study, regarding the human immunodeficiency virus (HIV) and the influence thereof on the development of children.

1.5.3 The method of the investigation is contained in Chapters 3, 4, 5 and 6. These chapters contain the four articles of the study.

- Chapter 3 contains the first article titled "The motor development of 2 to 6- year old children infected with HIV" and has been submitted to the South African Journal for Research in Sport, Physical Education and Recreation. The guidelines according to which the article had to be prepared are attached in Appendix A.

- Chapter 4 contains the second article titled "The value of a motor intervention programme for 2 to 6- year old children infected with and affected by HIV" and has been submitted to the Perceptual and Motor Skills journal. The guidelines according to which the article had to be prepared are attached in Appendix B.

- Chapter 5 contains the third article titled "The growth status of 2 to 6-year old children infected with HIV" and has been submitted to the African Journal of AIDS Research. The guidelines according to which the article had to be prepared are attached in Appendix C.

- Chapter 6 contains the fourth article titled "The growth status of 2 to 6-year old children infected by HIV over a period of nine months" and has been submitted to Child: Care, Health and Development. The guidelines according to which the article had to be prepared are attached in Appendix D.

The afore-mentioned articles are finalised according to the guidelines of the specific journals and are presented as such in this thesis. However, for technical purposes a few deviations were made to the guidelines the journals laid down in order to promote the uniformity of the entire thesis. The text of the articles is presented justified, and in one and a half and not double spacing. Furthermore, the margins are the same as in the rest of the thesis. The tables are inserted in the text and not attached to the end of the article as an appendix. Above-mentioned deviations make the thesis easier to read and fit in with the structure of the rest of the thesis. The measuring instruments used in this thesis are standardised test batteries that are subject to copyright; hence no further information could be provided regarding them.

1.5.3 Chapter 7 contains the summary, conclusions and recommendations of the study.

1.5.4 Appendixes. Appendixes follow at the end of the thesis, which include the following:

Appendix A: Guidelines for authors for South African Journal for Research in Sport, Physical Education and Recreation.

Appendix B: Guidelines for authors for Perceptual and Motor Skills.

Appendix C: Guidelines for authors for African Journal for AIDS Research.

Appendix D: Guidelines for authors for Child: Care, Health and Development.

Appendix E: Informed consent forms that had to be signed by the parents.

Appendix F: Motor intervention programme the children were subjected to.

Appendix G: Letter stating that article 1 (Chapter 3) is in the review process of the South African Journal for Research in Sport, Physical Education and Recreation.

Appendix H: Letter stating that article 2 (Chapter 4) is in the review process of the Perceptual and Motor Skills.

Appendix I: Letter stating that article 3 (Chapter 5) is in the review process of the African Journal for AIDS Research.

Appendix J: Letter stating that article 1 (Chapter 3) is in the review process of the Child Care, Health and Development.

The literature review of the study will subsequently follow in Chapter 2.

CHAPTER 2

LITERATURE OVERVIEW ON THE INFLUENCE OF HIV ON CHILD DEVELOPMENT

CHAPTER 2

Literature overview of the influence of HIV on child development

2.1 Introduction

According to the Department of Health (2003) HIV/AIDS is one of the largest challenges in South Africa to address, accompanied by poverty, unemployment and a lack of social skills. A study conducted in Cape Town established that HIV/AIDS is considered a social problem and that it arises from social backlogs and poverty (Kalichman & Simbayi, 2003:37). HIV destroys the body's natural resistance to diseases by destroying or damaging CD4-cells that are essential for immune reaction (Simmons, 2000; NIAD, 2004; Amfar AIDS Research, 2006). The immunity of the body decreases to such an extent that immune depression and AIDS is the ultimate result (Simmons, 2000; NIAD, 2004; Amfar AIDS Research, 2006). In this final stage any infection is life threatening and to date, there is no cure for this disease (Achmat, 2005). According to Chemtob and Srour (2005:138) HIV has been one of the largest threats to human health over the past two decades, and the pandemic has devastating consequences for vulnerable children who are affected by it (Children on the Brink, 2004).

Children's immature, undeveloped immune system causes disease progression in this population to be much faster than in adults (Luster *et al.*, 2005:177). The median survival period for HIV positive children is between 75 and 90 months, while 70% of HIV positive children will reach the age of six years, and 15–20% die before the age of three as a result of serious immune suppression (Touloumi & Hatzakis, 2000:389). In a study by Newell *et al.* (2004:1240) the death rate at 24 months was 52,5% for HIV-infected children as opposed to 7,6% for non-infected children. Antiretrovirals, which delay disease progression, are not readily available in South Africa. The AIDS treatment plan is also progressing slowly in this country and by March 2005 only 42 000 people had received antiretroviral treatment (ART), while 500 000 needed treatment and 300 000 would die within the following year (Abdool, 2004:1394).

Worldwide there are approximately 38,6 million people who are HIV positive (UNAIDS, 2006). According to this organization, 1 700 people are infected with this virus daily. Sub-Saharan Africa is worst affected by the virus, with 25,4 million HIV infected people, of whom 5,3 million

live in South Africa (UNAIDS, 2004). The Health Systems Trust (2007) indicates that 11,4% of the total South African population is infected with HIV, while 18.6% in the age group 15–49 are HIV positive. The Antenatal Survey indicated that HIV infection among women is still increasing significantly (Department of Health, 2006). Hence it is clear that this increase in HIV infection among women predicts problems for the children who are affected by it (Wolters *et al.*, 1995:328; Thorne & Newell, 2000:4; Loening-Voysey, 2002:103), since the virus is transmitted to the child during pregnancy, the labour process or breast-feeding in 80-90% cases (Wolters *et al.*, 1995:329; Elmer & Elston, 2004). It is indicated that 2,1 million children younger than 15 years was infected with HIV in 2003, of whom 630 000 were newly infected in the year 2003 (Children on the Brink, 2004; UNAIDS, 2004). Sub-Saharan Africa accommodates 90% of all newly infected children as well as 95% of the world's orphans (Children on the Brink, 2004). The number of orphans in Sub-Saharan Africa had increased from 1 million in 1990 to more than 12 million in 2003 (Children on the Brink, 2004). According to Health Systems Trust (2007) there already are more than 1 201 675 orphans due to HIV in South Africa.

Researchers point out that children with HIV display neuro-developmental, cognitive, motor and nutritional deficiencies (Davis-McFarland, 2000:20; Blanchette *et al.*, 2001:50) as well as socio-emotional and behavioural problems (Landry & Smith, 1998:160). The influence of the disease is complex and consequently has many implications for the planning of health services, especially for the children affected by it (South African Health Review, 2002). Meyers *et al.* (2006:235) are of the opinion that paediatric care for HIV-infected children is lagging behind as opposed to that of adults in South Africa. HIV is responsible for a rising trend in child mortalities in the country, which is causing child survival to decrease (Meyers *et al.*, 2006:235).

Due to the increase in children infected with HIV, it is important for child development specialists to understand the potential effects of this virus on babies and children's functioning (Landry & Smith, 1998:161). This chapter deals with a brief overview of the definition, incidence and causes of HIV/AIDS. As part of the objectives of this study, as set out in Chapter 1, an elaborate discussion follows on the consequences of HIV as well as the necessity of motor intervention for the children who are affected by the virus. In order to be able to understand the effect of HIV on the immune system a basic description is given of the functioning of the immune system.

2.2 Basic functioning of the immune system

The immune system is an interactive network of cells consisting of T- and B-lymphocytes, natural killer (NK) cells, phagocytes as well as several sub-classes of the afore-mentioned (Krammer, 2000:789). These cells "patrol" the body with the aim of providing resistance, healing and the identification and destroying of foreign elements in the form of bacteria, viruses, fungi, toxic chemicals and cancer cells (Dreher, 1995; Martini, 1998a:783, Neurosurgical Focus, 2000, NIAID, 2004). It is essential for these cells to function as a unit (Krammer, 2000:789). For better understanding of the immune system a brief discussion will follow on the different cells involved in immune functioning.

Lymphocytes: Lymphocytes are divided into T-lymphocytes (T-cells), B-lymphocytes (B-cells) and NK cells (natural killer) that are essential cell components of the immune system (Martini, 1998a:783, Neurosurgical Focus, 2000, NIAID, 2004). The body contains around 10^{12} lymphocytes, with a combined weight of over a kilogram (Martini, 1998a:783).

- **T-cells:** Approximately 80% of circulating lymphocytes are classified as T-cells. T-cells have receptors on the surface of the cells that enable them to recognise antigens. These receptors are so diversified that individual lymphocytes are equipped with receptors that recognise one antigen only (Neurosurgical Focus, 2000). There are many diffrent types of T-cells, including **cytotoxic T-cells**, **helper T-cells** (CD4-cells) as well as **suppressor T-cells** (Krammer, 2000:789; Neurosurgical Focus, 2000). Cytotoxic T-cells bind with intruding microbes, viruses and cancer cells and destroy the cells (Dreher, 1995; Krammer, 2000:789; Neurosurgical Focus, 2000). Helper T-cells, that is to say CD4-cells (so named due to receptors on the surface of the cell) stimulate the activation and function of both T-cells and B-cells (Dreher, 1995, Martini, 1998a:783). These cells are the primary target of HIV, the virus that causes AIDS. The destruction of CD4-cells is subsequently the primary reason why people with AIDS lose their capacity to fight diseases (Dreher, 1995, Amfar AIDS Research, 2006). Suppressor T-cells are capable of suppressing the action of other cells, and in so doing, maintaining a balanced immune response (Dreher, 1995; Martini, 1998a:783, NIAID, 2004). Without suppressor T-cells the immunity can become out of control and end in allergies. These cells are important for HIV-infected persons, seeing that it also destroys virus-infected cells (NIAID, 2004).

- **B-cells:** B-cells account for 10-15% of circulating lymphocytes (Martini, 1998a:783). The main function of B-cells is to produce antibodies in response to infection (Dreher, 1995, Martini, 1998a:783, Neurosurgical Focus, 2000). The moment B-cells are activated by an antigen (pathogens, parts or products of pathogens, or other foreign compounds), it differentiates into plasma cells. Plasma cells are resposible for the production and secretion of antibodies (soluble proteins that are also known as immunoglobulins) (Martini, 1998a:783, Krammer, 2000:789). When an antibody binds to its target antigen, it starts a chain of events leading to the destruction of the target compound or organism (Martini, 1998a:783). If the body does not offer proper resistance to these foreign elements, the result is an infection (Dreher, 1995).

- **Natural killer cells (NK-cells):** The remaining 5-10% of circulating lymphocytes are NK-cells (Martini, 1998a:783). These lymphocytes are non-specific immune cells that are capable of recognising viruses and cancer cells without it having had prior contact with it. NK-cells destroy these intruders quickly and with great efficiency (Dreher, 1995).

Phagocytes, of which macrophages are the main cells, absorb undesirable products from the blood stream by engulfing, binding and releasing toxic chemicals (Dreher, 1995, Martini, 1998a:792). Macrophages initiate a further immune response in that they display antigens of the intruder on the cellsurface. Lymphocytes are then sensitised by the antigens and bond with the macrophages. The product of this merging is the release of chemical substances that give other immune cells, especially CD4-cells and cytotoxic T-cells, the command to multiply (Cancer Research Institute, 2004). Sensitised or cytotoxic T-cells attack the intruders that they are sensitised for. The CD4-cells further activate B-cells to differentiate into plasma cells and to secrete antibodies (Cancer Research Institute, 2004). Once the intruders are destroyed, suppressor T-cells switch off the activated T- and B-cells and memory cells remain behind to activate the immune response faster, lest similar intrusions should occur again (Cancer Research Institute, 2004).

From the discussion above it is clear that the immune system relies on different immune cells to be able to function effectively. If certain cells are destroyed or damaged, it can lead to problems

with immune functioning and eventually to diseases and death. Subsequently, the effect of HIV on the functioning of the immune system will be discussed.

2.3 The effect of HIV on immune functioning

2.3.1 HIV and immunity

The Human Immunodeficiency Virus (HIV) is found in the tissue fluid of the body and belongs to a virus class known as *retroviruses* (NIAID, 2004; Avert, 2007). Retroviruses are RNA (ribonucleic acid) viruses, and in order to replicate (duplicate) they must make a DNA (deoxyribonucleic acid) copy of their RNA. It is the DNA genes that allow the virus to replicate (NIAID, 2004). Like all viruses, HIV can replicate only inside cells, commandeering the cell's machinery to reproduce. Only HIV and other retroviruses, however, once inside a cell, use an enzyme called reverse transcriptase to convert their RNA into DNA, which can be incorporated into the host cell's genes. In the human body, the virus binds with CD4-cells (CD4 is the membrane protein of helper T-cells). At this stage HIV can no longer be destroyed by the immune response of the body. This process causes the formula for replication to change, viral chromosomes are copied and new viruses are produced (NIAID, 2004,). In this process the CD4-cells serve as hosts and are consequently destroyed and damaged (NIAID, 2004).

The immune response of the body is broken down because CD4-cells play a central role in coordinating cell binding and antibody binding responses to antigens (Martini *et al.*, 1998b:806). The virus by no means affects suppressor T-cells and in the course of time these dominant factors "switch off" the normal immune response. Circulating antibody levels lower, hence immunity decreases and the body later has no resistance, thus slight illnesses can be fatal (Martini *et al.*, 1998a:806). According to Feinberg (1996:245), the HIV-induced damage to the immune system begins with the first increase of the virus and continues until death sets in. The damage caused by HIV is the direct result of active virus increase where essential CD4-cells are destroyed with each cycle of increase. Although CD4-cells appear to be the main targets of HIV, other immune system cells with and without CD4 molecules on their surfaces are infected as well. Among these are long-lived cells called monocytes and macrophages, which apparently can harbor large quantities of the virus without being killed, thus acting as reservoirs of HIV. CD4-cells also

serve as important reservoirs of HIV, a small proportion of these cells harbor HIV in a stable, inactive form (NIAID, 2004).

HIV forms part of the retrovirus subclass known as *lente-viruses*, which means "*slow virus*", since it has a long incubation period (NIAID, 2004; Avert, 2007). Only after three to seven years, immune cells have been sufficiently destroyed to result in immune deficiency (Winnick, 2000:247). The virus destroys the natural defence mechanisms of the body by destroying or damaging CD4-cells that are necessary for immune reaction. The body's immunity thus decreases and becomes vulnerable to attacks. The results are infections and malignancies until immune suppression and eventually AIDS (Acquired Immune Deficiency Syndrome) steps in (Simmons, 2000; NIAID, 2004; Amfar AIDS Research, 2006). It can take from a few months to a few years to develop a serious immune deficiency (Kopka *et al.*, 2005:238).

During initial infection with the virus, the same symptoms as during flu can occur as well as swollen lymph nodes and fever (Martini *et al.*, 1998a:806; 1998b:142). According to Godwin and Godwin (2000:392), 50–90% of cases experience this symptomatic period. It causes the formation of antibodies in the body two to six months after infection (Martini *et al.*, 1998b). Touloumi and Hatzakis (2000:389) maintain that HIV is characterised by a long and extended asymptomatic period after infection has taken place. According to the researchers, no symptoms of the virus can be present for five to ten years and the virus content in the blood can be very limited. During this period, the virus is active within the lymph nodes and it causes the lymph nodes to no longer remove viruses or other pathogens effectively. The body also loses its ability to stop foreign organisms during this period (Martini *et al.*, 1998b:142, Simmons, 2000). HIV penetrates the peripheral circulation and the person's viral load rises (Simmons, 2000). According to Winnick (2000:247), 30% of all HIV carriers develop life threatening diseases within five to seven years. HIV (Human Immunodeficiency Virus) is the primary cause of AIDS (Acquired Immune Deficiency Syndrome) (NIAID, 2004) and Martini *et al.* (1998a:806; 1998b:142) contend that it is the final phase of HIV. To date there is no cure for this disease (Achmat, 2005).

The CD-4 cell count together with the viral load indicates the health of the immune system, although a CD-4 percentage is used to assess the health of the immune system as well as the

progression tempo of the disease (Nam, 2004). A CD-4 count percentage of below 25% is seen to be an indication of serious damage (Nam, 2004). In a healthy immune system approximately 1 200 CD4-cells per microlitre (µl) is found. Martini *et al.* (1998b:143) contend that three stages of HIV exist. During the first stage the CD4 cell count is 500/µl, and these cells must comprise at least 29% of the total circulating lymphocytes. The second stage is characterized by a CD4 count between 200 and 499/µl, and the cells comprise 14 to 28% of the total circulating lymphocytes. Symptoms of the virus usually only make their appearance during this phase in the form of diarrhoea, weight loss and chronic morbidity (Martini *et al.*, 1998b:143). During the final stages, also known as the phase in which HIV is converted into AIDS, the CD4 count is below 200/µl while the cells comprise less than 14% of the total circulating lymphocytes (Martini *et al.*, 1998b:143). During this final stage any morbidity is life threatening because the body is vulnerable due to the fact that there is no defence against diseases (Martini *et al.*, 1998b:143; Sleasman & Goodenow, 2003:587; Nam, 2004).

In South Africa the HIV-status is determined using the FIRST RESPONSE HIV CARD TEST 1-2.O. The test is an immunochromatographic (rapid) test for the qualitative detection of all isotypes (IgG, IgM, IgA) spesific to HIV-1 including subtype O and HIV-1 in human serum, plasma or whole blood. In a comparison of the FIRST RESPONSE HIV CARD TEST 1-2.O versus a leading commercial anti-HIV1&2 ELISA and Rapid test, results gave sensitivity of 100% (120/120), a specificity of 99.18% (121/122) and a total agreement of 99.59% (241/242). Due to only three laboratories processing PCR testing in South Africa, 22% of the total capacity required, rapid tests are used (Meyers *et al.*, 2006).

2.3.2 The influence of HIV on children's immune system

Although HIV leads to serious deficiencies in the immune system of adults and children, there are nevertheless differences in the manifestation of problems in the two populations (Davis-McFarland, 2000:19). The manifestation of symptoms after infection is for instance shorter in children than in adults. The progression of the disease is also much faster in children, probably as a result of their immature, developing immune system (Luster *et al.*, 2005:177). Approximately 20% of children have an accelerated course of disease. These children already show manifestations of AIDS in the first year of their life and most of them die before the age of

four years (Luster *et al.*, 2005:177). According to the European Collaborative Study (1991:816), 23 to 26% of children have a fast progression of the disease and already develop symptoms of the virus in the first year of their life. Ioannidis *et al.* (2004) indicate that a higher viral load in the mother during or near labour can be an indication of faster disease progression in HIV-infected babies, especially in the first six months of the baby's life.

The majority of children who are infected vertically (mother–to–child) with HIV develop symptoms by 18 to 24 months (Luster *et al.*, 2005:177), although Grant (1999:251) showed that the mortality rate of the group mentioned above is the highest in the first year of the baby's life. The age at which the symptoms appear, predicts the degree to which the virus has already developed (Grant, 1999:251). Touloumi and Hatzakis (2000:389) indicate that the median survival time for HIV positive children is 75 to 90 months. According to these researchers, only 70% of HIV positive children reach the age of 6 years, while 15–20% of children already experience serious immune suppression during the first year of their life and die before the age of three years. The remaining 80-85% experience slower progression of the disease. The reasons for the faster progression in some children are not clear, but the group that showed fast progression probably was already infected in the womb, while the other children were infected after or during labour (Touloumi & Hatzakis, 2000:394). Abrams *et al.* (1995:451) found that a significantly higher mortality rate occurred at the age of 18 and 24 months in premature babies who were HIV infected, as opposed to HIV-infected full-term babies. The researchers attribute this phenomenon and symptoms to a faster disease progression in premature babies.

2.3.3 Classification of HIV children

HIV-infected children are classified into mutually exclusive categories according to three parameters: infection status, clinical status and immunological status. Once classified, an HIV-infected child cannot be reclassified in a less severe category even if the child's clinical or immunological status improves. Table 2.1 displays the paediatric Human Immunodeficiency Virus (HIV) classification according to the CDC (1994).

Table 2.1: Paediatric human immunodeficiency virus (HIV) classification

	Clinical categories			
Immunologic categories	N: No signs/ symptoms	A: Mild signs/ symptoms	B: Moderate signs/symptoms	C: Severe signs/symptoms
1. No evidence of suppression	N1	A1	B1	C1
2. Evidence of moderate suppression	N2	A2	B2	C2
3. Severe suppression	N3	A3	B3	C3

Children whose HIV-status is not confirmed are classified by placing a letter E before the appropriate classification (e.g. EN1)

According to the CDC (1994), the three immunologic categories are used to classify HIV-infected children in accordance with their immune suppression. The immunologic categorisation is based on CD4 lymphocyte counts or the CD4 percentage as part of the total lymphocyte count (see Table 2.2). If the last-mentioned two counts differ, the child must be placed in the more serious category (CDC, 1994).

Table 2.2: Immunologic categories based on age-specific CD4 T-lymphocyte counts and percentage of total lymphocytes

	Age of child					
	<12 months		**1 – 5 yrs**		**6 - 12 yrs**	
Immunologic category	**CD4/µl**	**CD4/%**	**CD4/µl**	**CD4/%**	**CD4/µl**	**CD4/%**
1. No evidence of suppression	>=1,500	(> = 25)	>=1,000	(> = 25)	>=500	(> = 25)
2. Evidence of moderate suppression	750 - 1499	(15 - 24)	500 - 999	(15 - 24)	200 - 499	(15 - 24)
3. Severe suppression	< 750	(<15)	<500	(<15)	<200	(<15)

In children infected with HIV the immune system is moderately intact when the CD4 cell count is higher than 1 500 cells/mm^3 in the first year of life, higher than 750 cells/mm^3 in the second year of life and from then on higher than 500 cells/mm^3. CD4 cell counts that are below 750, 500 and 200 cells/mm^3 in the respective years of life, predict serious immune deficiencies for these children and eventually death (Palumbo & Burchett, 1998:75).

Children infected with the virus can be classified into four clinical categories, according to the CDC (1994), based on signs, symptoms or diagnoses related to the HIV infection (see Table 2.3). The clinical categories are used to give a staging classification of the child's condition (prognosis in category N is better than in category A).

Table 2.3: Clinical categories for children with human immunodeficiency virus (HIV)

Category N: Not symptomatic	Children having no signs or symptoms that are considered to be the result of HIV infection or who have only one of the conditions listed in Category A.
Category A: Mildly symptomatic	Children with two or more of the conditions listed below, but none of the conditions listed in Categories B and C. • Lymphadenopathy (>=0.5 cm at more than two sites; bilateral = one site • Hepatomegaly • Splenomegaly • Dermatitis • Parotitis • Recurrent or persistent upper respiratory infection, sinusitis, or otitis media
Category B: Moderately symptomatic	Children having symptomatic conditions other than those listed for Category A or C that are attributed to HIV infection. Examples of conditions in clinical Category B include but are not limited to: • Anaemia (<8g/L); neutropenia (<1,000/mm^3), or thrombocytopenia (<100,000/mm^3) persisting >=30 days • Bacterial meningitis, pneumonia, or sepsis (single episode) • Oropharyngeal candidiasis (thrush), persisting >2 months in children >6

	months of age • Cardiomyopathy • Cytomegalovirus infection, with onset before 1 month of age • Diarrhoea, recurrent or chronic • Hepatitis • Herpes simplex virus (HSV) stomatitus, recurrent (more than 2 episodes within 1 year) • HSV bronchitis, pneumonitis, or esophagitis with onset before 1 month of age • Herpes zoster (shingles) involving at least two distinct episodes or more than one dermatome • Leiomyosarcoma • Lymphoid interstitial pneumonia (LIP) or pulmonary lymphoid hyperplasia complex • Nephropathy • Nocardiosis • Persistent fever (lasting >1 month) • Toxoplasmosis, onset before 1 month of age • Varicella, disseminated (complicated chickenpox)
Category C: Severely symptomatic	• Serious bacterial infections, multiple or recurrent (at least 2 culture-confirmed infections within a 2-year period) such as septicemia, pneumonia, meningitis, bone or joint infection, or abscess of an internal organ or body cavity • Candidiasis, esophageal or pulmonary (bronchi, trachea, lungs) • Coccidioidomycosis, disseminated • Cryptococcosis, extrapulmonary • Cytomegalovirus disease with onset of symptoms at age >1 month (at a site other than liver, spleen or lymph nodes) • Encephalopathy (at least one of the following progressive findings present

	for at least 2 months in the absence of a concurrent illness other than HIV infection that could explain the findings) 1) Failure to attain or the loss of developmental milestones or loss of intellectual ability, verified by a standard developmental scale or neuropsychological tests; 2) Impaired brain growth or acquired micocepahly demonstrated by head circumference measurements or brain atrophy demonstrated by computerized tomography or magnetic resonance imaging (serial imaging is required for children <2 years of age); 3) Acquired symmetric motor deficit manifested by two or more of the following: paresis, pathologic reflexes, ataxia or gait disturbance • Herplex simplex virus infection causing a mucocutaneous ulcer that persists for >1 month or bronchitis, pneumonitis or esophagitis for any duration affecting a child >1 month of age • Histoplasmosis, disseminated • Kaposi's sarcoma • Lymphoma, primary, in brain • Lymphoma, small, non-cleaved cell (Burkitt's) or immunoblastic or large cell lymphoma of B-cell or unknown immunologic phenotype • Mycobacterium tuberculosis, disseminated or extrapulmonary • Mycobacterium, other species or unidentified species, disseminated • Mycobacterium avium complex or Mycobacterium kansasii, disseminated • Pneumocystis carinii pneumonia • Progressive multifocal leukoencephalopathy • Salmonella (non-typhoid) septicemia, recurrent • Cerebral toxoplasmosis with onset at >1 month of age • Wasting in the absence of a concurrent illness other than HIV infection that could explain the following findings:

	1) persistent weight lower >10% of baseline, OR 2) downward crossing of at least two of the following percentile lines on the weight-for-age chart (e.g. 95th, 75th, 50th, 25th, 5th) in a child >=1 year of age, OR 3) <5th percentile on weight-for-height chart on two executive measurements, >=30 days apart PLUS 1) chronic diarrhoea (at least two stools per day for >30 days) OR documented fever (for >=30 days, intermittent or constant)

Barnhart *et al.* (1996:710) conducted a study on 2 148 HIV-infected children of whom all were in Category N of disease progression during birth, according to the clinical categories of the CDC (1994) (Table 2.3). They found that 348 children, that is to say 16%, died during the first four years. The study showed that the average time that had elapsed from birth (N) to Category C was 6,6 years. From this it is evident that children with HIV have a 50% risk of already developing serious symptoms by the age of 5 years. Furthermore, these researchers found that the average survival time for children who are vertically (mother-to-child) infected is 9,4 years, while the possibility of getting older than 5 years is 75%. The survival time for children with moderate symptoms (B) to death is 8,2 years, while the time of serious symptoms (C) to death is 2,8 years (Barnhart *et al.*, 1996:713).

A study by Newell *et al.* (2004:1238) to determine the survival time of HIV-infected children was conducted on 3 468 children between ages 1 and 58,4 months. The median birth weight of the children was 3 kg (1,2–5,4 kg) and less than 10% had a low birth weight (2,5 kg). The mortality rate was 110 per 1 000 live births at 12 months and this figure increased to 174/1000 at 24 months. At 12 months the mortality rate for HIV-infected children was 35,2%, as opposed to the 4,9% for non-infected children. The mortality rate was 52,5% and 7,6% respectively at 24 months (Newell *et al.*, 2004:1240). The study also showed that the mortality figure in Southern Africa is 12 times higher in infected children than in healthy children. The number of mothers who died during the study was 31/1 000, of whom most were from East and West Africa.

Research done by El Hachem *et al.* (1998:429) on 85 children with an average age of 14,8 months and a control group of 81 children showed that the average survival time is 40,2 months from the time that the diagnosis of AIDS (the final phase) is made. These children also had many dermatologic infections (89%) compared to the non-infected group (42%). Practically all (93%) HIV-infected children developed oral candidiasis (El Hachem *et al.*, 1998:429). A study in India, conducted by Shah *et al.* (2005:25) on 50 HIV positive children showed that 50% experienced fever and weight loss, 62% serious protein-energy malnutrition, 79% skin manifestations, 45% tuberculosis, 33.3% diarrhoea and 52.38% respiratory system problems due to the virus. Storm *et al.* (2005:177) found that 18% experience respiratory problems, 16% pain, 14% gastro-intestinal discomfort, 8% fatigue and insomnia and approximately a fourth of the children between five and 18 years infected with the virus experience moderate nausea, abdominal pain, diarrhoea and a loss of appetite. Research done by Johnson *et al.* (2003:206) on 728 adult AIDS patients proved that 89% experience weight loss, 97% pain, 74% chronic coughing, 56% respiratory problems and 52% chronic diarrhoea.

Storm *et al.* (2005:179) mention that there is a dramatic decrease in the mortality rate as well as an increase in survival age with the phasing in of antiretrovirals in the United States of America (USA). Subsequently the availability of antiretrovirals in the South African context will be discussed.

2.4 Antiretroviral therapy (ART)

In developing countries where antiretrovirals are not readily available, practically all infected children die before turning one, while non-infected children are left orphaned when their parents die (Akue *et al.*, 2000:1385). In industrialized countries children can survive up to the age of 10 years of age without antiretroviral treatment (ART), although many children in developing countries die within the first 24 months of their life (Evian, 1994:61). Meyers *et al.* (2006:235) note that the fact that ART is not readily available in South Africa contributes to the growing increase in child mortalities. Antiretrovirals during pregnancy decrease the vertical transmission to the baby (Fiscus *et al.* 1999:99; Ioannidis *et al.*, 2001:543). Meyers *et al.* (2006:238) calculated that 40% (110 000) of all HIV-infected children in South Africa need ART according to the clinical category of the CDC (1994) as well as a low CD4 cell count and percentage.

Practically no response was received from the South African government with regard to the AIDS pandemic (Abdool, 2004:1394). The government refused to provide pregnant women with ART, until 2001. This decision was revoked by the Constitutional Court and the pressure of the public sector to obtain access to treatment increased (Abdool, 2004:1394). The government introduced a treatment plan for AIDS in November 2003 (Achmat, 2005) which indicated that antiretrovirals would be given to pregnant women and individuals with CD4 counts of <200/μl (AIDS diagnosed) (Hassan *et al.*, 2005:6). The aim of this plan was to provide antiretrovirals to 180 000 people in the public sector before March 2005, as well as to appoint more health workers, provide feeding schemes, launch prevention campaigns and prevent mother-to-child transmission. However, this process progressed very slowly and by March 2005 only 42 000 people had received ART, while 5,6 million people were infected with the virus, 500 000 needed treatment and 300 000 would die in the next year. According to UNAIDS (2006), 190 000 South Africans had received ART by the end of 2005. However, this is still less than 20% of the more or less one million who need treatment. A shortage of human resources (Kober & Van Damme, 2004:103; Hassan *et al.*, 2005:6) and medication, long distances to clinics that do indeed provide ART, a lack of knowledge regarding ART, poor public communication as well as a lack of leadership contribute to this problem in South Africa (Hassan *et al.*, 2005:6). In order to execute the plan, Abdool (2004:1394) says that South Africa will have to create the largest AIDS treatment plan in the world, for which assistance from all sectors of society as well as international is needed.

The incidence of HIV in adults, children and babies will subsequently be elucidated to put the extent of this disease in perspective.

2.5 Incidence of HIV

Acquired Immune Deficiency Syndrome (AIDS) is a worldwide health threat which not only threatens adults but children and adolescents alike, according to Brown *et al.* (2000:81). According to statistics, an estimated 38,6 million (33,4–46 million) people worldwide were living with HIV in 2005 (UNAIDS, 2006). An estimated 4,1 million (3,2 million–6,4 million) became newly infected and 2,8 million (2,4 million–3,3 million) lost their lives to AIDS (UNAIDS, 2006). Sub-Saharan Africa is hardest hit by HIV/AIDS, where 10% of the world's population is accommodated, while more than 70% (23,3 million) of all people worldwide who are HIV

positive live here (Ferris & Kline, 2000:148). Approximately 930 000 adults and children lost their lives to AIDS in 2005; this is more or less one third of HIV mortalities worldwide.

The Health Systems Trust (2007) indicates that 11,4% of the total South African population and 18,6% of the age group 15–49 years is HIV infected. The occurrence in the North-West Province, where this study was performed, is 12,9%. Projections indicate that 15,3% of this total population will be infected in 2010 if no change sets in. Of the total South African population 5 511 751 are HIV infected, of whom 489 585 are in the North-West Province (Health Systems Trust, 2007). According to the Health Systems Trust (2007), 633 931 people are ill due to AIDS-related diseases, and this number can increase to 1 393 926 in 2010. AIDS is indicated as the main cause of mortalities in Africa and the fourth most important cause of mortalities worldwide (Sleasman & Goodenow, 2003:582). In South Africa, 47,5% of mortalities were attributed to AIDS-related diseases in 2006. Projections are that mortalities can rise to 65,7% in 2010 (Health Systems Trust, 2007). The statistics among adults, children and babies will subsequently be analysed further.

2.5.1 Adults

UNAIDS (2006) indicates that an estimated 38,6 million people in the world are infected with HIV, of whom most are adults. According to this organization, 1 700 people are infected with the virus daily. Burke (2004:416) points out that more women than men are affected by HIV. Sub-Saharan Africa is most affected by this condition in the world with 25,4 million people who are HIV positive and of whom 5,3 million live in South Africa (UNAIDS, 2004). In 2003, 3,1 million adults died worldwide due to the virus (UNAIDS, 2004).

The Antenatal Survey made data available pertaining to women who visited antenatal clinics in the nine provinces of South Africa from 2002 to 2005 (Department of Health, 2006). This survey showed that KwaZulu-Natal was most affected by the virus, after which Mpumalanga, Gauteng, North-West, Free State, Eastern Cape, Limpopo, Northern Cape and Western Cape provinces follow. The incidence of HIV also continues to increase in the respective provinces. Nationally it has increased from 26,5% in 2002 to 30,2% in 2005. Mpumalanga, North-West, Eastern Cape and Limpopo have shown the largest increase (Department of Health, 2006). See Table 2.4.

Table 2.4: Data of an antenatal survey in the respective provinces

Province	2002%	2003%	2004%	2005%
KwaZulu-Natal	36,5	37,5	40,7	39,1
Mpumalanga	28,6	32,6	30,8	34,8
Gauteng	31,6	29,6	33,1	32,4
North-West	26,2	29,9	26,7	31,8
Free State	28,8	30,1	29,5	30,3
Eastern Cape	23,6	27,1	28,0	29,5
Limpopo	15,6	17,5	19,3	21,5
Northern Cape	15,1	16,7	17,6	18,5
Western Cape	12,4	13,1	15,4	15,7
Nationally	26,5	27,9	29,5	30,2

Furthermore, the survey shows that women in the age group 25–29 years are most affected (39,5%), followed by the age group 30-34 years (36,4%) and 20-24 years (30,6%) (Table 2.5). The survey also showed that a statistically significant increase had already occurred in the age group 25-29 years (p=0,033) and 30-34 years (p=0,021) from 2001 to 2002, as well as in the age group 40+ years (p=0,002) of women who were infected with HIV (Department of Health, 2003). The HIV incidence in the age group 35–39 had increased by nearly 10% from 2002 to 2005 (Department of Health, 2006). It is clear that this increase in HIV infection among women predicts problems for the children who are affected by it (Wolters *et al.*, 1995:328; Thorne & Newell, 2000:4; Loening-Voysey, 2002:103).

Table 2.5: Data of antenatal survey according to respective age groups

Age group (years)	2002%	2003%	2004%	2005%
<20	14,8	15,8	16,1	15,9
20-24	29,1	30,3	30,8	30,6
25-29	34,5	35,4	38,5	39,5
30-34	29,5	30,9	34,4	36,4
35-39	19,8	23,4	24,5	28,0
40+	17,2	15,8	17,5	19,8

(Department of Health, 2006)

A study conducted among 2 231 adults in a mining community near Carltonville (Gauteng, South Africa) which included gold mine members, sex workers and local members of the community showed that 22% of the men and 37% of the women of the local community, 29% of the mine workers and 69% of the sex workers were infected with HIV. In the age group 20-29 years as many as 60% of the women tested HIV positive (Gilgen *et al.*, 2001:388). The South African

Health Review (2002) finally showed that the life expectancy with regard to adults had decreased from 57 years in 1996 to 52,5 years in 2002.

2.5.2 Children

With regard to children, it was indicated that 2,1 million children under the age of 15 years were living with HIV in 2003 worldwide, of whom 630 000 had been infected with the virus in 2003 (Children on the Brink, 2004; UNAIDS, 2004) and 510 000 children under the age of 15 years had died due to AIDS (UNAIDS, 2004). Gray (2000) points out that 40% of children who are admitted to the Chris Hani Baragwanath Hospital in Soweto, daily, are HIV infected. According to Groenewald *et al.* (2005:194) approximately 40 727 children under the age of five years died in South Africa in 2000/2001 as a result of HIV. According to UNAIDS (2006), approximately two million children are HIV infected in Sub-Saharan Africa and more or less 43% (860 000) of all children younger than 15 years, who are infected with HIV, live in Sub-Saharan Africa (UNAIDS, 2006).

This pandemic has devastating consequences for vulnerable children who are affected by it (Children on the Brink, 2004). In Sub-Saharan Africa 12,3 million (15%) children have already been left orphaned due to the virus. Children on the Brink (2004) reports that the number of children who are due to AIDS under the age of 18 years had increased from 1 million in 1990 to more than 12 million in 2003 and their projection for 2010 is 18 million in Sub-Saharan Africa. In South Africa, 1 201 675 children younger than 18 years were left orphaned due to HIV/AIDS. Projections indicate that 1 531 229 children can become orphans by 2010 (Health Systems Trust, 2007). In the North-West Province of South Africa there are 92 749 orphans due to HIV/AIDS. Sub-Saharan Africa also accommodates 90% of all newly infected children, as well as 95% of the world's AIDS orphans (Ferris & Kline, 2000:148).

Children on the Brink (2004) further stresses the impact of this growing pandemic on children in South Africa, in that it mentions that more than 1 100 000 children under the age of 15 years are affected by the virus, of whom 740 000 have already lost a mother due to the disease, 570 000 a father, while 290 000 have lost both parents. In 2003 alone, 370 000 new cases were reported who were left orphaned due to the disease (Children on the Brink, 2004). In Botswana, Lesotho,

Namibia, South Africa and Swaziland 15% of all orphans were left orphaned in 2003 and the same percentage of children live with one or both parents who are dying (Children on the Brink, 2004). Projections further indicate that one out of every five children in Botswana, Lesotho, Swaziland and Zimbabwe are going to be left orphaned by 2010 (Children on the Brink, 2004). The number of orphans due to AIDS had increased by 400% from 1994 to 1997 and it is predicted that they will comprise 9% to 12% of the population in 2010 (UNAIDS, 2004). Nyambedha *et al.* (2003:33) found that one out of every three children in Kenya had lost one biological parent, while one out of every nine children had lost both parents. Most of these orphans are cared for by surviving family members who are (approximately one out of every five) 55 years and older (Nyambedha *et al.*, 2003:33). Meyers *et al.* (2006:240) purports that a combination of improved census information collection, increased HIV testing of children, an increase in death registrations as well as the indication of cause-of-death on death certificates can facilitate the ongoing monitoring of paediatric HIV.

2.5.3 Babies

HIV has increased the mortality rate of babies by 50% (Ferris & Kline, 2000:149). The South African Health Review (2002) indicates that the mortality figure of babies at birth had increased from 45,4 to 59,0 per thousand live births. According to Rehle and Shishana (2003:6), the mortality figure in South Africa had increased from 9,1 in 1995 to 17,3 per thousand live births in 2005. This dramatic increase in deaths can be attributed to HIV/AIDS. It also appears that 90% of children born with the virus die before the age of 4 years (South African Health Review, 2002). Furthermore, the mortality rate for children younger that 5 years had increased from 59,4 in 1998 to 100,0 per thousand live births in 2002.

Most cases of an HIV diagnosis in babies and children are due to an HIV-infected mother who transmits it to the child (Wiener *et al.*, 1994:485). In South Africa HIV/AIDS increased among pregnant women from 23,1% in 2001 to 24,3% in 2003, in the Free State, Mpumalanga and KwaZulu-Natal it had increased by 30% (UNAIDS, 2004). According to Brown *et al.* (2000), more or less one quarter of babies born from HIV-infected mothers will also be infected with the virus. From this it can be deduced that the health of South African children has deteriorated,

while infection in pregnant mothers has increased, which contributes to the virus being spread further (Wolters *et al.*, 1995:328; Thorne & Newell, 2000:4; Loening-Voysey, 2002:103).

2.6 Causes of HIV

The causes of HIV will briefly be discussed under the captions horizontal and vertical transmission.

2.6.1 Horizontal transmission

The transmission of HIV can occur in two ways according to researchers (Greenberg *et al.*, 1998:25; Martini *et al.*, 1998a:806; 1998b:145, Winnick, 2000:247). The first is horizontal transmission, which takes place through sexual contact or through blood or body fluids that contain blood. The second is vertical transmission, which takes place when an infected mother transmits the virus to her baby. Individuals can only be infected with HIV by means of close contact with the body fluids of infected persons (Martini *et al.*, 1998a:806; 1998b:145; Winnick, 2000:247). Although the virus is present in all body fluids, it is only transmitted by blood, semen and vaginal secretions (Martini *et al.*, 1998a:806).

The largest number of individuals are infected through sexual intercourse with an infected person or by sharing infected needles as drug users. A small number of individuals are infected through transfusions of infected blood or blood products (Martini *et al.*, 1998a:806). Sexual activity, contact with blood, the vertical transmission from the mother to the child during pregnancy, birth and breast-feeding are considered as example of higher risk for transmission (Burke, 1994:416; Ferris & Kline, 2000:149). Research conducted by Carpenter *et al.* (1999:1083) indicated that the risk of horizontal transmission from the man to the woman is three times more than visa versa.

The safest defence against HIV is avoiding sexual contact with infected individuals. All forms of sexual contact bear the risk of virus transmission (Martini *et al.*, 1998:806). Using synthetic condoms reduces the risk of infection, although it is not entirely excluded (Martini *et al.*,

1998:806). Condoms that are not manufactured from synthetic material are effective in preventing pregnancy, but do not prevent transmission of viruses (Martini *et al.*, 1998:806).

2.6.2 Vertical transmission (mother-to-child)

An increasing number of babies are born with the virus because of the increase in infected mothers (Martini *et al.*, 1998a:806). According to Elmer and Elston (2004), transmission from the mother to the child is the main route of infection in children. It is reported that 80–90% of all HIV positive children contract the virus in this manner (Elmer & Elston, 2004). HIV can be transmitted to the child in three ways. Firstly, it is transmitted during pregnancy when the virus penetrates the blood of the foetus through the placenta (Wolters *et al.*, 1995:329; Doherty & Chopra, 2006:222). Secondly, it can be transmitted during the labour process because much blood switches between the baby and the mother during this period (Wolters *et al.*, 1995:329; Doherty & Chopra, 2006:222), and thirdly, it can be transmitted during breast-feeding (Doherty & Chopra, 2006:222). Approximately 7% of paediatric HIV transmission takes place through blood products and blood transfusions for the treatment of anaemia (Wolters *et al.*, 1995:329).

Martini (1998b:145) indicates that the chances of an infected mother transmitting the virus to the baby are between 22 and 30%. According to Children on the Brink (2004), the chances of transmission are between 25 and 45%, of which two thirds occur during pregnancy and labour and the rest is due to breast-feeding. Kourtis *et al.* (2001:709) contend that most cases of HIV transmission during pregnancy occur between 38 weeks and full-term., while only 20% occurs before the 38th week of pregnancy. Babies who are breastfed run a 24-42% risk of being infected with HIV, depending on how long the mother breastfeeds (Kourtis *et al.*, 2001:709; The Breastfeeding and HIV International Transmission Study Group, 2004:2160). A more advanced HIV status in the mother increases the risk factor for post-natal transmission because the viral load in the blood and breast milk is higher (Abrams *et al.*, 1995:451; The Breastfeeding and HIV International Transmission Study Group, 2004:2160; Doherty & Chopra, 2006:222). The presence of mastitis or breast abscesses in the mother or oral thrush in the baby can also increase the risk of transmission (Ogundele & Coulter, 2003:91; Doherty & Chopra, 2006:222). Doherty and Chopra (2006:222) point out that the mother-to-child transmission during breastfeeding has become one of the largest challenges in preventing HIV, since the advantages of breastfeeding must be measured against the risk of HIV transmission. Doherty and Chopra (2006:222) are also

of opinion that extending breastfeeding after six months can be the cause of up to 50% of HIV infection in children, since the transmission is higher in children who are not exclusively breastfed, but who received formula milk and solid food as supplements.

Research conducted by Gabiano *et al.* (1992:369) indicate that the risk of the second child being infected with the virus increases from 8.3 to 40% if the first child is infected with HIV. The percentage of infected children is higher in babies who are breast-fed, in girls, as well as in symptomatic mothers, while premature births, of a low birth weight and a vaginal labour did not influence virus transmission (Gabiano *et al.*, 1992:369). In contrast to this, Abrams *et al.* (1995:455) found that the risk of HIV transmission in prematurely born babies is doubled, while this risk increases fourfold in babies born before 34 weeks. Ioannidis *et al.* (2001:543) established that vertical transmission was less with the use of antiretrovirals, with higher CD4 counts in the mothers, with a caesarean section and with a heavier birth weight.

The diagnosis of HIV infection is made difficult in the first 18 months of a baby's life in that the mother's anti-HIV IgG antibodies cross the placenta to the foetus; hence it is still present in the baby's circulation (Rogers *et al.*, 1991:525; CDC, 1994; Lyons *et al.*, 1997:2; Thorne & Newell, 2000:4). Practically all these children test positive for HIV antibodies, while only 15–30% genuinely are positive (CDC, 1994). In the children who are not infected, it is often impossible to trace these antibodies at the age of nine months, although some are still present in the child's circulation up to the age of 18 months (CDC, 1994).

The consequences of HIV for children will be discussed next. This discussion includes aspects such as neuro-motor deficiencies and growth impediments.

2.7 Consequences of HIV

The influence of HIV/AIDS on children is complex, consequently it has many implications for the planning of health services for children (South African Health Review, 2002). Children with HIV run the risk of developing a variety of cognitive, neurological, behavioural and psychological deficiencies (Wolters *et al.*, 1995:327; Wachsler-Felder & Golden, 2002:441) as

well as changes in immune functioning, the central nervous system and growth (Lindsey *et al.*, 2000:1385). A variety of factors contributes to a child's deficiencies, including the route of infection, the time it takes for the virus to penetrate the central nervous system, the extent of medical intervention, care during the first year of life as well as a variety of environmental factors (Landry & Smith, 1998:162).

2.7.1 Affected children

The AIDS pandemic in Sub-Saharan Africa is confirmed to be the most serious threat to child survival and health in Africa (Bicego *et al.*, 2003:1245). It is predicted that orphans will constitute 9-12% of the population in 2010, since their number had increased by 400% due to AIDS from 1994 to 1997 (UNAIDS, 2004). In Zimbabwe, the orphans who had lost mothers, fathers and both parents increased 40%, 46% and 185% respectively during the 1990's, while 41% of orphans in Uganda lost one of or both parents to AIDS (Sarker *et al.*, 2005:210). Bicego *et al.* (2003:1245) found that grandparents take over the important role of taking care of the orphans when both parents have passed away. In Nigeria and Zimbabwe, 20% and 50% grandparents respectively are heads of households. Many of these children's guardians are themselves infected with the virus; hence it is possible for many of the infected children to not only lose one or two but a series of carers (Bicego *et al.*, 2003:1245).

The impact of the parent or carer's illness on the child starts when the parent is diagnosed or becomes ill with HIV/AIDS (Population Council, 2003). In this respect the Population Council (2003) proves that the school attendance of children between ages 13 and 18 years decreases by 26% and performance by 28% the moment the parent falls ill. Bicego *et al.* (2003:1247) found that orphans are less inclined to be on an age-related educational level and that the effect is bigger on younger (six-10 years) than older children (11-14 years). Girls between 15 and 18 years of whom the parents are seriously ill, who are orphaned or who live in a household in which there was a death in the past 12 months show a higher incidence of HIV infection, sexually transmitted diseases and teenage pregnancies (Gregson, 2005:785). These girls are also more inclined not to complete secondary schooling, to be sexually active and to marry early. This can impede the attempts to prevent HIV, can cause the cycle of poverty to continue and aid the spreading of the disease (Gregson, 2005:785).

2.7.2 Neuro-developmental deficiencies

Brain function in HIV-infected children is characterised by a variety of neuro-developmental deficiencies (Msellati, 1993:843; Davis-McFarland, 2000:20; Blanchette *et al.*, 2001:50), which are aggravated as the immunity deficit progresses (Epstein *et al.*, 1986:678). Children with HIV display neuro-developmental, cognitive, motor and nutritional deficiencies (Epstein *et al.*, 1986:678; Davis-McFarland, 2000:20; Blanchette *et al.*, 2001:50). Research conducted by Blanchette *et al.* (2001:52) confirmed that statistically significant differences in cognitive and motor development occur between children who are HIV infected on the one hand and healthy children on the other. They also found that children who are HIV positive already display handicaps in milestone development, during the first two years of their lives. A study was executed by Gay *et al.* (1995:1078) on 28 infected children and a control group of 98 non-infected children with the Bayley Scales of Infant Development. These children were tested from birth up until the age of 24 months on a 3-monthly basis. The researchers established that motor deficiencies already occur during the first three months of the baby's life and that these deficiencies increase as time progresses, since the children need to be able to execute more complex and integrated tasks (Gay *et al.*, 1995:1078). These results are confirmed by Blanchette *et al.* (2001:52).

The incidence of neurological deficiencies is estimated to be between 30 and 90% in infected children (Bode & Rudin, 1995:72). In this respect Epstein *et al.* (1986:678) found that the basal ganglia in the brain display symmetrical calcification in up to 50% of children who have symptoms and this could lead to neurological deficiencies. In a study conducted by Fundaro *et al.* (1998:135) it was found that HIV-infected children between six and 12 years of age performed poorer in cognitive and neuro-psychological tests than healthy children of the same age. HIV-associated encephalopathy in children is characterised by retarded brain growth and a decrease in cognitive and neuro-behavioural performances as well as motor dysfunctions (Epstein *et al.*, 1986:678; Rosenfeldt *et al.*, 2000:571; Mitchell, 2001:211). Children who contract HIV later by means of blood products are in general comparable with their age group until an advanced stage of the disease, while the risk of encephalopathy increases with early HIV infection, as well as high viral loads in the blood (Mitchell, 2001:211).

Msellati *et al.* (1993:843) found that 12,5% of children aged six months, 16% aged 12 months, 20% aged 18 months and 9% aged 24 months displayed neurological deficiencies compared to healthy children who showed a 5% or less similar backlog. These developmental deficiencies is mainly based on significantly lower gross motor counts for development. According to these researchers, the smaller percentage of children who is indicated at 24 months are the result of improvement in some children, but also because of the death of the seriously symptomatic children in the second year of their life (Msellati *et al.*, 1993:843). The loss of developmental milestones are often seen in progressive motor deficiencies as well as in intellectual and behavioural deterioration (Chamberlain, 1994:176). Research conducted by Nozyce *et al.* (1994:890) with the Bayley Scales of Infant Development indicate that children who contract a serious AIDS-related illness in the first 24 months of their life display deficiencies in motor and cognitive development. These deficiencies are visible very early. In the study under discussion it was found that asymptomatic HIV-infected children are at the same developmental level as non-infected children from the same socio-economic background.

Davis-McFarland (2000:19) points out that children's central nervous system is influenced more compared to adults in which the peripheral nervous system is influenced. The problem here is that the virus is projected on a developing central nervous system in children, which causes deficiencies to occur in developmental milestones (Davis-McFarland, 2000:19; Blanchette *et al.*, 2001:50; Wachsler-Felder & Golden, 2002:441). This phenomenon even occurs in children who are still asymptomatic (Boivin *et al.*, 1995:13).

2.7.3 Growth impediment

A few definitions will firstly be given that are generally used when commenting on the growth status of children, after which a discussion will follow on the influence of HIV on the growth status of children.

- *Stunting* – height-for-age Z-score (HAZ) below the median by more than minus two standard deviations (<-2SD).
- *Wasting* – weight-for-height Z-score (WHZ) below the median by <-2SD.
- *Underweight* – weight-for-age Z-score (WAZ) below the median by <-2SD.

Growth retardation, exhaustion of fat storage and neuro-developmental deficiencies are indicated in the literature as being related to HIV/AIDS (Aylward *et al.*, 1992:218; Miller & Garg, 1998:368; Davis-McFarland, 2000:20; Miller *et al.*, 2001:1287). HIV-infected children's growth patterns are often not normal. These children are often smaller with respect to both height and weight for their age (Miller *et al.*, 2001:1287). Growth retardation is common among HIV infected children and McKinney (1998:417) states that it occurs in two ways. The most common is growth retardation in height as well as weight, and this phenomenon already occurs during the first three to four months of the baby's life. The other is a relative weight-for-height loss and this occurs at the end of the life of the child with HIV when the child loses weight because of AIDS. According to Polsky *et al.* (2001:412), this weight loss includes the loss of lean body mass. Grinspoon and Mulligan (2003:S69) indicate that it is associated with an increased morbidity rate, accelerated disease progression, loss of muscle mass and loss of power and functionality. According to Miller and Garg (1998:368), a decrease in lean body mass occurs in children who are HIV positive before significant decreases in weight or fat storage occur. Research also indicates that the lean body mass in the children mentioned above is abnormally low compared to that of non-infected children (Polsky *et al.*, 2001:412). Although these children are shorter and lighter than children in their age group, their weight-height-ratio is normal (McKinney, 1998:417).

Children on the Brink (2004) remarks that it is important to monitor growth, seeing that reversed stunting due to malnutrition occurs in cases where the parents die. According to Guarino *et al.* (2004:349), gastro-intestinal diseases such as diarrhoea contribute to malnutrition. The main gastro-intestinal manifestations of full-blown AIDS are diarrhoea and weight loss. Malnutrition is a common phenomenon of the final phase of HIV, that is to say AIDS, and has several causes, say Guarino *et al.* (2004:349). There are two patterns of growth retardation, namely stunting and wasting. The first-mentioned is characterised by a retardation in linear growth for age, while wasting is a too low body weight for height. Wasting is also an AIDS-defined condition (CDC, 1994, Guarino *et al.*, 2004:349). According to these researchers, body weight decreases with initial infection of the virus and when malnutrition continues for an extended period, usually longer than a year, the linear growth is retarded (Guarino *et al.*, 2004:349). Eley *et al.* (2002:22) conducted a study in Cape Town among 60 HIV-infected children with an average age of 25 months. According to these researchers, malnutrition and growth retardation are two problems that often occurred in HIV-infected children. More than 25% of the 60 children were

underweight, while more than 50% of them displayed low height-for-age. Henderson *et al.* (1999:190) also confirms that the weight of HIV-infected children is statistically significantly lower than that of non-infected children of the same age. According to Eley *et al.* (2006:989), malnutrition is a big problem in HIV-infected children in South Africa. These researchers state that 66,7% of HIV-infected children in South Africa are stunted, 56,9% are underweight and 20,8% are wasted.

The growth status of 48 infected children and 93 non-infected children from the Durban area was compared from birth up until 18 months by Bobat *et al.* (2001:208). At birth there was no statistically significant differences between the two groups. From the age of three months the infected group displayed a sustained under average height-for-age and weight-for-age, although weight-for-height remained unchanged (Bobat *et al*, 2001:208). Significant differences occurred at three months, six months and 12 months between the two groups in height as well as in weight (Bobat *et al.*, 2001:203). The study also shows that infected children who died early showed more serious lower height-for-age, weight-for-height and malnutrition than children who survive to a later age (Bobat *et al.*, 2001:208). Children with a fast progression of the disease experienced both lower height-for-age and weight-for-age. Growth retardation can therefore be an indication of infection or of a fast progression of this disease. Bobat *et al.* (2001:209) purports that babies who display serious stunting and wasting run the risk of early death and must be thoroughly monitored.

The European Collaborative Study (2003:52) monitored 1 587 children's growth from birth up until 10 years. The group consisted of 1 403 non-infected children and 184 infected children. At three months the infected children weighed 460 gm lighter than the non-infected children (The European Collaborative Study, 2003:58) and they found that differences increased between the groups regarding weight and height with age. Infected children were significantly lighter and shorter than non-infected children. Between six and 12 months the non-infected children had increased 1,6% faster in height and 6,2% faster in weight than the infected children. The difference was 16 and 44% between eight and 10 years respectively. At 10 years of age the non-infected children were 7 kg (22%) heavier and 7,5 cm taller (5.6%) (The European Collaborative Study, 2003:58).

A study performed on 234 children from low socio-economic circumstances in Kenya found that 11-20% of HIV-infected children had a below average height-for-age (stunting) at the age of 12 months and 3-6% of the children's weight-for-height (wasting) was low. At 18 months the incidence of a low height-for-age had increased (Sherry *et al.*, 2000:684). Bailey *et al.* (1999:532) found that no differences were present at birth regarding height in HIV-infected and non-infected children in Kinshasa, Congo. By the age of three months, the infected children were already shorter than the non-infected children. Weight-for-age as well as weight-for-height was already affected at birth and the infected group was lighter and more wasted than the non-infected group (Bailey *et al.*, 1999:532). A longitudinal study performed by Villamor *et al.* (2004:372) on 524 children between ages six and 60 months in Dar es Salaam, Tanzania, found that HIV infection can be related to an annual decreased increase in height of 2,8 cm as well as in weight of 1,3 kg in children between six and 11 months (baseline) of age. Children between 12 and 23 months (baseline) increased 0,6 kg less in weight annually than non-infected children of the same age. This study found that HIV infection is linked to a significant retardation in linear growth in children younger than 11 months (baseline) (Villamor *et al.*, 2004:372). A further study performed by Villamor *et al.* (2005:61) found that HIV increases the risk of death fourfold. Other factors that also contribute to increasing the risk of deaths are the child's age (<24 months), stunting, small upper-arm circumference, anaemia and a shortage of water in the house. During the follow-up period of 24 months (every two weeks in the first year, every four months thereafter) stunting was associated with a doubled risk for death. The mortality risk for children who were wasted was 2.9 times higher than those who were not. Underweight for age did not have a statistical relation with increased deaths in this population (Villamor *et al.*, 2005:65). According to Hendricks *et al.* (2006:206), there are approximately 300 000 children under 15 years infected with HIV of whom 50% are stunted and/or underweight and 10–15% are seriously undernourished. They also indicate that the actual state of affairs regarding growth impediment and malnutrition among HIV-infected children in South Africa still needs to be established.

Because HIV-infected children run a high risk of malnutrition, feeding status assessment and intervention is of outmost importance in the management of HIV infection (Knox *et al.*, 2003:S63). Nutrition analysis and intervention for children with HIV can assist in preventing stunted growth and development. The early and regular analysis of nutrition status and nutrition intervention strategies designed to sustain normal growth and development, preventing nutrition

shortages and supporting the immune system are confirmed by several researchers as being important factors to increase quality of life (Fiore *et al.*, 2000:365; Knox *et al.*, 2003:S63).

2.8 Evaluation of children infected with HIV

In spite of progress in research related to HIV/AIDS, the exact effect of HIV on children's development is still poorly understood. It is difficult to compile a profile of the effect of HIV on the physical, neurological and psychological health of individuals, because of the variety of ways in which HIV affects individuals (Wolters *et al.*, 1995:325). A number of factors contribute to problems regarding assessment of this group. For instance, some children fall ill within a few months while others live asymptomatic lives for years. Thus, it is important that early intervention specialists should evaluate these children and follow up, because regression of development and physical functioning as a result of HIV/AIDS is inevitable (Wolters *et al.*, 1995:324). Researchers recommend that the interval between longitudinal testing should be determined by means of the child's age and neurological development. It is recommended that babies be evaluated each three - six months, infants each six - 12 months and school-going children each one - two years (Wolters *et al.*, 1995:324; Rodriguez et al., 1997:643). Another general recommendation is the use of standardised test batteries for monitoring neuro-developmental changes. This monitoring can yield evaluation results that can easily be converted into intervention programmes (Wolters *et al.*, 1995:326). The use of norm-based measuring instruments enables experts to compare developmental curves of children with HIV with those typical of the development of non-infected children (Wolters *et al.*, 1995:325).

Early intervention specialists who work with HIV children face enormous challenges (Landry & Smith, 1998:163). Given that individual children experience deficiencies in a variety of areas, understanding the effect of HIV on the neuro-cognitive development is essential in order to develop suitable intervention programmes (Landry & Smith, 1998:164). With this information as background, intervention possibilities will subsequently be looked into for the motor as well as physical development of HIV-infected children.

2.9 The necessity of motor intervention for children with HIV

Research shows that it is essential for children with HIV to receive motor intervention, since it can improve their life expectancy and quality of life (Brady 1994:18; Wilfert, 1996:438; Parks & Danhoff, 1999:527). In this respect researchers indicate that a need exists for additional intervention strategies, improved nutrition and exercise programmes to improve the quality of life of children who are HIV positive (Brady, 1994:18; Stein *et al.*, 1995:31).

According to researchers, HIV is associated with exhaustion and a decrease in physical functioning that limits the person in performing necessary life activities (Crystal *et al.*, 2000:1211; Cade *et al.*, 2004:655; Storm *et al.*, 2005:e173). According to Crystal *et al.*, (2000:1211) 50% of HIV-infected children who participated in their study showed a chronic disability to participate in life activities such as attending school. Wolters *et al.* (1995:325) point out that children with HIV are inclined to develop overall motor backlogs and abnormalities in muscle tone. Infants can develop problems with balance and gait and might even lose their ability to walk later on (Brouwers *et al.*, 1994:435). The motor deficiencies are aggravated in the course of time and when the children reach school-going age, abnormalities in balance, gait, perceptual-motor skills as well as a weakening of muscles can occur (Jay & Dalakas, 1994:433).

A study conducted in America on 2 864 HIV-infected adults with a view to establish their quality of life indicated that the physical functioning of adults with asymptomatic HIV infection is the same as that of the general population, while those with symptomatic HIV infection display much weaker physical functioning (Hays *et al.*, 2000:714). This group's emotional health was also statistically significantly poorer than that of the general population with other chronic diseases. Storm *et al.* (2005:e177) found that approximately 50% of HIV-infected children between five and 18 years have limitations regarding physical functioning. More regular limitations occurred in energy demanding activities (46%) than in basic survival activities (32%) and one or more limitations with regard to school activities occurred in 58% of the children. These researchers found that individual limitations, including health-related limitations in activities occurred in 13% cases, >1 day in bed during last four weeks in 19% cases, repeating a grade 21% of the cases and receiving assistance in the school in 32% of the cases.

Parks and Danoff (1999:525) tested 34 children between the ages 59 and 158 months with the Bruininks-Oseretsky test of Motor Proficiency over a period of two years. From this study it appears that HIV to a lesser degree affects fine motor skills and that the accent of intervention programmes should therefore rather be on gross motor skills (Parks & Danoff, 1999:524). These findings are attributed to the fact that gross motor skills demand the use of large-muscle groups and physical exertion, whereas fine motor skills demand less power (Parks & Danoff, 1999:527). Blanchette *et al.* (2002:235) found that HIV-infected children's motor deficiencies display lower counts in fine motor skills and motor strength. These researchers also found that statistically significant differences exist in infected compared to healthy children, with handgrip strength in the dominant ($p = 0,007$) as well as the non-dominant ($p = 0,02$) hand. Parks and Danoff (1999:527) are of opinion that, without specific attention to gross motor skills, HIV-infected children will not be capable of participating in age-appropriate activities such as physical games and sport or performing self-care tasks such as independently taking a bath. The maintenance of motor skills in the above-mentioned children therefore is an important objective for intervention programmes, because it enables these children to participate in activities that directly contribute to cognitive growth and social maturation (Parks & Danoff, 1999:525).

Rojas *et al.* (2003:452) established that 19 HIV-positive adults between the ages 28 and 59 years showed significant improvement in health status, emotional health, fitness and physical power after a 16-week intervention period twice weekly. The intervention programme consisted of both aerobic and resistance exercises at moderate intensity (Rojas *et al.*, 2003:446). Shor-Posner *et al.* (2004:1094) investigated the effect of massaging on HIV-infected children. The investigation group consisted of 10 HIV-infected children in an experimental group with an average age of 5.1 years, and 14 HIV-infected children in a control group with an average age of 4.7 years. The experimental group was massaged twice a week for 20 minutes, while the control group received friendly visits (read, play and talk). The duration of the intervention was 12 weeks. These researchers found that the average CD4 count had risen in the group that was massaged, while the control group's CD4 count had decreased (Shor-Posner *et al.*, 2004:1094). The probability of having a >20% decrease in CD4 count was significantly higher over the three months in the control group than in the massaged group ($p<0.03$). According to these researchers, massaging is a potentially safe, important and sustainable form of immune stimulation, especially in developing countries where antiretrovirals are not readily available (Shor-Posner *et al.*, 2004:1094).

It appears from the preceding discussion that appropriate treatment and an improvement in lifestyle can cause an increased number of HIV-positive children to survive into adolescence and some even into a more advanced age, in a relatively good health condition (Wilfert, 1996:438; Brown *et al.*, 2000:81). According to Wagner *et al.*, (1998:811) it is necessary to develop and evaluate health promoting interventions such as exercises for the potential advantage it holds in promoting quality of life, because HIV is increasingly becoming a chronic condition. However, the complexity and multiplicity of the problems of these children need multidisciplinary interventions, based on the child as a whole, and performed by professionals with different training and backgrounds (Fundaro *et al.*, 1998:139).

2.10 Chapter summary

It is obvious from this literature overview that HIV-infected children have motor deficiencies as well as physical inabilities to perform essential life activities. In order to develop the appropriate intervention programmes, it is essential to determine the state of the motor as well as physical deficiencies of these children. The necessity of motor intervention to improve these children's quality of life can clearly be seen from the preceding literature overview. Researchers are convinced that these children experience multiple and complex problems and that multidisciplinary interventions are necessary. It is also important to develop additional strategies for promoting quality of life. It is further clear from the literature overview that HIV-infected children run a high risk of malnutrition with accompanying growth impediments. Assessing growth status therefore is important in the management of HIV infection, since it can indicate a heightened risk of death.

With this literature overview as background, the results of the study will be analysed and discussed in the following four chapters.

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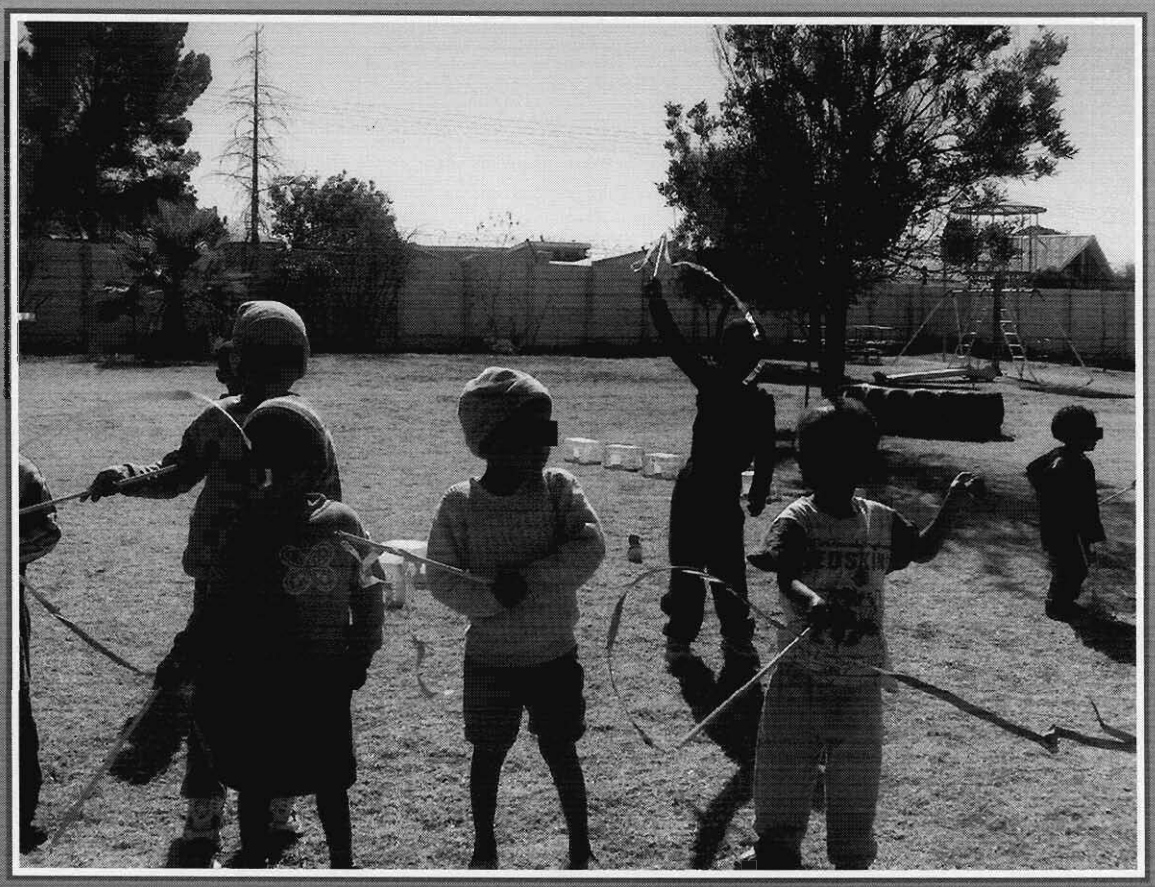
CHAPTER 3

THE MOTOR DEVELOPMENT OF 2 TO 6-YEAR OLD CHILDREN INFECTED WITH HIV



Title

The motor development of 2 to 6-year old children infected with HIV

Die motoriese ontwikkeling van 2- tot 6-jarige kinders geinfekteer met MIV

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Short title

Motor development of HIV-infected children

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Abstract

The aim of the study was to determine the motor development of 2 to 6-year old children (53.74 months, sd 12.49) who were infected (Group 1, n = 17) with HIV and to compare their development with an affected (Group 2, n = 13) and non-affected group (in that they are not infected with HIV, but have lost one or both parents to AIDS-related diseases) (Group 3, n = 12). The motor development of the group was determined by the Peabody Developmental Motor Scales (PDMS-2). Variance of analysis (ANOVA) revealed that the developmental level of the HIV-infected group varied between 45 and 51 months, compared to their mean chronological age of 57 months, and that they performed the poorest of the groups in all the variables regarding gross motor, fine motor and total motor ability. Their total motor ability differed significantly ($p<0.05$) from that of the healthy group, while their gross motor skills showed larger deficits compared to their fine motor development. A forward discriminant analysis further indicated that locomotor skills contributed most to the discrimination between the groups. It is concluded that the infected group exhibits serious motor deficiencies in contrast to healthy children of the same chronological age. These results highlight the necessity of motor intervention for HIV-infected children, focussing on gross motor skills to improve their motor development and quality of life.

Keywords: HIV, AIDS, Children, Paediatrics, Development, Motor Development, Intervention

INTRODUCTION

Statistics indicate that worldwide an estimated 38.6 million (33,4 – 46 million) people were living with the Human Immunodeficiency Virus (HIV) in 2005 (UNAIDS, 2006), an estimated 4,1 million (3,2 – 6.4 million) became newly infected and 2,8 million (2,4 million – 3,3 million) lost their lives to the Acquired Immune Deficiency Syndrome (AIDS) (UNAIDS, 2006). In South Africa 5 511 751 people are HIV positive according to statistics (Health Systems Trust, 2007) and the estimated HIV prevalence for the total population is 11,4%. In woman (age group 20-24 and 25-29 years) the prevalence increased from 2002 to 2005 respectively from 29,1 – 30,6% and from 34,5 – 39,5% (Department of Health, 2006). This increase in HIV prevalence in woman (child-bearing age) indicates difficulties for the children of South Africa (Wolters et al., 1995: Thorne & Newell, 2000: Loening-Voysey, 2002). Statistics indicate that 2,1 million children under the age of 15 are infected with HIV worldwide (UNAIDS, 2004: Children on the Brink, 2005). By 2003, 510 000 children younger than 15 years had already died as a result of AIDS (UNAIDS, 2004). This growing HIV/AIDS epidemic has far reaching consequences for children who are affected by it (Children on the Brink, 2005). In South Africa, more than 1 201 675 children under the age of 18 are maternal orphans due to this disease (Health Systems Trust, 2007). The number of orphans in Sub-Saharan Africa has increased from 1 million in 1990 to 12 million in 2003, while the projection for 2010 is that this number will increase to 18 million children (Children on the Brink, 2005).

The AIDS-pandemic in Sub-Saharan Africa is the most solemn risk for children's survival and health to date (Bicego *et al.*, 2003). In children, HIV is characterised by a variety of developmental deficiencies. Researchers indicate that children with HIV exhibit neuro-developmental, cognitive, motor and nutritional deficiencies (Msellati *et al.*, 1993; Wolters *et al.*, 1995; Davis-McFarland, 2000; Blanchette *et al.*, 2001; Wachsler-Felder & Golden, 2002) as well as changes in their immune and central nervous system (Lindsey *et al.*, 2000). The incidence of neurological deficiencies in HIV children is estimated to be between 30 – 90% (Bode & Rudin, 1995). HIV is also associated with encephalopathy, a condition characterized by a decline in brain growth, resulting in poorer cognitive, neuro and motor development (Epstein, 1986; Rosenfeldt *et al.*, 2000; Mitchell, 2001). Research reports that motor deficiencies are already apparent during the first three months of an infected baby's life (Gay *et al.*, 1995). This loss of motor developmental milestones is evident in progressive motor deficiencies, which in time worsen, as the children are required to perform increasingly more complex and integrated tasks

(Gay *et al.*, 1995; Blanchette *et al.*, 2001). This can result in deficiencies regarding balance, gait, perceptual-motor skills and muscle functioning (Brouwers *et al.*, 1994; Jay & Dalakas, 1994). In this regard research confirms statistically significant differences pertaining to cognitive and motor development of children infected with HIV compared to those of healthy children (Blanchette *et al.*, 2001).

The central nervous system of HIV children is influenced to a larger extent than the peripheral nervous system, which is influenced more in adults (Davis-McFarland, 2000). This causes the virus to be more prominent in the developing nervous system of a child, which, in turn, results in the deficiencies in developmental milestones (Davis-McFarland, 2000; Blanchette *et al.*, 2001; Wachsler-Felder & Golden, 2002). Motor developmental deficiencies are mainly the result of gross motor deficiencies rather than of fine motor deficiencies (Msellati *et al.*, 1993; Parks & Danoff, 1999). This conclusion is attributed to the fact that gross motor skills require the use of large-muscle groups and physical effort, whereas fine motor skills require less strength (Parks & Danoff, 1999). HIV is associated with exhaustion and a decline in physical functioning, which restrict the person in performing life-sustaining activities (Crystal *et al.*, 2000; Keyser *et al.*, 2000; Cade *et al.*, 2004; Storm *et al.*, 2005). Research reveals that 50% of HIV infected children's physical functioning is restricted and that 58% have one or more restrictions concerning school activities (Storm *et al.*, 2005). A loss of muscle mass contributing to a decrease in strength and functionality is also reported (Grinspoon & Mulligan, 2003).

Although South Africa is one of the countries in the world with the highest HIV/AIDS prevalence, access to antiretroviral treatment is limited (Abdool, 2004). Research is therefore essential for the development of alternative intervention methods to enhance the quality of life of children with HIV. The aim of this study was firstly to determine the level of gross and fine motor development of 2 to 6-year old children affected by and infected with HIV, and to compare it with children not affected by this disease. Secondly we wanted to determine which of the variables (stationary, loco-motor skills, object manipulation skills, grasping and visual motor integration) contribute most to the overall motor development profile of the child as this can be valuable information when compiling motor intervention programmes for such children.

METHODOLOGY

Research design

A three-group cross-sectional research design was used to analyse the results of a availability sample of 42 children classified as infected with HIV, affected and non-affected by HIV.

Participants

The HIV-infected group (Group 1) and HIV-affected group (Group 2) were selected at a Hospice day care centre for HIV-infected and affected children in Potchefstroom (South Africa) according to availability. Children are only allowed entrance to this day care centre if proof of their HIV status can be furnished, while medical clinics also refer HIV positive children to this day care facility. The affected children (HIV negative status, Group 2), are allowed access to the day care centre solely on the provisio that a death certificate of one of or both the parents is provided which states that the death was as a result of an AIDS-related disease such as tuberculoses, pneumonia and cardiac failure. A control group (Group 3) of children who were not infected with or affected by HIV was compiled from the Klerksdorp area near Potchefstroom. The control groups (Groups 2 and 3) were also selected on the basis of their age, sex, race and socio-economic status being similar to those of the experimental group. The HIV-status of the children was determined using the FIRST RESPONSE HIV CARD TEST 1-2.O. The test is an immunochromatographic (rapid) test for the qualitative detection of all isotypes (IgG, IgM, IgA) spesific to HIV-1 including subtype O and HIV-1 in human serum, plasma or whole blood. In a comparison of the FIRST RESPONSE HIV CARD TEST 1-2.O test versus a leading commercial anti-HIV1&2 ELISA and Rapid test, results gave a sensitivity of 100% (120/120), a specificity of 99.18% (121/122) and a total agreement of 99.59% (241/242). Due to only three laboratories processing PCR testing in South Africa, 22% of the total capacity required, rapid tests are used (Meyers *et al.*, 2006). The total group consisted of 42 children with a mean age of 53.74 months (sd 12.49). The HIV-infected group (Group 1) consisted of 17 children with a mean age of 57.41 months (sd 10.57), of which 12 were boys (60.58 months, sd 9.05) and five were girls (49.80 months, sd 10.89). The affected group (Group 2) consisted of 13 children with a mean age of 49.39 months (sd 12.96), of which 8 were boys (51 months; sd 13.71) and 5 were girls (46.80 months; sd 12.70). The children from both these groups were transported to and from the school with a bus belonging to the school on a daily basis. The socio-economic circumstances of the group were considered low, because their living conditions were characterised by poor sanitary

conditions and housing. Although a dietician did not compile the diet, they were part of a feeding scheme. This consisted of maize porridge, morvite or soya porridge for breakfast and a fruit for a snack during the course of the morning. Cooked lunches consisted of meat, rice and vegetables with a peanut butter or jam sandwich and at 15:00 and a cold drink before going home. The children were also supplied with morvite over the weekends when the school is closed. The non-affected (Group 3) consisted of 12 children with a mean age of 53.25 (sd 13.86) of which six were boys (59 months; sd 13.73) and six were girls (47.50; sd 12.44). This group consisted of children from similar socio-economic circumstances who where not infected with or affected by HIV. These children were all enrolled in a day care centre, although no feeding scheme was available at the centre. The method of pairing was used to even the groups regarding age, sex and race.

Measuring instruments

Peabody Developmental Motor Scales - second edition (PDMS-2)

The PDMS-2 (Folio & Fewell, 2000) consists of six subtests, which measure interdependent abilities during early motor development. It was developed to measure gross and fine motor skills in children from birth to 71 months of age. The subtests consist of reflexes, stationary, loco-motor skills, object manipulation skills, grasping and visual motor integration. The totals of the subtests are presented in a raw score, a percentile, age equivalents, as well as a standard score. The test developers (Folio & Fewell, 2000) contend that the standard score gives the best indication of an individual's progress in the subtests, and suggest that this score be used to compare the subtests with one another. These subtests contribute to a gross motor total [reflex (from birth – 12 months), stationary, loco-motor skills and object manipulation skills], a fine motor total (grasping and visual motor integration) and an overall motor total. The gross motor total, the fine motor total as well as the motor total are expressed in percentiles as well as quotients. The quotients are seen as the most reliable values for the PDMS-2 (Folio & Fewell, 2000), because they integrate the various subtests, are not reliant on a single subtest and display the child's abilities with regard to gross motor, fine motor as well as total motor abilities. The grading of motor development is represented as follows: (1) Very poor; (2) Poor; (3) Below average; (4) Average; (5) Above average; (6) Excellent and (7) Superior. The PDMS-2 has been tested as a reliable and valid measuring instrument (Folio & Fewell, 2000). The test-retest-reliability coefficient is >0.90, while the internal validity varies between 0.90 and 0.96. The content validity of the PDMS-2 is determined by the skills, which are measured and is

corroborated by knowledge of motor development, which is already available. It was also found that the test battery is suitable for use with any race, sex or ethnicity.

Procedure

The North-West University in Potchefstroom, South Africa provided ethical approval for conducting the study (nr. 06M02). The director of the Hospice Day Care Centre gave permission and the parents/guardians had to complete informed consent forms before the child was included in the study. The HIV status of each child was determined by the clinics responsible for their health. The research was done at the day care centres during school hours. Trained translators were used to ensure that the children understood the instructions.

Statistical procedure

The data was analysed using Statistica for Windows (Statsoft, 2006) as well as the SAS software (SAS, 2000-2003). Descriptive statistics were used to determine means (M), standard deviations (sd) and maximum and minimum values. A One-way variance of analysis was used to analyse the differences between the groups. A statistical equation [$n = (1.96)^2(6.52)^2/(3.75)^2$] (Steyn *et al.*, 1998), based on relevant results (Ernst, 2004), determined that each of the groups should consist of at least 11.6 (n = 12) children in order for the results to have statistical power. Practical significance of differences (ES) between groups was calculated by dividing the mean difference (M) by the largest standard deviation (sd) (Cohen, 1988; Steyn, 1999). The following guidelines for interpreting the practically significance were set, namely ES = 0.2 (small effect), ES = 0.5 (medium effect) and ES = 0.8 (large effect) (Cohen, 1988). Due to the number of subjects for this study, it was considered practically significant if the effect size indicated a medium or large effect. A histogram analysis was done to analyse the normality distribution of the different groups. A forward stepwise discriminant analysis was performed by way of SAS to determine which variables (subtests) could best discriminate between the groups, and a classification matrix was compiled from the same data to evaluate the accuracy of the prediction. Subsequently the SAS programme was used to analyse the cross validity of the discriminant function by making use of the Jack-knife method. The striking rate of the discriminant analysis was also analysed (Huberty, 1994), according to which the practical significance of the method was calculated and a value of 0.2 indicated a large practical effect.

RESULTS

Table 1 displays a comparison between the mean chronological and developmental ages of the three groups, while Table 2 provides descriptive information of the groups with regard to their mean values of the PDMS-2. Table 3 represents significant intergroup differences regarding the PDMS-2 variables.

Table 1 indicates that the infected group (Group 1) had the highest mean chronological age (57 months) of the three groups, although the age differences between the groups were not statistically significant. They exhibited the lowest developmental level (45 – 51 months) of the three groups in the various subtests. It is apparent that Group 1 fared the worse of the three groups in all the subtests compared to their chronological age [stationary (12 months), grasping (9 months) and loco-motor skills (11 months)]. Table 1 further indicates that the chronological age of Group 2 (49 months) is lower than their developmental age in three of the five subtests, one was similar and one was higher. Visual motor integration is the lowest in the group (6 months), although they fared better than their chronological age in grasping. Object manipulation was at the same level as their chronological age. Table 1 also reveals that the developmental age of Group 3 exceeds their chronological age (53 months) in all the subtests (0 – 5 months).

TABLE 1. **THE CHRONOLOGICAL AGE OF THE GROUPS IN RELATION TO THEIR DEVELOPMENTAL AGE IN VARIOUS SUBTESTS**

	Group 1 (n=17)			Group 2 (n=13)			Group 3 (n=12)		
	ChronA	DevA	Diff	ChronA	DevA	Diff	ChronA	DevA	Diff
Gross motor	M	M		M	M		M	M	
Stationary	57	45	-12	49	45	-4	53	56	+3
Loco-motor	57	46	-11	49	46	-3	53	56	+3
Object manipulation	57	51	-6	49	49	0	53	58	+5
Fine motor									
Grasping	57	48	-9	49	53	+4	53	53	0
Visual motor integration	57	50	-7	49	43	-6	53	55	+2

ChronA = Chronological age; DevA = Developmental age, Diff = Difference between chronological and developmental age; M= mean; n = number of subjects

An analysis of the standard scores obtained by Group 1 for all the subtests in the PDMS-2, as displayed in Table 2, indicates that the skills affected most in this group are stationary and loco-motor skills. Table 2 further indicates that the norm percentiles of all the subtests of the group vary between 26 and 37.58. Gross motor, fine motor and total motor development falls respectively on the 25th, 36th and 27th percentile. The grading in the various subtests, as well as the gross motor, fine motor and total motor development indicates a below average development according to the chronological age of the group. The fine motor quotient grading indicates an average development (between 90 and 110 standard score), while the gross motor and total motor quotient indicate a below average (between 80 and 89) development.

Group 2 fared poorest in the visual motor integration, loco-motor and stationary skills when comparing the various groups. This group tested below average in the above-mentioned skills, while grasping and object manipulation tested average. Percentiles varied between 30 and 61 for the various subtests; while gross motor skills were on the 41st percentile, fine motor on the 44th percentile and the total motor development on the 42nd percentile. The grading of the motor

quotient indicate that the development of this group was average (between 90 and 110) in gross motor, fine motor and total motor skills.

Table 2 indicates that Group 3 scored an average in the various subtests with percentiles ranging between 51 and 65 for the various subtests. They obtained almost the same standard scores in all the subtests (10.25 – 11.83) and as a result, fared average in all subtests. Gross motor skills of the group were on the 65th percentile, fine motor skills on the 60th percentile and total motor skills on the 64th percentile. The grading of the group for the various skills was average. This group exhibited average development (between 90 and 110) with regard to gross motor, fine motor as well as total motor quotient grading.

TABLE 2. **DESCRIPTIVE STATISTICS OF THE MOTOR DEVELOPMENT OF THE GROUPS**

	Group 1					Group 2					Group 3				
Variables	**n**	**M**	**sd**	**Min**	**Max**	**n**	**M**	**sd**	**Min**	**Max**	**n**	**M**	**sd**	**Min**	**Max**
Age	17	57.41	10.57	35	71	13	49.38	12.96	32	68	12	53.25	13.86	33	69
Gross motor															
Stationary SC	17	7.76	2.82	3	15	13	9.23	2.35	5	14	12	10.75	1.86	8	15
Stationary percentile	17	27.53	24.02	1	95	13	41.31	25.30	5	91	12	58.08	20.04	25	95
Stationary grading	17	3.47	1.18	1	6	13	3.92	0.76	2	5	12	4.17	0.58	4	6
Loco-motor SC	17	7.41	2.69	3	11	13	9.08	2.69	6	16	12	11.25	1.96	8	14
Loco-motor percentile	17	26.47	24.90	1	63	13	38.38	25.59	9	98	12	63.67	22.33	25	91
Loco-motor grading	17	3.12	0.93	1	4	13	3.92	0.76	3	6	12	4.42	0.51	4	5
Object manipulation SC	17	8.76	1.95	6	12	13	10.08	1.75	8	13	12	11.08	1.31	9	13
Object manipulation percentile	17	36.41	22.16	9	75	13	50.38	21.05	25	84	12	63.00	15.57	37	84
Object manipulation grading	17	3.65	0.49	3	4	13	4.23	0.44	4	5	12	4.17	0.39	4	5
Fine motor															
Grasping SC	17	8.59	2.74	1	13	13	11.00	2.42	6	15	12	10.25	2.83	6	16
Grasping percentile	17	43.53	25.34	5	102	13	61.00	25.31	9	95	12	51.67	29.03	9	98
Grasping grading	17	3.71	0.99	1	5	13	4.31	0.75	3	6	12	4.42	0.67	4	6
Visual motor SC	17	8.47	3.02	5	13	13	8.08	2.56	5	13	12	11.83	3.10	8	17

Visual motor percentile	17	35.59	31.57	5	84	13	30.77	26.39	5	84	12	65.50	29.55	25	99
Visual motor-grading	17	3.47	1.01	2	5	13	3.46	0.88	2	5	12	4.83	1.03	4	7
Gross motor percentile	17	25.06	22.43	1	84	13	41.77	21.32	10	84	12	65.33	18.99	23	90
Gross motor quotient	17	86.94	12.87	1	84	13	96.54	9.18	81	115	12	106.58	8.24	89	119
Gross motor grading	17	3.18	1.07	1	5	13	3.85	0.55	3	5	12	4.25	0.62	3	5
Fine motor percentile	17	42.29	31.44	8	102	13	44.23	28.66	5	95	12	60.83	31.86	16	97
Fine motor quotient	17	91.18	13.35	61	112	13	97.23	13.66	76	124	12	106.25	15.59	85	127
Fine motor grading	17	3.41	1.06	1	5	13	3.77	1.01	2	6	12	4.58	1.08	3	6
Total motor percentile	17	27.94	25.54	2	84	13	42.23	23.97	6	91	12	64.83	19.99	35	93
Total motor quotient	17	87.47	12.92	70	115	13	96.46	11.14	77	120	12	106.83	9.45	94	122
Total motor grading	17	3.23	1.03	2	5	13	3.69	0.75	2	5	12	4.50	0.79	4	6

n = subjects; M = mean; sd = standard deviation; Min = minimum value, Max = maximum value SC= standard score

Table 3 displays significant intergroup differences in the different variables that were assessed. Statistically significant differences are indicated in the standard scores ($p<0.05$) for stationary, loco-motor skills as well as object manipulation between Groups 1 and 3. These differences are also of high practical significance (ES of 1.06; 1.06 and 1.19 respectively). Similar statistically and practically significant differences were also found in the percentiles of the various subtests.

In the visual motor standard score, the differences between Groups 1 and 3 as well as 2 and 3 are statistically significant ($p<0.05$), and the ES of both indicate a large practical significance. The visual motor standard score of Group 2 was the poorest of the three groups. Statistically significant differences are indicated between the gross motor percentile of Groups 1 and 3 as well as Groups 2 and 3. The ES between Groups 1 and 3 (1.80) indicates the largest practical significant difference in all the subtests. There is also a statistically significant difference in the total motor percentile between Groups 1 and 3 and it indicates a large practical significance (ES=1.44). A statistically significant difference also occurred between the gross motor and total motor quotients of Groups 1 and 3 ($p<0.05$), while, likewise, a significant difference ($p<0.01$) was found in the fine motor quotient.

TABLE 3. **SIGNIFICANT INTERGROUP DIFFERENCES WITH REGARD TO PDMS-2 VARIABLES**

	Group 1	Group 2	Group 3	Group 1 and 2	ES	Group 1 and 3	ES	Group 2 and 3	ES
Gross motor	*M*	*M*	*M*	p		P		p	
Stationary SC	7.76	9.23	10.75	-	-	0.0128*	1.06	-	-
Stationary percentile	27.53	41.31	58.08	-	-	0.0076*	1.27	-	-
Loco-motor SC	7.41	9.08	11.25	-	-	0.0017*	1.42	-	-
Loco-motor percentile	26.47	38.39	63.67	-	-	0.0018*	1.49	0.0399*	0.99
Object manipulation SC	8.76	10.08	11.08	-	-	0.0062*	1.19	-	-
Object manipulation percentile	36.41	50.39	63			0.007*	1.2	-	-
Fine motor									
Grasping SC	8.59	11	10.25	0.05*	0.87	-	-	-	-
Grasping percentile	43.53	61	51.67	0.04*	0.68	-	-	-	-
Visual motor SC	8.47	8.08	11.83	-	-	0.0198*	1.08	0.0085*	1.21

Visual motor percentile	35.59	30.77	65.5	-	-	0.0448*	0.95	0.0171*	1.18
Gross motor percentile	25.06	41.77	65.33	-	-	0.0022*	1.80	0.0254*	1.11
Gross motor quotient	86.94	96.54	106.58	-	-	0.0003*	1.52	-	-
Fine motor percentile	42.29	44.23	60.83	-	-	-	-	-	-
Fine motor quotient	91.18	97.23	106.25	-	-	0.033*	0.97	-	-
Total motor percentile	27.94	42.23	64.83	-	-	0.0014*	1.44	-	-
Total motor quotient	87.47	96.46	106.83	-	-	0.0006*	1.48	-	-

*p<0.05; M = mean; ES = effect size; SC= standard score

A stepwise discriminant analysis was performed on the standard scores of the five subtests to determine which exhibited the largest discriminatory value between the three groups. A summary of this analysis is reported in Table 4, while Table 5 shows the classification matrix, which indicates whether the subjects are classified into the correct groups on the basis of the variables (subtests), which discriminate between the groups. Table 6 represents the results of the cross validity which was determined by reclassifying the groups.

According to Table 4, three subtests entered into the model, of which loco-motor skills discriminated most between the groups and was also the only subtest making a statistically significant ($p<0.05$) contribution. Visual motor integration and grasping also contributed to the discrimination between the groups, while stationary and object manipulation was omitted from the model.

TABLE 4. **FORWARD STEPWISE DISCRIMINANT ANALYSIS**

Variable	F-value	Wilks' Lambda
Loco-motor standard score	8.24	0.7029
Visual motor standard score	2.81	0.6125
Grasping standard score	4.26	0.4977

Table 5 indicates the number of children who are correctly placed in their group after the reclassification on the grounds of the discriminant analysis. This percentage varies between 50% and 79%, and Group 1 was reclassified best. The prior probabilities, which were chosen as the

proportion of the groups due to the groups not being of equal size, were (Group 1: 17/42 = 0.4048; Group 2: 13/42 = 0.3095; Group 3: 12/42 = 0.2857) respectively.

TABLE 5. **RECLASSIFICATION OF SUBJECTS IN THE VARIOUS GROUPS**

Group	1 (N = 17)	2 (N = 13)	3 (N = 12)
1	12 (70.59%)	3	2
2	2	9 (69.23%)	2
3	4	2	6 (50%)
Total	18	14	10

The results of the cross validity of the discriminant analysis, which were determined by way of the Jack-knife method, are displayed in Table 6. According to this, the percentage of correct classifications of the different groups varies between 58.82, 46.15 and 50.00%. The better-than-chance index is also calculated, because the cross validity exhibited low values and the practical significance of the discriminant analysis therefore also needed to be analysed. The following formula which was used [(I = $(Ho-He)/(1-He)$, where Ho is the observed hitrate (10+6+6)/42 = 0.524) and He is the expected hitrate (0.4048)(17)+(0.3095)(13)+(0.2857)(12) = 0.341 thus I = (0.524-0.341)/1-0.341)] exhibited a practical significance of 0.28, which is an indication of large practical validity (Huberty & Lowman, 2000).

TABLE 6. **SUMMARY OF THE CROSS VALIDITY OF THE JACK-KNIFE METHOD**

	Group 1	Group 2	Group 3	Total
Group 1	10	3	4	17
Percentage correct	58.82	17.65	23.53	100
Group 2	4	6	3	14
Percentage correct	30.77	46.15	23.08	100
Group 3	4	2	6	12
Percentage correct	33.33	16.67	50.00	100
Total	18	11	13	42
Percentage correct	42.86	26.19	30.95	100

DISCUSSION

The results of the study regarding the percentiles obtained for total motor skills of the infected group (28th percentile), the affected group (42nd percentile) and the non-affected group (65th percentile), showed that the infected group differed significantly from the non-affected group. A comparison with the findings of a study on five to six year old (66.1 months) South African children from poor socio-economic circumstances indicated that the HIV-infected children's loco-motor skills were much poorer (26th percentile compared to 48th percentile), while their total motor quotient was also lower (87.47) compared to 90.84 in a low socio-economic group (Pienaar *et al.*, 2007). This clearly indicates that the infected group already exhibits serious motor deficits compared to other children of the same chronological age, especially the non-affected children. According to the grading scale of the PDMS-2, their development is already below average in comparison to the other two groups, who exhibited average development. Researchers point out that such deficiencies are already noticeable in the first three months of an infected baby's life (Blanchette *et al.*, 2001), while these results are also confirmed by researchers who studied 28 infected and 98 uninfected children (Gay *et al.*, 1995). These researchers also found that motor deficiencies were already evident during the first three months of the baby's life and that it deteriorates in time.

The gross, fine and total motor quotients indicated that the infected group performed below average with regard to the gross motor and total motor skills, while their performance was average in the fine motor skills. Groups 2 and 3 fared average in the gross motor, fine motor and total motor quotients. Furthermore, the infected group performed worst with regard to their gross motor skills (25th percentile), against the 41st and 65th percentiles of Group 2 and 3. A reasonable difference was also recorded between the fine and gross motor skills development of Group 1 in comparison to the other two groups that obtained more or less the same percentile values for fine and gross motor development. These differences between the groups exhibited the largest practical significance (EG = 1.80). It thus seems that the gross motor skill development of the HIV infected group is influenced to a greater degree than their fine motor skills development, although their total development was also below average. These results are in agreement with other literature findings, indicating that the gross motor skills of infected children are affected most by the virus (Msellati *et al.*, 1993; Parks & Danoff, 1999).

The discriminant analysis indicated that loco-motor skills can best distinguish the groups from one another ($p<0.05$). This can possibly be attributed to the fact that large muscle groups underlie the performance of gross motor skills and require physical exertion, whereas fine motor skills require less strength (Parks & Danoff, 1999). This result therefore also confirms that gross motor development of infected children is affected most. The discriminant analysis also provides valuable information regarding the content when compiling motor intervention programmes for such children.

CONCLUSION

A clear tendency of poorer motor development is apparent in young children infected by HIV. The necessity of motor intervention for children with HIV to promote their development and quality of life is therefore emphasized. Literature has also confirmed that additional intervention strategies, improved nutrition and exercise programmes can improve the life expectancy and quality of life of children with HIV (Brady, 1994; Stein *et al.*, 1995). In this regard Lerner (1993) alleges that when handicaps are identified at an early stage and intervention is applied timeously, a significant difference in the growth and development of a child can occur (Lerner, 1993). These results confirm that the emphasis of motor intervention programmes for young children with HIV must be on gross motor skills, especially on loco-motor skills.

These results of the study should be evaluated against the fact that the study had limitations. The progression of the children's HIV status could not be determined due to ethical constraints, and could possibly have played a role in the performance of motor skills, where exhaustion would be apparent earlier in children who have advanced HIV. Further shortcomings are the small research group and the fact that the study was based on an availability sample that made it difficult to generalize the findings to larger populations.

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CHAPTER 4

THE VALUE OF A MOTOR INTERVENTION PROGRAMME FOR 2 TO 6-YEAR OLD CHILDREN INFECTED WITH AND AFFECTED BY HIV

The value of a motor intervention programme for 2 to 6-year old children infected with and affected by HIV

Abstract

Researchers recommended that it is essential for children with HIV to receive motor intervention, since it can promote their life expectancy and quality of life. The experimental group consisted of 22 test subjects of whom 11 were HIV-infected children (51.73 months, SD 10.15) and 11 HIV-affected children (44.45 months, SD 10.76). A two-group (experimental and control group) pre-test-post-test research design was used. The HIV-infected and affected children were randomly matched and grouped into an experimental and control group. The experimental group participated in a 12-week motor intervention programme of 60 minutes per session, twice a week. The effect of the programme was analysed with regard to motor abilities, as established by the PDMS-2 as well as physical abilities. An ANCOVA adjusted for pre-test differences was done to analyse the effect of the programme ($p<0.05$) and effect sizes (ES) were used to determine practical significance of differences. The results indicated that the intervention programme led to statistically significant improvement ($p<0.05$) of loco-motor, fine motor as well as total motor skills. The infected children also showed better improvement compared to the affected children. Modifications for improvement to the programme are suggested, based on the results attained.

THE VALUE OF A MOTOR INTERVENTION PROGRAMME FOR 2 TO 6 YEAR-OLD CHILDREN INFECTED WITH AND AFFECTED BY HIV

Human immunodeficiency virus (HIV)/Aquired Immune Deficiency Syndrome (AIDS) has become one of the largest threats to human health over the past two decades (Chemtob & Srour, 2005), and therefore one of the largest challenges to address (South African Department of Health, 2003). The influence of HIV/AIDS is complex; consequently it involves many implications for planning health services in South Africa (South African Health Review, 2002). Statistics indicate that 2.1 million children under the age of 15 live with the HIV virus worldwide and that 510 000 under the age of 15 have died as a result of AIDS (UNAIDS, 2004).

The increase in orphans (affected children) due to AIDS has increased by 400% from 1994 to 1997, and it is predicted that they will form 9-12% of the population by 2010 (UNAIDS, 2004). The impact of the illness of the parent or caregiver on the child sets in when the parent is diagnosed or becomes ill with HIV/AIDS (Population Council, 2003). A study in this regard indicated that the school attendance of children between ages 13 and 18 had dropped with 26% and their performance with 28% as soon as the parent had fallen ill (Population Council, 2003). The guardians themselves of many of these children have also been infected with the virus, increasing the possibility that many infected children will yield not only one or two but a range of caregivers to death.

According to researchers, children with HIV display neuro-developmental, cognitive, motor and nutritional deficits (Davis-McFarland, 2000; Gay *et al.*, 1995). Research done by Blanchette (2001) confirms statistically significant differences in cognitive and motor development in HIV-infected children, compared to healthy children. This researcher also found that children who are HIV positive already display deficits in developmental milestones in the first two years of their lives, while a study conducted by Gay *et al.*, (1995) found that these deficits already appear during the first three months of the baby's life and that they gradually intensify as the children need to be able to execute more complex and integrated tasks (Gay *et al.*, 1995; Blanchette, 2001).

HIV is associated with exhaustion and a decline in physical functioning along with other aspects, which restrict the person from performing life-sustaining activities (Crystal *et al.*, 2000). In the last-mentioned study it was found that 50% of the children who participated exhibited a chronic inability to perform activities such as attending school. Consequently these children will not be capable of participating in age suited activities such as physical games and sport, or to perform self-care activities such as bathing themselves, if specific attention is not given to the

development of gross motor skills. Research indicates that it is therefor essential for children with HIV to receive motor intervention, since it can promote their life expectancy as well as their quality of life (Brady 1994; Stein *et al.*, 1995; Wilfert, 1996; Parks & Danhoff, 1999). Maintenance of motor skills in aforementioned children can further enable them to participate in activities which directly contribute to cognitive growth and social skills (Parks & Danoff, 1999).

Wilfert (1996) points out that an improvement in lifestyle can also bring about that an increasing number of HIV positive children can survive to adolescence and some even to a more advanced age, of which many in a relatively good health condition. According to Wagner *et al.* (1998), it therefore is important to develop and evaluate health-promoting interventions such as exercise for the potential thereof to promote quality of life, since HIV is increasingly becoming a chronic condition. However, Fundaro et al. (1998) contends that the complexity and multiplicity of the problems of these children require multidisciplinary interventions, based on the child as a whole and presented by professionals with various backgrounds and qualifications.

Having consulted the literature, it became clear that although the necessity of health promoting intervention studies done on children who are infected with and affected by HIV/AIDS has been accentuated, no motor intervention studies have been undertaken on these children as yet. Hence this study is aimed at investigating the value of a motor intervention programme for 2 to 6 year-old children infected with and affected by HIV, and to compare the effect of the programme on the infected and affected subjects who participated in the intervention programme.

Method

Research design

A two-group (experimental group and control group) pre-test-post-test-research design was used by means of which the experimental group was exposed to an intervention programme. Following the first test and before the onset of the intervention, the HIV-infected and HIV-affected children were divided into an experimental and control group by means of random matching. This matching was done due to the fact that it was an availability sample and because the intention was to establish the effect of the intervention programme on both populations. The experimental group participated in the intervention programme, while the other group, which also consisted of matched infected and affected children, served as a control group. For ethical

reasons, the control group was also exposed to an intervention programme after completion of the research.

Participants

The HIV-infected group and HIV-affected group were selected for the study from a Hospice day care centre for HIV-infected and affected children in Potchefstroom (South Africa). Children are only allowed entrance to this day care centre if proof of their HIV status can be furnished, while medical clinics also refer HIV positive children to this facility. The affected children (HIV negative status), are allowed access to the day care centre solely on the proviso that a death certificate of one of or both the parents is provided which states that the death was as a result of an AIDS-related disease such as tuberculosis, pneumonia or cardiac failure.

The HIV-status of the children were determined using the FIRST RESPONSE HIV CARD TEST 1-2.O. The test is an immunochromatographic (rapid) test for the qualitative detection of all isotypes (IgG, IgM, IgA) spesific to HIV-1 including subtype O and HIV-1 in human serum, plasma or whole blood. In a comparison of the FIRST RESPONSE HIV CARD TEST 1-2.O test versus a leading commercial anti-HIV1&2 ELISA and Rapid test, results gave a sensitivity of 100% (120/120), a specificity of 99.18% (121/122) and a total agreement of 99.59% (241/242). Due to only three laboratories processing PCR testing in South Africa, 22% of the total capacity required, rapid tests were used (Meyers *et al.*, 2006).

At the onset of the study the research group consisted of 30 children, of which 8 (6 HIV-infected and 2 affected) left the school in the course of the presentation of the programme. The final research group subsequently consisted of 22 children with a mean age of 49.64 months SD 11.08. The group size of the experimental and control groups as well as the number of infected and affected children consequently also differed. The experimental group comprised of 4 HIV-infected children and 5 HIV-affected children with a mean age of 45.55 months SD 9.13 (4 boys and 5 girls), while the control group consisted of 7 HIV-infected children and 6 HIV-affected children with a mean age of 49.84 months SD 11.96 (10 boys and 3 girls) (Table 1).

Table 1:

Descriptive characteristics of the experimental and control group

	Experimental group (n=9)				**Control group (n=13)**				**Total Group**	
	Boys		**Girls**		**Boys**		**Girls**			
	n	**Age**	***n***	**Age**	***n***	**Age**	***n***	**Age**	***n***	**Age**
HIV-infected	1	46.0	3	50.33	7	53.14	0	-	11	51.73
HIV-affected	3	46.0	2	37.5	3	51.67	3	40.33	11	44.45
Total	4		5		10		3		22	

Note: *n* = number of participants, Age = mean age in months

The children from both these groups were transported to and from the school with a bus belonging to the school on a daily basis. Their socio-economic circumstances were considered low, because their living conditions were characterised by poor sanitary conditions and housing. Although the diet was not compiled by a dietician, they received food from the school daily. This consisted of maize porridge, morvite or soya porridge for breakfast and a fruit for a snack during the course of the morning. Cooked lunches consisted of meat, rice and vegetables with a peanut butter or jam sandwich and at 15:00, a cold drink before going home. The children were also supplied with morvite over the weekends when the school is closed.

Apparatus

Peabody Developmental Motor Scales - second edition (PDMS-2)

The PDMS-2, compiled by Folio and Fewell (2000), consists of six subtests, which measure interdependent abilities during early motor development. It was developed to measure gross and fine motor skills in children from birth to 71 months of age. The subtests consist of reflexes, stationary, loco-motor skills, object manipulation skills, grasping and visual motor integration. The totals of the subtests were presented in a raw score, a percentile, age equivalents, as well as a standard score. The grading of motor development is represented as follows: (1) Very poor; (2) Poor; (3) Below average; (4) Average; (5) Above average; (6) Excellent and (7) Superior. Folio and Fewell (2000:30) contend that the standard score gives the best indication of an individual's progress in the subtests, which is why it is suggested that it be used to compare the subtests with one another. These subtests contribute to a gross motor total (reflex, stationary, loco-motor skills

and object manipulation skills), a fine motor total (grasping and visual motor integration) and an overall motor total. Reflexes are only measured from birth to 12 months. Consequently it was not used in this study. The gross motor total and the fine motor total as well as the total motor total are expressed in percentile as well as quotients. The afore-mentioned is therefore seen as the most reliable value for PDMS-2 (Folio and Fewell, 2000), because these quotients integrate the various subtests and are not reliant on a single subtest and display the child's abilities with regard to gross motor, fine motor as well as total motor abilities.

The PDMS-2 has been tested by Folio and Fewell (2000) as a reliable and valid measuring instrument. The test-retest-reliability coefficient is >0.90, while the internal validity varies between 0.90 and 0.96. The content validity of the PDMS-2 is determined by the skills which are measured and is corroborated by knowledge of motor development which is already available. It was also found that the test battery was suitable for use with any race, sex or ethnicity.

Physical abilities

Determining physical ability was based on the following strength tests:

- Left and right handgrip strength (kg), measured using the Lafayette handgrip dynamometer (Wood, 1997).
- Standing long-jump – The child stands with his feet beside each other and the toes touching the measuring tape at 0cm. The knees are bent, the arms are swung and a forward jump is performed. The measurement is taken at the back of the child's heals, unless the child steps back or falls, in which case the measurement is taken at the mark closest to the beginning (0 cm). Each child was afforded two opportunities and the best result was noted.

Procedure

The North-West University in Potchefstroom, South-Africa provided ethical approval for conducting the study (nr. 06M02). Having received permission from the director of the Hospice in question and from the completed informed consent forms of the parents/guardians, the child was included in the study. The HIV status of the children was determined by the clinic responsible for their health. The research took place at the day care centre during school hours. Trained translators were used to ensure that the children understood the instructions.

Intervention programme

The programme was based on loco-motor skills, stationary skills, object manipulation skills, visual-motor skills, grasping improvement as well as the stimulation of aspects such as vestibular,

reflex inhibition and indirect improvement of physical skills. A 12-week intervention programme of 60 minutes per session was presented twice a week during the morning hours from 10:00 to 11:00. The 60 minutes consisted of group activities. Gross motor skills received the largest amount of attention during the programme, because, according to the literature, it is worst affected if a child is HIV positive. The activities were often alternated and rest periods were built in to compensate for the attention span of the children and for exhaustion. Subsequently a schematic exposition is given of a typical lesson at the beginning and the end of the intervention period with the view to indicate the progression of the programme.

Week 3

Loco-motor and physical skills (7 min)

Crab walking

Baboon walking

Frog jumping

Hopping

Galloping

Reflexes and Vestibular (5 min)

Boat rolling

Aeroplane

Trunk rolls

Fine motor (10 min)

Pressing sticks into clay and removing them again — using different fingers

Threading a string through holes in a piece of cardboard

Loco-motor and physical skills (5 min)

Two-leg jumping

Single-leg jumping

Learning steps for skipping — hoop

Rest period (3 min)

Stationary (10 min)

Standing on one leg with eyes open, eyes closed

Walking on ropes placed in forms – forwards, backwards, oblique, legs crossed

Object manipulation (10 min)

Tossing up a large ball and catching it

Rolling a ball forward

Rolling a ball into goal area

Kicking a ball

Kicking a ball into the goal area

Fine motor (5 min)

Colouring a picture

Game (5 min)

Parachute game

Week 10

Loco-motor and physical skills (7 min)

Crab walking through and over different objects (hoops, frisbees)

Baboon walking through and over different objects (hoops, frisbees)

Frog jumping over frisbees

Hopping through objects

Galloping through objects

Reflexes and Vestibular (5 min)

Boat rolling on ball

Aeroplane on ball

Trunk rolls

Fine motor (10 min)

Attaching laundry pegs to shapes — using different fingers

Threading string through different forms of noodles

Loco-motor and physical skills (5 min)

Two-leg jumping - over and on small benches

One-leg jumping – around small benches

Skipping

Rest period (3 min)

Stationary (10 min)

Frisbee - on different body parts

Standing on frisbee on one leg with eyes open, eyes closed

Walking on edge of hoops – forwards, backwards, oblique, legs crossed

Object manipulation (10 min)

Tossing up a ball and catching it – Bigger children use tennis balls

Rolling ball through markers

Kicking a ball softly

Kicking a ball through markers

Tossing a ball into a bucket – increase distance

Fine motor (5 min)

Duplicating, cutting out and colouring a picture

Game (5 min)

Parachute game with balls

Statistical procedure

The data was analysed using Statistica for Windows (StatSoft, Inc S.A., 2006). Descriptive statistics were used to determine means (M), standard deviations (SD) and maximum and minimum values. An independent T-test was done to determine whether any statistically significant differences occurred between the HIV-infected and affected children before they were matched into an experimental group and control group. Furthermore, a dependent T-test was used to compare the differences between the pre-test and post-test results within the groups, as well as within the infected and affected groups. Due to differences found in the pre-test values of the experimental and control group, an ANCOVA was done to equalize the groups. Adapted means (Table 3) were calculated by means of the ANCOVA (Thomas & Nelson, 1996) in which the pre-test was used as a co-variable to determine the effect of the intervention programme based on the post-test means. The level of statistical significance was set at $p<0.05$. Practical significance of differences (ES) between the testing sessions were calculated by dividing the mean difference (M) between the two testing sessions by the largest standard deviation (SD), as recommended by Cohen (1988) and Steyn (1999). Cohen (1988) set the following guidelines for interpreting practical significance, namely ES = 0.2 (small effect); ES = 0.5 (medium effect) and ES = 0.8 (large effect). Due to the small number of subjects it was considered practically significant if this effect size indicates a medium and larger effect.

Results

Table 2 presents the means and standard devians obtained by the affected and the infected children before they were matched into an experimental group and a control group. No statistically significant differences ($p<0.05$) was found before the onset of the intervention programme between the infected and affected subjects (Table 2). From this it can be assumed that the groups were more or less similar regarding age, all the components measured with the PDMS-2 as well as physical skills before they were matched into an experimental group and a control group.

Table 2

Significance of differences between the HIV-infected and affected children before matching them into an experimental group and control group

	Infected participants (n = 11)		**Affected participants (n = 11)**		
	M	***SD***	***M***	***SD***	***p***
Age	51.73	10.15	44.45	10.76	0.1187
Stationary-S	8.18	2.79	9.45	3.05	0.3187
Stationary-P	31.64	25.46	42.64	30.96	0.3736
Loco-motor-S	7.45	2.30	9.09	2.74	0.1444
Loco-motor-P	25.00	21.48	37.64	26.13	0.2297
Object manipulation-S	9.45	2.21	9.91	2.43	0.6508
Object manipulation-P	43.91	25.34	49.00	27.25	0.6549
Grasping-S	9.64	1.96	11.64	3.17	0.0905
Grasping-P	44.82	22.19	64.91	27.15	0.0719
Visual-motor-S	9.45	3.33	8.09	2.26	0.2739
Visual-motor-P	46.18	34.43	30.55	23.52	0.2280
Gross motor-P	30.55	24.29	42.09	25.63	0.2910
Gross motor-Q	89.82	13.48	96.64	11.31	0.2134
Fine motor-P	43.82	25.80	47.64	30.41	0.7541
Fine motor-Q	97.00	11.30	99.18	15.12	0.7056
Total motor –P	34.45	24.35	43.82	28.36	0.4159
Total motor-Q	92.18	12.60	97.18	13.56	0.3810
Handgrip strength-right	4.05	1.68	3.77	2.26	0.7515
Handgrip strength-left	3.27	1.75	3.50	2.10	0.7855
Standing long-jump	42.09	23.12	44.14	34.07	0.8708

Note: *p<.05; M = mean, SD = standard deviation, S = standard score; P = percentile, Q = quotient

Table 3 displays the results of the experimental and control group with regard to the pre-test and the post-test as well as statistically significant differences between the testing sessions. It appears from Table 3 that the experimental group had improved statistically significantly ($p<0.05$) in some of the skills during the post-test. The standard score for grasping as well as the fine motor quotient and percentile, and the total motor percentile and quotient improved statistically significantly in this group ($p<0.05$). Opposed to this, the control group displayed a statistically significant ($p<0.05$) deterioration in the fine motor percentile as well as the fine motor quotient. Lower values were also found in the visual-motor percentile, gross motor percentile and quotient and in the total motor percentile and quotient during the post-test, although these differences were not statistically significantly lower. The rest of the motor and physical skills remained more or less at the same level in the control group.

Table 4 displays the results of the analysis done by means of an ANCOVA to determine the effect of the intervention programme. The analysis was done because t-testing indicated that significant intra-group differences during pre-testing between the experimental and control groups occured; hence these differences had to be adjusted for by means of an ANCOVA (Table 4). According to these results where the pre-test was used as a co-variable during the analysis of the data the intervention programme led to statistically significant improvement in post-test values in the standard score $F(1.19) = 4.44$ ($p = 0.04$) and the percentile $F(1.19) = 5.15$ ($p = 0.03$) of loco-motor skills, with effect sizes of 0.82 and 0.96 respectively, which indicates a large practical effect. The percentile $F(1.19) = 9.22$ ($p = 0.007$) and quotient $F(1.19) = 11.396$ ($p = 0.003$) of fine motor skills also indicated statistically significant differences between the groups, with effect sizes of 1.66 and 2.02 respectively, which is indicative of a large practical effect. The total motor percentile $F(1.19) = 3.81$ ($p = 0.07$) and quotient $F(1.19) = 4.44$ ($p = 0.05$) had also improved, with effect sizes showing a large practical effect (0.88 and 0.96).

Table 3:

Comparison between the pre-test and the post-test in the experimental and control groups

	Experimental group (n = 9)					Control group (n = 13)				
	Pre-T		Post-T			Pre-T		Post-T		
	M	*SD*	*M*	*SD*	*p*	*M*	*SD*	*M*	*SD*	*p*
Stationary-S	7.44	2.30	8.11	2.85	0.5632	9.77	3.00	9.69	2.72	0.8506
Stationary-P	25.00	17.79	33.44	25.29	0.3718	45.54	31.57	45.08	28.91	0.9172
Loco-motor-S	8.22	3.35	10.00	2.40	0.1614	8.31	2.10	8.23	2.35	0.7938
Loco-motor-P	29.67	29.73	50.56	25.88	0.0869	32.46	20.84	32.69	22.94	0.9370
Object manipulation-S	9.44	2.01	10.78	2.22	0.2249	9.85	2.51	9.92	1.93	0.8078
Object manipulation-P	43.67	22.54	57.33	23.60	0.2419	48.38	28.59	49.00	23.37	0.8449
Grasping-S	9.44	2.19	10.89	2.52	*0.0499	11.46	2.90	11.15	2.03	0.4874
Grasping-P	44.44	25.27	60.11	26.72	0.0694	62.08	25.41	61.92	21.35	0.9733
Visual-motor-S	7.78	2.77	9.11	2.47	0.2133	9.46	2.82	8.92	2.96	0.3156
Visual-motor-P	28.11	28.23	37.78	24.35	0.3613	45.46	29.94	39.69	31.02	0.3407
Gross motor-P	31.44	23.29	45.22	21.50	0.1965	39.69	26.61	35.62	25.14	0.6412
Gross motor-Q	90.11	13.25	97.67	9.29	0.1757	95.38	12.24	93.62	11.69	0.6508
Fine motor-P	31.67	22.22	51.11	24.73	*0.0068	55.46	27.42	41.38	31.51	*0.0432
Fine motor-Q	91.33	10.44	100.00	11.62	*0.0064	102.77	12.99	94.92	16.81	*0.0237
Total motor –P	29.67	22.51	47.11	20.70	*0.0291	45.69	27.44	36.77	28.02	0.2460
Total motor -Q	89.56	11.96	98.22	9.60	*0.0339	98.23	12.98	93.46	14.12	0.1770
Handgrip strength-right	3.06	2.21	3.32	2.41	0.0941	4.50	1.57	4.65	1.66	0.1654
Handgrip strength-left	3.11	1.95	3.33	1.92	0.1690	3.58	1.90	3.65	2.06	0.5486
Standing long-jump	40.56	28.89	40.78	29.16	0.5588	44.88	29.16	45.81	29.15	0.0821

Note: *p<.05; M = mean, SD = standard deviation, S = standard score; P = percentile, Q = quotient, Pre-T = Pre-test, Post-T = Post-test

Table 4

Adapted post-test means calculated with an ANCOVA with the pre-test as a co-variable

	Experimental group (n=9)		Control group (n=13)		
	M	*SD*	*M*	*SD*	*ES*
Stationary-S	8.98	0.78	9.09	0.64	-
Stationary-P	42.22	6.95	39.00	5.71	-
Loco-motor-S	10.03	0.66	8.21	0.55	0.82
Loco-motor-P	51.53	6.60	32.02	5.49	0.96
Object manipulation-S	10.89	0.59	9.84	0.49	-
Object manipulation-P	58.84	6.40	47.96	5.32	-
Grasping-S	11.67	0.51	10.61	0.42	-
Grasping-P	66.94	5.97	57.20	4.91	-
Visual-motor-S	9.74	0.75	8.49	0.62	-
Visual-motor-P	44.05	7.81	35.35	6.44	-
Gross motor-P	46.34	7.94	34.84	6.59	-
Gross motor-Q	98.35	3.61	93.14	3.00	-
Fine motor-P	62.84	7.19	33.26	5.87	1.66
Fine motor-Q	106.45	3.50	90.46	2.85	2.02
Total motor –P	52.35	7.41	33.14	6.11	0.88
Total motor-Q	101.25	3.57	91.36	2.94	0.95
Handgrip strength-right	4.22	0.14	4.03	0.11	-
Handgrip strength-left	3.61	0.15	3.46	0.13	-
Standing long-jump	43.34	0.52	44.03	0.43	-

Note: *p<.05; *M* = mean, *SD* = standard deviation, *ES* = effect size, S = standard score; P = percentile, Q = quotient

Table 5 displays the pre-test and post-test results of the infected and affected subjects in the experimental and control groups respectively, since the second aim of the study was to determine whether infected and affected children would react differently to intervention.

The infected children in the experimental group improved statistically significantly regarding their loco-motor standard score and percentile as well as their total motor percentile ($p<0.05$). These improvements showed a large practical effect ($ES>0.8$). The affected subjects in the experimental group showed statistically significant ($p<0.05$) improvement in the fine motor percentile as well as quotient, although the improvement had a small to medium effect ($ES>0.5$).

In the control group, the affected subjects deteriorated statistically significantly with regard to the fine motor percentile as well as the quotient ($p<0.05$), with an ES of 1.27 and 0.17 respectively. Although several values were lower during the post-test in the infected group, no statistically significant changes had occurred in the group.

Table 5:

Comparison of the pre- and post-test results of the infected and affected children in the experimental and control groups

Experimental group	**Infected group (n = 4)**							**Affected group (n = 5)**						
	Pre-T		**Post-T**					**Pre-T**		**Post-T**				
	M	***SD***	***M***	***SD***	***Diff***	***p***	***ES***	***M***	***SD***	***M***	***SD***	***Diff***	***p***	***ES***
Stationary-S	7.25	3.1	8	2.58	0.75	0.689	-	7.6	1.82	8.2	3.35	0.6	0.732	-
Stationary-P	26	21.8	30.3	25.6	4.25	0.751	-	24.2	16.6	36	27.8	11.8	0.442	-
Loco-motor-S	6.5	1.73	9.75	1.89	3.25	*0.022	1.72	9.6	3.85	10.2	2.95	0.6	0.77	-
Loco-motor-P	15	14.8	48	22.2	33	*0.038	1.49	41.4	34.9	52.6	31	11.2	0.558	-
Object manipulation-S	8.25	1.71	11.5	2.65	3.25	0.184	-	10.4	1.82	10.2	1.92	-0.2	0.704	-
Object manipulation-P	30.3	17.5	64.3	25.9	34	0.182	-	54.4	21.5	51.8	22.9	-2.6	0.704	-
Grasping-S	8.25	0.96	10.8	1.5	2.5	0.096	-	10.4	2.51	11	3.32	0.6	0.374	-
Grasping-P	28.8	10.2	59.3	19	30.5	0.09	-	57	27.5	60.8	34	3.8	0.529	-
Visual-motor-S	7.75	3.59	8.5	0.58	0.75	0.729	-	7.8	2.39	9.6	3.36	1.8	0.152	-
Visual-motor-P	28.5	37.3	31	6.93	2.5	0.912	-	27.8	23.5	43.2	32.7	15.4	0.163	-
Gross motor-P	21.5	18.9	46.3	11.7	24.8	0.069	-	39.4	25.3	44.4	28.6	5	0.769	-
Gross motor-Q	84	14.7	98.5	4.43	14.5	0.147	-	95	11.1	97	12.5	2	0.774	-
Fine motor-P	21.5	13.8	44.3	13.2	22.8	0.119	-	39.8	25.7	56.6	31.7	16.8	*0.045	0.53
Fine motor-Q	87.3	6.65	97.8	5.12	10.5	0.11	-	94.6	12.4	102	15.5	7.2	*0.042	0.46
Total motor –P	18.5	14.8	44.3	10.1	25.8	*0.046	1.77	38.6	25	49.4	27.7	10.8	0.328	-
Total motor-Q	84	10.8	97.8	3.86	13.8	0.079	-	94	12	98.6	13.2	4.6	0.308	-
Handgrip strength-right	2.38	0.48	2.75	0.29	0.37	0.215	-	3.6	2.97	3.78	3.31	0.18	0.374	-
Handgrip strength-left	2.63	0.48	2.88	0.25	0.25	0.391	-	3.5	2.65	3.7	2.64	0.2	0.374	-
Standing long-jump	39.3	34	39.3	34	0		-	41.6	28.3	42	28.8	0.4	0.587	-
Control group	**Infected group (n = 7)**							**Affected group (n = 6)**						
Stationary-S	8.71	2.69	9.14	3.02	0.43	0.534	-	11	3.1	10.3	2.42	-0.7	0.102	-
Stationary-P	34.9	28.5	38.6	30.4	3.71	0.643	-	58	32.8	52.7	27.8	-5.3	0.121	-

Loco-motor-S	8	2.52	8.14	2.79	0.14	0.766	-	8.67	1.63	8.33	1.97	-0.3	0.363	-
Loco-motor-P	30.7	23.6	33.3	26.5	2.58	0.582	-	34.5	19.2	32	20.5	-2.5	0.51	-
Object manipulation-S	10.1	2.27	9.86	1.95	-0.3	0.172	-	9.5	2.95	10	2.1	0.5	0.456	-
Object manipulation-P	51.7	26.9	48.7	23.7	-3	0.178	-	44.5	32.6	49.3	25.3	4.83	0.465	-
Grasping-S	10.4	1.99	10.6	1.27	0.14	0.838	-	12.7	3.5	11.8	2.64	-0.8	0.141	-
Grasping-P	54	22.3	56.7	15	2.71	0.756	-	71.5	27.5	68	27.3	-3.5	0.15	-
Visual-motor-S	10.4	2.99	9.57	3.05	-0.9	0.37	-	8.33	2.34	8.17	2.93	-0.2	0.741	-
Visual-motor-P	56.3	30.9	46.7	32.2	-9.6	0.381	-	32.8	25.5	31.5	30.3	-1.3	0.802	-
Gross motor-P	35.7	26.8	30.3	27	-5.4	0.744	-	44.3	28.1	41.8	23.6	-2.5	0.636	-
Gross motor-Q	93.1	12.6	90.7	13	-2.4	0.745	-	98	12.4	97	9.94	-1	0.649	-
Fine motor-P	56.6	22.2	34.7	30.3	-22	0.092	-	54.2	34.8	49.2	33.9	-5	*0.057	1.27
Fine motor-Q	103	9.55	90.6	17.3	-12	0.06	-	103	17.2	100	16.2	-3	*0.041	0.17
Total motor –P	43.6	24.7	30	28.4	-14	0.352	-	48.2	32.6	44.7	27.9	-3.5	0.397	-
Total motor Q	96.9	11.7	89.4	14.9	-7.4	0.265	-	99.8	15.3	98.2	12.7	-1.7	0.358	-
Handgrip strength-right	5	1.29	5.14	1.35	0.14	0.356	-	3.92	1.77	4.08	1.93	0.16	0.363	-
Handgrip strength-left	3.64	2.14	3.71	2.45	0.07	0.766	-	3.5	1.79	3.58	1.72	0.08	0.363	-
Standing long-jump	43.7	17.5	44.3	17.2	0.58	0.172	-	46.3	40.9	47.6	41	1.33	0.235	-

Note: *p<.05; M = mean, SD = standard deviation, ES = effect size, S = standard score; P = percentile, Q = quotient, Pre-T = Pre-test, Post-T = Post-test, Diff = difference between Pre-T and Pos-T

Discussion

The total motor, fine motor as well as loco-motor skills of the children in the experimental group benefited statistically significantly ($p<0.05$, $ES>0.5$) from the intervention programme. The improvement of loco-motor skills, can be ascribed to the fact that the programme predominantly focussed on such skills, seeing that these are the skills which are worst affected, according to the literature (Brady, 1994; Stein *et al.*, 1995; Wilfert, 1996; Parks & Danoff, 1999; Crystal *et al.*, 2000). The fine motor skills of the control group deteriorated statistically significantly ($p<0.05$) during the intervention period, while the skills of the experimental group had improved statistically significantly ($p<0.05$). In this respect, Wagner *et al.* (1998) points out that HIV is increasingly becoming a chronic condition and that these children can survive longer.

Consequently it is important to improve fine motor skills, since 50% of an average school day is devoted to fine motor activities (Amundson & Weil, 1996). In this respect, Cantell *et al.* (1994) also indicated that fast and efficient handwriting would have an impact on a child's scholastic performance. It is evident from the results that the intervention programme did indeed lead to an improvement in total motor skills in the experimental group, although not statistically significantly in all the skills. Analyses of the intervention programme, indicates that the largest portion of time was devoted to the skills which did improved statistically significantly (loco-motor and fine motor skills). Although the total motor skills of the experimental group also improved statistically significantly, more improvement could possibly have taken place in specific skills, if more attention had been given to it (stationary and object manipulation).

It might be that these children react differently to intervention, and some of them might need exposure to a wide variety of activities, whereby the amount would be the determining factor, while a more qualitative approach is more important in those skills which did not improve. Another possibility is that the intervention period might have been too short. Very little change had also taken place in the physical skills of the experimental group (standing long-jump and handgrip strength) during the intervention period, from which can be deduced that more activities will need to be included in an intervention programme so as to bring about improvement regarding these aspects.

From the results it furthermore appears that the infected children reacted better to the intervention programme regarding loco-motor and total motor skills (ES >0.8) than the affected children in the group. It can possibly be ascribed to the fact that the infected children performed poorer during the pre-test with more room for improvement in this group. The responsiveness of these children to motor intervention is also evident from the differences between the pre-test and post-test values which, compared to the infected children in the control group, all indicated larger improvement. The fine motor skills of the affected children in the experimental group had improved statistically significantly, while the fine motor skills of the affected children in the control group deteriorated statistically significantly. It therefore seems from the results that children infected and affected by HIV/AIDS can indeed benefit from a motor intervention programme, and that infected children are especially receptive for such a programme. However, it is recommended that a few adaptations be made to the programme content and duration in order for the programme to become more effective. The intervention programme was also presented in a group context but, based on the results attained, it is recommended that an individual approach be followed during the presentation of intervention programmes for children

with HIV/AIDS, since such a approach might lead to more marked improvements in motor ability. Sensory-neurological evaluations coupled with the PDMS-2 evaluation are also recommended in order to determine the nature of the underlying problems in order to increase the effect of the motor intervention.

A shortcoming of this study is the fact that the progression of the disease of the children could not be established due to the ethical aspects attached to it. It could possibly have played a role in the execution and improvement of motor skills, because exhaustion will probably set in faster with children in whom HIV is in a more advanced stage. The small experimental group also makes it difficult to generalise the findings to a larger population.

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CHAPTER 5

THE GROWTH STATUS OF 2 TO 6-YEAR OLD CHILDREN INFECTED WITH HIV

The growth status of 2 to 6-year old children infected with HIV

Running title: Growth status of HIV-infected children

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Abstract

Research indicates that children infected with HIV often show growth impediments and that they are smaller in both height and weight-for-age. The aim of the study was to determine the growth status of 2 to 6-year old children in the North-West Province, South Africa, who are infected with HIV and to compare it with children who are affected and non-affected by the virus. An HIV-infected (n=17) and an affected group (n=13) from a Hospice day-care centre, together with a non-affected group (n=11), were selected to be participants in this study. The subjects were more or less from the same socio-economic circumstances. All the subjects were subjected to a series of anthropometric measurements of height, weight, circumference (hip, waist, upper arm, both tensed and relaxed) as well as skin folds (triceps, sub-scapular, calf) according to standard procedures. Fat percentage, body mass index, as well as stunting and wasting were calculated. From the descriptive statistics that were analysed by means of Statistica, it appears that the infected group displays the poorest growth status of the three groups compared to the Centre for Disease Control (CDC) growth profiles, although they do not differ significantly from the affected children. The infected children differ significantly from the non-affected group regarding height percentile, fat percentage and height-for-age Z-score (HAZ). This group showed serious signs of being underweight and stunted, while wasting did not occur among them. It is concluded that it is important to monitor growth of children who are HIV-infected or at risk for infection, since it can be an indication of possible infection or disease progression. Further research is recommended to substantiate the results of this study.

Keywords: HIV; AIDS; children, pediatrics, growth, deficiencies

Introduction

Human immunodeficiency virus (HIV) has been considered one of the largest threats to human health over the past two decades (Chemtob & Srour, 2005). The influence of this disease is complex and consequently has many implications for the planning of health services, especially for the children who are affected by it (South African Health Review, 2002). Growth retardation, depletion of fat stores as well as neuro-developmental deficiencies in children infected with HIV/AIDS are indicated as problems in the literature (Aylward *et al.*; 1992; Miller & Garg, 1998; Davis-McFarland, 2000). In this respect Luster *et al.*, (2005) report that children infected with HIV often do not grow normally and that they are smaller in both height and weight-for-age. Subsequently, it is important to monitor growth in HIV/AIDS-infected children, since growth retardation can be an indication of infection or disease progression, according to Bobat *et al.* (2001). Babies who display serious stunting and wasting run an increased risk of early death and must be thoroughly monitored (Bobat *et al.*, 2001).

A study conducted by Bobat *et al.*, (2001) in the Durban area of South Africa, indicated that infected children already display significant differences in height as well as weight at three months, six months and 12 months, as opposed to uninfected children, although there were no statistically significant differences between the groups at birth. The infected group displayed a sustainable under-average height-for-age as well as weight-for-age from three months, although not weight-for-height (Bobat *et al.*, 2001). In the afore-mentioned study, infected children who died early displayed more seriously low height-for-age and weight-for-height as well as malnutrition than the children who survived to a later age (Bobat *et al.*, 2001). Infected children display an earlier and sustained lower height-for-age as well as malnutrition, although children with a fast progression of the disease experience both lower height-for-age and lower weight-for-height. Non-infected children showed average height-for-age and malnutrition although it only appeared at a later age, while under-average weight-for-height did not occur among them (Bobat *et al.*, 2001).

McKinney (1998) states that HIV contributes to growth retardation in two ways. The most common is growth retardation in height as well as weight, which already occurs during the first three to four months of the baby's life. The other is a relative loss of weight-for-height which occurs at the end of the HIV infected child's life and which is evident in serious weight loss.

According to this researcher, these children's weight-height-ratio is normal, even though they are shorter and lighter than their age group (McKinney, 1998).

The European Collaborative Study (2003) monitored the growth of 1 587 children from birth to 10 years of age. At three months the infected group already weighed 460 g less than the non-infected group, and these differences in weight increased with age. Infected children were also significantly shorter and lighter than non-infected children and both the differences increased with age. The largest increase in growth rate was after two years for height and after four years for weight. Between six and 12 months the non-infected children increased 1,6% faster in height and 6,2% faster in weight than the infected children. These growth differences were 16 and 44% between eight and 10 years respectively. At 10 years of age the non-infected children weighed 7 kg (22%) heavier and were 7,5 cm (5.6%) taller.

Eley *et al.* (2002) conducted a study in Cape Town among 60 HIV-infected children of an average age of 25 months. This study indicated that more than 25% of the children were underweight, while more than 50% of the children displayed a low height-for-age. Henderson *et al.* (1999) also confirmed that HIV-infected children's weight is statistically significantly lower than that of non-infected children of the same age.

This study aims to determine the growth status of 2 to 6-year old children who are infected by HIV and to compare it with affected and non-affected children.

Method

Empirical investigation

Research design

A three-group cross-sectional research design was used for analysing the results.

Investigation group

The total group consisted of 41 black subjects living in the North-West Province of South Africa, of whom the ages varied between 2.7 years (33 months) and 6.8 years (68 months). The total group was divided into three groups: an HIV-infected group (Group 1), an HIV-affected group (Group 2) and an non-affected group (Group 3). Group 1 consisted of 12 boys (between ages 3.8 and 6.8 years, SD 0.94) and 5 girls (between 2.7 and 4.5 years, SD 0.78). Group 2 consisted of 7 boys (between ages 2.9 and 6.6 years, SD 1.37) and 6 girls (between 3.5 and 6.3 years, SD 1.24) and Group 3 comprised 5 boys (between 2.8 and 5.7 years, SD 1.19) and 6 girls (2.9 and 5.6 years, SD 1.05). The ages within the various groups as well as genders differed slightly, since this was an availability sample.

The HIV-infected group (Group 1) and HIV-affected group (Group 2) were selected at a Hospice day care centre for HIV-infected and affected children in Potchefstroom (South Africa) according to availability. Children are only allowed entrance to this day care centre if proof of their HIV status can be furnished, while medical clinics also refer HIV positive children to this day care facility. The affected children (HIV negative status, Group 2), are allowed access to the day care centre solely on the proviso that a death certificate of one of or both the parents is provided which states that the death was as a result of an AIDS-related disease such as tuberculoses, pneumonia or cardiac failure. A control group (Group 3) of children who were not infected with or affected by HIV was compiled from the Klerksdorp area near Potchefstroom. The control groups (Groups 2 and 3) were also selected on the basis of their age, sex, race and socio-economic status being similar to those of the experimental group.

The HIV-status of the children was determined using the FIRST RESPONSE HIV CARD TEST 1-2.O. The test is an immunochromatographic (rapid) test for the qualitative detection of all isotypes (IgG, IgM, IgA) spesific to HIV-1 including subtype O and HIV-1 in human serum, plasma or whole blood. In a comparison of the FIRST RESPONSE HIV CARD TEST 1-2.O test versus a leading commercial anti-HIV1&2 ELISA and Rapid test, results gave sensitivity of 100% (120/120), a specificity of 99.18% (121/122) and a total agreement of 99.59% (241/242). Due to only three laboratories processing PCR testing in South Africa, 22% of the total capacity required, rapid tests are used in South Africa (Meyers *et al*, 2006).

Measuring instruments

All the subjects within the different groups were subjected to a series of anthropometric measurements of height, weight, circumference (hip, waist, upper arm - both tensed and relaxed), as well as skin folds (triceps, sub-scapular, calf), in accordance with standard procedures as prescribed by the International Society of Advanced Kinanthropometry (ISAK). Height was measured to the nearest 0.1 cm, an electronic scale was used to determine weight to the nearest 0.1 kg, the circumferences were measured to the nearest 0.1 cm, while the skin folds were measured with Harpendum skinfold pliers to the nearest 0.2 mm. The fat percentage as well as the bodymass index (BMI) (kg/m^2) was calculated for each participant.

The triceps, calf and sub-scapular skin folds were measured and the formula from Boileau *et al.* (1985) for determining fat percentage was used. Seeing that no norms exist for South African children, the interpretation of BMI and fat percentage according to Lohman (1992) and height and weight according to the Centre for Disease Control's growth profiles (CDC, 2003) were used. The rating for fat percentage is represented as follows: (1) Very low; (2) Low; (3) Optimal range; (4) Moderately high; (5) High (6) and Very high. Values indicating stunting, wasting, under and overweight as well as obesity were calculated, and the following definitions of the different variables are relevant for this study:

- *Stunting* – height-for-age Z-score (HAZ) below the median by more than minus two standard deviations (<-2SD).
- *Wasting* – weight-for-height Z-score (WHZ) below the median by <-2SD.
- *Underweight* – weight-for-age Z-score (WAZ) below the median by <-2SD.
- *Overweight* – WHZ above the median by >1SD.
- *Obesity* – WHZ above the median by >2SD.

Research procedure

Ethical approval for undertaking the study was granted by the North-West University (nr. 06M02). Having obtained permission from the director of the Hospice involved and having received informed written consent from the parents/guardians, a child was included in the study for testing. The clinic responsible for their health determined the HIV status of the children twice

a year. The research was conducted at the day-care centre during school hours. Trained translators were used to ensure that the children understood the instructions.

Statistical analysis

The data was analysed by means of the Statistica for Windows (Statsoft, Inc S.A., 2006) computer program. Descriptive statistics were used to determine means (M), standard deviations (SD) and maximum and minimum values, as well as frequency tables and "box-en-whisker plots". The SAS software (SAS Institute Inc, 2000-2003) were used to determine the Z-scores of some variables. A variance of analysis was used to determine differences between the groups. Practical significance of differences (ES) between the testing sessions was calculated by dividing the mean difference between the two test sessions by the largest standard deviation (SD), as recommended by Cohen (1988) and Steyn (1999). Cohen (1988) set the following guidelines for the interpretation of the practical significance, namely ES = 0.2 (small effect); ES = 0.5 (medium effect) and ES = 0.8 (large effect). Due to the number of subjects, it was regarded practically significant if the effect size showed a medium effect or larger.

Results

Table 1 displays the results of the descriptive information of the different groups regarding the different aspects that reflect their growth status. Table 2 indicates the distribution of subjects within the various groups in accordance with the growth percentile of CDC for weight and height, while Figures 1 and 2 indicate the distribution around the mean of weight and height, as well as the mean standard deviation.

It appears from Table 1 that the mean weight of the HIV-infected group (Group 1) (13.82, sd 2.48) lies on the 5th percentile (5.88) according to the CDC growth profile (CDC, 2000), while their mean height (95.29, sd 7.25) (CDC, 2000) lies below the 5th percentile (2.94). The fat percentage (13.74, sd 4.92) of the group can be considered as low, according to the ratings of Boileau *et al.* (1985), although it is very near to the optimal range. The children's relaxed upper arm circumference was 14.82 (sd 1.20), while the tensed circumference was approximately 15.29 (sd 1.39).

The mean weight (13.65, sd 2.84) of the HIV-affected group (Group 2) lies between die 5th and 10th percentile (8.46) (CDC, 2003), while their height (93.62, sd 9.89) (CDC, 2000) lies on the 5th percentile (5.77). Fat percentage (14.31, sd 3.28) of this group can be considered to be low, although it is very near to the optimal range. The children's relaxed upper arm circumference was 15.04 (sd 1.13), while the tensed circumference was 15.96 (sd 1.31).

The mean weight (14.55, sd 2.80) as well as height (98.95, sd 8.63) of the non-affected group (Group 3) lies between the 10th and 25th percentile according to the CDC growth norms (CDC, 2000). The children's relaxed upper arm circumference was 15.27 (sd 1.29), while the tensed circumference is 16.05 (sd 1.23). Fat percentage (10.18, sd 3.34) in this group can be considered to be low.

Table 1: Descriptive statistics of the different groups

	Group 1					Group 2					Group 3				
	N	**M**	**sd**	**Min**	**Max**	**N**	**M**	**sd**	**Min**	**Max**	**N**	**M**	**sd**	**Min**	**Max**
Age	17	4.76	1	2.7	6.8	13	4.29	1.26	2.9	6.6	11	4.34	1.14	2.8	5.7
Weight	17	13.82	2.48	9.0	18.85	13	13.65	2.84	9.60	19.05	11	14.55	2.80	10.50	20.30
Weight-percentile	17	5.88	9.72	<5	25	13	8.46	6.58	<5	25	11	18.18	18.48	<5	50
Height	17	95.29	7.25	82.0	108.00	13	93.62	9.89	80.00	109.00	11	98.95	8.63	85.00	114.00
Height-percentile	17	2.94	4.35	<5	10	13	5.77	9.32	<5	25	11	21.36	20.99	<5	50
Triceps skin fold	17	9.35	2.98	5.0	16.00	13	9.42	2.04	7.00	12.50	11	7.18	1.40	5.00	10.00
Sub-scapular skin fold	17	6.00	2.27	3.0	13.00	13	5.96	1.39	4.00	8.00	11	4.18	1.17	3.00	6.00
Calf skin fold	17	9.38	4.56	4.0	22.00	13	8.23	1.52	6.00	10.50	11	6.77	2.11	3.50	10.00
Fat percentage	17	13.74	4.92	6.0	22	13	14.31	3.28	9	20	11	10.18	3.34	5.00	16.00
Fat percentage rating	17	2.82	0.64	2.0	4	13	2.62	0.51	2	3	11	2.09	0.70	1.00	3.00
Bodymass index (BMI)	17	15.11	1.19	13.35	17.85	13	15.47	1.1	13.39	17.84	11	14.74	1.01	13.45	16.1
Arm circumference (relaxed)	17	14.82	1.20	12.50	17.00	13	15.04	1.13	13.00	16.50	11	15.27	1.29	13.00	17.50
Arm circumference (tensed)	17	15.79	1.39	13.50	18.00	13	15.96	1.31	13.50	18.00	11	16.05	1.23	14.00	18.00

Table 2 gives an exposition of the frequency distribution of the subjects in the various percentiles for weight and height, while Figure 1 graphically illustrates the mean distribution as well as standard deviations of the weight and height of the different groups around the mean percentile. Table 2 and Figure 1 indicate that 64.71% of the HIV-infected group (Group 1) lie below the 5th percentile for weight. While none of the subjects lie above the 25th percentile, this group displays almost the same tendency with regard to height where 64.71% also lie below the 5th percentile, and none lie above the 10th percentile (see Figure 1). In the HIV-affected group (Group 2) (Figure 1), a smaller percentage (23.08%) lie below the 5th percentile, while none lie above the 25th percentile for weight. With regard to height, 61.54% of the group lie below the 5th percentile, although they showed a slightly larger distribution compared to Group 1 where no children lie above the 10th percentile. In this group there were differences, but still no children who lay above the 25th percentile. In Group 3 only 18.18% lies below the 5th percentile for weight (Group 3), while none of the group lie above the 50th percentile for weight. With regard to their height, 27.27% of the group lie below the 5th percentile for height, while none were above the 50th percentile. From Figure 1 it is clear that a larger distribution of height and weight occurs in the children in Group 3 than in Groups 1 and 2.

Table 2: Frequency distribution for weight and height according to growth profiles (CDC, 2000)

	Group 1 (n = 17)				Group 2 (n = 13)				Group 3 (n = 11)			
Category	n	Cumul n	% n	Cumul % n	n	Cumul n	% n	Cumul % n	n	Cumul n	% n	Cumul % n
Weight												
<5	11	11	64.71	64.71	3	3	23.08	23.08	2	2	18.18	18.18
5	1	12	5.88	70.59	1	4	7.69	30.77	3	5	27.27	45.45
10	2	14	11.76	82.35	8	12	61.54	92.31	1	6	9.09	54.55
25	3	17	17.65	100.00	1	13	7.69	100.00	3	9	27.27	81.82
50	-	-	-	-	-	-	-	-	2	11	18.18	100.00
Height												
<5	11	11	64.71	64.71	8	8	61.54	61.54	3	3	27.27	27.27
5	2	13	11.76	76.47	1	9	7.69	69.23	2	5	18.18	45.45
10	4	17	23.53	100.00	2	11	15.38	84.62	-	-	-	-
25	-	-	-	-	2	13	15.38	100.00	3	8	27.27	72.73
50	-	-	-	-	-	-	-	-	3	11	27.27	100.00

Cumul = cumulative; n = number of subjects

Table 3 displays the descriptive results on the different groups in respect to the various Z-scores calculated in this study. Figures 2 (a – c) are graphic representations of underweight, stunting as well as wasting in the different groups (<-2SD).

In Table 3 the Z-scores are reported for weight-for-age, height-for-age and weight-for-height. It can be seen that the Z-score in the HIV-infected group (Group 1) is <-2SD for both weight-for-age (-2.45, sd 1.94) and height-for-age (-2.53, sd 1.27). This shows underweight and stunting respectively in this group. The group's weight-for-height Z-score (0.81, sd 1.20) lies within the normal boundaries (>-2SD and >1SD). The weight-for-age of the HIV-affected group (Group 2) (-1.97, sd 1.46) as well as their weight-for-height (-0.54, sd 0.87) lies outside the underweight and wasting boundaries (<-2SD), although there are tendencies of being underweight in this group. The height-for-age of the group is <-2SD (-2.35, sd 1.45), which indicates stunting. Opposed to this, the weight-for-age (-1.33, 1.16), height-for-age (-1.02, sd 1.04) and weight-for-height (-0.93, sd 1.05) of the non-affected group (Group 3) is >-2SD. Figures 3, 4 and 5 graphically illustrate the Z-scores of the groups.

Table 4 displays the significance of intergroup differences and indicates statistically significant differences in height ($p<0.05$) between Groups 1 and 3, as well as Groups 2 and 3. The difference between Groups 1 and 3 is also of high practical significant (ES = 0.88), while the difference between Groups 2 and 3 shows a medium practical significance (ES = 0.74). Furthermore it is evident from this table that statistically significant differences occur in the height-for-age (stunting, -2SD) of Groups 1 and 3 as well as Groups 2 and 3 and that the difference is practically significant showing an ES of 1.18 and 0.92 respectively.

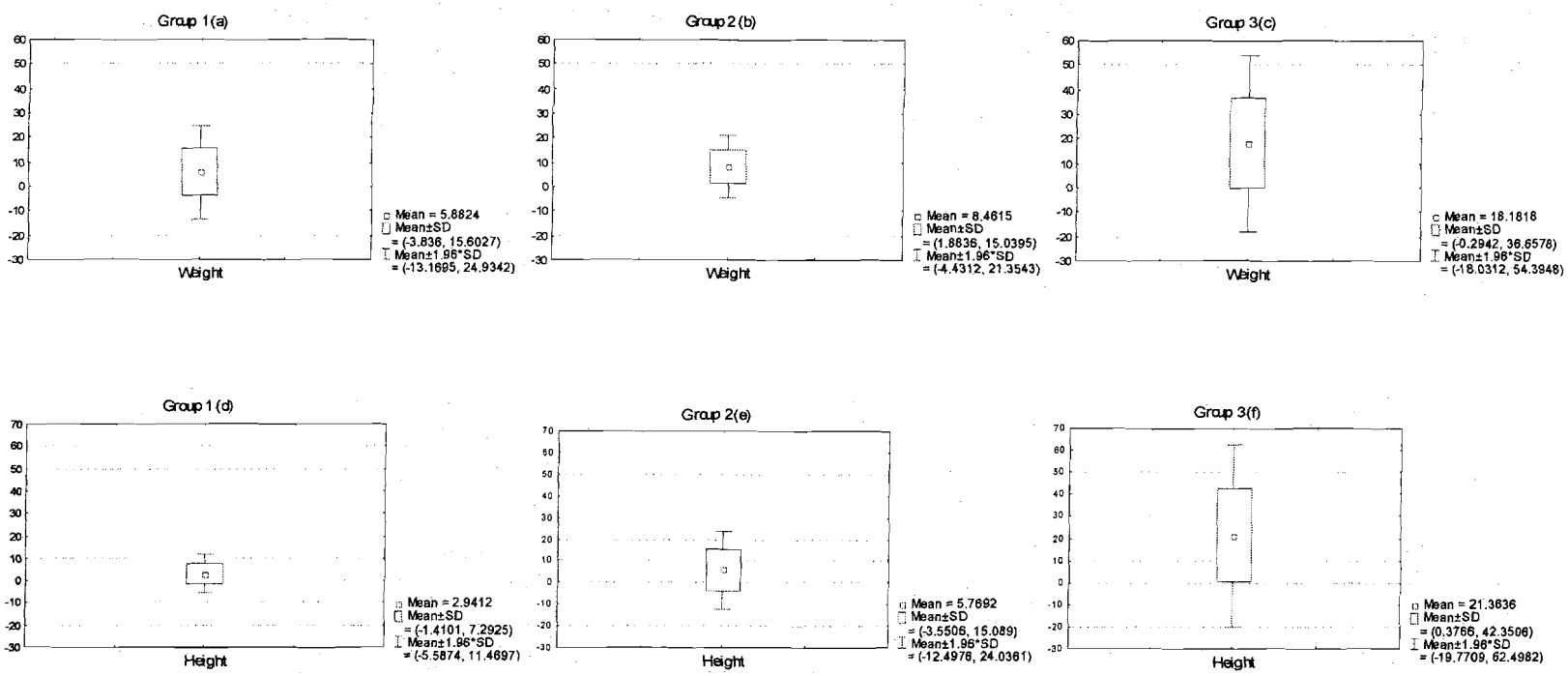

Figure 1 (a – f): The mean distribution of weight and height in the different groups according to CDC growth percentiles (CDC, 2000)

Table 3: Descriptive statistics of the Z-scores of the different groups

	Group 1 (n = 17)				Group 2 (n = 13)				Group 3 (n = 11)			
	M	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**
Weight-for-age (underweight <-2SD)	-2.45	1.94	-7.13	0.17	-1.97	1.46	-4.82	-0.30	-1.33	1.16	-3.57	0.21
Height-for-age (stunting <-2SD)	-2.53	1.27	-5.29	-1.16	-2.35	1.45	-4.82	-0.41	-1.02	1.04	-2.66	0.29
Weight-for-height (wasting <-2SD)	-0.81	1.20	-3.45	1.49	-0.54	0.87	-2.18	0.95	-0.93	1.05	-2.23	0.20

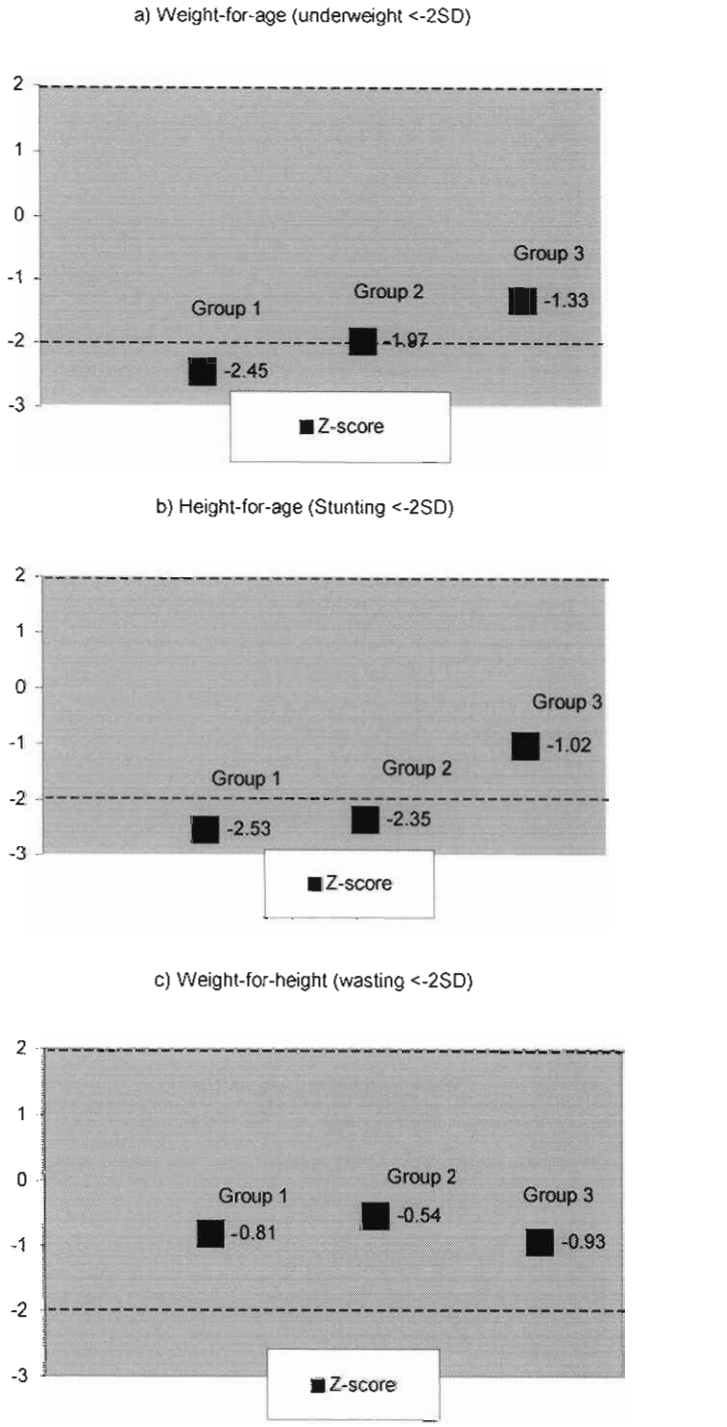

Figure 2 (a - c): Z-scores for a) weight-for-age, b) height-for-age and c) weight-for-height in the different groups

Table 4: Statistical and practical significant intergroup differences regarding growth status of the different groups

	Group 1	Group 2	Group 3	1 and 2	ES	1 and 3	ES	2 and 3	ES
	M	M	M	p		p		p	
Weight	13.82	13.65	14.56	0.986	-	0.798	-	0.711	-
Weight-percentile	5.88	8.46	18.18	0.848	-	0.053	-	0.151	-
Height	95.29	93.62	98.96	0.871	-	-0.577	-	0.317	-
Height percentile	2.94	5.77	21.36	0.828	-	*0.003	0.88	*0.014	-0.74
Triceps skin fold	9.35	9.42	7.18	0.997	-	0.092	-	0.080	-
Sub-scapular skin fold	6.00	5.96	4.18	0.998	-	0.054	-	0.060	-
Calf skin fold	9.38	8.23	6.77	0.644	-	0.160	-	0.552	-
Fat percentage	13.74	14.31	10.18	0.932	-	0.114	-	0.057	-
Fat percentage rating	2.82	2.62	2.09	0.668	-	*0.022	0.26	0.128	-
Body mass index (BMI)	5.11	5.47	14.75	0.696	-	0.735	-	0.302	-
Arm circumference (relaxed)	14.82	15.04	15.27	0.892	-	0.658	-	0.892	-
Arm circumference (tensed)	15.79	15.96	16.05	0.945	-	0.897	-	0.988	-
Weight-for-age (underweight <-2SD)	2.45	-1.97	-1.33	0.731	-	0.243	-	0.619	-
Height-for-age (stunting <-2SD)	-2.53	-2.35	-1.02	0.934	-	*0.023	1.19	*0.049	0.92
Weight-for-height (wasting <-2SD)	-0.81	-0.54	-0.93	0.793	-	0.959	-	0.661	-

p<0.05 (significant intergroup differences*); ES > 0.5 medium practical significance, ES > 0.8 high practical significance

Discussion of results

The results indicate that the growth status of the HIV-infected group is the most affected of the three groups. These children have the lowest weight as well as height for their age. The results agree with those of Henderson *et al.* (1999) who indicate that the weight statistics of HIV-infected children are significantly lower than those of non-infected children of the same age. Bobat *et al.* (2001) also indicate that infected children display an earlier and sustainably lower height-for-age as well as malnutrition, while children with a faster progression in the disease experience both lower height-for-age and weight-for-height – a tendency that is also confirmed by this study.

The infected group was stunted and underweight, although no signs of wasting (weight-for-height <-2SD) were found yet. However, compared to groups 2 and 3, they reached the lowest values. This result is confirmed by McKinney (1998) who indicates that some infected children experience a relative loss of weight-for-height which occurs nearer to the end of this child's life, when the child loses weight. According to this researcher, the weight-height-ratio of such children is normal, although they are shorter and lighter than their age group.

The affected group was also stunted, although they were not underweight or wasted. However, studies on South African children indicate that a large percentage of black children from poor socio-economic circumstances are stunted (Zere & McIntyre, 2003, Mamabolo *et al.*, 2005). The non-affected group displayed no signs of stunting, wasting or being underweight. This group had however smaller triceps and subscapular as well as calf skinfolds compared to Group 1 (infected) and Group 2 (affected), which led to a lower fat percentage in the group. The phenomenon can possibly be ascribed to the fact that Groups 1 and 2 were in a feeding scheme where they were provided with balanced meals at school, while Group 3 had to provide their own food, which mostly consisted of mealie-meal porridge.

Shortcomings in this study include the fact that the state of the progression of the children's disease could not be determined due to ethical aspects and this could possibly have played a role in the growth and nutritional status of these children. The small group of participants and the fact that the study is based on an availibility sample also makes it difficult to generalize the findings

to a larger population. In spite of this, the study yielded valuable results regarding the growth status of HIV infected children between the ages of 2 to 6-years. This study confirmed that the growth status of HIV infected children are under pressure as a result of their HIV infection. Signs of being underweight and stunted were found, although wasting did not occur in their case.

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CHAPTER 6

THE GROWTH STATUS OF 2 TO 6-YEAR OLD CHILDREN INFECTED WITH HIV OVER A PERIOD OF 9 MONTHS

Descriptive title

The growth status of 2 to 6-year old children infected by HIV over a period of 9 months

Running title

Growth status of HIV-infected children

Abstract

Background HIV infection is associated with growth retardation and conditions such as stunting, wasting and malnutrition, especially among children under the age of two years. The aim of this study was to monitor the growth status of 2 to 6-year old South African children in the North-West Province infected and affected by HIV over the period of nine months and to compare it with children who are not affected by the condition.

Method An HIV-infected group (n=16, mean age = 4.63 years) and an affected group (n=11, mean age = 3.9 years) were selected at a Hospice day-care centre while a non-affected control group (n=11, mean age = 4.34 years) was compiled from children of more or less the same socio-economic circumstances. Anthropometric measurements including height, weight, upper arm circumference (tensed and relaxed), and skinfolds (triceps, sub-scapular, calf) were obtained according to standard procedures, while bodymass index as well as stunting and wasting were calculated. The subjects were tested over a period of nine months, with three month intervals between tests.

Results A repeated measures ANOVA was used to analyse the data. The growth status of the infected children (Group 1) was the most affected of the groups and this group also displayed the least significant effects in the form of growth increases over the nine months monitoring period.

Conclusion The impaired growth status of young children with HIV indicate the neccesity of nutrition intervention for such children.

Introduction

Malnutrition and growth retardation are problems that often occur in HIV-infected children (Aylward *et al.*, 1992; Miller & Garg, 1998; Davis-McFarland, 2000; Miller *et al.*, 2001; Eley *et al.*, 2002). These children usually are small for their age with respect to weight and height (Bailey *et al.*, 1999; Miller *et al.*, 2001; Eley *et al.*, 2002), although their height-weight-ratios usually are normal, according to McKinney (1998). McKinney (1998) confirms that the most common phenomenon is growth retardation in height and weight and points out that it already occurs during the first three to four months of the baby's life. The other phenomenon is a relative loss of weight-for-height that occurs at the end of the child's life. This weight loss includes the loss of lean body mass (Polsky *et al.*, 2001), which in turn is associated with increased progression of disease, a loss of muscle mass, a decrease in power and functionality and an increased rate of mortality, (Grinspoon & Mulligan, 2003). Research indicates that a decrease is found in lean body mass before a significant difference in weight or fat stores is traced in HIV-infected children (Miller & Garg, 1998). These children's lean body mass is abnormally low compared to that of uninfected children, according to Polsky *et al.* (2001).

Two growth retardation patterns occur in HIV-infected children, namely stunting and wasting. Stunting is characterised by an abnormality in linear growth, while wasting defines a low body weight for height (CDC, 1994, Guarino, 2004). Wasting is described by the CDC (1994) as an AIDS-defined condition. In Kenya it was found that 11%-20% of HIV-infected children from low socio-economic circumstances were stunted and 3%-6% wasted by the age of 12 months (Sherry *et al.*, 2000). In Cape Town (South Africa) it was established that more than 25% of 60 HIV-infected children (mean age of 25 months) were underweight, while more than 50% of the children displayed a too low height-for-age (Eley *et al.*, 2002).

In certain longitudinal studies, infected children already showed 'n sustainable under average height-for-age as well as weight-for-age from as early as three months compared to non-infected children (Henderson *et al.*, 1999; Bobat *et al.*, 2001). Bobat *et al.* (2001) also found that the infected children who died at an early age had a poorer growth status than those who died at a later age. Children with a fast disease progression

experienced both a lower height-for-age and weight-for-height (Bobat *et al.*, 2001). The European Collaborative study (2003) found that infected children weighed 460 gm less at the age of three months than non-infected children, and these differences between the groups had increased with age. Between six and 12 months the non-infected children had increased 1.6% more in height and 6.2% more in weight than infected children (this difference was 16% and 44% between eight and 10 years respectively). The infected children weighed 7 kg (22%) less at the age of 10 years and were 7.5 cm shorter (5.6%) than the non-infected children. In their study in Tanzania, Villamor *et al.* (2004) found that HIV infection can be related to an annual decreased increase of 2.8 cm in height as well as 1.3 kg in weight in children between six and 11 months, while children between 12 and 23 months increased 0.6 kg less in weight annually than non-infected children of the same age. The largest retardations in linear growth were in children under 11 months (Villamor *et al.*, 2004).

HIV infection increases the risk for mortalities four-fold, while the child's age (<24 months), stunting, a small upper arm circumference, anaemia, and a shortage of water in the house are also factors that contribute to an increased risk (Villamor *et al.*, 2005). Stunting is associated with a doubled risk for mortalities, while the risk for children who are wasted is 2.9 times higher. Low weight-for-age had no statistical relation to increased mortalities in this population (Villamor *et al.*, 2005). Bobat *et al.* (2001) emphasise that monitoring babies who display serious stunting and wasting is important, since the risk of early death in such children increases.

Because HIV-infected children show a high risk for malnutrition, nutrition status assessment and intervention are very important in managing HIV infection (Knox *et al.*, 2003; Children on the Brink, 2004). Nutrition analysis and intervention in children with HIV can assist in decreasing stunted growth and development. Early and regular analysis of nutrition status and nutrition intervention assist in sustaining normal growth, preventing nutrition shortages and supporting the immune system. These strategies are consequently singled out as critical factors to increase quality of life of HIV children (Fiore *et al.*, 2000; Knox *et al.*, 2003).

It is clear from research findings that the growth patterns of HIV-infected children under 2 years of age have already been researched rather extensively, but that relative little information is available on older HIV-infected children's growth patterns. This study is aimed at monitoring the growth status of 2 to 6-year old children infected by HIV over a period of nine months and comparing it with children who are affected and non-affected by the condition.

Method

Participants

Initially the investigation group consisted of 41 children, of whom 3 (1 HIV-infected and 2 affected) dropped out of the study during the period. The final investigation group therefore consisted of 38 black children living in the North-West Province of South Africa, of whom the ages varied between 2.7 years (32 months) and 6.0 years (72 months) during base line surveys. The investigation group was divided into three subgroups namely an HIV-infected group (Group 1, n = 16), HIV-affected group (Group 2, n = 11) and a non-affected group (Group 3, n = 11). Group 1 consisted of 11 boys (between 3.8 and 6.0 years, sd = 0.80) and 5 girls (between 2.7 and 4.5 years, sd = 0.78), during the base line surveys. Group 2 consisted of 6 boys (between 2.9 and 5 years, sd = 0.96) and 5 girls (between 3.5 and 5.6 years, sd = 0.90) and Group 3 of 5 boys (between 2.8 and 5.7 years, sd = 1.19) and 6 girls (2.9 and 5.6 years, sd = 1.05). The mean age within the different groups (Group 1 = 4.63 years, Group 2 = 3.9 years, Group 3 = 4.34 years) as well as the number of boys and girls in each group differed slightly, since this was based on availability.

The HIV-infected group (Group 1) and HIV-affected group (Group 2) were selected for the study from a Hospice day-care centre for HIV-infected and affected children in Potchefstroom (South Africa). Children are only allowed access to this day-care centre if proof can be provided of their HIV status, while clinics also refer children there who are HIV infected. Furthermore, the affected children are only admitted to the centre if a death certificate of one of or both parents can be provided which indicates that they died of an AIDS-related diseases such as tuberculosis, pneumonia or heart failure. The

children in both these groups are transported to and from the school with a Hospice bus daily. Their socio-economic circumstances are considered to be low, since their living conditions are characterized by poor sanitary facilities and housing. The school forms part of a feeding scheme, although the diet is not compiled by a dietician. The diet consists of mealie meal porridge, morvite or soy porridge for breakfast and a fruit as a snack during the morning. Cooked lunch consists of meat, rice and vegetables. a Slice of bread with peanut butter or jam and a cool drink are provided before the children leave for home at 15:00. The children are also supplied with morvite over weekends when the school is closed. A control group (Group 3) was compiled from the Klerksdorp area with similar socio-economic circumstances, but were not infected with or affected by HIV. The control groups (Groups 2 and 3) were also selected on the basis of their age, gender, race and socio-economic status being similar to those of the experimental group.

The HIV status of the children was determined by using the FIRST RESPONSE HIV CARD TEST 1-2.O. The test is an immunochromatographic (rapid) test for the qualitative detection of all isotypes (IgG, IgM, IgA) spesific to HIV-1 including subtype O and HIV-1 in human serum, plasma or whole blood. In a comparison of the FIRST RESPONSE HIV CARD TEST 1-2.O test versus a leading commercial anti-HIV1&2 ELISA and Rapid test, results gave sensitivity of 100% (120/120), a specificity of 99.18% (121/122) and a total agreement of 99.59% (241/242). Due to only three laboratories processing PCR testing in South Africa, 22% of the total capacity required, rapid tests were used (Meyers *et al.*, 2006).

Measuring instruments

All the subjects within the different groups were subjected to a series of anthropometric measurements of height, weight, circumference (upper arm - both tensed and relaxed), as well as skinfolds (triceps, sub-scapular, calf), in accordance with standard procedures as prescribed by the International Society of Advanced Kinanthropometrist (ISAK). The period of the four test sessions was nine months, with three-month test intervals during this period. The measurements were done by a Level 2 kinanthropometrist, approved in 2002 by the International Society of Advanced Kinanthropometrist (ISAK). Height was

measured to the nearest 0.1 cm, an electronic scale was used to determine weight to the nearest 0.1 kg, and the circumferences were measured to the nearest 0.1 cm, while the skin folds were measured with Harpendum skinfold pliers to the nearest 0.2 mm. The fat percentage as well as bodymass index (BMI) (kg/m^2) were calculated from these measurements. The interpretation of the BMI and fat percentage values were done according to cut-off points provided by Lohman (1992) and the interpretation of height and weight according to the Centre for Disease Control's growth profiles (CDC, 2000), seeing that no norms exist for South African children. Stunting, wasting, under and over weight were calculated. The following definitions of the different variables come up for discussion and are define as follows:

- Stunting – height-for-age Z-score (HAZ) below the median by more than minus two standard deviations (<-2SD).
- Wasting – weight-for-height Z-score (WHZ) below the median by <-2SD.
- Underweight – weight-for-age Z-score (WAZ) below the median by <-2SD.
- Overweight – WHZ above the median by >1SD.
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Procedure

Ethical approval for the study was granted by the North-West University in Potchefstroom (nr. 06M02). Having obtained permission from the director of the Hospice involved and informed consent from the parents/guardians, a child was included in the study. The clinics responsible for the health of the children, determined the HIV status of the children twice a year. The research was conducted at the day-care centres during school hours. Trained translators were used to ensure that the children understood the instructions.

Statistical analysis

The data were analysed by means of the Statistica for Windows (Statsoft, Inc S.A., 2006) computer program. Descriptive statistics was used to determine means (M), standard deviations (sd) and maximum and minimum values, as well as frequency tables. The SAS software (SAS Institute Inc, 2000-2003) were used to determine the Z-scores of some variables. A repeated measures ANOVA was conducted, followed by a Bonferroni post hoc analysis to determine how each group differed among the four testing periods (within group differences). Practical significance of differences (ES) over the testing period (T1–T4) was determined by means of the following formula: $d = X1–X2 / \sqrt{}$ Mean Square Error. The following guidelines were set for the interpretation of the practical significance, namely $d = 0.14$ (large effect); $d = 0.06$ (medium effect) and $d = 0.01$ (small effect). Due to the number of subjects, it was regarded practically significant if the effect size showed a medium effect or larger.

Results

Table 1 displays descriptive characteristics of the different groups regarding all the growth variables during the four testing sessions (T1–T4) over the period of nine months, while Figures 1 (a–g) is a graphic illustration of these results for a) weight, b) WAZ c) height, d) HAZ, e) BMI, f) BMIZ, g) WHZ. Table 2 shows the frequency distribution of the subjects within the different groups measured against the growth percentile of CDC for weight and height. The time effect of growth was further analysed and Table 3 indicates the significance of the time effect within the different groups over the period of nine months (T1–T4). Each group's results will firstly be discussed separately with regard to all the above-mentioned analyses and especially regarding significant time effects that were found.

Group 1

Table 3 displays the variables with which a significant interaction with time was found. Practical significant effects were obtained for weight, height and HAZ. From Table 1 and Figure 1 (a), which describe and illustrate these variables, it is seen that the weight of

Group 1 had increased by 1.48 kg from T1 to T4. In this group the weight of the majority (56.25%) of subjects was below the 5th percentile. Only one subject moved to a higher percentile (T1 to T2) during this period, so that 50% of them fall below the 5th percentile (Table 2). A significant increase in weight occurred between T1 and T3, T1 and T4 as well as T2 and T4. Height had increased statistically significantly ($p<0.05$) during each testing session, with a mean increase of 2.97 cm over the period of the study (Figure 1 (b), Table 3). All the subject's height fall on or below the 10th percentile, with most of the group below the 5th percentile (62.5%). The height of two subjects moved from (T1) 10th percentile to (T2) 5th percentile, while one moved from the 5th percentile (T2) to below the 5th percentile (T3) (Table 2). However, Table 3 and Figure 1(d) indicate that this Group's HAZ had decreased significantly by 0.29 from T1 to T4. None of the other growth variables displayed significant changes in this group over the period of nine months.

Group 2

Group 2 displayed practical significant effects in all the growth variables from T1 to T4, except for the calf skin fold and HAZ (Table 3). The mean of Group 2 for weight showed an increase of 2.89 kg from T1 to T4. Table 1 and Figure 1(b) indicate that this group's WAZ also increased by 1.07 over the period of nine months. From Table 2 it is clear that the majority of the group (63.64%) fell on the 10th percentile for weight at the beginning of the study (T1), while 63.64% fell on the 25th percentile at the end (T4). Group 2 had increased 3.95 cm in height from T1 to T4. This Group's HAZ showed a non-significant decrease of 0.10 over the period from T1 to T4 (Table 2), while a decrease of 0.17 between T2 and T4 was significant (Table 3). Table 2, further indicates that the majority of the group (54.55%) fell on the 5th percentile for height, of which one subject moved from the 5th percentile to below the 5th percentile. Table 1 also shows that WHZ had increased by 0.63 from T1 to T4, while BMI also had increased during this period by 1.93. The Z scores for BMI display the same tendency with an increase of 1.41. This tendency can clearly be seen in Figures 1 (e) and (f). Table 3 also indicates that WHZ, BMI and BMIZ had increased significantly over the periods, except between T3 and T4.

The Group's triceps and sub-scapular skinfold measurements had also increased statistically significantly from T1 to T4, by 0.41 and 0.72 respectively (Tables 1 and 3). No statistically significant increases were found in the calf skin fold over any of the periods. Increases in relaxed and tensed arm circumference showed a significant effect over the study period (Table 3) and increased by 1.05 and 0.78 respectively (Table 1).

Group 3

Practically significant time effects were obtained in all the variables of Group 3, except in die skin folds (Table 3). Table 1 as well as Figure 1(a) indicate that the weight of Group 3 had increased by 1.8 kg from T1 to T4. Figure 1(b) shows that this group's WAZ had increased by 0.92 from T1 to T3, but that there was a levelling off effect from T3 to T4 (0.04), although the period from T1 to T4 still showed significant effects (Table 3). Table 2 indicates that the majority of subjects in this group fell on the 5th percentile (27.27%) as well as on the 25th percentile (27.27%) for weight during T1, while at the end of the period 27.27% fell on the 25th and 27.27% on the 50th percentile. Two subjects moved from the 5th (T1) to the 10th percentile (T2) for bodymass, while one moved from the 10th to the 25th and one from the 25th to the 50th percentile in the same period. The group's mean height had increased from T1 to T4 by 4 cm. Table 1 and Figure 1(d) indicate that this Group's HAZ had decreased by 0.10 from T1 to T4, and this decrease was significant over the period (Table 3). The height of the subjects was distributed, with 27.27% of them falling below the 5th, on the 25th and 50th percentile respectively and the remaining 18.18% of the group on the 5th percentile. However, from T3 to T4 one subject moved from the 25th percentile to the 5th percentile, 27.27% of the subjects were now below the 5th, on the 5th and 50th percentile respectively. The remaining 18.18% of this Group were on the 25th percentile (Table 2). WHZ had increased by 0.62 from T1 to T4 (Table 3 and Figure 1 (g)), although a levelling off effect (0.06 increase) occurred from T3 to T4. The same tendency occurred in both BMI and BMIZ, with an increase of 0.58 and 0.57 respectively between T1 and T3 and a 0.05 and 0.06 increase between T3 and T4 (Figures 1 (e) and (f)). Furthermore, from Table 3 it can

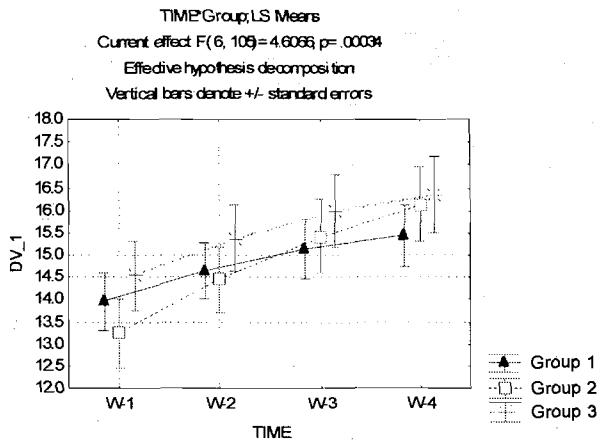
be seen that relaxed and tensed arm circumferences showed a significant increasing effect over time from T1 to T4 (increases of 0.59 and 0.40 respectively).

Table 1: Descriptive statistics of the growth variables of the different groups over the period of 9 months

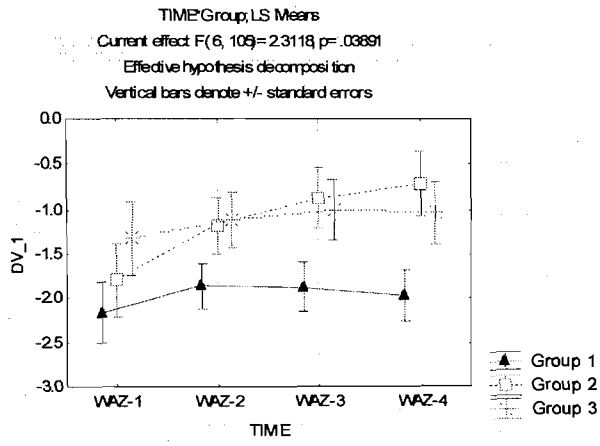
	Test 1				Test 2				Test 3				Test 4			
Group 1 (N = 16)	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**
Age	4.63	0.88	2.7	6.0	4.88	0.91	2.9	6.3	5.13	0.88	3.2	6.5	5.39	0.88	3.4	6.8
Weight	13.96	2.49	9.0	18.9	14.64	2.19	12.0	19.5	15.12	2.53	11.5	21.0	15.44	2.75	11.0	21.5
Weight percentile	6.56	9.78	0.0	25.0	6.88	9.64	0.0	25.0	6.88	9.64	0.0	25.0	6.88	9.64	0.0	25.0
WAZ	-2.16	1.56	-6.7	0.2	-1.86	0.97	-3.6	0.0	-1.87	1.25	-4.9	0.0	-1.97	1.43	-5.8	-0.1
Height	95.44	7.47	82.0	108.0	96.66	7.78	82.5	109.5	97.53	7.78	83.5	110.5	98.41	7.89	84.0	111.5
Height percentile	3.13	4.43	0.0	10.0	2.50	3.65	0.0	10.0	2.19	3.64	0.0	10.0	2.19	3.64	0.0	10.0
HAZ	-2.35	1.08	-5.0	-1.2	-2.41	1.12	-5.0	-1.2	-2.52	1.10	-5.0	-1.4	-2.64	1.11	-5.1	-1.5
WHZ	-0.69	1.13	-3.4	1.5	-0.25	0.78	-1.5	1.2	-0.09	1.03	-2.9	1.3	-0.07	1.28	-3.6	1.4
BMI	15.22	1.14	13.4	17.9	15.64	1.13	14.1	18.7	15.84	1.29	13.2	18.6	15.87	1.48	12.6	18.8
BMIZ	-0.32	1.01	-2.5	1.7	0.10	0.85	-1.3	2.1	0.22	1.04	-2.6	2.1	0.17	1.28	-3.5	2.1
Arm circumference (relaxed)	14.94	1.14	12.5	17.0	15.16	1.27	13.0	18.0	15.28	1.64	11.0	18.0	15.38	1.86	10.0	18.5
Arm circumference (tensed)	15.91	1.36	13.5	18.0	16.13	1.38	14.0	19.0	16.25	1.72	12.0	19.0	16.31	1.75	12.0	19.0
Triceps skinfold	9.63	2.85	6.0	16.0	9.47	3.08	6.0	17.0	9.44	3.17	5.5	17.5	9.44	3.15	6.0	17.5
Sub-scapular skin fold	6.13	2.28	3.0	13.0	6.22	1.59	4.5	10.5	6.09	1.65	4.5	10.5	6.09	1.76	4.0	11.0
Calf skin fold	9.72	4.49	4.0	22.0	9.44	4.28	4.0	21.0	9.69	4.21	4.5	21.0	9.41	4.04	4.0	20.0
Triceps+Sub-scapular skin fold	15.75	4.45	9.0	24.0	15.69	4.10	11.0	24.0	15.53	4.12	10.0	24.5	15.53	4.13	11.0	24.5
Triceps+Calf skin fold	19.34	7.13	10.0	38.0	18.91	7.17	10.0	38.0	19.13	7.13	10.0	38.5	18.84	6.96	10.5	37.5

	Test 1				Test 2				Test 3				Test 4			
Group 2 (N = 11)	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**
Age	3.90	0.89	2.9	5.6	4.11	0.95	3.1	5.9	4.40	0.89	3.4	6.1	4.66	0.88	3.7	6.3
Weight	13.25	2.55	9.6	17.7	14.45	2.30	11.5	18.4	15.43	2.60	12.0	20.5	16.14	2.61	12.6	21.0
Weight percentile	9.09	6.64	0.0	25.0	14.55	10.60	0.0	25.0	18.18	14.88	0.0	50.0	21.36	13.98	0.0	50.0
WAZ	-1.79	1.27	-4.8	-0.3	-1.17	0.95	-3.1	-0.2	-0.87	0.94	-2.8	0.4	-0.72	0.85	-2.6	0.3
Height	91.91	9.45	80.0	108.0	93.64	9.33	82.0	110.0	94.68	9.34	83.0	111.0	95.86	9.28	84.0	112.0
Height percentile	6.82	9.82	0.0	25.0	6.36	10.02	0.0	25.0	6.36	10.02	0.0	25.0	6.36	10.02	0.0	25.0
HAZ	-2.22	1.45	-4.8	-0.4	-2.15	1.42	-4.7	-0.5	-2.25	1.35	-4.8	-0.7	-2.32	1.32	-4.9	-0.8
WHZ	-0.48	0.73	-1.5	0.9	0.29	0.78	-0.8	2.0	0.83	0.68	-0.2	2.3	1.11	0.61	0.0	2.3
BMI	15.61	0.98	14.3	17.8	16.48	1.33	14.3	19.4	17.18	1.23	15.0	19.8	17.54	1.17	15.3	19.7
BMIZ	-0.03	0.73	-1.0	1.6	0.67	0.89	-0.7	2.5	1.17	0.74	-0.1	2.7	1.38	0.67	0.0	2.6
Arm circumference (relaxed)	15.09	0.94	13.0	16.5	15.45	1.13	13.0	17.0	15.82	1.06	14.0	17.0	16.14	1.16	14.0	17.5
Arm circumference (tensed)	15.95	1.01	13.5	17.0	16.27	1.15	13.5	17.5	16.55	1.01	14.5	18.0	16.73	1.21	14.5	18.5
Triceps skinfold	9.68	2.08	7.0	12.5	9.86	1.99	7.0	12.5	10.05	2.05	7.0	13.0	10.09	1.92	7.0	13.0
Sub-scapular skin fold	6.23	1.33	4.0	8.0	6.64	1.45	4.5	9.0	6.82	1.52	4.5	9.5	6.95	1.56	5.0	9.5
Calf skin fold	8.45	1.49	6.0	10.5	8.50	1.76	6.0	12.0	8.59	1.88	6.0	12.5	8.73	1.77	6.0	12.0
Triceps+Sub-scapular skin fold	15.91	2.96	11.0	20.5	16.50	2.72	12.0	20.5	16.86	2.70	13.0	21.0	17.05	2.66	13.5	21.5
Triceps+Calf skin fold	18.14	3.16	13.0	23.0	18.36	3.12	13.5	23.0	18.64	3.17	14.0	23.5	18.82	3.01	14.5	23.5

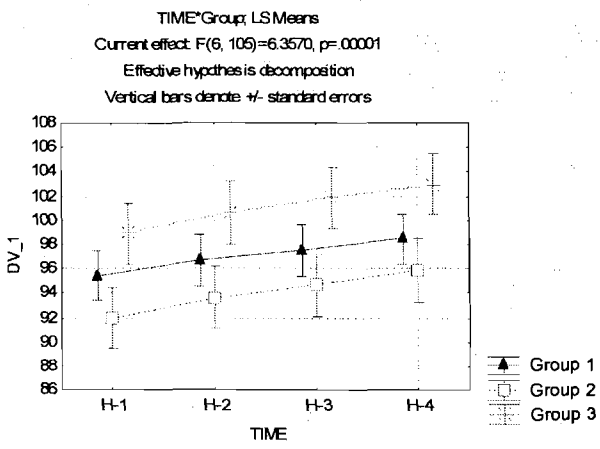
	Test 1				Test 2				Test 3				Test 4			
Group 3 (N = 11)	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**	**M**	**sd**	**Min**	**Max**
Age	4.34	1.14	2.8	5.7	4.57	1.12	3.0	5.9	4.84	1.14	3.3	6.2	5.07	1.12	3.5	6.4
Weight	14.55	2.80	10.5	20.3	15.38	3.04	10.9	21.6	15.99	3.00	11.8	22.0	16.35	2.96	12.3	22.6
Weight percentile	18.18	18.48	0.0	50.0	22.73	19.79	0.0	50.0	22.73	19.79	0.0	50.0	22.73	19.79	0.0	50.0
WAZ	-1.33	1.16	-3.6	0.2	-1.12	1.21	-3.6	0.4	-1.00	1.08	-3.4	0.3	-1.04	1.05	-3.4	0.3
Height	98.95	8.63	85.0	114.0	100.64	8.70	87.0	116.0	101.86	8.74	88.0	117.0	102.95	8.58	89.0	118.0
Height percentile	21.36	20.99	0.0	50.0	21.36	20.99	0.0	50.0	21.36	20.99	0.0	50.0	19.55	21.50	0.0	50.0
HAZ	-1.03	1.04	-2.7	0.3	-1.02	1.03	-2.7	0.2	-1.11	1.03	-2.8	0.1	-1.21	1.02	-2.9	0.1
WHZ	-0.92	1.06	-2.2	0.2	-0.61	1.08	-2.2	0.7	-0.36	0.95	-2.0	0.7	-0.30	0.94	-2.1	0.6
BMI	14.75	1.02	13.5	16.1	15.06	1.10	13.5	16.5	15.30	1.01	13.5	16.5	15.33	1.03	13.4	16.3
BMIZ	-0.78	1.08	-2.1	0.5	-0.47	1.07	-2.0	0.9	-0.21	0.96	-2.0	0.9	-0.15	0.97	-2.2	0.7
Arm circumference (relaxed)	15.27	1.29	13.0	17.5	15.55	1.31	13.0	18.0	15.77	1.49	13.0	18.5	15.86	1.43	13.0	18.5
Arm circumference (tensed)	16.05	1.23	14.0	18.0	16.23	1.35	14.0	18.5	16.36	1.32	14.5	19.0	16.45	1.25	14.5	19.0
Triceps skinfold	7.18	1.40	5.0	10.0	7.18	1.49	5.0	10.0	7.23	1.51	5.0	10.0	7.27	1.40	6.0	10.0
Sub-scapular skin fold	4.18	1.17	3.0	6.0	4.32	1.45	3.0	7.5	4.45	1.42	3.0	7.5	4.41	1.32	3.0	7.5
Calf skin fold	6.77	2.11	3.5	10.0	6.68	2.22	3.5	10.0	6.73	2.36	3.5	10.5	6.77	2.34	3.5	10.5
Triceps+Sub-scapular skin fold	11.36	2.38	8.0	16.0	11.50	2.59	8.0	16.0	11.68	2.53	8.5	16.0	11.68	2.21	9.0	15.0
Triceps+Calf skin fold	13.95	3.27	8.5	20.0	13.86	3.49	8.5	20.0	13.95	3.62	9.0	20.5	14.05	3.48	9.5	20.5


TIME*Group; LS Means
Current effect: F(6, 109)=4.6066, p=.00034
Effective hypothesis decomposition
Vertical bars denote +/- standard errors
DV_1
W-1
W-2
W-3
W-4
TIME
Group 1
Group 2
Group 3

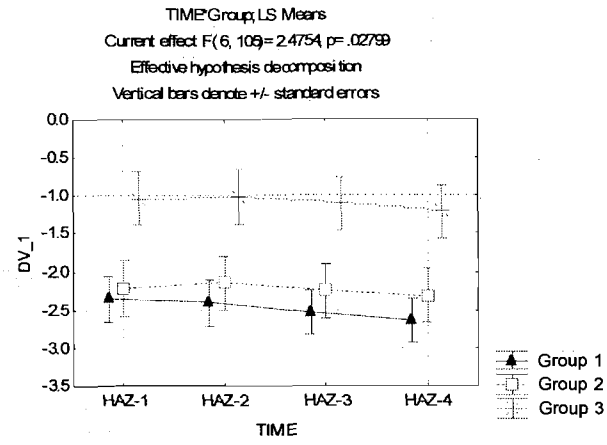
a)


TIME*Group; LS Means
Current effect: F(6, 109)=2.3118, p=.03891
Effective hypothesis decomposition
Vertical bars denote +/- standard errors
DV_1
WAZ-1
WAZ-2
WAZ-3
WAZ-4
TIME
Group 1
Group 2
Group 3

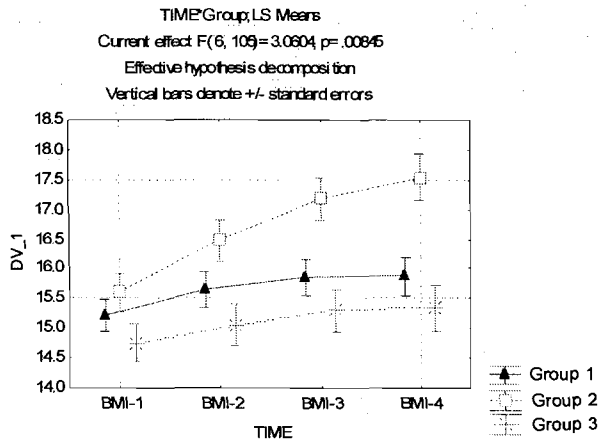
b)


TIME*Group; LS Means
Current effect: F(6, 105)=6.3570, p=.00001
Effective hypothesis decomposition
Vertical bars denote +/- standard errors
DV_1
H-1
H-2
H-3
H-4
TIME
Group 1
Group 2
Group 3

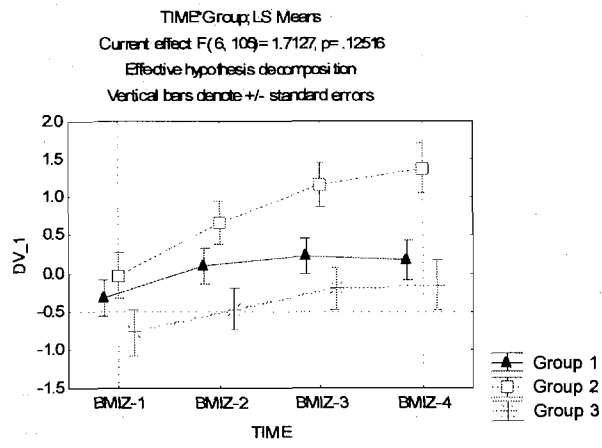
c)


TIME*Group; LS Means
Current effect: F(6, 109)=2.4754, p=.02799
Effective hypothesis decomposition
Vertical bars denote +/- standard errors
DV_1
HAZ-1
HAZ-2
HAZ-3
HAZ-4
TIME
Group 1
Group 2
Group 3

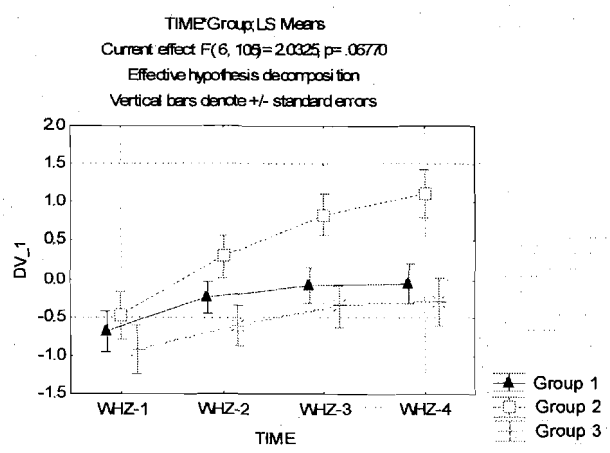
d)


TIME*Group; LS Means
Current effect: F(6, 109)=3.0604, p=.00845
Effective hypothesis decomposition
Vertical bars denote +/- standard errors
DV_1
BMI-1
BMI-2
BMI-3
BMI-4
TIME
Group 1
Group 2
Group 3

e)


TIME*Group; LS Means
Current effect: F(6, 109)=1.7127, p=.12516
Effective hypothesis decomposition
Vertical bars denote +/- standard errors
DV_1
BMIZ-1
BMIZ-2
BMIZ-3
BMIZ-4
TIME
Group 1
Group 2
Group 3

f)



g)

Figure 1: Growth status of a) weight, b) WAZ, c) height, d) HAZ, e) BMI, f) BMIZ and g) WHZ over the period of 9 months, in the three groups.

Table 2: Frequency table for the distribution of weight and height according to the CDC growth profile (CDC, 2000)

Category	Test 1				Test 2				Test 3				Test 4			
	N	Cumul N	% N	Cumul % N	N	Cumul N	% N	Cumul % N	N	Cumul N	% N	Cumul % N	N	Cumul N	% N	Cumul % N
Weight																
Group 1 (N = 16)																
<5	9	9	56.25	56.25	8	8	50.00	50.00	8	8	50.00	50.00	8	8	50.00	50.00
5	2	11	12.50	68.75	3	11	18.75	68.75	3	11	18.75	68.75	3	11	18.75	68.75
10	2	13	12.50	81.25	2	13	12.50	81.25	2	13	12.50	81.25	2	13	12.50	81.25
25	3	16	18.75	100.00	3	16	18.75	100.00	3	16	18.75	100.00	3	16	18.75	100.00
Group 2 (N = 11)																
<5	2	2	18.18	18.18	2	2	18.18	18.18	2	2	18.18	18.18	2	2	18.18	18.18
5	1	3	9.09	27.27	1	3	9.09	27.27	1	3	9.09	27.27	-	-	-	-
10	7	10	63.64	90.91	3	6	27.27	54.55	2	5	18.18	45.45	1	3	9.09	27.27
25	1	11	9.09	100.00	5	11	45.45	100.00	5	10	45.45	90.91	7	10	63.64	90.91
50	-	-	-	-	-	-	-	-	1	11	9.09	100.00	1	11	9.09	100.00
Group 3 (N = 11)																
<5	2	2	18.18	18.18	2	2	18.18	18.18	2	2	18.18	18.18	2	2	18.18	18.18
5	3	5	27.27	45.45	1	3	9.09	27.27	1	3	9.09	27.27	1	3	9.09	27.27
10	1	6	9.09	54.55	2	5	18.18	45.45	2	5	18.18	45.45	2	5	18.18	45.45

25	3	9	27.27	81.82	3	8	27.27	72.73	3	8	27.27	72.73	3	8	27.27	72.73
50	2	11	18.18	100.00	3	11	27.27	100.00	3	11	27.27	100.00	3	11	27.27	100.00
Height																
Group 1 (N = 16)																
<5	10	10	62.50	62.50	10	10	62.50	62.50	11	11	68.75	68.75	11	11	68.75	68.75
5	2	12	12.50	75.00	4	14	25.00	87.50	3	14	18.75	87.50	3	14	18.75	87.50
10	4	16	25.00	100.00	2	16	12.50	100.00	2	16	12.50	100.00	2	16	12.50	100.00
Group 2 (N = 11)																
<5	6	6	54.55	54.55	7	7	63.64	63.64	7	7	63.64	63.64	7	7	63.64	63.64
5	1	7	9.09	63.64	-	-	-	-	-	-	-	-	-	-	-	-
10	2	9	18.18	81.82	2	9	18.18	81.82	2	9	18.18	81.82	2	9	18.18	81.82
25	2	11	18.18	100.00	2	11	18.18	100.00	2	11	18.18	100.00	2	11	18.18	100.00
Group 3 (N = 11)																
<5	3	3	27.27	27.27	3	3	27.27	27.27	3	3	27.27	27.27	3	3	27.27	27.27
5	2	5	18.18	45.45	2	5	18.18	45.45	2	5	18.18	45.45	3	6	27.27	54.55
10	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
25	3	8	27.27	72.73	3	8	27.27	72.73	3	8	27.27	72.73	2	8	18.18	72.73
50	3	11	27.27	100.00	3	11	27.27	100.00	3	11	27.27	100.00	3	11	27.27	100.00

Table 3: Significance of intergroup differences in growth variables over the four test sessions

	Intercept		Time	Differences between tests (p<0.05)					
	d	Partial eta-^{2}	Partial eta-^{2}	1 – 2	1 - 3	1 - 4	2 - 3	2 - 4	3 - 4
Group 1									
Weight	-3.05	0.976	0.454	-	*0.00	*0.00	-	*0.02	-
WAZ	-	0.748	0.042	-	-	-	-	-	-
Height	-0.19	0.994	0.915	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00
HAZ	0.13	0.845	0.698	-	*0.00	*0.00	*0.002	*0.00	*0.003
WHZ	-	0.113	0.113	-	-	-	-	-	-
BMI	-	0.996	0.102	-	-	-	-	-	-
BMIZ	-	0.004	0.084	-	-	-	-	-	-
Arm circumference (relaxed)	-	0.991	0.098	-	-	-	-	-	-
Arm circumference (tensed)	-	0.992	0.106	-	-	-	-	-	-
Triceps skin fold	-	0.913	0.020	-	-	-	-	-	-
Sub-scapular skin fold	-	0.926	0.015	-	-	-	-	-	-
Calf skin fold	-	0.845	0.094	-	-	-	-	-	-
Triceps/Sub-scapular skin fold	-	0.938	0.021	-	-	-	-	-	-
Triceps/Calf skin fold	-	0.886	0.104	-	-	-	-	-	-
Group 2									
Weight	-0.58	0.975	0.958	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00
WAZ	-0.54	0.593	0.781	*0.00	*0.00	*0.00	-	*0.002	-
Height	-0.21	0.991	0.958	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00
HAZ	0.04	0.741	0.290	-	-	-	-	*0.112	-
WHZ	-1.21	0.328	0.866	*0.00	*0.00	*0.00	*0.001	*0.00	-
BMI	-0.84	0.996	0.862	*0.00	*0.00	*0.00	*0.00	*0.00	-
BMIZ	0.94	0.574	0.847	*0.00	*0.00	*0.00	*0.001	*0.00	-
Arm circumference (relaxed)	-0.51	0.996	0.617	-	*0.00	*0.00	-	*0.011	-
Arm circumference (tensed)	-0.36	0.996	0.571		*0.001	*0.00	-	*0.009	-
Triceps skin fold	-	0.965	0.336	-	*0.026	*0.009	-	-	-
Sub-scapular skin fold	-	0.960	0.393	-	*0.013	*0.002	-	-	-
Calf skin fold	-	0.966	0.063	-	-	-	-	-	-
Triceps/Sub-scapular skin fold	-	0.976	0.516	-	*0.001	*0.00	-	-	-

Triceps/Calf skin fold	-	0.975	0.281	-	-	*0.021	-	-	-
Group 3									
Weight	-0.31	0.969	0.879	*0.00	*0.00	*0.00	*0.00	*0.00	-
WAZ	-0.13	0.526	0.380	-	*0.003	*0.01	-	-	-
Height	0.23	0.993	0.968	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00
HAZ	0.09	0.554	0.586	-		*0.00	-	*0.00	*0.021
WHZ	-0.32	0.257	0.505	-	*0.001	*0.00	-	-	-
BMI	-0.29	0.996	0.458	-	*0.001	*0.001	-	-	-
BMIZ	-0.32	0.154	0.492	-	*0.001	*0.00	-	-	-
Arm circumference (relaxed)	-0.22	0.993	0.612	*0.041	*0.00	*0.00	-	*0.012	-
Arm circumference (tensed)	-0.16	0.994	0.465	-	*0.005	*0.00	-	-	-
Triceps skin fold	-	0.966	0.016	-	-	-	-	-	-
Sub-scapular skin fold	-	0.923	0.123	-	-	-	-	-	-
Calf skin fold	-	0.908	0.030	-	-	-	-	-	-
Triceps/Subscapular skin fold	-	0.962	0.104	-	-	-	-	-	-
Triceps/Calf skin fold	-	0.948	0.023	-	-	-	-	-	-

d = 0.14 (large effect); d = 0.06 (medium effect) and d = 0.01 (small effect), *p<0.05

Discussion

From the results regarding weight, it appeare that the HIV-infected Group (Group 1) had increased 1.41 kg and 320 g less in weight from T1 to T4 than the affected (Group 2) and non-affected Group (Group 3), respectively. This tendency was also obvious in the height of Group 1 that increased 0.98 cm and 1.03 cm less than that of Groups 2 and 3, respectively. Furthermore, it appeared that the weight of the majority of the subjects (56.25%) in Group 1 was below the 5th percentile in T1. Opposed to this, the weight of the majority of the subjects (63.64%) in Group 2 fell on the 10th percentile, while the distribution of the weight of Group 3 was much wider than in Groups 1 and 2 with 27.27% on the 5th and 25th, 18.18% below the 5th and 18.18% on the 50th percentile. Group 2 displayed the most shifts in subjects during the nine months with 63.64% falling on the 25th percentile at the end of the period. With regard to height, the largest percentage of Group 1 fell below the 5th percentile (62.50% of Group 1, 54.55% of Group 2, 27.27% of Group 3). These results regarding weight and height are confirmed by the European Collaborative Study (2003) and the findings of Villamor *et al.* (2004), who both indicate that HIV-infected children show a slower increase in both weight and height as opposed to non-infected children, making these children shorter and lighter than non-infected children of the

same age group (Miller *et al.*, 2001). The weight of Group 2 increased more than that of Group 3, which can probably be ascribed to the fact that both Groups 1 and 2 formed part of a feeding scheme but not Group 3. As is evident from Table 1 as well as Figure 1 (b), the WAZ of Group 1 showed a smaller increase than Groups 2 and 3. The difference in WAZ between Groups 1 and 2 as well as 3 at the beginning of the 9 months was 0.37 and 0.83 respectively and at the end of the nine months this difference had increased to 1.25 and 0.93 respectively. The HAZ of all the Groups weakened statistically significantly from T1 to T4 (Table 3), but the same tendency occurred as with the WAZ of Group 1, which was weaker (0.13 and1.32) at the beginning and weaker (0.32 and 1.43) at the end than Groups 2 and 3 respectively (Figure 1(d)). Groups 1 and 2 were stunted <-2 SD, while Group 3 showed no signs of stunting. At the beginning of the study period, Group 1 was underweight <-2 SD, while the WAZ of the group had improved from T1 to T4. Opposed to this, the WAZ of Groups 2 and 3 was >-2 SD, which indicates that these groups were not underweight. The WAZ of Group 2, which was also exposed to a feeding scheme, had improved the most during the period. BMI, BMIZ and WHZ (Figures 1[e, f, g]) displayed practically significant effects from T1 to T4 for groups 2 and 3, while no significant effects occurred during any of the periods for these variables in Group 1. None of the groups were wasted <-2 SD. However, wasting is an AIDS defined condition (CDC, 1994; Guarino *et al.*, 2004), and increases the risk for mortality 2.9 times (Villamor *et al.*, 2005). The WHZ of Group 2 showed the same tendency and improved the most of the groups.

From the afore-mentioned results it appears, in summary, that the growth status of infected children (Group 1) was affected most of all the groups and that this group also showed the least significant effects in the form of growth increases over the nine months (Table 3). The growth variables of the affected children (Group 2) who were exposed to the same feeding scheme had shown a sharper increase with more practical significant effects than Group 3, which was not exposed to a feeding scheme. However, Group 3 still showed more significant effects in weight, WAZ, height, HAZ, WHZ, BMI, BMIZ, arm circumference (relaxed en tensed) as opposed to the infected group (Group 1).

This study had shortcomings in the sense that, due to ethical aspects, the state of progression of the children's disease could not be determined. It could possibly have played a role in the growth changes of these children. The small experimental groups, slight age differences between the groups as well as the fact that the study was founded on an availability sample, also made it difficult to generalise the findings to a larger population. In spite of this, the study yielded valuable results with respect to the importance of feeding interventions regarding

these children, since the growth status of the non-affected group that was not exposed to a feeding scheme was poorer than the affected group that was indeed exposed to such a scheme. Further studies are recommended to investigate the value of feeding interventions in improving the growth status of HIV children.

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CHAPTER 7

Summary, Conclusions and Recommendations

CHAPTER 7

Summary, conclusions and recommendations

7.1 Summary

HIV/AIDS is a reality that needs to be addressed among South African children. According to researchers a need exist for additional intervention strategies to improve the quality of life for HIV-infected children. The maintenance of motor skills, especially gross motor skills, in above-mentioned children is evident from the literature, while the monitoring of growth status is also important in the management of HIV infection. Children with serious stunting and wasting run the risk of early death, while growth retardation can also be an indication of infection or fast disease progression.

The problem, aim and hypotheses of the study is stated in Chapter 1. The first aim of this study (Article 1 – Chapter 3) was to determine the state of the motor development of 2 to 6-year old children infected with HIV and to compare it with that of affected and non-affected children. Secondly the study aimed (Article 2 - Chapter 4) to determine the effect of a motor intervention programme for 2 to 6-year old children infected with and affected by HIV. A third aim (Article 3 - Chapter 5) was to determine the growth status of 2 to 6-year old children infected with HIV and to compare it with that of affected and non-affected children; and the last aim (Article 4 - Chapter 6) was to monitor the developmental tendencies of body composition and growth of 2 to 6-year old children infected with HIV in the course of nine months and to compare it with that of affected and non-affected children.

Chapter 2 gives a literature overview of the influence of HIV on child development as well as an overview on motor interventions that are being performed in this respect. The incidence of HIV in South Africa for the total population is 11,4% (2007), while the incidence for women in the age group 25-29 years is 39,5%. From this it can be deduced that the health of South African children will degenerate further through a ongoing transmission of the virus from infected mothers to their babies. Furthermore it is evident from the literature study that the pandemic has devastating consequences in that 1 100 000 children under the age of 15 years had already lost

their father, mother or both, to the virus. Neurodevelopmental deficiencies as well as growth impediments are indicated in the literature as consequences of HIV infection in children. Effective intervention methods, improved nutrition as well as exercise programmes are indicated to be important strategies to promote the quality of life of children who are infected by HIV.

Literature further indicates that HIV-infected children display handicaps in milestone development during the first two years of their lives. Without the maintenance of motor skills HIV-infected children will not be capable of participating in age-appropriate activities such as such as physical games and sport and performing self-care tasks such as independently taking a bath. Literature indicates that gross-motor skills is influenced most by the virus, therefore the focus of intervention programmes needs to be on gross motor skills. These findings are attributed to the fact that gross motor skills require the use of large-muscle groups and physical exertion, whereas fine motor skills demand less power. Growth retardations, exhaustion of fat storage and neuro-developmental deficiencies are indicated in the literature as being related to HIV/AIDS. The growth patterns of HIV-infected children are often abnormal and a lower weight-for-age and height-for-age are reported in several studies. From the literature study it also became clear that little knowledge is available concerning the health and total well-being of South African children who are HIV/AIDS-infected, especially after the age of 24 months.

Chapter 3, which is presented in the form of an article and submitted to the *South African Journal for Research in Sport, Physical Education and Recreation*, presents the results found with respect to the motor development of 2–6 year-old children (M = 57,41 months) who were HIV-infected, compared to that of an affected (M = 49,39 months) and that of a non-affected (M = 53,25 months) group of children. The motor development of the group was determined by the Peabody Developmental Motor Scales – second edition (PDMS-2). Variance of analysis (ANOVA) revealed that the HIV-infected group performed the poorest of the groups in all the variables regarding gross motor, fine motor and overall motor skills. The developmental level of the HIV-infected group varied between 45 and 51 months, compared to their mean chronological age of 57 months. Their total motor ability differed significantly from that of the healthy group, while their gross motor skills showed larger deficits compared to their fine motor development. A forward discriminant analysis further indicated that locomotor skills contributed most to the discrimination between the groups. It was concluded that the infected group exhibits serious

motor deficiencies in contrast to healthy children of the same chronological age. These results highlighted the necessity of motor intervention for HIV-infected children, focussing on gross motor skills to improve their motor development and quality of life.

Chapter 4, which is presented in the form of an article and submitted to *Perceptual and Motor Skills*, presents the results found with respect to the effect of a motor intervention programme for 2 to 6 year-old children infected and affected by HIV. The research group consisted of 22 subjects of whom 11 were HIV-infected children (51,73 months, SD 10,15) and 11 HIV-affected children (44,45 months, SD 10,76). A two-group (experimental and control group) pre-test-post-test research design was used. The HIV-infected and affected children were randomly matched and grouped into an experimental and control group. The experimental group participated in a 12-week motor intervention programme of 60 minutes per session, twice a week. The effect of the programme was analysed with regard to motor abilities, as established by the PDMS-2 as well as physical abilities. An ANCOVA adjusted for pre-test diffrences was done to analyse the effect of the programme ($p<0.05$) and effect sizes (ES) were used to determine practical significance of differences. The results indicated that the intervention programme led to statistically significant improvement ($p<0.05$) of loco-motor, fine motor as well as total motor skills. The infected children also showed better improvement compared to the affected children. Participation in motor development programmes for HIV children are recommended from the resulta, although modifications for improvement to the programme are suggested in 7.3, based on the results attained.

Chapter 5, which is presented in the form of an article and submitted to *African Journal of AIDS research*, presents the results found with respect to the growth status of 2 to 6-year old children in the North-West Province, South Africa who are infected with HIV and a comparison with children who are affected and non-affected by the virus. An HIV-infected (n=17) and an affected group (n=13) from a Hospice day-care centre, together with a non-affected group (n=11), were selected to be participants in this study. The subjects were more or less from the same socio-economic circumstances. All the subjects were subjected to a series of anthropometric measurements of height, weight, circumference (hip, waist, upper arm, both tensed and relaxed) as well as skinfolds (triceps, sub-scapular, calf) according to standard procedures. Fat percentage, body mass index, as well as stunting and wasting were calculated. From the descriptive statistics

that were analysed by means of Statistica, it appears that the infected group displayed the poorest growth status of the three groups compared to the CDC growth profiles, although they did not differ significantly from the affected children. The infected children differed significantly from the non-affected group regarding height percentile, fat percentage and HAZ. This group showed serious signs of being underweight and stunted, while wasting did not occur among them. It is concluded from the results that it is important to monitor growth of children who are HIV-infected or at risk for infection, since it can be an indication of possible infection or disease progression. Further research is recommended to substantiate the results of this study.

Chapter 6, which is presented in the form of an article and submitted to *Child: Care, Health and development* presents the results found with respect to the monitoring of growth status of 2 to 6-year old South African children in the North-West Province infected and affected by HIV over the period of nine months and to compare it with children who are not affected by the condition. An HIV-infected group (n=16, mean age = 4,63 years) and an affected group (n=11, mean age = 3,9 years) were selected at a Hospice day-care centre while a non-affected control group (n=11, mean age = 4,34 years) was compile from children of more or less the same socio-economic circumstances. Anthropometric measurements including height, weight, upper arm circumference (tensed and relaxed), and skinfolds (triceps, sub-scapular, calf) were obtained according to standard procedures, while bodymass index as well as stunting and wasting was calculated. The subjects were tested four times over a period of nine months, with three month intervals between tests. A repeated measures ANOVA was used to analyse the data. The growth status of the infected children (Group 1) was the most affected of the groups and this group also displayed the least significant effects in the form of growth increases over the nine months monitoring period. The impaired growth status of young children with HIV indicate the neccesity of nutrition intervention for such children, since the non-affected children's growth status was poorer in some cases than that of the affected children, who were involved in a feeding scheme.

7.2 Conclusions

The results of the study were used to formulate the conclusions of the study.

7.2.1 Conclusion 1

Hypothesis 1 states that the gross motor and fine motor development of 2 to 6-year old children infected with HIV will display significant difficulties compared to that of affected and non-affected children. No statistically significant differences were found between the gross motor and fine motor skills of infected and affected children. However, the infected children's gross as well as fine motor skills did show significant deficiencies compared to those of the non-affected group. The hypothesis is therefore partially accepted for motor development, since the infected group only differed statistically significantly from that of the non-affected group.

7.2.2 Conclusion 2

Hypothesis 2 states that a motor intervention programme will lead to the significant improvement of motor abilities and physical skills in 2 to 6-year old children infected with and affected by HIV. With regard to the motor skills of the infected group, only loco-motor and total motor skills improved statistically significantly during the intervention programme, therefore the hypothesis is only partially accepted for the infected group. Only fine motor skills had improved statistically significant in the affected group, after participation in the programme, therefore the hypothesis is only partially accepted for the affected children. The hypothesis is rejected for both infected and affected children regarding physical skills, since no statistically significant changes occurred in these skills during the intervention period.

7.2.3 Conclusion 3

This hypothesis states that the body composition and body growth status of 2 to 6-year old children infected with HIV will be poorer compared to that of affected and non-affected children. No significant differences in growth variables occurred between those of the infected and the affected group. Significant differences occured between the infected and non-affected groups with regard to the percentile for height, fat percentage grading and HAZ. This hypothesis is therefore only partially accepted.

7.2.4 Conclusion 4

This hypothesis states that the body composition and body growth of 2 to 6-year old children infected with HIV will be poorer than that of affected and non-affected children in the course of nine months. The infected group exhibited significant effects in weight, height and HAZ during this period, while the affected group's weight, WAZ, height, HAZ, WHZ, BMI, BMIZ, arm circumference (relaxed and tensed) triceps and sub-scapular skin fold and the non-affected group's weight, WAZ, height, WHZ, BMI, BMIZ, arm circumference (relaxed and tensed) showed statistically significant differences. This hypothesis is therefore accepted, since the infected group displayed the least significant effects of all three groups over the 9-month period.

7.3 Recommendations

From the results of the above-mentioned study, it is clear that the motor development and the growth variables of children infected with HIV are affected by the virus. These results highlight the necessity of motor intervention for HIV-infected children, focussing on gross motor skills to improve their motor development and quality of life. Modifications for improvement to the programme are suggested, based on the results attained. Growth impairment was also found in children infected with HIV over the 9-month period and the importance of intervention strategies, such as feeding schemes, is highlighted from these results.

Although this study was thoroughly planned, certain limitations were found that should be addressed by researchers who want to conduct similar research studies in the future. In order to improve the generalization of the results, as well as to improve the outcomes of further studies of this nature, the following recommendations can be made:

7.3.1 In this study growth of HIV children was monitored over a nine-month period. The period could not be extended, since some of the children had left the school to enter primary school. Although growth differences occur over the nine-month period, it is recommended that this period be extended, for more meaningful results.

7.3.2 For ethical reasons, the classification of the HIV-infected children disease progression could not be determined. This information could possibly have explained why

improvement of motor and physical skills differed in children during the intervention period, as well as changes in growth variables. Children whose disease progression was more advanced would probably have performed poorer, but this could not be established. It is therefore recommended, where possible, to collect this information during studies of this nature.

7.3.3 The current study was based on an availability sample, with a large risk of dropouts of subjects. This led to small experimental groups, limiting the generalizability of the findings. A larger experimental groups is therefor recommended to compensate for drop-outs and to increase the generalizability of the results.

7.3.4 The intervention period was too short for the improvement of certain aspects of motor development. Loco-motor and total motor skills in the infected group and fine motor skills in the affected group is the only variables that improved statistically significant after participation in the intervention programme. It is thus recommended for future research that the intervention period should be increased, or the frequency of participation per week.

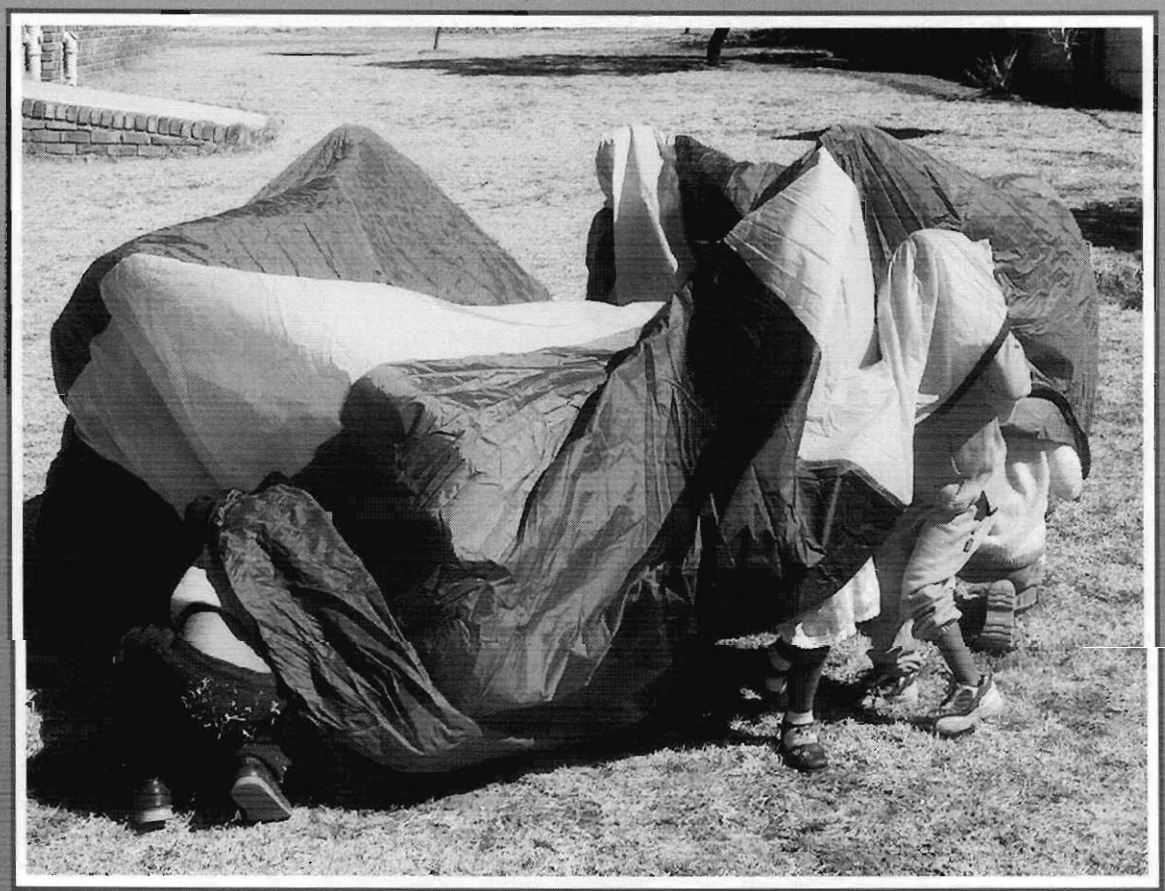
7.3.5 This intervention was performed in group context and the experimental group consisted of an availability sample. The ages of the children in the intervention programme was between 2 and 6 years, which complicated the selection of activities for the programme because of the different developmental levels. Thus, it is recommended that future studies in this respect be performed on groups with a smaller age difference to increase the effect of similar programmes.

7.3.6 No information was available regarding underlying reasons for the motor problems of the children. Performing a sensory-neurological test battery together with the PDMS-2 can possibly provide more information on underlying reasons for the deficiencies and is strongly recommended. The underlying causes can then be addressed more effectively in the intervention programme, and in so doing increase the effect of the program.

7.3.7 From the results it is recommended that further research be done on the importance of nutrition intervention for HIV-infected children and for children from poor socio-economic environments.

7.3.8 Although an attempt was made to keep the testing conditions as favourable as possible, the results were influenced by weather conditions such as cold, heat and wind as well as other unfavourable testing conditions. It is recommended that future researchers must attempt to minimise these external factors.

APPENDIXES



APPENDIX A

GUIDELINES FOR AUTHORS:

SOUTH AFRICAN JOURNAL FOR RESEARCH IN SPORT, PHYSICAL EDUCATION AND RECREATION

The *South African Journal for Research in Sport, Physical Education and Recreation* is published by the Stellenbosch University. Contributions from the fields of Sport Science, Movement Education, Recreation/Leisure Studies, Exercise Science and Dance Studies will be considered for publication. The articles submitted will be administered by the appropriate Subject Review Editor and evaluated by two or more referees. The decision as to whether a particular article is to be published or not, rests with the Editorial Board.

SUBMISSION

Manuscripts should be typed with **one and a half spacing** in 12-point Times New Roman letter size and printed on A4-size white paper in laser quality. The original manuscript (clearly indicated) and three copies of the manuscript must be submitted. Length must not exceed 20 pages (tables, figures, references, etc. included). Original manuscripts may be submitted in English or Afrikaans and should be sent to:

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CONDITIONS

A signed declaration in respect of the originality must accompany each manuscript. On submission of the manuscript, the author shall present a written statement that the article has not been published or is not being presented for publication elsewhere. Should the article be taken from a Master's thesis or Doctoral dissertation, academic ethic requires that the student will be the first author. The author should also ensure that the LANGUAGE of the manuscript has been thorougly edited at the time of submission (in British english). The name, address and telephone number of the person who has done the language editing must be provided. On receiving a written notification from the Managing Editor that the article has been accepted, a final hard copy of the manuscript and a diskette (virus checked) should be submitted using MS WORD as a DOC-file (see Figures). It can also be send per e-mail as an attached file.

PREPARATION OF MANUSCRIPT

Title page

The first page of each manuscript should be indicate the title in English and Afrikaans (will be translated for foreign authors), the *names* (title, first name in full and other initials, surname) of the author(s), the *telephone* numbers (work & home), *facsimile* number, *e-mail* address (if available) and *field of study*. The mailing address of the first named author and the institution where the work was conducted should be provided in full. A short title of not more than 45 characters, including the spaces, should be provided for use as a running head.

Abstract

Each manuscript must be accompanied by an abstract of approximately 150-200 words in *English* and should be set on a *seperate page* as a SINGLE paragraph (one and a half spacing). A list of

three to seven **key words** in *English* is required for indexing purposes and should be typed below the abstract.

Articles in Afrikaans must include an *additional* extended summary (500-1000 words) in English. This summary must start on a new page (following the list of sources) providing the English title of the article at the beginning.

Text

Start the text on a new page with the title of the article (centred and *without* the names of the authors). Follow the style of the most recent issue of the journal regarding the use of headings and subheadings. Use only one space between sentences.

Tables and figures

Tables and figures should be numbered in *Arabic* numerals (1, 2, etc.). Tables require a heading at the *top* and figures a legend *below* and seperate from the figure. ***Note:*** Use the decimal POINT (not the decimal comma).

References

In the *text* the Harvard method must be adopted by providing the author's surname and the date placed in the parentheses. *For example*: Daly (1970); King and Loathes (1985); (Botha & Sonn, 2002); McGuines *et al.* (1986) or Daly (1970: 80) when Daly is not part of the sentence. More than one reference must be arranged chronologically. Note that *et al.* is used in the body text when there are more than two authors, but never in the list of references.

List of references

Only the references cited in the text should be listed alphabetically according to surname (last name) of authors (capitals) after the body of text under the heading, **References** (capitals) starting on a new page. In the case of articles published in *JOURNALS*, references listed should include the surnames and initials (capitals) of all authors, the date of publication in parentheses, the full title of the article, the full title of the journal (italics), the volume number, the serial number (omitted only if the said journal does not issue numbers), followed by a colon and the first and last page numbers seperated by a hyphen.

VAN WYK, G.J. & AMOORE, J.N. (1995). A practical solution for calculating instantaneous values of tension in the extensor muscles of the knee joint during extension and flexion. *South African Journal for Research in Sport, Physical Education and Recreation,* 18(1):77-97.

If the reference is a *BOOK*, the surname (last name) and initials of the author or editor (Ed.) must be given, followed by the date of publication in parentheses, the title of the book (italics) as given on the title page, the number of the edition (ed.) in parentheses, the city (and abbreviation for the state in the case of the USA) where published, followed by a colon and the name of the publisher.

JEWETT, A.E.; BAIN, L.L. & ENNIS, C.E. (1995). *The curriculum process in Physical Education* (2nd ed.). Madison, WI: WCB Brown & Benchmark.

For a *CHAPTER* from a book, the page numbers of the chapter cited must be provided in parentheses (not italics) after the title of the book. For further details, authors should consult the most recent publication of this journal for other examples.

DE RIDDER, J.H. (1999). Kinanthropometry in exercise and sport. In L.O. Amusa; A.L. Toriola & I.U. Onyewadume (Eds.), *Physical education and sport in Africa* (235-263). Ibadan (Nigeria): LAP Publications.

If the reference is a *THESIS* or *DISSERTATION*, no italics is used as it is an unpublished work.

CRAVEN, D.H. (1978). The evolution of major games. Unpublished PhD dissertation. Stellenbosch: Stellenbosch University.

For *ELECTRONIC SOURCES* all references start with the same information that would be provided for a printed source (if available). The web page information follows the reference. It will usually contain the name of the authors(s) (if known), year of publication or last revision, title of complete work in inverted commas, title of web page in italics, Uniform Resource Locator (URL) or access path in text brackets (do not end the path statement with a full stop) and date of access. See "*How to cite information from the internet and the world wide web* " at http://apa.org/journals/webref.html for specific examples. When citing a web site in the text, merely give the author and date (in this case: Ackermann, 1996).

ACKERMANN, E. (1996). "Writing your own Web Pages." *Creating Web Pages*. Hyperlink [http://www.mwc.edu/ernie/writeweb/writeweb.html]. Retrieved 22 October 1999.

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APPENDIX B

GUIDELINES FOR AUTHORS:

PERCEPTUAL AND MOTOR SKILLS

Instructions for Submitting a Manuscript to:

Perceptual and Motor Skills or Psychological Reports

1. Be sure your study is within the topic areas in Psychological Reports and Perceptual and Motor Skills: a. Review the topic areas list for PMS or PR. b. Search the online Journal databases to be sure your submission is directed to the correct Journal. Search c. Be sure your design is acceptable. Note on online samples.

2. A manuscript should be prepared in APA* format, double-spaced in clear, 12-point type throughout the paper. Print only on the front side of each page.

3. Begin with a Title Page, which must include: (a) the complete title,

(b) names and affiliations of all authors in the order they should appear,

(c) the running head, and

(d) contact information for readers (name, address, e-mail information).

4. Include a Summary or Abstract on a separate page following the title page. Length should be less than 150 words.

5. A Reference List should be included at the end of the paper. Check to ensure that:

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(b) all references are actually cited in the body of the paper, and

(c) all citations in the paper are included in the Reference list.

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8. If your study used copyrighted questionnaires, instrumentation, etc., then you must also send a copy of permission with your submission. Permission Instructions

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(b) the name of the journal to which the paper is being submitted,

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10. Mail (please do not fax or e-mail) your letter and the original manuscript plus three copies (to facilitate peer-reviewing) to:

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P.O. Box 9229

Missoula, MT 59807-9229 USA.

General Instructions for Figures

Editors' Note: Tables are preferable to any style of graph,because they can be used much more effectively by other researchers.We strongly urge you to consider using tables instead of graphs.

Basic Issues for all Figures

1. Do not place a box around the figure.

2. Axis labels

· Outside labels larger, inside labels smaller, ideally 10- and 8-point fonts, respectively, in the final form of the figure. Reduction of the figure size to fit the journal page will result in smaller fonts, so please take that into account.

· Do not use acronyms. Units of measurement should be abbreviated in SI format, placed in parentheses after the label, e.g., Interstimulus Interval (msec.). ·

Use a sans serif font for all text in the figure (Arial is a good choice). Do not boldface the font. Use the same font and the same weight in all text, varying only the font size in labels of differing importance.

- Use upper and lower case lettering in all text.
- Center the axis labels. Center numerical labels next to or below their respective tic marks on the vertical and horizontal axes.
- Text of axis labels and numerical labels should not touch, nor should the numerical labels touch the tic marks. All text and figure elements should be easily discriminable.
- Use the same number of digits in all the numerical labels, e.g., 2.0, 1.0, 0.5, 0.0, -0.5, etc.
- Use decimal points, not commas, in numerical labels, e.g., 0.5 not 0,5.

3. Tic marks

- Use lines for tic marks, equal in weight to the axes. Do not use small boxes.
- Place tic marks on the outside of both axes.
- Center the tic marks under the data points or bars, not between them.

4. Data points

- Use only the following characters for symbols (data points): and the open styles of these symbols. If you use only these points, there is no need for a legend. The symbols can be described in the caption. This tends to look much cleaner.
- Do not place data symbols on the axes. Ranges of values on each axis should be set so that data points do not fall on the axes or too close to them.
- Symbols used for data points should all be the same size (font size), regardless of which characters are used.
- When choosing the size of symbols, be aware of the final size of the figure. Reduction in size can make symbols too small to be seen easily.

Instructions for Specific Figure Types

Line Graphs

These should only be used if the data are continuous on the horizontal axis, i.e., time or scores. Otherwise a bar graph should be used.

· Usually error bars are required, to indicate standard errors or standard deviations for each data point.

· Symbols depicting data points should be large enough to be seen clearly despite connecting lines. Lines should not pass over the points, but behind them (points hiding lines). Symbols should be open and closed circles, squares, and triangles. Other symbols can be used but are more difficult to read.

· Lines connecting data points may be solid, dotted, or dashed. Dashed lines should only be used if the pattern is clear. Preferably, differentiate between lines by using different symbols instead. Do not use color or gray scale.

· We require a high resolution printout so that lines and curves appear to be continuous, with no obvious jaggedness. Printouts must be free of marks, smudges, or copier dust (small dark specks). Use 1200 dots per inch resolution if possible.

Bar Graphs

· Usually error bars are required, to indicate standard errors or standard deviations for each bar. At least the top half of the error bars should be visible.

· Do not use grey scale or color as a fill for bars. Use patterned fills that are as simple as possible. Black and white fill, dots and hash marks are preferred. It is preferable not to use a legend, but to describe the symbols and fill types in the caption. If a legend is used, be sure it is contained within the area of the figure.

· We require a high resolution printout so that lines and curves appear to be continuous, with no obvious jaggedness. Printouts must be free of marks, smudges, or copier dust (small dark specks). Use 1200 dots per inch resolution if possible.

Line Art

· In line art, use patterned fills when possible, or heavier and lighter fills.

· If arrows are used, be sure that the arrow heads' size matches the lines they are used with, that the arrow heads touch their intended targets.

· Ends of lines, edges of objects, etc. should match up or come into exact contact if a complex structure is created in a graphics package. Otherwise the result will look sloppy.

· We require a high resolution printout so that lines and curves appear to be continuous, with no obvious jaggedness. Printouts must be free of marks, smudges, or copier dust (small dark specks). Use 1200 dots per inch resolution if possible.

Pictures

· Non-digitized pictures should be gray scale only and printed on glossy photographic paper.

· Gray scale pictures, or color if there is no other option, can be sent to us on CD-ROM. Please do not change the file format, but send output from your software in .tif, .pdf, .jpg, or .gif format.

Guidelines for Tables

· Our page is 4 1/2 by 7 inches wide only. Tables can be landscaped, but this requires a full page and is not always desirable. Try turning rows into columns if there is a spacing problem.

· If the words in column headings are long, the column will be wide, resulting in an unbalanced look.

· The larger the left-hand column of descriptives, the less space there is for the rest of the columns.

· The easiest way to judge whether a table will fit on a page or landscaped page is to compare it to similar tables in this journal.

APPENDIX C

GUIDELINES FOR AUTHORS:

AFRICAN JOURNAL FOR AIDS RESEARCH

Author Guidelines

Editorial Policy:

Submission of a manuscript implies that the material has not previously been published, nor is it being submitted elsewhere for publication. Submission of a manuscript will be taken to imply transfer of copyright of the material to the publishers, NISC. Contributions are accepted on the understanding that the authors have the authority for publication. Material accepted for publication in AJAR may not be reprinted or published in translation without the express permission of the publishers, NISC. AJAR will publish research articles of 5 000 to 10 000 words, although longer articles may be accepted. Review papers will be accepted only if they make an original conceptual or theoretical contribution to the field. The entire paper must be presented in English, although the abstract may, in addition, be presented in another language.

Review process: Papers submitted to AJAR will be reviewed by two appropriately qualified and experienced referees to ensure that all papers accepted for publication are methodologically and conceptually sound and make an original contribution to the field. Reviewers are instructed to rate papers using the following criteria:

1. the paper is well-structured and presentation is clear;
2. the goals of the project are readily apparent;
3. the methods used are appropriate to the project and appear to have been satisfactorily executed;
4. results and conclusions are well argued and cognisance is taken of alternative interpretations;
5. appropriate use is made of figures and tables (where relevant);
6. the paper takes into account related empirical and/or analytic work in the field; and
7. the paper makes an original contribution to knowledge in the area.

Papers should be submitted to the Editorial Assistant at ajar@ru.ac.za. Any queries regarding presentation should be addressed to the Copy Editor or Editorial Assistant. Further information on format and references, including examples of tables and graphs, may be obtained at http://www.cadre.org.za. When a manuscript is submitted, the corresponding author will be given a reference number that should be used when communicating with AJAR.

Manuscripts must adhere to the following criteria for submission and papers failing to do so will be returned to authors to be corrected before being reviewed:

Format: Papers should be submitted in MSWord or recent, compatible software format. Headings and text should be presented in 12-point non-serif font such as Arial. Text should be 1.5 line spaced and should not include text columns. Headings should be cased in sentence format (e.g. The history of injectable contraception). Primary headings should be presented in bold, secondary headings in bold and italics and tertiary headings in italics only. Margins should be 25mm and paragraphs should not be indented. Complex graphs and scanned images should be saved as separate files and preferred insertion point referenced in the text.

Manuscripts should contain a title page, an abstract page, the body of the text beginning on a new page, and a reference list.

Title page: This should include the title, author/s names (first and surname), corresponding author e-mail and postal addresses, and a short biographical sketch for each author on work and research interests. Author names must only appear on the title page. If any acknowledgements are due these should appear on the title page. The date of submission to AJAR should also be stated.

Abstract page: This should include the title of the paper and an abstract, which should be a concise statement of the scope of the work and the principal findings. It should summarise the information presented in the paper but should not contain references. Below the abstract up to five additional index words which are not included in the title must be listed in alphabetical order for retrieval purposes.

Citation and referencing style: Authors should follow the Harvard style of referencing:(http://www.lmu.ac.uk/lss/ls/docs/Harvard/uploads/quoteunq.doc).

Citations: If a citation refers to a sentence it must be located before the period at the end of the sentence — e.g. (Akintola, 2001). If it refers to a paragraph it must be included after the period at the end of the paragraph. Multiple citations should be separated by semicolons and these must be

cited chronologically — e.g. (Habib,1998; Bwanika & Davis, 2000; Bam, 2001). If there is more than one citation with the same publication year, these should be listed alphabetically. If the author is referred to in the text the following format applies: 'Nzioka (2001) suggests that...'. If direct quotes are used the author, year of publication and page number must follow the quote in brackets — for example, (Ajulu, 1999, p. 63). If more than one page is referred to the following format is applicable: pp. 55–56. If the author name needs to be mentioned in relation to quoted text the following format applies: Machel (1998) suggests that 'Quote' (p. 66). If there are more than two authors in a cited reference, the first time the work is cited all the authors' names must be used and thereafter, the first author followed by et al.

Reference list: This must appear at the end of the paper and must contain a list of all references cited in the text, in alphabetical order of first author, and should not include references not referred to in the text. All authors must be included in the reference list and full journal titles must be used.

Examples: Abraham, J. & Subrahmanian, C. (1998) Barriers towards the implementation/utilization of HIV counselling services. Paper presented at XII International Conference on AIDS, Geneva, Switzerland.

Ajuwon, A., Akin-Jimoh I., Olley, B. & Akontola, O. (2001) Perceptions of sexual coercion: learning from young people in Ibadan, Nigeria. Reproductive Health Matters 9(17), pp. 128–136.

Mann, J. (1992) AIDS in the World. Cambridge Massachusetts, Harvard University Press.Webb, D. (1998) The sexual and economic politics of reintegration: HIV/AIDS and the question of stability. In: Simon, D. ed. South Africa in Southern Africa. Reconfiguring the Region. Oxford, James Currey.

UNAIDS (2000) A framework for action 2000. Available at www.unaids.org/africapartnership/files/FrameworkEnglish-final.doc [Accessed 12 April, 2002]. (Some caution should be exercised in citing internet references, as URLs are prone to change. It is therefore better to refer to a site URL where the reference may be searched for. It is generally better to reference the hard copy publication if possible.)

Body of text: All papers should include an introduction and conclusion section, but given the different types of papers that might be published in AJAR, we do not prescribe a standard format for the middle section. In structuring the body of the article authors are requested to take into account the review criteria described above.

Footnotes/endnotes: Endnotes should be used rather than footnotes, although it is preferable to limit use of endnotes. Full references should appear in the reference list and not in endnotes.

Writing style: This should be concise and clear. Long and complex sentences should be avoided. Authors must bear in mind that AJAR will be read by non-native English speakers and efforts should be made to define terms and jargon which are discipline-specific or infrequently used.

Abbreviations: These should generally not be used in the text. 'For example', 'that is' and 'namely' should be written in full, although abbreviations such as 'e.g.', 'i.e.' and 'viz.' may be used in text which is separated from the main text body by hyphens or brackets.

Non-English words: These should be italicised and should not be capitalised by virtue of being non-English words.

Acronyms: When an acronym is used for the first time, it should be followed in parentheses by the full text to which it refers. Thereafter the acronym may be used without explanation.

Numbers: The period (.) must be used as the decimal indicator, and 'thousands' must be designated by a space rather than a comma (e.g. 1 500 000).

Inverted commas: Double inverted commas should only be used to designate quotes. Otherwise single inverted commas should be used.

Tables: Each table must be accompanied by an appropriate standalone caption. Data may not be presented in both tabular and graphical form. Tables must use thin single lines and should not include shading. Tables should contain only information directly relevant to the content paper.

Figures: Highly stylised formatting should be avoided. Figures should preferably be two dimensional and inward-turning scale marks should be used. The use of grey tones should be avoided and pattern textures should rather be used.

Scanned images: Line artwork and photographs should be scanned and saved as separate files, rather than included in the text. References to these files should be clearly marked in the text. The preferred point of insertion should be labelled in the text. TIF, GIF, JPG or EPS formats may be used. Images must be scanned at a minimum of 300dpi format.

Corresponding authors will receive an electronic copy of their manuscript for reprint use.

Submission Preparation Checklist (All items required)

- The submission has not been previously published nor is it before another journal for consideration; or an explanation has been provided in Comments to the Editor.

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APPENDIX D

GUIDELINES FOR AUTHORS:

CHILD: CARE, HEALTH AND DEVELOPMENT

Submission

Manuscripts should be submitted online at http://mc.manuscriptcentral.com/cch. Full instructions and support are available on the site and a user ID and password can be obtained on the first visit. Support can be contacted by phone (+1 434 817 2040 ext. 167), e-mail (support@scholarone.com) or at http://blackwellsupport.cushelp.com. if you cannot submit online, please contact the Editorial Assistant in the Editorial Office by e-mail CCHofice@oxon.blackwellpublishing.com.

A covering letter must be submitted as part of the online submission process, stating on behalf of all the authors that the work has not been published and is not being considered for publication elsewhere. All accepted papers should be accompanied by a copyright assignment form. Copyright of accepted manuscripts and all published material becomes the property of the Journal. For guidance on ethical aspects, authors are recommended to consult the porposals of the MR. Report 1963/3 on human invistigations published in the *British Medical Journal* (1964) B, 178-180.

Preparation of the manuscript

The following checklist should be used to check the manuscript before submission. Articles are accepted for publication at the discretion of the Editor. A manuscript, which ideally will be between 2000 and 3000 words, should consist of the sections listed below.

Manuscript style

Manuscripts must be submitted online at http://mc.manuscriptcentral.com/cch. All parts of the manuscript must be available in an electronic format and it is recommended that, where possible, figures be embedded into a single Microsoft Word document. Manuscripts should be typed using double spacing and size 12pt. No identifying details of the authors or their institutions must appear in the submitted manuscript. Author details will be inputted as part of the online submission process.

Title page

The title page should give both a descriptive title and short title. The title should be concise and should give a brief indication of what is in the paper.

Main text

Generally, all papers should be divided into the following sections and appear in this order: Abstract (structured abstracts, not more thatn 300 words, including background, methods, results and conclusions are preferred); Introduction; Methods; Results; Discussion; Acknowledgements; References; Tables; Figures. Authors must provide a word count for the main body of the text.

Units and spellings

Sytème International (SI) units should be used, as given in *Units, Symbols and Abbreviations* (4th edition, 1988), published by the Toyal Society of Medicing Services Ltd, 1 Wimpole Street, London W1M 8AE, UK. Spelling should conform to that used in *The Concise Oxford Dictionary*, published by Oxford University Press.

References

References cited in the text should list the authors names followed by the date of their publication, unless there are three or more authors when only the first author's name is quoted followed by *et al.* References listed at the end of the paper should include all authors' names and initials, and should be listed in alphabetical order with the title or the article or book, and the title of the Journal given in full as shown:

Havermans, T. & Eiser, C. (1994) Siblings of a child with cancer. *Child: care, health and development,* **20**, 309-322.

Cart, P. (1984) Observation. In: *The Research Process in Nursing* (ed. D.F.S. Cormack), pp.XX-XX. Blackwell Publishing, Oxford, UK.

Work that has not been accepted for publication and personal communications should not appear in the reference list, but may be referred to in the text (eg. 'A. Author, unpubl. Observ.' Or 'B. Author, per. Comm.'). It is the authors' responsibility to obtain permission from colleagues to include their work as a personal communication. A letter of permission should accompany the manuscript.

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Acknowledgements

These should be brief and must include references to sources of financial and logistical support.

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Proofs must be returned to the production office within 3 days of receipt. Only typographical errors can be corrected at this stage. Major alterations to the text cannot be accepted.

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APPENDIX E

INFORMED CONSENT DOCUMENTS

Dear parent/caretaker,

Growth status and motor development of 2- to 6-year-old children, affected and infected by HIV: an intervention study.

I am from the Northwest University. I would like to start a physical and motor development programme at Amaphelo crèche to enhance the children's motor and fitness skills. For the physical and motor development we would like to take measurements such as stature, body mass, fat percentage, arm circumference, physical fitness and motor development. A qualified Kinderkineticist will offer the programme during school hours. None of the measurements or activities will be harmful or painful, either physically or mentally; we instead aim to improve the skills of the children involved.

In order to interpret the data successfully, I need to be informed about the child 's HIV status and general health status of the child. All data will be confidential and used for this research project only.

No money is needed from you or the child.

When you would like to have more information, you can get this from the teachers at the school or I will be at the school regularly. You could also contact us by telephone at the university (018 299 1796). You have the right to withdraw your child from the project at any stage, without having to provide any reason.

We hereby ask you for your permission that the child under your care can be involved in the activities as outlined above. When you agree, please complete and sign the form attached to this letter and let the child take it back to school. You can keep this letter for your information.

With kind regards.

Jo-Anne Botha

Title of the project: *Growth status and motor development of 2- to 6-year-old children, affected and infected by HIV: an intervention study*

Name of child: .....

Address: .....

Age: .....

School: ..... Grade: .....

I, the undersigned, ... the parent/legal guardian of the child named above, have read the description and explanation of the project *Growth status and motor development of 2- to 6-year-old children, affected and infected by HIV: an intervention study* and declare that I understand it. I hereby consent that the child named above may participate in the project, in which he/she will undergo some physical measurements and answering questions related to the project. I understand that my child will not be harmed in any way, physically or mentally.

.....

Signature

Relationship to child named above: .....

Date: .....

APPENDIX F

MOTOR INTERVENTION PROGRAMME

Die Kliniek vir Kinderkinetika se
KLEUTER BEWEGINGSONTWIKKELING

Week 1 (Lesson 1 & 2)

Loco-motor and physical skills (7 minutes)

Crab walking

Baboon walking

Frog jumping

Reflexes and Vestibular (5 minutes)

Boat rolling

Aeroplanes

Egg rolls

Fine motor (10 minutes)

Complete the picture (cat)

Cut out cardboard along different lines

Loco-motor and physical skills (5 minutes)

Galloping

Running – big steps, small steps, quick steps, slow steps

Rest period (3 minutes)

Stationary (10 minutes)

Stand heel-to-toe on rope

Stand on toes on rope

Stand on rope-hands on hips, hands on head, hands to the side

Walking on ropes placed in forms – forwards, backwards, oblique, legs crossed

Object manipulation (10 minutes)

Tossing up a beanbag and catching it

Throwing a beanbag to a hoop against the wall

Fine motor (5 minutes)

Copy different shapes

Game (5 minutes)

Games with parachute

Week 2 (Lesson 3 & 4)

Loco-motor and physical skills (7 minutes)

Crab walking

Baboon walking

Frog jumping

Reflexes and Vestibular (5 minutes)

Boat rolling

Aeroplanes

Egg rolls

Fine motor (10 minutes)

Colour the picture

Loco-motor and physical skills (5 minutes)

Galloping

Running – big steps, small steps, quick steps, slow steps

Rest period (3 minutes)

Stationary (10 minutes)

Stand on toes on rope

Stand heel-to-toe on rope

Stand on rope-hands on hips, hands on head, hands to the side

Walk on ropes placed in forms – forwards, backwards, oblique, legs crossed

Object manipulation (10 minutes)

Tossing up a beanbag and catching it

Throwing a beanbag in a hoop against the wall

Throwing a beanbag to each other

Fine motor (5 minutes)

Finger games-different shapes with fingers, walking with fingers, finger tapping

Game (5 minutes)

Ribbons on sticks

Week 3 (Lesson 5 & 6)

Loco-motor and physical skills (7 minutes)

Crab walking

Baboon walking

Frog jumping

Hopping

Galloping

Reflexes and Vestibular (5 minutes)

Boat rolling

Aeroplane

Trunk rolls

Fine motor (10 minutes)

Pressing sticks into clay and removing them again — using different fingers

Threading a string through holes in a piece of cardboard

Loco-motor and physical skills (5 minutes)

Two-leg jumping

Single-leg jumping

Mastering steps skipping — hoop

Rest period (3 minutes)

Stationary (10 minutes)

Standing on one leg with eyes open, eyes closed

Walking on ropes placed in forms – forwards, backwards, oblique, legs crossed

Object manipulation (10 minutes)

Tossing up a large ball and catching it

Rolling a ball forward

Rolling a ball into goal area

Kicking a ball

Kicking a ball into the goal area

Fine motor (5 minutes)

Colouring a picture

Game (5 minutes)

Activities with parachute

Week 4 (Lesson 7 & 8)

Loco-motor and physical skills (7 minutes)

Crab walking

Baboon walking

Frog jumping

Galloping

Reflexes and Vestibular (5 minutes)

Boat rolling on a big ball

Aeroplanes on a big ball

Trunk rolls on the grass

Fine motor (10 minutes)

Necklace -Threading a string through macaroni

Loco-motor and physical skills (5 minutes)

Two-leg jumping

Single-leg jumping

Skipping

Running

Rest period (3 minutes)

Stationary (10 minutes)

Standing on one leg with eyes open, eyes closed on frisbee

Turn slowly around on the frisbee

Stand on one leg on frisbee – touch different body parts

Jump from the frisbee – forward, backward, and sideways

Children stand in a row and walk over the frisbee

Object manipulation (10 minutes)

Tossing up a large ball and catching it

Rolling a ball forward

Rolling a ball into goal area

Kicking a ball

Kicking a ball into the goal area

Fine motor (5 minutes)

Copying and colouring a picture

Game (5 minutes)

Parachute with balls

Week 5 (Lesson 9 & 10)

Loco-motor and physical skills (7 minutes)

Skipping

Galloping

Reflexes and Vestibular (5 minutes)

Boat rolling on frisbee

Aeroplane over the frisbee

Trunk rolls on the grass

"Angels in the snow"

Fine motor (10 minutes)

Open laundry pegs with different hands and fingers

Put laundry pegs on the side of a paper plate and take them off again

Loco-motor and physical skills (5 minutes)

Two-leg jumping

Single-leg jumping

Skipping

Rest period (3 minutes)

Stationary (10 minutes)

Standing on one leg with eyes open, eyes closed on frisbee

Turn slowly around on the frisbee

Stand on one leg on frisbee – touch different body parts

Jump from the frisbee – forward, backward, and sideways

Jump over the frisbee – forward and backward

Object manipulation (10 minutes)

Tossing up a large ball and catching it

Rolling a ball forward

Throw ball against the wall and try to catch it

Throw the ball in a bucket

Kick ball against the wall

Fine motor (5 minutes)

Copy and paste a lion with different shapes

Game (5 minutes)

Activities with parachute and balls

Week 6 (Lesson 11 & 12)

Loco-motor and physical skills (7 minutes)

Skipping

Galloping

Running

Crab walking

Baboon walking

Frog jumping

Reflexes and Vestibular (5 minutes)

Boat rolling on a small bench

Aeroplane over the bench

Trunk rolls on the grass

"Angels in the snow"

Fine motor (10 minutes)

Roll a snake with dough

Roll the dough in a small ball

Press the dough between different fingers

Make different shapes with the dough

Loco-motor and physical skills (5 minutes)

Two-leg jumping

Single-leg jumping

Rope jumping with hoop

Rest period (3minutes)

Stationary (10 minutes)

Standing on one leg on small bench - with eyes open, eyes closed

Turn slowly around on the bench

Stand on one leg on bench – touch different body parts

Jump from the bench – forward, backward, and sideways

Children stand in a row and walk over benches

Object manipulation (10 minutes)

Kick ball on the ground

Run and kick ball on the ground

Kick ball against the wall

Kick ball into goal area

Fine motor (5 minutes)

Open elastic bands with different hands and fingers

Game (5 minutes)

Activities with parachute and balls

Week 7 (Lesson 13 & 14)

Loco-motor and physical skills (7 minutes)

Crab walking

Baboon walking

Frog jumping

Skipping

Galloping

Running

Reflexes and Vestibular (5 minutes)

Boat rolling on a small bench

Aeroplane over the bench

Trunk rolls on the grass

"Angels in the snow"

Fine motor (10 minutes)

Finger painting

Loco-motor and physical skills (5 minutes)

Two-leg jumping

Single-leg jumping

Rope jumping with hoop

Rest period (3 minutes)

Stationary (10 minutes)

Standing on one leg on small bench - with eyes open, eyes closed

Turn slowly around on the bench

Stand on one leg on bench – touch different body parts

Jump from the bench – forward, backward, and sideways

Children stand in a row and walk over benches

Object manipulation (10 minutes)

Kick ball on the ground

Run and kick ball on the ground

Kick ball against the wall

Kick ball into targets against the wall

Fine motor (5 minutes)

Tighten and loosen bolts – different hands

Game (5 minutes)

Activites with parachute and balls

Week 8 (Lesson 15 & 16)

Loco-motor and physical skills (7 minutes)

With parachute:

Skipping

Galloping

Running

Reflexes and Vestibular (5 minutes)

Boat rollling

Aeroplane

Trunk rolls on the grass

"Angels in the snow"

Fine motor (10 minutes)

Finger painting

Loco-motor and physical skills (5 minutes)

With parachute:

Two-leg jumping

Single-leg jumping

Rest period (3 minutes)

Stationary (10 minutes)

Standing on one leg on small bench - with eyes open, eyes closed

Turn slowly around on the bench

Stand on one leg on bench – touch different body parts

Jump from the bench – forward, backward, and sideways

Children stand in a row and walk over benches through tunnel

Object manipulation (10 minutes)

Kick ball on the ground

Run and kick ball on the ground

Kick ball against the wall

Kick ball into targets against the wall

Fine motor (5 minutes)

Tighten and loosen bolts – different hands

Game (5 minutes)

Activites with parachute and balls

Week 9 (Lesson 17 & 18)

Loco-motor and physical skills (7 minutes)

Skipping

Galloping

Crab walking – around and through hoops

Baboon walking - around and through hoops

Frog jumping - around and through hoops

Reflexes and Vestibular (5 minutes)

Boat position on a big ball

Aeroplanes on a big ball

Forward and backward walk with arms and hands – body resting on big ball

Fine motor (10 minutes)

Cut out picture with scissor

Necklace -threading a string through sweets

Loco-motor and physical skills (5 minutes)

Running

Two-leg jumping

Single-leg jumping

Mastering steps skipping with hoop

Rest period (3minutes)

Stationary (10 minutes)

Standing on one leg in hoop - with eyes open, eyes closed

Stand on one leg in hoop – "touch the sky"

Walk on the side of the hoop

Jump zigzag over the side of the hoop

Jump zigzag forward, backward over the sides of the hoop

Object manipulation (10 minutes)

Kick ball on the ground

Run and kick ball on the ground

Kick ball against the wall

Kick ball into hoops against the wall

Fine motor (5 minutes)

Tighten and loosen bolts – different hands

Game (5 minutes)

Activites with parachute and balls

Week 10 (Lesson 19 & 20)

Loco-motor and physical skills (7 minutes)

Crab walking through and over different objects (hoops, frisbees)

Baboon walking through and over different objects (hoops, frisbees)

Frog jumping over frisbees

Hopping through objects

Galloping through objects

Reflexes and Vestibular (5 minutes)

Boat rolling on ball

Aeroplane on ball

Trunk rolls

Fine motor (10 minutes)

Attaching laundry pegs to shapes — using different fingers

Threading string through different forms of noodles

Loco-motor and physical skills (5 minutes)

Two-leg jumping - over and on small benches

One-leg jumping – around small benches

Skipping - hoops

Rest period (3 minutes)

Stationary (10 minutes)

Frisbee on different body parts

Standing on one leg with eyes open, eyes closed on frisbee

Walking on edge of hoops – forwards, backwards, oblique, legs crossed

Object manipulation (10 minutes)

Tossing up a ball and catching it – Bigger children use tennis balls

Rolling ball through markers with fingers

Kicking a ball softly

Kicking a ball through markers

Tossing a ball into a bucket – increase distance

Fine motor (5 minutes)

Duplicating, cutting out and colouring a picture

Game (5 minutes)

Activities with parachute and balls

Week 14 (Lesson 21 & 22)

Loco-motor and physical skills (7 minutes)

Crab walking through tunnel and around benches

Baboon walking through tunnel and around benches

Frog jumping from benches

Skipping –swinging ribbons on sticks

Galloping – swinging ribbons on sticks

Reflexes and Vestibular (5 minutes)

Boat rolling on ball

Aeroplane on ball

Trunk rolls

Fine motor (10 minutes)

Elastic bands around different fingers

Copy different shapes and cut them out

Loco-motor and physical skills (5 minutes)

Two-leg jumping - over and on small benches, climb through tunnel

One-leg jumping – around small benches, climb through tunnel

Skipping (smaller children - hoops and bigger children – ropes)

Rest period (3 minutes)

Stationary (10 minutes)

Standing on one leg on small bench - with eyes open, eyes closed

Turn slowly around on the bench- swinging ribbon

Stand on one leg on bench – touch different body parts, while swinging ribbon

Jump from the bench – forward, backward, and sideways, while swinging ribbon

Children stand in a row and walk over benches and through tunnel

Object manipulation (10 minutes)

Tossing up a ball and catching it – bigger children use tennis balls

Rolling ball through markers with fingers

Kicking a ball softly

Kicking a ball through markers

Tossing a ball into a bucket – increase distance

Fine motor (5 minutes)

Attaching and removing laundry pegs to and from a paper plate

Game (5 minutes)

Activities with parachute and balls

Week 12 (Lesson 23 & 24)

Loco-motor and physical skills (7 minutes)

Crab walking around parachute

Baboon walking around parachute

Frog jumping around parachute

Skipping around parachute

Galloping around parachute

Reflexes and Vestibular (5 minutes)

Boat rolling

Aeroplane

Trunk rolls

Fine motor (10 minutes)

Elastic bands around different fingers

Making balls with elastic bands around newspaper

Loco-motor and physical skills (5 minutes)

Two-leg jumping – with parachute

One-leg jumping – with parachute

Running – with parachute

Rest period (3 minutes)

Stationary (10 minutes)

Standing on one leg while holding the parachute - with eyes open, eyes closed

Stand on one leg while holding the parachute –move parachute to different levels

Make popcorn with balls, while standing on one leg

Object manipulation (10 minutes)

Tossing up a ball and catching it – Bigger children use tennis balls

Rolling ball around parachute

Throwing ball unto parachute (increase distance)

Kicking a ball softly around parachute

Fine motor (5 minutes)

Threading string through different sweets

Game (5 minutes)

Activites with parachute and balls

APPENDIX G

SUBMISSION CONFIRMATION

Mail Message

Reply Resend Read Later Delete

Mail Properties

From: Botha JE Friday - November 30, 2007 9:06 AM
To: floris@sun.ac.za
Subject: Submission
Attachments: ARTICLE 1- SA JOURNAL.doc (143853 bytes) [View] [Open] [Save As]
ARTICLE 1- SA JOURNAL.doc (254976 bytes) [View] [Open] [Save As]

Submission letter
The undersigned authors transfer the ownership of copyright to South African Journal for Research in Sport, Physical education and recreation, should the work be published in this journal. They state that the article is original, has not been submitted for publication in other journals and has not already been published. We state that we are responsible for the research been carried out; that we are responsible for the drafting and revising of the manuscript and that we approve the contents. We state that the research was undertaken in compliance with the Helsinki Declaration and the International principles governing research on animals

Jo-Anne Botha and Anita Pienaar

APPENDIX H

SUBMISSION CONFIRMATION

PERCEPTUAL AND MOTOR SKILLS

Box 9229 Missoula, Montana 59807 www.AmmonsScientific.com

August 6, 2007

Dr. Jo-Anne E. Botha
School of Biokinetics
Recreation and Sport Science
North-West University
Potchefstroom Campus
Private Bag X6001, Potchefstroom 2520
REPUBLIC OF SOUTH AFRICA

Dear Dr. Botha:

We are pleased to acknowledge receipt of your manuscript, "The value of a motor intervention program for 2 to 6 year-old children infected with and affected by HIV," which has been submitted for possible publication in *Perceptual and Motor Skills*.

Ordinarily, we require two to four months to process reviewers' comments. If there are any special considerations or problems, please do not hesitate to send an inquiry.

We are pleased to announce that all articles published since 1970 have been archived on our website and are fully registered with CrossRef. Articles are viewable as full text with subscription (i.e., through a library that subscribes) or as abstracts. Full text is purchasable by non subscribers at $1.00 per page, about 15% of the standard industry cost. More articles are being added weekly until all 480,000 pages of *Psychological Reports* and *Perceptual and Motor Skills* are on the site. **Since your topic is a familiar one in *Perceptual and Motor Skills*, we ask that you search the database to be sure you have cited materials that are relevant.** If you have any comments or suggestions, please feel free to send them along. Our goal is to help researchers find materials easily.

Sincerely,

Carol H. Ammons, Ph.D.
Senior Editor

CHA:dw
Enclosure

APPENDIX I

SUBMISSION CONFIRMATION

Mail Message

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From: Botha JE Friday - November 30, 2007 9:29 AM
To: ajar@ru.ac.za
Subject: Submission
Attachments: Article - AJAR.doc (464896 bytes) [View] [Open] [Save As]

Submission letter
The undersigned authors transfer the ownership of copyright to the African journal of AIDS research, should the work be published in this journal. They state that the article is original, has not been submitted for publication in other journals and has not already been published. We state that we are responsible for the research been carried out; that we are responsible for the drafting and revising of the manuscript and that we approve the contents. We state that the research was undertaken in compliance with the Helsinki Declaration and the International principles governing research on animals

Jo-Anne Botha and Anita Pienaar

APPENDIX J

SUBMISSION CONFIRMATION

Submission Confirmation

Thank you for submitting your manuscript to *Child: Care, Health & Development*.

Manuscript ID: CCH-2007-0222

Title: The growth status of 2 to 6-year old children infected by HIV over a period of 9 m

Authors: Botha, Jo-Anne
Pienaar, Anita

Date Submitted: 30-Nov-2007

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