

**THE INFLUENCE A 10-WEEK ZULU STICK FIGHTING  
INTERVENTION PROGRAMME HAS ON MOTOR  
PROFICIENCY AND HEALTH-RELATED PHYSICAL  
FITNESS OF PREPUBESCENT ZULU MALES**

**SABELO ABED-NEGO NXUMALO**

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PROFICIENCY AND HEALTH-RELATED PHYSICAL  
FITNESS OF PREPUBESCENT ZULU MALES**

By

**SABELO ABED-NEGO NXUMALO**

Submitted in the fulfilment of the academic requirements for the degree

**MASTER OF SCIENCE (HUMAN MOVEMENT SCIENCE)**

In the

FACULTY OF SCIENCE AND AGRICULTURE

(Department of Biokinetics and Sport Science)

University of Zululand

December 2010

**SUPERVISOR: PROF MF COETSEE**

**PROF SJ SEMPLE**

**CO-SUPERVISOR: DR GK LONGHURST**

## DECLARATION

I hereby declare that this study represents the original work by the author and has not been submitted in any form at another University. Where use is made of the work of others, it has been duly acknowledged in the text and included in the list of references cited.

.....

S. A. Nxumalo

31 December 2010

## **DEDICATION**

This dissertation is dedicated to my parents:

**PHILEMON MLINDO NXUMALO**

**(1936 - 1978)**

**Missed terribly**

**THEMBEKILE BHEKENI NXUMALO**

*For you created my inmost being; you knit me together in my mother's womb. I praise you because I am fearfully and wonderfully made; your works are wonderful, I know that fully well. My frame was not hidden from you when I was made in the secret place. When I was woven together in the depths of the earth, your eyes saw my unformed body. All the days ordained for me were written in your book before one of them came to be (Psalm 139:13-16).*

## ACKNOWLEDGEMENTS

This study would not have been possible without the co-operation and assistance from other people and institutions. The author humbly wishes to express sincere gratitude towards the persons and institutions whose names appear below:

- ❖ My supervisor, the late **Professor MF Coetsee**, for the valuable time he spent on this piece of work. Prof Coetsee might not be here to see the fruits of his hard work, I would like to thank him for his wonderful experience, patience, competence and constructive comments.
- ❖ **Dr Glynis Longhurst** and **Prof Stuart Semple** for having stepped in as supervisors to oversee the progress of this work till completion when Prof Coetsee passed away. I understand how difficult this might have been, I bow before you.
- ❖ **Dr Ranel Venter** of the University of Stellenbosch, Sport Science Department, for having shared ideas on the research design that could work for this study.
- ❖ **Prof Faans Steyn** of the North West University Statistical Services, Potchefstroom Campus, for offering his statistical expertise, thus making analysis of data for this study possible.
- ❖ All the children that agreed to avail themselves as **participants** of this study.
- ❖ **Ms Siphwe Ntuli**, for her assistance and patience in typing this piece of work.
- ❖ **Mrs Mandi Semple**, for proofreading every chapter of this work and making constructive inputs.
- ❖ **The University of Zululand Research Committee**, for having afforded me funding to conduct this study and the research administration staff members, Mrs D Viljoen and Ms N Shoba, for the swift manner in which all my queries were resolved.
- ❖ **The Medical Research Council**, for having afforded me funding to present the findings of this study in an international conference.
- ❖ Mesdames **Zama Mntambo**, **Sinenhlanhla Xulu** and **Kanalelo Ramone**, for spending their precious time as my research assistants.

- ❖ **Mr R. M. Yaka** of Ofasimba Primary School and **Mrs E. D. Mthembu** of Mngampondo Combined Primary School and their respective staff members, for having given me permission to use their schools to conduct my research.
- ❖ All **my colleagues** in the Biokinetics and Sport Science Department, University of Zululand, for words of encouragement.
- ❖ Former lecturers in the Biokinetics and Sport Science Department, University of Zululand, **Prof Steve Olivier** and wife, **Amanda Olivier** (University of Arbetray, Scotland), **Prof Simeon Davies** (Cape Peninsula University of Technology) and **Prof Johan van Heerden** (University of KwaZulu-Natal), for their inspiration, support and wishes to see me become better qualified.
- ❖ **My colleagues** in the Faculty of Education especially Professor DR Nzima, Drs HB Khuzwayo and ET Dlamini, Messrs NH Ngwenya and EXS Zwane and Mesdames NC Luthuli and AB Mhlongo, for words of encouragement.
- ❖ **My ‘brother from another mother’** Professor David Phathabantu Ngidi, the Dean of the Faculty of Humanities, Central University of Technology. You are an inspiration! Thank you for the support and your interest in me.
- ❖ My dearest mother, **Thembekele Bhekeni Nxumalo**, for having played the role of both parents for a number of years and for having afforded me the opportunity to be what I am today. You have been a wonderful mother, God bless you. Mpangazitha!
- ❖ The woman in me, **Ntandokazi**, two souls with but a single thought, two hearts that beat as one.
- ❖ Above all, the credit of this piece of work goes to **God** without whom this work would not have been possible. My God is an awesome God; He reigns from above with love, wisdom and power.

## SUMMARY

The aim of this study was to investigate the effect of a 10-week stick fighting intervention programme on anthropometrical measures, motor proficiency and health-related physical fitness parameters such as body composition, cardiovascular fitness, flexibility, muscular endurance and muscular strength.

Twenty two prepubescent Zulu males (mean age =  $9.80 \pm 0.64$  years, range 8.60-11.10) formed the experimental group and twenty three other Zulu males (mean age =  $10.09 \pm 0.73$ , range 8.43-11.70) formed the control group. The experimental group underwent a 10 week stick fighting intervention programme facilitated by two professional stick fighters whilst for the same period, the control group did not receive any intervention programme rather continued with their daily activities.

For motor proficiency, data was collected at three intervals: pre, post and post-post intervention. The Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) was used to assess motor proficiency: fine and gross motor skills. For anthropometrical measures and health-related physical fitness, data was collected at two intervals: pre- and post-intervention. The five health-related components of physical fitness were measured by the following: body composition, flexibility, muscular endurance, muscular strength and cardiovascular fitness.

The experimental group showed significant improvements ( $p < 0.05$ ) in the post-intervention motor proficiency composite mean scores for balance and upper limb dexterity subtests whereas the control group did not exhibit significant improvements in any of their post-intervention composite mean scores. The experimental group also experienced an 11.62% significant improvement ( $p < 0.05$ ) in their motor proficiency mean scores relative to the control group when the pre-intervention and the post-post intervention scores were compared. The low internal consistency and inter-item correlation of the Bruininks-Oseretsky Test of Motor Proficiency suggests that there are challenges with the reliability of the results. Thus, the results should be interpreted with

caution. The experimental group also recorded significant improvements ( $p < 0.05$ ) in the body composition, cardiovascular fitness and flexibility after a 10-week Zulu stick fighting intervention programme when post-intervention mean scores are compared adjusted for pre-intervention mean scores whereas no significant improvement in the post-intervention mean scores was recorded for the control group.

It appears that the levels of motor proficiency and health-related physical fitness can be positively influenced through participating in traditional Zulu games such as Zulu stick fighting. It would seem the benefits derived from engaging in Zulu stick fighting may be the same as the one derived from doing any kind of physical activity. It must be said though that the results of the motor proficiency in the current study can not be declared as useful data.

## OPSOMMING

Die doelwit vir hierdie studie was om die effek te ondersoek wat 'n 10-weke stok geveg intervensie program sal hê op antropometriese meetings, motoriese vaardigheid, en gesondheids georiënteerde fisiese fiksheid parameters, soos liggaams komposisie, kardiovaskulêre fiksheid, soepelheid, spier uithouvermoë en spierkrag.

Twee en twintig voor-puberteitsperiode Zulu jong mans (gemene ouderdom =  $9.80 \pm 0.64$  jare, omvang 8.60 – 11.10) het die eksperimentele groep gevorm en drie en twintig ander Zulu jong mans (gemene ouderdom =  $10.09 \pm 0.73$ , omvang 8.43 – 11.70) het die kontrole groep gevorm.

Vir motoriese vaardigheid, is data gekollekteer by drie intervalle: pre-, post- en post-post-intervensies. Die Bruininks-Oseretsky Toets vir Motoriese Vaardigheid (BOTMP) was gebruik om motor vaardigheid te toets. Vir antropometriese meetings en gesondheids georiënteerde fisiese fiksheid, was data gekollekteer by twee intervalle: pre- en post-intervensie. Die gesondheids georiënteerde komponente van fisiese fiksheid was deur die volgende metodes gemeet: liggaams komposisie; soepelheid, spieruithouvermoë, spierkrag en kardiovaskulêre fiksheid. Die eksperimentele groep het opvallende verbeterings getoon ( $p < 0.05$ ) in die post-intervensie motor vaardigheid gemene resultate vir balans en boonste ledemaat ratsheid subtoetse terwyl die kontrole groep nie merkwaardige verbeterings getoon het nie. Die eksperimentele groep het ook opvallende verbeterings van 11.62% aangedui ( $p < 0.05$ ) in hulle motor vaardigheds gemene resultate, relatief tot die kontrole groep, toe die pre- en post-post- intervensie resultate vergelyk was. Die eksperimentele groep het ook aansienlike verbeterings opgeneem ( $p < 0.05$ ) in liggaams komposisie, kardiovaskulêre fiksheid en slapheid na 'n 10 week Zulu stok geveg intervensie program terwyl geen opvallende verbeterings merkbaar was vir die kontrole groep nie.

Dit kom voor dat die vlakke van motor vaardigheid en gesondheids georiënteerde fisiese fiksheid positief bēinvloed kan word deur deelname aan tradisionele Zulu spele en Zulu stok gevegte.

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## LIST OF ABBREVIATIONS

ABC	:	assessment battery for children
AIDS	:	acquired immune deficiency syndrome
ACSM	:	American college of sports medicine
ANCOVA	:	analysis of covariance
ASIS	:	anterior superior iliac spine
ANOVA	:	analysis of variance
ATA	:	American Taekwondo Association
BD	:	body density
BMD	:	bone mineral density
BMI	:	body mass index
BOTMP	:	Bruininks-Oseretsky test of motor proficiency
CG	:	centre of gravity
cm	:	centimetre
com	:	centre of mass
COSATU	:	Confederation of South African unions
CSA	:	Computer Science and Appliance
diff	:	difference between scores
% diff	:	percentage difference between scores
et al	:	and others
HIV	:	human immunodeficiency virus
i.e.	:	for an example
IKS	:	Indigenous Knowledge Systems
INC.	:	Incorporated
kg	:	kilograms
kg.m <sup>2</sup>	:	kilograms metre squared
kg.ml.min <sup>-1</sup>	:	kilograms millilitres per minute
km.h <sup>-1</sup>	:	kilometres per hour
KZN	:	KwaZulu-Natal
m	:	meter

max	:	maximum
MES	:	Medical Equipment Services
min	:	minimum
Movement ABC	:	movement assessment battery for children
n	:	number
p	:	probability value
PE	:	physical education
PNF	:	Proprioceptive Neuromuscular Facilitation
pre	:	pre test
post	:	post test
post-post	:	post-post test
ROM	:	range of motion
RER	:	respiratory exchange ratio
sd	:	standard deviation
UNICEF	:	United Nation's Children Foundation
VAMS	:	visual analogue mood scales
Vo <sub>2</sub> max	:	maximal oxygen uptake
WHR	:	waist-to-hip ratio
20 MST	:	20 metre multi-stage fitness test
y	:	years

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# CHAPTER ONE

## INTRODUCTION

This chapter provides the background to the study, the research problem, the aims of the study, the hypothesis and the null hypotheses. Delimitations and limitations of the study are highlighted in this chapter. The chapter ends off by clarifying concepts and providing an outline of the organisation for this dissertation.

The next section deals with the background:

### 1. BACKGROUND TO THE STUDY

Children do not automatically develop skills, knowledge, attitudes and behaviour that leads to regular and enjoyable participation in physical activity. A wide variety of fundamental skills obtained in childhood would make more specific skills easier to acquire in adolescence and adulthood. Motor skill development is enhanced when children are stimulated to perform and exercise specific activities focusing on development of these skills. Through movement activities a child acquires skills, knowledge and attitudes that help him/her to discover and understand his/her body: how it works, its physical abilities and its limitations (Scheepers, 2002). There is also evidence to show that people are more likely to take up or continue participating in sports if they have adequate skill. The importance of skill development from a young age is therefore very important (MacInnis, 2008).

Throughout the history of mankind, physical activity, free play, sport and traditional games, have played a significant role in the day-to-day life of people. Physical activity for primitive people was related first to survival activity such as the incessant search for food, clothing, shelter and protection from a hostile environment, and the propagation of the species (Barrow & Brown, 1988). It became a means of preparing youth for adult life, as some games were taken from life's activities and became a recognised way to improve strength, speed, and skill, qualities necessary for survival. In ancient Greece, particularly in Athens, physical activity and sport was used to help develop children and

improve general physical health ensuring the development of the total individual in all aspects of life (Bucher & Wuest, 1999).

Human movement scientists and physical educators have long been emphasising the importance of physical activity and skill development. Numerous studies have been conducted in which the importance of physical activity and sport skill development in the school curricula has been identified (Arnold, 1979; Katzenellenbogen, 1994, Pillay & Oosthuizen, 1994; Miller, 1995). The focus on physical activity and skill development has implications not only for the development of highly skilled sports people, but also for general wellbeing and health. Many chronic diseases are in part due to lack of physical activity (Corbin & Lindsey, 1997; Noakes, 1992).

With the advent of a non-racial South Africa, international sport bodies re-admitted the country back into the international sporting arena. The 1995 Rugby World Cup, 2003 Cricket World Cup, the rights to host the 2010 Soccer World Cup as well as the re-inclusion of South Africa in the Olympic Games have enhanced the profile of sport amongst the youth and society in general. Exposure to physical activity at primary and secondary school level plays an essential role in formulating attitudes of youth towards sport and physical activity (Gildenhuis et al., 1995; Thomson, 1996). Therefore, schools should be vigilant in ensuring continued physical activity through participation. Ultimately this will promote positive attitudes towards sport and physical activity.

Schools should try to promote the sport skill development of children from as young as possible. The emphasis during pre-school and primary school should be on fundamental motor skill development. Prepubescent children from 6 to 12 years of age have the capacity to substantially improve the ability to move and manipulate their environments (Cratty, 1979). Prepubescent children tend to learn by doing and are highly energetic (Steyn, 1983). Movement activities are natural avenues for this energy (Scheepers, 2002). However, the last 30-40 years has brought with it television, computer games as well as electrical household appliances. All of which has contributed to a decline in physical activity patterns of children. The major focus of development for children in the prepubescent phase should be on motor skill proficiency and development. It is thus clear that the motor proficiency of children in this age group may be stimulated by

participation in any form of physical activity. It is therefore imperative that opportunities promoting movement should be provided for prepubescent children (Richmond et al., 2006).

South Africa is still largely a third world country and the majority of people, especially Blacks, still live in rural areas. Discrepancies regarding the allocation of resources resulting from the apartheid era impacts negatively on the provision of physical activity opportunities in these communities. The challenge in the provision of resources is not simply about shortage but also the location of the facilities - they are just not where the majority of people are. Schools in rural areas appear to be lacking adequate resources such as basic sports facilities, commitment to physical education teaching, and sufficient funding. There is a severe shortage of basic facilities and equipment, and existing facilities are in a poor state (Walter, 1994). In a study conducted by Thomson (1996), the attitudes towards physical education in KwaZulu-Natal were investigated. He states that poor allocation of resources resulted in deficient facilities and equipment. These factors caused a significant inhibition of attitudes of teachers and children towards physical activity. The big question is: "What should be done in situations like these to ensure continual participation of children in any form of physical activity?"

Moreover, the current physical education syllabus has also been criticised for being largely westernised; no cognisance has been taken of endemic activities, traditional dances and games (Du Toit, 1980; Botha, 1983). Burnett-van Tonder (1985) claims that the African tradition of collective association, emphasising social interaction and group values has been ignored by the western oriented education that focuses more on individual achievement. This, therefore, poses a challenge to the outcomes-based education with its "holistic development" concept. Criticism directed at western traditional games. includes: favouring the highly skilled (elitism), no learning outcomes, the goal being just fun, neglecting developmental principles, teacher-centred, students spending much time standing not learning, used as a means to provide academic breaks and have weak learning progressions (Belka, 1994). The role played by the indigenous knowledge system relating to movement phenomena has for centuries remained an untapped resource (Burnett-Louw & Hollander, 2001). To this end Sparks and Webb (1993) suggest that attempts should be made to utilise local amenities and be flexible and

adaptable to group needs. This may ensure that pride and respect in one's own cultural values are encouraged. More importantly, it will offer enjoyment. The enjoyment of physical activity is an important incentive for young, primary school children. It will go a long way in bridging the gap between the home and school environment.

This could also be seen as a commitment to former President Thabo Mbeki's vision of an African Renaissance, which is the economic, political and social rebuilding of the African continent (Ahluwalia, 2002). This will ensure that it moves the African experience towards the centre-stage of society after it was marginalised for so long by western cultures and traditions. Moreover, this will lead to the establishment of African tradition and the regaining into our present, the experience, wisdom and value of the past (Buthelezi, 1997).

The South African education system is at present at a turning point whereby a paradigm shift from a traditional aims-and-objectives form of education, characterised by rote learning, teacher-centred and content-based to a child-centred outcomes-based education system characterised by the concept of lifelong learning (Van Der Horst & McDonald, 1997). Outcomes-based education emphasises life skills in real life situations. Knowledge is not seen as being transferred intact from the teacher to the learner. Instead knowledge is seen as being constructed in the mind of the learner. Moreover, it also emphasises the "holistic development" of a child (Le Grange & Reddy, 1998). Each learner brings his/her own prior knowledge and experiences to any learning situation (Curriculum 2005, 1997). Learners make sense of new knowledge in the context of their knowledge and then develop their original concept as learning takes place (Le Grange & Reddy, 1998). It is for this reason that Curriculum 2005 embraces Life Orientation, under which physical activity and skill development falls. According to the Revised National Curriculum Statement (2002) some of the most important specific outcomes of life orientation are to help learners:

- Understand and accept themselves as unique and worthwhile beings
- Demonstrate the values and attitudes necessary for a healthy and balanced lifestyle

- Evaluate and participate in activities that demonstrate effective human movement and development.

A concern is that even though the education department sees the important role played by physical activity in the well-being of learners, life orientation is still ‘afforded’ less credits. It is also given fewer contact hours per week when compared with the other learning areas (Table 1).

**Table 1: Summary of credit and time allocation for all learning areas**

LEARNING AREA	CREDITS	TIME ALLOCATION (hours per week)
Language 1	20	4.5
Language 2	20	4.5
Mathematics / Mathematical Literacy	20	5
Life Orientation	6	2
Core Subjects	40	4.5 x 2
Elective Subjects	20	4.5

Life orientation entails recreation and physical activity, personal wellness, citizenship education and social justice, careers and career choice. It is clear that physical activity gets very little, if any time, within life orientation as a learning area. Consequently this warrants more attention in the physical activity patterns of learners in general.

There is a paucity of studies that have been conducted on the motor proficiency of black rural children. In one of the few studies conducted in the North West Province, Pienaar (2000) found that the motor proficiency levels of children were not up to standard and that this required urgent attention at a national level. To design an appropriate physical education programme, Pienaar (2000) suggests establishing a motor proficiency database of all 9 provinces across South Africa.

Zulu stick fighting is an indigenous martial art form and it is tentatively suggested that just like any physical activity or sport, the components of this activity may develop

certain aspects of motor proficiency. This martial art form requires (and thus presumably develops) motor skills such as coordination, speed, anticipation, reaction time, agility and balance. The influence that Zulu stick fighting training has on motor proficiency and health-related physical fitness was investigated in this study. Information about stick fighting has not been well documented. Coetzee (1996) relied heavily on informal interviews with knowledgeable people in the rural areas of KwaZulu-Natal to gain information. The informants used in the study generally agreed that stick fighting was utilised as a means of training men from a young age for combat (self-defence and war), to become proficient warriors and develop courage and skill.

In Zulu communities at present, young men fight at public ceremonies such as weddings, and inter-district fighting competitions. Little has been reported on the technique of the activity or the physical skills involved. Kofman and Borovkov (1995) strongly emphasise the inclusion of traditional and playful games as an integral part of the physical education program and sport activities highlighting that this stimulates movement vocabulary and motor ability. An investigation into the role that stick fighting plays in motor proficiency of Zulu children could contribute meaningfully to nation-building, inter-cultural exchange, value education and ideals of cultural identification and socialisation. Stick fighting also offered an opportunity for boys to assert themselves within a specific age group and achieve a degree of 'independence' unavailable to the common person (Alegi, 1997). The researcher is of the firm belief that this may still be achieved even in this modern world. It may also present empirical research evidence of the role/s played by traditional activities in the development of a child.

South African academics and their African counterparts have to a large extent become consumers, rather than producers of knowledge, resulting in a legacy of an impoverished knowledge base (Amusa, 1999). In view of the increased acculturation and globalisation of modern sport, many forms of traditional activities are disappearing, leaving a 'vacuum' to be filled with 'cultural imperialism' (Western imported games and sport) (Burnett-Louw & Hollander, 2001). Acculturation refers to a process by which ideas from one culture are adopted by another so that what evolves, are actually novel ideas (Blanchard, 1995). Burnett-Louw & Hollander (2001) suggest that schools, churches and urbanisation may also contribute to the process of acculturation. The fact that schools may be 'grounds'

for acculturation may also motivate for the inclusion of stick fighting as a traditional activity, into the physical education curriculum of South African schools.

The next section deals with the research problem:

## **1.1 RESEARCH PROBLEM**

The main focus of this study was to investigate motor proficiency of prepubescent Zulu boys before and after 10 weeks of stick fighting training. The results are compared to the motor proficiency of prepubescent Zulu boys who did not receive any training in stick fighting. The secondary concern of this study was to identify possible benefits on health-related physical fitness. The results of the study may justify the use of traditional activities and games in the physical education curricula especially where the shortage of facilities and equipment makes it impossible to offer a structured physical education program.

The next section deals with the aims of the study:

## **1.2 AIMS OF THE STUDY**

To determine whether engaging in stick fighting training will impact on:

- anthropometric measures (body mass),
- motor proficiency, and
- health-related physical fitness parameters.

The next section deals with the hypothesis of the study:

## **1.3 HYPOTHESES**

- 1.3.1 There will be significant differences in selected anthropometric measures between Zulu children who have been trained in traditional martial arts of stick fighting and Zulu children who have not.

- 1.3.2 There will be significant differences in motor proficiency between Zulu children who have been trained in the traditional martial arts of stick fighting and Zulu children who have not.
- 1.3.3 There will be significant differences in health-related physical fitness parameters between Zulu children who have been trained in traditional martial arts of stick fighting and Zulu children who have not.

The next section deals with the null hypotheses of the study:

## 1.4 NULL HYPOTHESES

The following hypotheses were postulated. :

### Null Hypothesis 1

No significant differences will exist in selected anthropometric measures between Zulu children who have been trained in traditional martial art of stick fighting and Zulu children who have not.

Stated statistically the null hypothesis is:

$$H_0: a_{Zsf} = a_{Znsf}$$

Where:

(a) = Anthropometric measures (body mass)

Zsf = Zulu children who have been trained in the martial art skills of stick fighting

Znsf = Zulu children not exposed to the martial art skills of stick fighting

### Null Hypothesis 2

No significant differences will exist in motor proficiency between Zulu children who have been trained in the traditional martial art of stick fighting and Zulu children who have not.

Stated statistically the null hypothesis is:

$$H_0: pm_{Zsf} = pm_{Znsf}$$

Where:

pm = motor proficiency

Zsf = Zulu children who have been trained in the martial art skills of stick fighting

Znsf = Zulu children not exposed to the martial art skills of stick fighting

### **Null Hypothesis 3**

No significant differences will exist in the health-related physical fitness parameters between Zulu children who have been trained in the traditional martial art of stick fighting and Zulu children who have not.

Stated statistically the null hypothesis is:

H0:  $pfZsf = pfZnsf$

Where:

pf = health-related physical fitness parameters

Zsf = Zulu children who have been trained in the martial art skills of stick fighting

Znsf = Zulu children not exposed to the martial art skills of stick fighting

The next section deals with the delimitations of the study:

## **1.5 DELIMITATIONS**

Participants were selected from two rural schools in Ndlangubo Reserve in the Biyela area in Zululand, KwaZulu-Natal, South Africa. One school provided the control group and the other school provided children to form the experimental group. The use of one school for the experimental group ensured that all participants were available at the same time to take part in the intervention programme. The intervention programme took place after school hours from 14h30-15h30. The intervention was run twice a week for an hour. In total, twenty intervention sessions were provided over a period of 10 weeks. Testing was conducted after school hours to allow children not to miss too much class work. The children selected were in a prepubescent phase of development.

The next section deals with the limitations of the study:

## **1.6 LIMITATIONS**

This study involved Zulu boys only. Traditionally and culturally, only Zulu males practice the art of stick fighting. All children in this study came from Ndlangubo Reserve

in the Biyela area in Zululand, KwaZulu-Natal. The sample (N=44) of subjects for this study came from two rural schools. The characteristics of such a 'specific group' put the following limitations on the study:

- Variability between the children in terms of their motor development.
- Use of two different stick fighting trainers for the intervention programme.
- Morphological differences which made it difficult to pair children accordingly.
- The sample being small and dropouts experienced that may hamper with generalisation of results to the general population.

All of the above factors were controlled as far as possible. The two schools chosen for the study resembled each other closely in terms of size, facilities, physical activities done in school, socio-economic status and the type of learners the researcher dealt with. Moreover, children were paired to increase the validity and reliability of the results.

The next section deals with the clarification of concepts:

## **1.7 CLARIFICATION OF CONCEPTS**

For the purpose of attaining clarity, the following conceptual definitions are offered for terms used in the investigation:

### **1.7.1 Motor proficiency**

According to Sherrill (1993) motor proficiency is defined as the specific abilities measured by tests of running speed, agility, balance, bilateral co-ordination, strength, upper-limb co-ordination, response speed, visual-motor control, upper-limb speed and dexterity. Maldonado-Duran et al., (2002) defines motor proficiency as the successful accomplishment of motor skills, assuming successful motor development. Motor proficiency is not a synonym for motor performance; rather it refers to the specific abilities on which performance is built.

### **1.7.2 Prepubescent male**

These are males who have not reached puberty or developed secondary sex characteristics. It is after puberty that performance differences in motor skills and subsequently the overall motor proficiency becomes more significant and appears to be linked with increased strength, speed and power (Williams, 1983).

### **1.7.3 Stick fighting**

Stick fighting is defined as an activity that was utilised, in history, as a means of training men from a young age for combat (self-defence and war) and also a method of defending and asserting the boundaries of a territory. Presently the activity serves as a social ritual performance that instructs males about the social role, qualities and behavioural patterns of a male in Zulu society (Coetzee, 1997). The activity includes the use of two different sticks, specifically designed for fighting and a small shield to protect the knuckles in a fight. The first stick is used for offensive fighting. The second is a long parrying smooth stick that tapers down to a point. It is used as a defensive weapon and is skillfully maneuvered with the wrist of the defensive arm to protect the body and ward off blows from the opponent (Coetzee, 1997). The shield is usually made from cow skin and is also held on the defensive arm. Currently, there are no studies which analyse the impact of stick fighting on motor proficiency and health-related physical fitness.

### **1.7.4 Indigenous games**

The concept indigenous refers to the origin and locality of the knowledge system, i.e. that it originated and/or developed among the population groups and communities within a specific region or country (Burnett-Louw & Hollander, 2002). Indigenous Knowledge Systems (IKS) reflects the circumstances, traditions and cultures of the various groups and communities which have been recognised by the people as being part of their cultural heritage (Corlett and Mokgwathi, 1986). To this end, indigenous knowledge is defined as, ‘the sum total of the knowledge and skills which people in a particular geographic area possess, and which enable them to get the most out of their natural environment. Most of this knowledge and these skills have been passed down from earlier generations, but individual men and women in each new generation adapt and add to this body of

knowledge in a constant adjustment to changing circumstances and environmental conditions. They in turn pass on the body of knowledge intact to the next generation, in an effort to provide them with survival strategies' (Mascarenhas, 2004). The study and analysis of indigenous knowledge systems reveals that indigenous games are a component of this knowledge base (Nkopodi and Mosimege, 2009).

Indigenous games refer to "...local active games of recreational character, requiring specific physical skills, strategy or chance, or a combination of these three elements" (Van Mele & Renson, 1990). These games are then handed down from one generation to another (Utuh, 1999). Utuh (1999) further argues that the value of participating in indigenous games is similar to those of modern games. Inter alia, the values are social, physical, mental, cognitive, moral and psychomotor. Indigenous games can be used to obtain not only psychomotor, cognitive, affective and social outcomes of physical activity (physical education) but also convey indigenous and cultural knowledge from one generation to the next (Roux, 2007). Indigenous games can also be used to craft and foster national identity (DeSensi, 1995; Gardiner, 2003) where self-esteem can be affirmed and enhanced through pride and heritage whilst recognizing, acknowledging and celebrating racial diversity (Roux, 2007).

The next section provides an outline of how the dissertation is organised. :

## **1.8 ORGANISATION OF DISSERTATION**

This study will be organised as follows:

### **CHAPTER ONE**

This chapter consists of introduction, motivation, aims, hypothesis and the null hypotheses of the study, delimitations, as well as statement of the problem, clarification of concepts and an outline for the organisation of the dissertation.

## **CHAPTER TWO**

- 2.1 A theoretical background on the origin of Zulu stick fighting and its social use.
- 2.2 A review of previous and relevant research findings.

## **CHAPTER THREE**

- 3.1 A theoretical background on motor proficiency and the potential benefits of Zulu stick fighting.
- 3.2 A review of previous and relevant research findings.

## **CHAPTER FOUR**

Chapter four details the research design and methodology. This includes the selection of participants, and the proposed method of collection and analysis of the data.

## **CHAPTER FIVE**

Chapter five deals with the presentation, analysis and interpretation of data.

## **CHAPTER SIX**

Chapter six comprises a discussion of the findings.

## **CHAPTER SEVEN**

This chapter provides conclusions based on the research. A summary, recommendations and possible avenues for future research are outlined.

## **1.9 CONCLUSION**

This chapter focuses on the background to the study, the research problem, the aims of the study, the hypothesis and null hypotheses. Delimitations and limitations of the study are highlighted in this chapter.

The next chapter will focus on the literature review on Zulu stick fighting:

## **CHAPTER TWO**

# **LITERATURE REVIEW ON THE ZULU, ZULU STICK FIGHTING AND ITS SOCIAL USE**

## **INTRODUCTION**

This chapter provides a theoretical background on the isiZulu speaking people of South Africa, an overview of the different types of stick fighting associated with different cultures in the world, the origin of Zulu stick fighting, the Zulu stick fighting equipment and the social gatherings associated with Zulu stick fighting.

The next section deals with the Zulu:

### **2.1 THE ZULU**

In the Great Lakes region of sub-equatorial East-Central Africa lived Black races collectively labeled by early European anthropologists as Bantu, a term derived from the Zulu collective noun for 'people'. In certain scholarly circles the term 'Bantu' is used to differentiate Black languages from the click-tongues of Bushmen to the South (Schoeman, 1975). It is generally admitted by anthropologists and philantropists alike that there were three native racial groups in Africa: the Khoisan (Bushmen and San); the Sudanese or Hamitic and the Bantu (Schoeman, 1975). Among the Bantu group, there were the Nguni, largely known as the ancestors of today's Zulus. Nguni was the charismatic leader who in a previous epoch had led migration from Egypt to the Great Lakes via the Red Sea corridor and Ethiopia. The Great Lakes became the mystical Embo Zulu storytellers refer to even today. Nguni is a group of languages spoken in Southern Africa. These languages include isiZulu, isiXhosa, isiSwati and isiNdebele. Linguistically and culturally, the Xhosa, Pondo and Thembu are Southern Nguni while the Zulu, Swazi and Ndebele are Northern Nguni (Coetzee, 2002).

In the late sixteenth century, the Nguni migrated from the Great Lakes southwards (Schoeman, 1975). No-one really knows what triggered the movement southwards. It is however thought that population explosion and the search for new grazing lands for livestock inevitably led to quest for new land. The Nguni were largely dependent on horticulture and cattle breeding (Alegi, 1997). The Nguni are said to have followed an inland course via the region between Lake Ngam and the headwaters of the Zambezi where they made contact with the KhoiSan people (Bryant, 1949). The Nguni are said to have migrated further on and their language from then onwards was enriched with strange click-like sounds acquired from the wild hunters (Schoeman, 1975). The Nguni were not the only Bantu-speaking group that moved southwards. To the east, a group called the Venda-Karanga also migrated in the same general direction. They settled in the territory comprising modern-day Zambia and Zimbabwe. A third group, the Thonga followed the east coast (Schoeman, 1975).

Moving southwards to the most northerly bend on the Limpopo River, which marks the boundary between South Africa and Zimbabwe, the Nguni split into separate migrations (Schoeman, 1975). . The first Nguni group settled on the North-East border of KwaZulu-Natal into what is now known as Swaziland. The second Nguni group entered the Transkei and these are commonly referred to as the forebears of the amaPondo. The last and the third Nguni group to leave the Limpopo settled for a while in what is now the South-Eastern region of Mpumalanga province. They then moved on in stages into central KwaZulu-Natal. They found the north-east and north-west already occupied. Two smaller groups branched off from the third Nguni group and moved on. One of these smaller groups found the coastal regions of the South occupied by the amaPondo. The group kept to the inland high ground to become the amaXhosa. The other of the smaller groups found a home as the coastal neighbours of the amaPondo to become the abaThembu of today. The final Nguni group to migrate populated the heart of what is today known as KwaZulu-Natal and they are today known as the amaZulu.

When this group arrived, they settled into what is now known as Zululand, in the Northern inland region of KwaZulu-Natal from the Thukela river to the regions on either side of the uMhlathuze river (Schoeman, 1975). In this region, they found only a handful of Khoisan hunting groups and a group called the amaLala. They then split into central

clans of one family or few families living together. They recognised no central ruler and remained independent of each other. There were continual fighting between the clans over women and cattle.

One of these groups was led by Malandela. It was in 1670 that Malandela found himself a home in the fertile upper uMhlathuze River Valley somewhere between the present towns of Empangeni and Eshowe (Schoeman, 1975). He established his family there. He had two sons, Qwabe the elder and Zulu ('Heaven' in Nguni) the younger son. Malandela passed away and Qwabe soon quarreled with his mother Nozinja. It is customary in the Zulu culture that the eldest son is the automatic heir of his father's assets should he die. Qwabe then laid his rightful claim to the land.

With no land of their own, Nozinja along with this younger son, Zulu set off to find another place to claim as theirs. Zulu and the wives he had paid dowry for with a herd of cattle and his followers ventured South to look for land. They found a beautiful valley watered by the UMkhumbane river, with Nhlazatshe, a flat topped mountain to the west and a high ridge, eMthonjaneni to the East. Here Zulu is said to have lived until he died (Bryant, 1949).

Zulu was succeeded by his son Phunga, then Mageba, Ndaba, and then Jama. With each generation the clan grew in numbers and size into a small village. By the time Jama's son Senzangakhona was born in the 1700's, the clan called itself abakwaZulu (people of Zulu). Senzangakhona became Chief in 1785. The whole village still lived in the small valley, in beehive grass huts. One day Senzangakhona met a beautiful girl of the Elangeni clan by the name of Nandi. They got involved in ukhlobonga which is touching excluding sexual penetration. Somehow, from ukhlobonga Nandi got pregnant. When Senzangakhona heard that she was pregnant, he thought it could not be true. After all, she had fallen pregnant without being the official wife of the chief. Later on, Senzangakhona finally agreed that the child was his. When the boy was born in 1787, he was given the name Shaka. The name Shaka relates to how he was conceived. When Shaka's father, Senzangakhona, heard that Nandi was pregnant after a night of ukhlobonga, he thought she had iShaka, an intestinal beetle said to inhabit the stomach and give rise to a bloated abdomen (Bryant, 1949).

Perhaps it was because Shaka was teased about his illegitimacy as a young boy that he grew up to be a great warrior. At the tender age of 16, he invented a short, broad-bladed stabbing spear which revolutionised Zulu warfare at the time. The short spear was to become a devastating weapon in his armies. He also developed the ‘chest and horns’ tactic of surrounding enemy forces and annihilating them. He became chief at the age of 30. All men under the age of 40 were called to battle and he systematically raided all the neighbouring clans to form a big nation. By 1823, the Zulu nation had grown incredibly. Shaka built a new capital for the Zulus as the village was too small, unable to cater for them anymore. He called the place kwaBulawayo – loosely translated “place of the persecuted man”. This is thought to refer to the hardships his mother, sister and he had to endure while he was growing up in the Elangeni clan. When her mother was pregnant with him, his father Senzangakhona disowned her. He and his younger sister had to seek refuge with the Elangeni clan. He built another hut city for himself and called it kwaDukuza – the place of the lost person because of the massive maze of huts (Bryant, 1949).

The Zulus of today are the largest indigenous group in South Africa at approximately 11 million of the estimated 48 million people living in South Africa. They live mainly in KwaZulu-Natal province. KwaZulu-Natal (KZN) is bordered on the Western side by the Drakensberg mountains and on the Eastern side by the Indian Ocean. On the Northern side, KZN shares a border with Mozambique and on the Southern side the Eastern Cape Province which was formally the Transkei homeland. KwaZulu-Natal covers a surface area of 92 180 km<sup>2</sup> which is 7.6% of the total area of the country (1 219 090 km<sup>2</sup>). 22.9% (7 204 562) of the total number of Blacks (31 460 970) in South Africa lives in KwaZulu-Natal. Within the province Blacks constitute 82.7% of the total population, Asians at 9.2% are the second largest group. Of the Zulu-speakers in the country, 74.6% live in KwaZulu-Natal (Census, 2001).

The legacy of a monarch has been retained since the early days of Shaka; the present being King Goodwill Zwelithini kaBhekuzulu. The different clans that make up the nation have retained their own clan names such as Qwabe, Dlamini, Ximba, Mkhwanazi but they still consider themselves as amaZulu (Darlymple, 1983). Though a portion of the Zulus of today have been influenced by Western ideals, the traditional Zulus are still

bound together by their customs and traditions. The majority of Zulus live in rural areas and the tradition of thatched bee-hive houses, the chiefs, traditional dance and stick fighting is still very common (Coetzee, 2002).

The next section deals with the Zulu social organisation:

## **2.2 ZULU SOCIAL ORGANISATION**

The Zulus live under a patriarchal, exogamous system which is governed by strict rules of etiquette and codes of honour (Darlymple, 1983). There are three important genealogical groups in the social organisation of the Zulu. The first according is the house (indlu) or nuclear family which consists of a man, his wife and children. In some circles, polygamous and extended families are the norm. In such instance, each wife has her own house as do married sons and other adult dependent relatives in an extended family set-up (Bryant, 1949).

The second group is the homestead (umuzi) which is commonly referred to as the kraal. It is an extended family group and may consist of one or more wives and their children, married sons and their families and their children. The head of the homestead is the senior man (umnumzane) and he is respected by all the members of his household and by anyone entering his homestead (Bryant, 1949).

The third group is lineage (umndeni (family), uzalo (lineage), usendo (heredity)) and it is made up of relatives who trace their decent to a common ancestor through the male. They observe strict taboos about intermarriage among themselves. The lineage functions as a corporate localised community and its solidarity is important for the solidarity of the tribe. This is evident in the Zulu saying that say “Umuntu, umuntu ngabantu” (a person is a person through other people) (Bryant, 1949).

The next section deals with the Zulu political and cultural organisation:

### **2.3 ZULU POLITICAL AND CULTURAL ORGANISATION**

The Zulu political organisation is characterised by the hereditary institution of the chieftainship. The chief's powers are an extension of the authority of the head of the homestead. The chief is regarded as the father of the tribe. His position is reinforced by the traditional beliefs that he is a link between the more powerful tribal ancestors and the living ancestors of the tribe (Darylmpfe, 1983).

The king, to whom the chiefs have owed allegiance since the days of King Shaka Zulu, is at the apex of the pyramid of political power. This pyramid is made up of the head of the household at the bottom, the lineage and the clan head or chief. Great respect is paid to the king, chief and the homestead head (umnumzane). The females and their families do not necessarily expect the same show of respect as the head of the homestead.

Culturally, the Zulu people have strict division of roles for each family member. Adult men graze the cattle, clear the surrounding fields for agricultural use, build houses and do repairs on fences. In the dry season, men engage themselves in some craft-making. Women take care of children and the family home. They cook meals and brew sorghum beer. The women are further responsible for heavy agricultural labour including planting, weeding and harvesting crops though the whole family may help out now and then. Children and youth help their parents with light agricultural labour. The girls help their mothers with domestic chores and the boys help their fathers with cattle-herding and construction (Alegi, 1997).

There was little time for leisure during the agricultural season between planting and harvesting. A Zulu child did not receive much formal education designed to socialise them for their roles in traditional society. Informal stick fighting was one of the "skills and behaviour patterns" that instructed Zulu males about the social roles, social norms, qualities and behavioural patterns expected of them. From an early age, a Zulu boy was expected to look after the cattle in the field. The herding of cattle afforded the boys an opportunity to develop their manliness and independence in a world away from parental supervision (Coetzee, 2002).

The next section deals with stick fighting.

## **2.4 STICK FIGHTING**

### **2.4.1 Stick fighting**

Stick fighting is a generic term for any of several martial arts which employ a small staff, cane or walking stick as a blunt hand weapon ([http://en.wikipedia.org/wiki/stick\\_fighting](http://en.wikipedia.org/wiki/stick_fighting)). Some techniques can also be performed with a sturdy umbrella or a sword in its scabbard. Most stick fighting systems are serious combat techniques that are intended to be used if a person is under attack and is not fully armed.

Stick fighting is still part of the anthropological heritage of various societies and cultures. Many cultures or societies have stick fighting as the traditional form of self-defense. All over the world, some form of traditional stick fighting survives. In Portugal “Jogo do Pau” literally translated as stick or staff game, is a Portuguese martial art which developed in the Northern regions of Portugal ([http://en.wikipedia.org/wiki/Jogo\\_do\\_Pau](http://en.wikipedia.org/wiki/Jogo_do_Pau)). The game involves the tossing/throwing of sticks. The primary purpose was self-defence helping practitioners survive bad encounters with robbers and other aggressors. It was also used to settle accounts, disputes and matters of honour between individuals, families and even villages ([http://en.wikipedia.org/wiki/Jogo\\_do\\_Pau](http://en.wikipedia.org/wiki/Jogo_do_Pau)). There are also references of Jogo do Pau being used by the guerrillas (led by Ze do Telhado) against the French troops of Napoleon during the Napoleonic wars.

In France Bâton Francais, also known as French staff, is practiced. The game involves players being placed close together, the feet remaining immovable and all strokes being delivered with a whip-like action of the wrist from a high hanging guard, the hand being held above the head. Blows on any part of the body above the waist are allowed except those aimed at the head which are employed only to gain openings ([http://en.wikipedia.org/wiki/Single\\_stick](http://en.wikipedia.org/wiki/Single_stick)). The winner is determined only by a broken head, that is, a cut on the head that draws blood. At first the left hand and arm were used to ward off blows not parried with the stick. In the 18th century, the left hand grasped a

scarf tied loosely round the left thigh, the elbow being raised to protect the face ([http://en.wikipedia.org/wiki/Single\\_stick](http://en.wikipedia.org/wiki/Single_stick)).

In England, a similar game named singlestick or a cudgel was practiced. It was a popular pastime in the United Kingdom from the eighteenth century to the early twentieth century. Its popularity resulted in it being included in the 1904 Olympics Games held in St. Louis, Missouri, United States of America ([http://en.wikipedia.org/wiki/Stick\\_fighting](http://en.wikipedia.org/wiki/Stick_fighting)). The sport was then removed from the fencing events of the 1908 Olympic Games. Strangely, these Olympics were held in London, United Kingdom ([http://en.wikipedia.org/wiki/Fencing\\_at\\_the\\_1908\\_Summer\\_Olympics](http://en.wikipedia.org/wiki/Fencing_at_the_1908_Summer_Olympics)). The game slowly declined and was re-introduced in the Royal Navy in the 1980's.

The Nilotic Ethiopian Surma (Ethiopia) are generally obsessed with a form of stick fighting called 'donga' ([http://en.wikipedia.org/wiki/stick\\_fighting](http://en.wikipedia.org/wiki/stick_fighting)). This form of stick fighting is used to show off whilst looking for a bride, often naked or nearly naked. The paragraph below best summarises what 'donga' is all about:

“Once the bodies are painted and men and women have started courting one another, the other side of stick fighting starts. Once a week the Surma men from different villages come together, sometimes walking thirty miles on very small grass paths to meet one another to perform the wildest sport we have ever seen on the entire Africa continent. The donga stick fight is fought with long, straight poles of about eight foot long made of very hard wood, and the Surma men perform these fights to prove their masculinity, to settle personal vendettas, but most importantly, to win wives (<http://www.pulseplante.com>). And at the end of the day, the winner of the day's fighting is carried out of the arena on a wonderful platform of poles, he's held high in the air, and he's carried towards a group of very beautiful young girls. So as he arrives, the winner is taken by one of the girls.”

In Sudan, the Moro area which is located halfway between Kadugli and Talodi is occupied by the Moro tribe. The Moro people maintain and practice ancient traditions. One of these traditions is stick fighting (<http://www.nubasurvival.com>). The contest is conducted by a stick and a shield between two contestants. The fight begins by an invitation from one tribe to the other. Another way of starting the competition is by

symbolic provocation. A typical scenario would be a man aged 17-20 years old holding the hands of his rival's fiancée for a couple of minutes or cutting her bracelets made from beads (<http://www.nubasurvival.com>). When the husband-to-be hears about this, he instantly declares the fight by tying a handkerchief or piece of cloth on his competitor's house at night so that the contest should begin the next morning.

There are special arenas set aside for fighting where every athlete arrives with his equipment. Every fighter ties ribbons of thick cloths or torn blankets around the body to lessen the effects of the stick blows. Hats made of seeds or even mud may be put on the head for protection (<http://www.nubasurvival.com>). While the stick-fighting is performed, girls sing continually, praising one fighter as a bull, a leopard, an elephant or a lion and on the other hand scolding the competitor as a coward, a hooligan and a womaniser. If one fighter is badly hurt, he might be compensated with symbolic reparation such as a cow. The sport is carried out at the end of autumn and the beginning of harvest. It is forbidden during the cultivation season in case it puts the youths off their work. After the harvest, stick fighting is played to give thanks to god for providing a good harvest (<http://www.nubasurvival.com>).

Egyptian stick fighting takes a form of fencing more than anything else ([http.en.wikipeida.org/wiki/Egyptian\\_stick\\_fighting](http.en.wikipeida.org/wiki/Egyptian_stick_fighting)). It was practiced during religious ceremonies, processions and as a sport or game in Ancient Egypt. Stick fighting or fencing was performed as a tribute to the Pharaoh. There is evidence that this form of stick fighting or stick fencing was a contest for endurance and skill whose goal (aim) was to hit the head of the opponent. More recently (about the eighteenth century) reports indicated that similar stick fighting or fencing still existed. It is said to be very popular during the month of Ramadan. Ramadan, the ninth month in the Muslim year, is the holy month of fasting. In that month, Muslims give up eating and drinking during the daylight hours from dawn to sunset ([http.en.wikipeida.org/wiki/Egyptian\\_stick\\_fight](http.en.wikipeida.org/wiki/Egyptian_stick_fight)).

In Northern Egypt, stick fighting and stick dancing is largely performed during marriage ceremonies. It is referred to as 'tahteab' or 'tahtib'. Egypt is largely a Muslim country. Due to the strong links to Islam, stick fighting or fencing and dancing is largely a male sport only. Females can perform the sport provided they are dressed as males, and they

are dancing with other women. The dance with women is to be flirtatious and the stick is a general symbol of masculinity and is manipulated by the women. The stick is about four feet in length and is called an Asa, Asaya or Assay or Nabbout ([http://en.wikipedia.org/wiki/Egyptian\\_stick\\_fighting](http://en.wikipedia.org/wiki/Egyptian_stick_fighting)).

In South Africa, Nguni stick fighting is practiced by the Nguni people, notably the Zulus who call it “ukudlala izinduku (playing the sticks)”, Xhosa and Ndebele who collectively call it “iintonga”. It is a martial art traditionally practiced by teenage herdboys ([http://en.wikipedia.org/wiki/Nguni\\_stick\\_fighting](http://en.wikipedia.org/wiki/Nguni_stick_fighting)). Each combatant is armed with two long sticks, one of which is used for defence and the other for offence. The Zulus differ in that they also carry a shield to help with parrying shots (Coetzee, 2002).

The next section deals with the origins of Zulu stick fighting:

#### **2.4.2 Origins of Zulu stick fighting**

The origins of Zulu stick fighting have been lost in the annals of time. Its ancestry is buried, its practice a spirited testimonial to an ancient and respected tradition (Coetzee, 1933). The genealogy of the presumed originators of Zulu stick fighting is traced to Malandela, son of Gumede who inhabited the Umhlatuze Valley in about 1670 (Werner, 1996). If stick fighting as presumed has been part of the earliest Zulu life since pre-history, it is possible that its origins may date back as long ago as the fifteenth century A.D. (Coetzee, 1996).

The recent history though can be traced back to the legacy of Shaka the son of Senzangakhona, who founded the Zulu nation. He established the Zulu empire and went on to become Southern Africa’s most legendary warrior-king. The rise of Shaka is said to have changed the nature of warfare in Africa. Shaka's military expansion caused much disruption and turmoil and played a major role in shaping the area where he resided and beyond. Shaka utilised stick fighting as a means of training men from a young age for both self-defence and war. The techniques and movements applied in stick fighting are identical to those implemented during wars, the only difference being the weapons utilised. Stick fighting provided an opportunity for men to build courage and skill as well

as distinguish themselves as proficient warriors in the military ranks while earning respect in the community. Recent research suggests that the weapons, strategies and tactics were established before Shaka's rise to power. However, there is little documented history of the period before the rise of Shaka hence he has been credited with almost everything. Even after Shaka's reign, a man's experience and skill in stick fighting assisted him to climb the military ladder and earn a distinguished reputation within the community (Coetzee, 2002).

Nowadays stick fighting is still practised in rural areas in KwaZulu-Natal as a process of socialisation, and self-defence. It is instrumental in nurturing dignity and pride within men. It assists in upholding the social system by perpetuating socially constructed roles and accepted mould of male behaviour and ideals (Coetzee, 1996). However, Coetzee (2002) states that the decontextualisation and exploitation of stick fighting for political gain has negatively affected perceptions of the art. Crowds misuse elements of stick fighting during marches or mass actions in cities for example by implementing instruments that are not related to fighting sticks to express ethnicity (Zuluness). In most cases, these crowds run out of control and injure innocent bystanders. The values of respect, control and accountability which are of utmost importance in a proper stick fight are mostly ignored. The use of sticks has been politicised to the extent that any African person carrying a stick is classified a "violent Zulu" (Coetzee, 2002).

Despite it still being practiced, stick fighting is no longer as appealing as in years gone by. Practitioners struggle to validate its existences in these days of actuation and modernisation. This is despite the fact that stick fighting can still play didactic function in some Zulu communities. Moreover, stick fighting can fill the void created by lack of facilities to offer these communities opportunities for mass sport participation (Coetzee, 2002).

### **2.4.3 Who participates in stick fighting?**

It is the nature of human beings to every now and again engage in some form of power testing where strength and technique are put to the test. Tyrell and Gurgens (1963) point out that a Zulu child did not receive much formal education designed to socialise them

for their roles in traditional society. They maintain that “traditional education for the individual constituted a gradual absorption into society and the acquisition of certain skills and behaviour”. In this world, informal stick fighting was one of the “skills and behaviour patterns” that instructed Zulu males about the social roles, qualities and behavioural patterns expected of them (Coetzee, 2002). Zulu boys were expected to look after the cattle. The herding of cattle afforded the boys an opportunity to develop their manliness and independence in a world away from parental supervision. Tyrell and Gurgens (1963) believes that part of the exploration entails a boy fighting his way up to a position of leadership among the other herders. The way he did this was by defeating his age mates at sparring with sticks. The intricate skills of stick fighting and sparring are learned by observation, imitation and experience (Coetzee, 2002).

Boys herding cattle engage in stick fighting almost daily. They play stick fighting more as a foretaste of things to come. Due to the fact that stick fighting takes place whilst herding cattle it is seen as training more than anything, it is commonly referred to as sparring. More often than not, instead of using real sticks they will use small tree shrubs. The tree shrubs can be manoeuvred easily and they serve the purpose of perfecting skills in stick fighting. Real sticks can also be used though the fighters do not aim to hit each other’s heads and often do not use an ihawu (shield) (Coetzee, 1996).

The sparring matches take place under strict supervision of the ingqwele (senior herd boy). According to Krige (1965), the recognised manner of challenging another herd boy to a sparring match is to tap him on the head with a stick and utter a daring verbal comment. From personal experience, whilst herding cattle in the Biyela area, Empangeni, the author observed that the following was commonly used to start the fight: One herd boy: (tapping the other on the head) “Nqo, nqo mfana udla amasi embongolo, mina ngidla awenkomo yakithi uNaliti.” [meaning, knock, knock, boy you eat sour milk from a donkey, I eat sour milk from my father’s cow Naliti (cow’s name)]. A boy being tapped on the head by another whilst the rest of the boys looked on was enough humiliation. Adding salt to the wound was being told that you ate sour milk from a donkey. Zulu people eat sour milk from a cow only. The statement that the sour milk was from a donkey has the connotation that your father’s cows can’t bear calves to breastfeed. That was an insult not only to the boy but to his family as well.

Alternatively, the senior herd boy will stand in between the two boys he might want to see fight and spit on the ground. He would then ask a question directed at the two boys:

Senior herd boy: “Ekabani le ngcili?” (meaning whose worm is this? The worm in question is found in the intestines of the cow). If one of the boys responds by saying that it belongs to the other boy, a challenge has been thrown. The challenged then either prepares to fight or agrees with the statement and prevents a fight. A fight then breaks out and an informal audience is in attendance to witness the fight. Exclamations indicating an acknowledgement of a hit “ngiyavuma” (I agree) and requests to stop the sparring “khumu or maluju” are utilised for sparring matches and adhered to very strictly (Coetzee, 2002).

Coetzee (1996) indicates that stick fighting is associated with masculinity. It is mainly boys who engage in stick fights though in some homes where there are girls only and no boys to herd cattle, the activity is performed by girls. Such girls end up taking part in all activities usually engaged in by the herd boys. They therefore learn the art of playing sticks. Mashiyane (nd) argues that the girls work this art to perfection. He further observes that many boys and sometime future husbands to these girls are often rudely embarrassed when, during times of misunderstandings, an open challenge is advanced to them.

A competitive form of stick fighting for boys takes place at public ceremonies and social gatherings at about 18 years of age (Coetzee, 2002). It is not uncommon though to get younger stick fighters, some of whom have not reached puberty yet (Coetzee, 1996). Though the ‘categorisation’ of these stick fights is competitive, Zulu people refer to them as “ukudlala induku” is singular expression and “ukudlala izinduku” in plural expression which roughly translates as “play sticks with you” (Coetzee, 1996). Stick fight challenges have been reported at the first fruits festivals (Clegg, 1981), the installation of a new traditional leader (Larham, 1985), inter-district fighting (Clegg, 1981), an imbizo (village gatherings) (Coetzee, 2002), the lung festival (Schoeman, 1982), courtship (Coetzee, 2002) and the puberty ceremony (Elliot, 1978).

Stick fighting can also take place on a “professional level” (Coetzee, 2002). A professional stick fighter, or “ishinga”, travels around in search of stick fights. The main

aim of ishing is to demolish the opposition. The fighter normally uses well-worn fighting equipment and has an unkempt appearance (Coetzee, 1996). Men tend not to fight him since the element of play is seemingly lacking in the “ishinga’s” approach.

The next section deals with the Zulu fighting sticks equipment:

## **2.5 ZULU STICK FIGHTING EQUIPMENT**

Zulu men traditionally owned fighting sticks as this was customary. The sticks were stored in the roof of a house and were carried for self-defence or used when the owner was challenged to a stick fight (Coetzee, 2002). The following equipment is necessary for use in a stick fight:

### **2.5.1 Fighting sticks**

Fighting sticks (izinduku) may differ in appearance according to their region of manufacture. It is generally agreed that the sticks should not be too big, too long or have a rough surface or knots giving an ‘unfair’ advantage to the owner. However, regardless of the appearance, fighting sticks must be stout enough to withstand the impact of blows from an opponent’s weapon (Coetzee, 2002). It should be conducive to quick movements to suit the fast maneuvers demanded by stick fighting. Fighting sticks are commonly carved from the following trees; umqambothi, umazwenda, ibelendlovu, umphahla, umthathe and umunquma (Coetzee, 1996).

The first stick is the offensive stick, or induku. Mzimela (1990) defines induku as ‘a piece of wood smoothly carved for the purpose of fighting’. It can be referred to as umshiza, umzaca, isikhwili, inviko and umqambathi. Depending on the geographical location a person comes from, any term could be used. In this study, the term induku will be used. It is used for striking blows at the opponent and held in the fighter’s dominant hand. The length of induku depends on the physical stature of the owner. It is generally about 88 centimetres in length (Coetzee, 2002). The circumference of induku increases slightly from bottom to top. It increases in size from the grip, ending in a slight ‘head’ that resembles the ‘hoof of a donkey’. A piece of cowhide can be tied around one end of

the stick to secure the fighter's grip on the weapon. The whisk of a cow's tail can be tied around the bottom of the stick to hide a sharp point.

The second stick is a long, smooth stick that tapers down to a sharp point called "ubhoko". Ubhoko is used for parrying blows. It is used as a defensive weapon and is skillfully manoeuvred with the wrist of the left hand to protect the body of a combatant from the opponent's blows (Coetzee, 2002). The length of the parrying stick is generally dependant on the physical stature of its owner. It is meant to ensure protection from head to foot and is therefore longer than induku (Coetzee, 1996). It is generally about 165 centimeters in length and just like induku, the circumference increases from the grip upwards (Coetzee, 2002). The action of defence with ubhoko can be referred to as ukuvika or ukuzihlaba (Mzimela, 1990).

The third stick is a short stick called "umsila"(the tail) (Coetzee, 2002). It is held in the fighter's non-dominant hand. It is not for striking purposes and is instead used to uphold the small shield or ihawu. Umsila runs vertically down the middle of the shield through four triangular nooses and tapers to a point.

"Ihawu" or shield, is a small, oval shaped piece of cow skin held in the fighter's non-dominant hand. There is no set size but consensus is that it must be large enough to protect the hand and wrist yet small enough not to impede the mobility of ubhoko in parrying shots (Coetzee, 2002). As a rule, the shield used for stick fighting is between 55-63 centimetres long and 31-33 centimetres wide (Coetzee, 2002).

A handle big enough to hold two or three fingers (the index, middle and ring fingers) is located at the back of the shield. Fighters first clutch the handle with two or three fingers before placing ubhoko in the hand. A soft cushion is placed on the inside of the shield to ensure that the hand remains protected from an opponent's blows (Coetzee, 2002). Traditionally this cushion was made from sheep skin, and is called ibhusha. In modern times, sponge or other soft material named isibhusha is utilised as a protective measure inside the shield.

### **2.5.2 Zulu stick fighting technique**

Stick fighting is a highly stylised discipline (Coetzee, 1996). Steenkamp (in King, 1994) observes that combatants ground themselves by spreading their legs and lowering their centre of gravity. This in turn, increases the stability of the combatants. The body remains still and constant eye contact between combatants is kept. The legs are bent and knees absorb the impact of weight transference (Coetzee, 1996). A right-handed fighter leads with the left leg. A left-handed fighter leads with the right leg. Fighters are able to advance and retreat with great speed, indicating that their mass is more or less equally distributed between the legs to accommodate quick movements through space (Coetzee, 1996).

It would seem that all movements in a stick fight are initiated from the hips where the centre of gravity is located (Potgieter, 1984). The torso is noticeably kept forward. Coetzee (1996) believes that the torso is kept forward primarily to maintain a safe distance from the opponent's stick and to assist in maintaining balance. However, biomechanically, this action could be attributed to gravity. The body has a centre of gravity (CG) or center of mass (COM), which acts vertically downwards (towards the centre of the earth). In order for an object to remain stable, this line from the CG to the ground must fall within the base of support. For the body, this base of support is composed of the two feet and the area between them. Moving the torso forward moves the centre of gravity forward thereby making the body unstable and easier for the fighter to advance forward. To counteract the instability, stick fighters bring their leading leg forward because the larger the base of support, the more stable the body becomes (Shea and Wright, 1997).

Ubhoko, the parrying stick, is held in a vertical position. Twisting movements of the wrist tilt the stick diagonally clockwise or counter clockwise to parry blows. In a right-handed fighter, it is held on the left arm. In the left-handed fighter, it is held on the right arm. Coetzee (1996) reports that informants she observed, held their ubhoko at some distance away from their bodies, presumably to avoid the stick getting in close range with the body. The arm that carries the ubhoko, carries the shield as well.

After the top of the stick has been pulled backwards above the shoulders, a blow is delivered with an induku, the offensive stick (Coetzee, 1996). At times, combatants can strike with a cutting motion, sometimes accompanied by a slight forward lunge. In other instances, circular or swinging motions of the sticks can also be incorporated. Sticks can also be shaken before striking or circled around the head (Coetzee, 1996).

Coetzee (1996) indicates that stick fighting manoeuvres often parallel those of fencing. It has been described as 'balletic' (Fighting Sticks, nd). In stick fighting, beat attacks or deflecting an opponent's weapon before an attack is made, are common. A beat attack is an attack in fencing which involves a sharp hit on the opponent's blade before attempting to land on a valid target area. The beat attack is used to move the opponent's blade away from its established line or gain right of way (<http://www.colorado.edu>). Feint attacks are often used as well. The main aim of a feint attack is to draw reaction thus weakening the opponent's defences. Compound attacks are yet another area of convergence between stick fighting and fencing. A compound attack can for example, include a feint to the chest taking the weapon across, downwards and up on the opposite side to hit the flank (Fighting Sticks, nd).

The next section deals with the rules and protocols of Zulu stick fighting.

### **2.5.3 Rules and protocols of Zulu stick fighting**

#### **2.5.3.1 INTRODUCTION**

Stick fighting takes place outside the cattle enclosure of the homestead (Coetzee, 2002). People who don't belong to that homestead won't be allowed to fight inside a family's cattle enclosure due to the presence of a family's ancestors in the enclosure. If a fight does take place inside the enclosure, it is normally a fight among the members of the family. In most cases there is no space specifically set aside for stick fighting. A space is selected on the basis that it suits the needs of the occasion (Coetzee, 1996).

### **2.5.3.2 THE ROLE OF ELDERS**

Zulu stick fighting is a gentleman's game, specific rules and protocol govern its practice (Coetzee, 1996). Breach of rules or protocol is unacceptable as this may indicate that the fighter does not have confidence in his own abilities to beat the opponent fairly or by the rules. A man only proves his supremacy at stick fighting in a fair fight or "impi yamanqamu" where the rules are followed (Derwent, et.al., 1998). They further state that a stick fighter voices a challenge to indicate that he is ready to fight. A challenge is also referred to as "ukuphonsa inselelo". Elders who normally go to public ceremonies should grant permission for a fight before any challenge is made. In most cases, activities around public ceremonies are regulated by the warrior captain or "umphathi wezinsizwa". In certain instances, induna may fill in and fulfil the role of the warrior captain (Derwent, et.al., 1998).

One of the roles for the warrior captain is to ensure that correct sticks are used by both fighters. The weight and the length should be the same. He also has to ensure that the game or contest follows the rules and subsequently results in a fair fight. One of the things that the warrior captain needs to look for is that there is no stabbing with the parrying stick (ubhoko). In a situation that a fighter drops his sticks, it is only fair that he be given a chance to pick up his sticks before resuming the fight. Last but not least, a man fights his peers and not someone significantly younger or older than himself. It is not uncommon though to see fighters differing substantially in terms of their age. In old times "revenging" for a relative or family member who had been beaten to death could be done by a relatively younger member of the family as he comes of age (Coetzee, 2002).

### **2.5.3.3 THE UKUGIYA (SOLO DISPLAY OF SKILLS) AND ASSOCIATED IZIBONGO (PRAISES) AND IZIGIYO (CHANTS)**

Prior to any stick fighting contest, a solo display of skills or ukugiya takes place. The stick fighters take turns demonstrating against an imaginary opponent (Coetzee, 2002). The historical context of ukugiya is that it prepared fighters psychologically for warfare and reaffirmed the army's superior skills (Coetzee, 2002). There are no set floor or step patterns that are followed. Darlymple (1983) states that ukugiya is usually accompanied by praises called izibongo and war cries and chants called izigiyo. Izigiyo are

characterised by militaristic phallocentrism, and often liken men to powerful totems such as bulls or lions that are self-reliant and “fiercely individualistic” (Derwent et al., 1998). Gunner and Gwala (1994 : 230) cite an example:

Igoso (Leader): “Yaphind’ inkunzi!” (the bull came again!)

Abanye (Rest): “Yahlaba: (it stabbed).

Other war chants commonly used in ukugiya include:

Igoso (Leader): “Babengaphi?” (where were they?)

Abanye (Rest): “Babe ngapha thina singapha usikiza uha ha.” (they were there, we were here)

Igoso (Leader): “Umuzi wempi, umuzi wothuli” (the house of war, the house of fights). “Uthuli” in isiZulu means dust. When there is a fight, dust rises up.

Abanye (Rest): “Iya, Iya” (yes, yes)

The fighter will then ‘hit’ the air whilst his group members clap hands and recite izibongo (praises) of that particular fighter. Praises may liken the stick fighter to a powerful wild animal. They may also re-tell the heroic deeds of the ancestors of the fighter. They may also take into cognisance the hardships that a stick fighter might have faced and how the fighter managed to overcome them. An example goes as follows:

*Mbalabala uyadlalwa ebaSuthwini, (Morababa is a game played by the Sotho speaking people)*

*Malamba aze acele ekatini, (The one who gets horny and even makes advances on a cat)*

*Lizilandulele ikati lithi (The cat refuses and says):*

*Mtaka Felaphakathi ngabe ngiyakusiza, (Child of Felaphakathi, I would like to help you, however)*

*Inkinga kuncane khona. (You are well endowed)*

Coetzee (1997) maintains that ukugiya is still performed before faction fights. However, it has transcended its historical roots to become a celebration of youthful masculinity (Coetzee, 2002).

#### **2.5.3.4 THE FIGHT**

The challenge often entails the challenger circling the fighting arena while brandishing his shield. He then goes across to the chosen opponent and shouts, “Nansi Inkunzi” (here is a bull) (Derwent et al., 1998). The modern way of challenging an opponent is when a challenger shouts “zinjani la” (how are things here?). In the first instance, another fighter will accept the challenge by stepping forward and proclaiming “Nansi enye inkunzi” (here is another bull). In the second instance, the fighter will step forward and reply by saying “woza uzithathe izinduku” (sticks understood) (Clergy, 1997).

The fight does not commence immediately. Fighters square up and exchange blows to the shields. This action helps the fighters to warm up muscles before they engage in the fight. This session could also be used by “intelligent” fighters to detect any weaknesses from the opponent or the opponent’s favourite type of a blow. Once the initial ‘pleasantries’ have been completed, the intensity of the fight increases. The focus is on finding the weak points of the opposition (Coetzee, 2002).

The main aim of the fight is to strike the opponent’s head commonly known as ukweqisa (Coetzee, 2002). A fighter might strike the opponent anywhere on the body. The ultimate aim of striking the opponent on the body is to create an opening in the opponent’s defence, allowing the fighter to strike the opponent’s head. This is similar to the tactics used by boxers for example, who will punch the opponent in the early rounds of the fight making the opponent’s defence weak thus ensuring a knock-out very early on. Basic rules govern stick fighting contests:

- No stabbing is allowed.
- Proper fighting sticks should be used, (no use of a club or stick with a knob).
- Should it happen that a fighter drops his stick, time should be given to him to pick it up before resuming the fight.

- No hitting of the opponent with a shield and/or tripping him.
- A fighter cannot be hit when he has fallen down.
- No grabbing of an opponent or his weapons.
- No locking of shields which may result in a wrestling contest rather than a stick fight (Coetzee, 2002).

The fight normally ends when one of the fighters is severely beaten or when first blood is drawn. Zulu stick fighting has a strict protocol on ending fights. In case a fighter is not coping, outside intervention may end the fight. The fight may be stopped by the induna, the warrior captain and the elders. With young boys who have a leader ingqwele who can fight better than the lot, the fight could be stopped by him. Good sportsmanship is also practiced during a fight. If a fighter is not coping, he can stop the fight by exclaiming “khumu”, “it is enough” or “maluju” “hold it” (Msimang, 1975). The victor is expected to rejoice with humility as a sign of maturity at the peak of triumph.

Many injuries can be sustained during a stick fight. These include broken wrists and ribs. In the event of inflicting a head injury, and as a token of goodwill, the victor accompanies the loser to a river or any other source of water and helps him wash his wounds (Msimang, 1975).

The next section deals with stick fighting and social gatherings:

## **2.6 STICK FIGHTING AND SOCIAL GATHERINGS**

### **2.6.1 Background**

KwaZulu-Natal was divided into various regions, districts, and inter-district areas under the rule of the king, chiefs, paramount chiefs, local chiefs and headmen (Clegg, 1991). Bad blood over the possession of land inflamed tension between leaders and disputes over territory were settled by means of stick fighting (Coetzee, 2002). Stick fighting may thus serve as a means to defend a group’s territory. In some instances, these feuds result/stem from revenge. One group whose fighter may have lost a fight might feel

aggrieved and want revenge on his behalf. Females could also be a source of these scuffles and is discussed later in this chapter.

#### **2.6.1.1 THE PUBERTY (UKUTHOMBA) CEREMONY**

In Zulu society, ukuthomba or male puberty ceremony marks the “attainment of physical maturity” (Mahlobo & Krige, 1934). Stick fighting is a prominent element of male puberty rites and forms the symbolic passage of a male to the adult world (Coetzee, 2002).

It all starts after a boy experiences his first nocturnal emission, thus providing concrete evidence that he is entering a new phase of his life (Elliot, 1978). As per custom, he gets up before dawn, secretly steals his father’s cattle and drives the herd to a place where they will not be easily located. The father on noticing the missing cattle and son, announces the news. The boy’s peers follow the example of ‘stealing’ their father’s cattle and join the cattle with the stolen herd. As soon as the boy is found, the area around his stomach is smeared with ‘crab mud’ and he must swim in nearby water. This is done to cleanse the boy as he enters the new life (Bryant, 1949).

The next phase of the ceremony involves the finding of cattle. First attempts to reclaim the cattle involve sending girls of the local kraals to bring the boys and cattle home (Elliot, 1978). Both girls and boys carry sticks and shields and stick fighting is likely to erupt between the sexes (Coetzee, 2002). Due to the playful context of the fighting actions, the boys engage in sparring rather than actual stick fighting. The fight is said to take place in the space selected to hide the cattle. On the rare occasions when the girls won, the boy reaching puberty was labeled as a weakling.

In one of the fights observed by Elliot (1978), he claims to have observed girls who were experts with the fighting sticks. Be that as it may be, the girls were eventually beaten by the boys and chased home. Bryant (1949) gives a different account of the fight between the two sexes he had observed;

“The girls, armed with their switches, were mustered and dispatched to bring both cows and truant back. A brisk battle, in which sticks were liberally used all round, naturally ensued out in the veld between the rival sexes, but soon the bigger girls got boys and cows together on the run and drove them in one big scamper all back home.”

The use of switches should not create a doubt that indeed fights broke out between boys and girls. Elliot (1978) is of the opinion that whipping switches were traditionally used. They were later replaced by fighting sticks which are used up to the present day.

In cases where the girls do not recover the ‘stolen’ cattle, the fathers of the kraals go out to fetch their cattle and boys. A stick fight erupts between the boys and men (Coetzee, 2002). The more experienced you are in stick fighting, the better are your chances of being victorious. It doesn’t come as a surprise then that in this type of fight, the men will be victorious and drive the cattle and the boy’s home. This marks the start of the puberty ritual which may last for a couple of days.

#### **2.6.1.2 THE IPHAPHU (LUNG) FESTIVAL**

It is common practice in the Zulu nation to slaughter an animal, mostly a cow, to fulfill different purposes. These may range from slaughtering for the ancestors to when a father is doing a coming of age ceremony for a girl child in the homestead (umemulo). The ceremonies attract people from the village as well as from other districts. On many occasions, stick fighters will gather where the cow has been slaughtered.

When a cow has been slaughtered, certain parts of the animals are reserved for the herd boys only. Msimang (1975) states that the heart, lungs (iphaphu) and other smaller fleshy parts of the animal such as the ears, spleen and the upper lip are the ones normally reserved. The lungs and the best meat received from the one reserved for the boys is not eaten in the kraal. It is taken away by the senior boy (ingqwele) to a space specifically selected for the lung festival (Schoeman, 1982).

The location on which the lung festival takes place must:

- Be high enough to keep a watchful eye on the surrounding area and possible enemies,
- Accommodate the need for privacy and safety of participants, and
- Have a substantial amount of rocks. The rocks are shifted in order to produce a sound that is clearly audible throughout the surrounding area (Coetzee, 2002).

The sound is said to function as an invitation to other herd boys in the area (Coetzee, 1996). The boys drive their herds of cattle in the direction of the sound and once assembled at the designated space, the younger boys are sent to collect wood for a fire. The boys barbecue the lungs, cut them into pieces and distribute the pieces for consumption among the participants. The senior boys stuff the pleura with choice meat. The pleura (thoracic segments) are barbecued exclusively for the ingqwela (the leader of herd boys). The heart of the animal is then barbecued next, cut into pieces and divided amongst the izingqwela (senior herd boys) (Schoeman, 1982).

During the lung ceremony, juniors can challenge the leadership of their seniors. A challenge occurs within an accepted structure of events. Placing fat from the piece of lung reserved for the izingqwela on a stick and daring boys to take it away and eat it, constitutes a challenge. Coetzee (1996) maintains that the izingqwela can also invent a reason for a youngster to go and see if all is well with the cattle. Upon his return the youngster is told that another boy made inflammatory statements about him or about his mother's private parts. The statements might well have been made, but are very likely a fabrication. The boy is morally obliged to accept the challenge.

The stick fight in the lung festival will continue until a victor emerges or until one of the pair exclaims "khumu" or "maluju" meaning "It is enough" (Msimang, 1975). Afterwards, the victor receives praise and applause from the whole congregation of boys while the loser is subjected to playful jests and laughter (Coetzee, 2002).

### **2.6.1.3 COURTSHIP (UKWESHELA)**

In traditional Zulu custom, a boy should discover where the girl he admires collects water (Coetzee, 2002). In a period spanning a couple of months up to three years, or more, a

boy will try to convince the girl to fall in love with him. In the course of courtship (*ukweshela*), a girl may attract other admirers from the same district or another district. The girl therefore becomes a “bone of contention” which may result in the boys engaging in a stick fight to try and win her attention. Coetzee (2002) maintains that the girl would always be present to observe the outcome of the fight.

The outcome of the fight might develop into a larger fight involving groups of boys. This is possible if the loser of the fight is seriously aggrieved or wishes to challenge the outcome of the fight (Coetzee, 2002). The loser may inform friends about the fight and provide a handy excuse for his loss. The loser’s friends may be well aware that the excuse is fictional since it is common knowledge that a better stick fighter should win a stick fight. Nonetheless, the friends will willingly suspend their disbelief in order to have an opportunity to fight (Coetzee, 1996). Both parties then patiently wait for an appropriate opportunity such as a traditional Zulu wedding, (though not limited to it) to engage in a clash of arms, one party to restore its friend’s honour and impress the girl, the other to again prove its superiority and impress the girl for the second time (Coetzee, 2002).

#### **2.6.1.4 THE UMGANGELA (INTER-DISTRICT FIGHTING)**

“Umgangela” is a highly organised, “pre-arranged inter-district fighting match” with set rules (Coetzee, 2002). Although “umgangela” as a social ritual expresses a violent subtext, it actually controls and contains the potential violence (Clegg, 1981). Violence is channelled in such a way as not to endanger the immediate social environment. Potential antisocial impulses are transformed into an interactive and constructive process of socialisation (Coetzee, 1996).

“Umgangela” takes place during the summer, normally between November and January (Clegg, 1981). Men from the same region wear similar costume pieces which help identify which region they come from. Coetzee (2002) argues that costumes thus make a statement about the group’s social solidarity and may manifest itself in many forms, from sashes to hairstyles. She further points out that stick fighters of a particular region may take a collective name as a means of identification. The researcher is familiar with a

group in the Ndlangubo Reserve who call themselves izinyosi (bees) as a metaphor for their “stinging” blows.

Three or four districts may be represented at the “umgangela”, forming “companies of men singing and shouting their war cries” (Clegg, 1981). He further explains that the warrior captains or “umphathi wezinsizwa” from the different districts come together and lead the companies into rhythmic movements, thus displaying their district’s potential ability to conquer.

The following period is characterised by well-known stick fighters emanating from each district breaking away from each group to perform “ukugiya”, the solo display. Whilst a fighter is doing the solo display, a challenge may be thrown. If the fighter accepts the challenge, space is given to the fighters for them to fight. A large contingent of spectators is always present to witness what happens. Men whistle, women ululate and the spectators generally show appreciation. The fight, rules, and how a winner is determined has already been discussed in earlier sections (Coetzee, 2002).

#### **2.6.1.5 THE UDWENDWE (TRADITIONAL WEDDING CEREMONY)**

A traditional Zulu wedding is a public event (Darlymple, 1983). Stick fighting is an expected part of a Zulu wedding (Coetzee, 2002). Stick fighters may engage in a fight even if there are no disputes to be settled. Accordingly, men attend the wedding fully prepared for a stick fight.

It is common knowledge among Zulus that a stick fight may break out at a wedding - to impress the girls present and to build up a reputation as a stick fighter. In some cases stick fights break out after a man has pretended to be interested in another man’s girlfriend. This is of course done intentionally to provoke a fight (Coetzee, 2002). Alternatively, a man might intentionally overdress and appear or act arrogantly in order to provoke other men (Coetzee, 1996).

The nature of stick fighting that occurs at a traditional Zulu wedding is similar to the inter-district fights discussed earlier in this chapter. Just like in the inter-district fights, a

suitable space for the fighting is selected. The fighting takes place under strict supervision of the warrior captains or leaders of the different groups. Spectators delineate the space by forming a human circle big enough to accommodate the action.

Prior to any stick fight, “ukugiya” (solo display) takes place. The stick fighters take turns demonstrating against an imaginary opponent (Coetzee, 2002). After the performance, the challenge takes place. The challenge often entails the challenger circling the “human circle” while brandishing his shield. He then shouts, “Nansi inkunzi” (Here is a bull). The modern way of challenging an opponent is when a challenger shouts “Zinjani la?” (How are things here?). To begin the stick fight, a man from the opposite party accepts the challenge by taking a step forward and proclaiming, “Nansi enye inkunzi” (Here is another bull).

Fighters square up and exchange blows to the shields. This action is said to be a warm-up session for the fighters (Coetzee, 2002). The intensity of the fight increases thereafter. The spectators exclaim their delight at a good manoeuvre and watch quietly as the fight gets serious. Ululating girls assist in building the excitement and perform their stamping dance called “ukugqiza” to add colour to the day’s events. As soon as a man is defeated, another from the opposition takes the stage. A great number of men can partake in the stick fighting depending on the following of the bridal parties (Coetzee, 2002).

The next section deals with the conclusion:

## **2.7 CONCLUSION**

Stick fighting in Zulu people has an educational role. It taught young members of society social values, gender roles and respectability of physical endeavours (Alegi, 1997). It also created a stage for young boys to assert themselves within a specific age-group, achieve a social identity with others and more importantly a degree of “independence” unavailable to the common persons. Boys learnt at the early age the utilitarian function of sport, sharpening physical skills and mental attitudes necessary for hunting game and combat (Alegi, 1997). The subtle call for African renaissance is a call for Africa to find ways to deal with problems inherited from the past. Stick fighting can still play an educational

role in schools where there are no facilities for mass participation in sport by the learners (South African Sports Commission, 2001).

The next chapter will focus on literature review on motor proficiency, physical fitness and the potential benefits of Zulu stick fighting:

## **CHAPTER THREE**

# **MOTOR PROFICIENCY, PHYSICAL FITNESS AND THE POTENTIAL BENEFITS OF ZULU STICK FIGHTING**

### **INTRODUCTION**

This chapter provides a theoretical background on motor proficiency, the importance of motor proficiency, a theoretical background on motor skills and the development thereof of different motor skills, the factors that influence children's ability to acquire motor proficiency and a theoretical background in physical fitness. The chapter ends off by looking at reasons that prevents the development of motor proficiency and health-related physical fitness in children in South Africa and the potential benefits of Zulu stick fighting.

The next section deals with a definition of motor proficiency:

### **3.1 DEFINITION OF MOTOR PROFICIENCY**

Although the term motor proficiency has been extensively used, a comprehensive search of literature yielded only one definition which is widely used to define motor proficiency. The definition is generally considered as the operational definition of motor proficiency:

Motor proficiency is the specific abilities measured by tests of running speed and agility, balance, bilateral coordination, strength, upper-limb coordination, response speed, visual-motor control, and upper-limb-speed and dexterity (Sherrill, 1993; Sherrill, 2003).

The above definition caters for both the lower and the upper extremities. Tests of running speed, agility, balance and bilateral co-ordination focus on the lower limbs. Tests of strength, upper-limb co-ordination, response speed, visual-motor control, upper-limb speed and dexterity on the other hand, focus on the upper-limbs.

Motor proficiency is the specific abilities upon which performance is built (Sherrill, 1993; Sherrill, 2003). Motor proficiency is multidimensional; therefore it cannot be assessed by doing a single test. One's ability to exhibit high levels of speed, balance, strength, agility and co-ordination are some of the critical abilities that need to be tested. It is on this basis that motor proficiency is based upon the execution of flexion, extension and rotational movements that lead to the successful performance of locomotor, balance and manipulative skills (Sherrill, 1986).

Sherrill (1986) maintains that motor proficiency is not the same as motor performance. Motor performance is the observable behaviour exhibited when one performs a motor task (skill) (Sage, 1984; Schmidt and Wrisberg, 2000). A measure of motor performance would be the score that one achieves on a given trial or practice period (or a game or sports). For example, ten seconds could be an indicator of motor performance of a sprinter in a given race. Fifteen out of twenty field goals attempted by a basketball player during the game could be considered a measure of motor performance. Performance is a temporary occurrence which can fluctuate due to many variables inter alia attention, focus, motivation, physical conditioning and fatigue (Schmidt and Wrisberg, 2000). Motor proficiency on the other hand is used to describe the level of skill one possesses (Sage, 1984). Skill as an indicator of proficiency implies that a person exhibits competence in carrying out a task that can be defined in terms of its desired goal. Such a person is then referred to as skilled or skillful. There is a positive relationship between level of skill (proficiency) and motor performance. Level of skill does not fluctuate over many performances, however, over many performances the skill level may change i.e. poorly skilled to highly skilled (Sage, 1984).

The next section deals with the importance of motor proficiency.

### **3.2 THE IMPORTANCE OF MOTOR PROFICIENCY**

Motor proficiency is very important in children (Scheepers, 2002). A thorough review of literature revealed the following points in terms of the importance of motor proficiency in children.

Firstly, motor proficiency leads to the development of fundamental motor skills ([http://www.clt.estate.edu/bdean/MotorSkills/Introduction\\_files/fullscreen.htm](http://www.clt.estate.edu/bdean/MotorSkills/Introduction_files/fullscreen.htm)).

Fundamental motor skills involve gross movements that involve body parts such as the feet, legs, trunk, head, arms and hands. Fundamental motor skills play a significant role in the development of a child's overall motor skill. ([http://www.clt.estate.edu/bdean/MotorSkills/Introduction\\_files/fullscreen.htm](http://www.clt.estate.edu/bdean/MotorSkills/Introduction_files/fullscreen.htm)).

Goddard-Blyth (2000) suggests that balance and coordination (all part of fundamental motor skills) are the primary ABC's upon which all later learning depends. Fundamental motor skills thus lay the foundation for the acquisition of more complex motor skills. Children who do not master fundamental motor skill are less able and often less willing to persist with learning more complex motor skills, and will avoid activities which expose them to failure. Ultimately, such children often avoid participation in physical activity (Haywood, 1993; Haywood and Getchell, 2001). Fundamental skills are discussed in detail later in this chapter.

Secondly, the development of motor proficiency has important implications for health. Children who are physically active on a regular basis are healthier than those who are sedentary (Gannotii et al., 2007). Many modern diseases are due in part to a lack of physical activity, the most evident being the lack of exposure at an early age to physical development activities (Corbin and Lindsey, 2006). Physical activity patterns developed in childhood tend to last throughout adulthood. People are more likely to take up or continue sports or some kind of physical activity if they are proficient in the required degree of skill (Janz et al., 2000; Smith and O'Keefe, 1999). Physical activity in many schools and homes does not receive the level of importance it deserves (Ntshingila, 2004, De Villiers, 2005). Worldwide, childhood obesity has reached epidemic proportions with an estimated 155 million school-aged children either obese or overweight (Noakes, 2004). In a first of its kind, the South African Department of Health conducted a national youth risk health survey in 2002 and found that 29% of the youth had no physical education classes in schools and 25% watched television for over three hours per day (Department of Health, 2002).

The motivation to continue with sport or any kind of physical activity is therefore enhanced if motor proficiency levels are at an acceptable level (McInnis, 2008). Wrotniak et al. (2006) examined the relationship between motor proficiency and physical activity in eight to ten year old children. Children's physical activity was assessed by a Manufacturing Technologies Incorporated/Computer Science and Applications (CSA) accelerometer (model 7164) and their motor proficiency was determined by the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP). Their results indicated that children with higher levels of motor proficiency were more physically active than children with lower levels of motor proficiency. Children's motor proficiency was positively associated with activity counts and percentage of time in moderate and moderate-to-vigorous intensity physical activity and inversely related to percentage of time in sedentary activity. Children in the greatest quartile of motor proficiency were the most physically active compared with children with lower levels of motor proficiency who had similar levels of physical activity.

Thirdly, motor proficiency has been found to have a positive effect in helping learners with learning disabilities (Scheepers, 2002). Learning disability refers to a broad range of brain-related abnormalities that persistently interfere with an individual's ability to learn and use new information, usually despite normal intellectual ability (Silver, 1989). Learning disability is commonly due to a developmental condition, but may be due to an acquired condition when a specific injury occurs in one or another brain area - impeding normal learning (Heyward, 1993; Haywood and Getchell, 2001). A learning disability is normally characterised by a discrepancy between achievements and assessed intellectual ability (Bluehardt et al., 1995). In a study conducted in Empangeni, South Africa, statistically significant improvements on the overall functional ability of the learners with learning disabilities after undergoing a twelve weeks intervention programme were reported (Scheepers, 2002). Both experimental groups (the sensory motor and the perceptual motor) that participated in a motor proficiency intervention programme for twelve weeks showed improvement whilst the control group who did not participate on the intervention programme did not show any improvement in their motor proficiency scores.

Lastly, having good motor proficiency levels can contribute to a child's development both psychologically and socially. Krombholz (1997) states that having good motor proficiency, which leads to good perceived competency to perform motor skills, plays a significant role in establishing the child's reputation amongst peers and the development of self-esteem in later childhood (relationship between self-esteem and physical activity is discussed later in this chapter). Children who are successful at movement patterns are more likely to become willing learners motivated by curiosity and will find pleasure in participation (Haywood, 1993; Sherrill, 1993; Haywood and Getchell, 2001; Sherrill, 2003). Poorly coordinated children perceived to have a lowered competence in the motor domain might have reduced social support and interaction from peers (Davis et al., 2000; Haywood and Getchell, 2001).

The next section deals with motor skills:

### **3.3 MOTOR SKILLS**

To develop good motor proficiency, one needs to acquire motor skills (Haywood, 1993; Sherrill, 1993; Haywood and Getchell, 2001; Sherrill, 2003, MacInnis, 2008). The ability to move is more than just a convenience that enables human beings to walk, play or manipulate objects, it is a critical aspect of evolutionary development, no less important than the evolution of intellectual and emotional capabilities (Schimdt, 2005).

Scientists have been trying for centuries to understand the determinants of skill and the factors that affect performance. The knowledge gained has provided applications to numerous aspects of life, including improving performance in sports and physical activities. Most humans are born with the capacity to produce movement (Schimdt, 1991). Crawling, walking, running, chewing and balancing are some examples of the relatively innate behaviour that a human being possesses (Schimdt, 1991). A second class of these movements entails what is commonly referred to as “automatic movements” or the reflexes. Reflexes are involuntary movements that a person makes in response to specific stimuli. Blinking of an eye and moving a hand away from painful stimuli are examples of a reflex (Haywood, 1993; Haywood and Getchell, 2001). There are as many as up to ten different types of reflexes that a human being is born with. These include the

moro, walking/stepping, rooting, tonic neck, palmar grasp, plantar, gallant, swimming, babkin and parachute reflexes ([http://en.wikipedia.org/wiki/Primitive\\_reflexes](http://en.wikipedia.org/wiki/Primitive_reflexes)). A third class can be thought of as “learned”, for example, those involved in performing a triple twisting somersault from the diving board (Schmidt, 1991). Learned movements are not inherited and mastering them requires long periods of practice and experience. Learned movements are commonly referred to as a skill (Haywood, 1993; Haywood and Getchell, 2001). When a number of perceptual and motor abilities have been acquired by learning, we refer to it as a motor skill (Davis et al., 2000).

The word “motor” refers to movement (Haywood, 1993; Haywood and Getchell, 2001). Skill on the other hand, “consists of the ability to bring about some end result with maximum certainty and minimum outlay of energy or of time and energy” (Guthrie, 1952; Knapp, 1977). When the words are combined, they have a very specific meaning. A motor skill is defined as a skill that requires an organism to utilise the skeletal muscles effectively ([http://en.wikipedia.org/wiki/Motor\\_skill](http://en.wikipedia.org/wiki/Motor_skill)). Another definition of a motor skill states that, “a motor skill is an action that involves the movement of muscles in the body” (Wells, 2007). Motor skill could also refer to “a skill for which the primary determinant of success is the quality of the movement that the performer produces” (Schmidt and Wrisberg, 2000). Most motor skills are learned throughout the lifespan ([http://en.wikipedia.org/wiki/Motor\\_skill](http://en.wikipedia.org/wiki/Motor_skill)).

Singer (1982) is largely credited with developing the first system of classifying motor skills in an effort to impose some order on the many different types of motor skills. Singer (1982) classifies motor skills in terms of bodily involvement, duration of movement, cognitive involvement, pacing conditions and feedback availability. Stalling (1982) provides a slightly different classification system. Motor skills are classified in terms of continuity, coherence, pacing, environmental conditions and intrinsic feedback. Davis et al. (2000) provides another classification taking seven elements into consideration namely body involvement, continuity, environmental requirements, pacing, interaction, difficulty, and organisation. For the purposes of this study, the Davis et al. (2000) classification method shall be adopted. The Davis et al. classification has been adopted for this study as it considers more than any other classification the various factors that might influence motor skills. It therefore consists of more categories of the

different types of motor skills. The Davis et al. classification is also more recent than that of the other two classifications by Singer and Stalling (1982). The different types of motor skills are grouped into seven main categories:

- Fine and gross motor skills: This is based on the extent to which the entire body is used. This is discussed in detail in the section to follow (Section 3.3.1 and 3.3.2, pages 52-53).
- Discrete, serial and continuous skills: This is based on the distinctiveness of beginning and ending of movements. Discrete skills are characterised by recognisable beginnings and endings. They involve a single exertion such as shooting an arrow or throwing a baseball. The task is serial in nature when the beginning and ending of components can be identified but the events follow each other in sequence, such as a gymnastics routine on the high bar or on a mat. Continuous skills are repetitious movements such as running and free-style swimming (Sage, 1984; Davis et al., 2000; Schmidt and Wrisberg, 2000).
- Self paced and externally paced skills: This is based on whether the pace of movement execution is under the control of the performer. Self paced skills entail those skills where the performer has full control of the pace of the skill. Bowling and golf is considered a self paced skill. Externally paced skills entail those skills where the performer has no control of the pace of the skill. Fielding in baseball and cricket is an externally paced skill, as the performer has to react to the pace at which the ball is travelling (Sage, 1984; Davis et al., 2000; Schmidt and Wrisberg, 2000).
- Open and closed skills: This is based on the stability of the environment during movement. An open skill is one that is performed in an environment that is variable and unpredictable during the action. Examples include defending against a fast break in basketball and engaging an opponent in a wrestling match. In situations like these, it is difficult for the performer to effectively predict the future moves of others. Closed skills on the other hand, entail skills that are performed in an environment that is stable and predictable. Examples include gymnastics routines and swimming in an empty lane in a pool (Davis et al., 2000; Schmidt and Wrisberg, 2000).
- Individual, coactive and interactive skills: This is based on the nature of interactions between competitors and the extent to which the opposition can affect

the performers' performance. An individual skill is that in which the competitor performs alone without the physical presence of the opposition. Examples include high jump and figure skating. In high jump, other competitors are in the area but do not perform at the same time. They cannot physically affect performance though they may exert psychological pressure. In figure skating, if performers wish, they can distance themselves from each other before and after performance. Coactive skills are those in which the competitors are performing at the same time but they are physically separated. Hence the competition cannot physically inhibit the performance of another. Examples include a 100 metre sprint event in athletics and swimming. Interactive skills are those skills in which performance can be controlled by the opposition. Interactive games involve maintaining possession and avoiding being tackled or intercepted as space is shared and body contact allowed. Examples include rugby and American football (Davis et al., 2000).

- Simple and complex skills: This is based on the level of difficulty in executing the skill as well as the stage of learning of the performer. There are a number of factors that contribute to the complexity of the task inter alia the amount of information to be processed, the number of decisions to be taken, the speed at which information processing and decision making have to occur, the number of sub-routines and the extent of coordination required, speed/power required, accuracy needed and the type and timing of feedback available. The higher the requirements are on all these factors, the more complex the skill is. Simple skills make lower demands on all the above-mentioned factors. Examples include sprinting and overhead kicking in soccer. Competitive success in sprinting is derived from only two mentioned factors that determine success namely speed and power. An overhead kick in soccer requires high levels of all mentioned factors except feedback Davis et al. (2000).
- Highly organised and low-organisation skills: This is based on the number of sub-routines within the total performance of the skill and the difficulty or simplicity of dividing the sub-routines. Highly-organised skills and sub-routines are closely integrated and difficult to separate in practice without destroying the movement dynamics of the skill. Tennis and gymnastic skills are examples of highly organised skills. They are both practiced as a whole and can't be broken down

into smaller sub-routines. Low-organisation skills are made up of sub-routines that tend to be discrete (characterised by a recognisable beginning and end) and may be practiced separately and then integrated into the whole skill without too many problems. Swimming strokes particularly front or back crawl are examples of low-organisation skills (Davis et al., 2000).

Due to the fact that the Bruininks-Oseretsky test of motor proficiency that will be used in this study for the assessment of motor proficiency can only assess fine and gross motor skills, only one category out of the seven categories shall be considered relevant for the purpose of this study:

### **3.3.1 Fine motor skills**

A fine motor skill is defined as, “a physical skill that involves the coordination of small muscles to perform a task” (Davis et al., 2000; Papalia et al., 2006). Fine motor skills include the ability to manipulate small objects, transfer objects from hand to hand to perform tasks that are precise in nature ([http://en.wikipedia.org/wiki/Motor\\_skill](http://en.wikipedia.org/wiki/Motor_skill)). Fine motor skills are also being referred to as manipulative or manual tasks (Sage, 1984). Playing a piano, playing a video game, writing and typing on a computer keyboard are examples of fine motor skills.

### **3.3.2 Gross motor skills**

A gross motor skill is defined as, “physical skills that involve large muscle groups” (Davis et al., 2000; Papalia et al., 2006). Sage (1984) defines gross motor skills as: “actions that involve total body movement and multi-limb movement”. Activities such as walking, jumping, swimming and kicking a rugby or a soccer ball are examples of gross motor skills.

The next section deals with development of motor skills:

### **3.4 DEVELOPMENT OF MOTOR SKILLS**

Children normally develop motor skills in a sequential manner (Schmidt and Wrisberg, 2000). The development of motor skills can thus be categorised into a three level developmental hierarchy namely the rudimentary motor skills, the fundamental motor skills and specialised movement skills. Each level is important in its own way, not less nor more important than the other. Understanding the various levels of skills that children need to learn thus becomes very important.

#### **3.4.1 Rudimentary motor skills**

Rudimentary motor skills entail *stability movements* such as gaining control of the head, neck and trunk muscles, *manipulative tasks* of reaching, grasping and releasing and *locomotor movements* of creeping, crawling and walking. A child's rudimentary motor skill development relies largely on (the normal physical development of that child). In order for the child to crawl, walk, climb and grasp, certain levels of skeletal, neural and muscular development must have been reached (Louw, 1995). At birth, a child may possess a repertoire of movement patterns/behaviour that can be used in their new environment. These are referred to as innate movement behaviours. The collections of movement responses exhibited by children are the building blocks to build on for later movement patterns. When a child becomes more mobile, a series of more complex movement patterns are performed with all limbs. Louw (1995) suggests that the development of movement patterns is likely to progress from homologous to homolateral movements and then to more complex cross-lateral patterns during creeping and crawling.

As children grow, they are enchanted by emerging motor capabilities. Motor abilities are inherited, relatively enduring, stable traits of the individual that underlie or support various kinds of activities or skills (Schmidt and Wrisberg, 2000). Motor abilities represent the "hardware" that individuals bring with them to performance or learning situations. Prepubescent stage is the most appropriate period for exposing children to a variety of movement experiences which go a long way in helping to create and expand neural networks in the developing brain (Scheepers, 2002).

### 3.4.2 Fundamental motor skills

Fundamental motor skills are common motor activities with specific observable patterns (<http://www.scu.edu.au>). They are referred to as phylogenetic skills because of their universal occurrence (Burton and Miller, 1998). Most skills used in sports are advanced versions of fundamental motor skills, that involve body parts such as feet, legs, trunk, head, arms and hands ([http://www.clt.estate.edu/bdean/MotorSkills/Introduction\\_files/fullscreen.htm](http://www.clt.estate.edu/bdean/MotorSkills/Introduction_files/fullscreen.htm)).

Fundamental motor skills, involve the projection of the body e.g. jumping (Seefeldt, 1984). Fundamental motor skills usually emerge between the age of one and seven years of age (Burton and Miller, 1998). Children at the fundamental movement skill stage (ages between 2 and 6 years) are building upon previously learned movements (rudimentary motor skills) preparing for the acquisition of more advanced skills (specialised movement skills).

The development of fundamental motor skills and physical fitness must begin in the earliest years of primary school. During these years, children are physically and intellectually capable of benefiting from instruction in Physical Education, since they are often highly motivated and enthusiastic about learning during this stage (Schmidt and Wrisberg, 2000). The development of fundamental motor skills lead to the development of a variety of motor skills: body management skills, locomotion skills and manipulative skills ([http://www.clt.estate.edu/bdean/MotorSkills/Introduction\\_files/fullscreen.htm](http://www.clt.estate.edu/bdean/MotorSkills/Introduction_files/fullscreen.htm)).

Body management skills involve controlling body balance. Body balance can be controlled statically, when the body is stationary, as well as dynamically, when the body is in motion. Body management skills also involve body awareness what movement the body is capable of doing and how those movements could be executed. Locomotion skills involve moving the body from one place to another in any direction. Activities such as walking, running, dodging, landing, leaping, skipping and sliding are examples of locomotion skills. They can also be used to project an object upward as in projecting oneself in activities like jumping and hopping. Manipulative skills are sometimes referred to as Object-control skills. Manipulative skills entail all movements involved in hand-eye or foot-eye coordination in manipulation of objects. Objects that can be manipulated

during these activities include balls, hoops, jumping ropes, racquets, bats and hockey sticks. Thus, motor skills such as throwing, catching, bouncing, dribbling, rolling and striking are examples of object-control skills ([http://www.clt.estate.edu/bdean/MotorSkills/Introduction\\_files/fullscreen.htm](http://www.clt.estate.edu/bdean/MotorSkills/Introduction_files/fullscreen.htm)).

### **3.4.3 Specialised movement skills**

Specialised movement skills are defined by Gallahue and Ozman (2002) as “mature fundamental movement patterns that have been refined and combined to form sport skills and other specialised complex movement skills”. The specialised movement skills are referred to as ontogenetic (Burton and Miller, 1998). They are not performed by persons in all cultures, nor by all persons in any single culture, they are unique to individual performers (Burton and Miller, 1998). Specialised movement skills are situation-specific and involve a high level of refinement. Progression in developing specialised movement skills is usually attained through planned instruction and drills (Gallahue and Ozman, 1998). Basic sports skills are usually a combination of body management skills, locomotion skills and manipulative skills (object-control skills) (all part of the fundamental motor skills discussed earlier) (Burton and Miller, 1998). Activities such as throwing a ball in a game of cricket, dribbling a ball in soccer or running and jumping in an activity like gymnastics could be considered specialised movement skills. According to Burton and Miller (1998), specialised movement skills can be classified into two general categories:

- Skills involving control of the body independent of other players (e.g. golf); and
- Skills including reactions to other players in the sports activity (e.g. soccer).

The skills that involve the control of the body independent of other players entails demonstration of skills such as posture and balance control, agility, power and coordination. These are not necessarily fundamental motor skills discussed earlier but form part of motor fitness which is discussed later in this chapter. The skills that involve the control of the body independent of other players are most obvious in sports such as gymnastics and track and field that demand high performance from an individual participant who is free to move without interference from another player. The skills including reactions to other players in the sports activity encompasses interaction with

another player or participant (Burton and Miller, 1998). This includes various offense-defense situations, such as those that occur in volleyball, basketball and soccer to mention just a few (Schmidt and Wrisberg, 2000). Smith and O'Keefe (1999) are of the opinion that mastering specialised movement skills requires good fundamental motor skills which can only be acquired if children are exposed to a variety of different physical activities.

The next section deals with factors that influence children's ability to acquire motor proficiency:

### **3.5 FACTORS THAT INFLUENCE CHILDREN'S ABILITY TO ACQUIRE MOTOR PROFICIENCY**

Throughout our life span, we constantly develop or adapt our abilities and skills to live our lives in a satisfying and meaningful manner (Schmidt and Wrisberg, 2000). The capacity to exist within the environment is influenced by our ability to function, and the quality of our functional ability is related to all aspects of development: physical, social, emotional and mental (Cech and Martin, 2002). During the process of motor development, children change in size, shape, maturity, physical activity, and motor proficiency. These changes are driven by two factors namely biological factors which include genetics, gender and maturation and environmental factors which include experience, opportunity (stimulation), and encouragement (feedback) (Gallahue, 1982; Thomas, 2001).

The ability to develop motor proficiency depends on many factors. Inter alia, it is dependent on the interaction between the learner and environment, the personal characteristics of the child, motivation, previous motor skill experience, physical characteristics such as body size, strength, balance and brain maturation (Newell, 1986). The extent to which children develop their genetic potential for motor skills further depends on temperament and personality factors such as energy levels, risk taking/aversion, aggression, and persistence as well as body image and self-esteem and their eagerness to participate in group activities and competition (Edward and Finn-Stenesen, 1987; Burton and Miller, 1998; Gallahue and Ozman, 2002). Factors that

affect children's' ability to acquire motor proficiency are mainly divided into environmental and biological factors.

### **3.5.1 Biological factors**

#### *a) Gender differences*

Few gender-specific maturation differences are observed between boys and girls before puberty. Prior to puberty, gender differences in motor proficiency of children are generally negligible. The differences tend to increase across the high school years. Following puberty, girls are typically shorter, lighter, have less muscle than boys (characteristics that are likely to impact motor and sport performance) and have lower maximal oxygen uptake values (Haywood, 1993; Haywood and Getchell, 2001; Cech and Martin, 2002; Papalia .et al., 2006). These differences favour boys in direct and relative strength tasks such as ball-throwing, running and standing broad jump (gross motor skills). Girls on the other hand, tend to excel in precise actions or movements involving accurate hopping and balance (fine motor skills). In a study conducted in rural Australia, children's' proficiency in fundamental motor skills was rated by the 'Move it Groove it' Project. Primary school children were rated on the following fundamental motor skills: balancing, throwing, catching, sprinting, hopping, kicking, side galloping and jumping. Both boys and girls rated highly on balance and then boys performed better in throwing and kicking compared to girls. Conversely, in hopping and side galloping, the girls performed better than the boys (van Beurden et al., 2002).

Significant relationships have been found to exist between physical skills, such as the 40-yard(36.5 meters) dash, standing broad jump and throwing distance and various anthropometrical measurements such as height, weight and carpal development of children at primary (foundation and intermediate phases) school level. Prepubescent boys and girls of similar growth status seemed to be equally effective in activities involving running and jumping, however boys appear to excel over girls in throwing and kicking (Govatos, 1959; Krombholz, 1997). In terms of developmental sequences regarding the specific action of throwing, research has shown boys to achieve mature throwing patterns at an earlier age than girls (Butterfield and Loovis, 1993). Heyward and Getchell (2001)

seems to suggest that the earlier maturity in throwing patterns achieved by boys is due to the mechanical constraints and neurological development which they consider as rate controllers in the development of throwing. In observing developmental sequence for throwing, a validated developmental sequence is used. Step one of the validated developmental sequences involves throwing with no trunk rotation or forward-backward movements with the arm the only body part involved in force production. There is no step and the humerus is oblique. Step two involves upper trunk rotation or total trunk “block” rotation. There is a homolateral step and the humerus is aligned. Step three involves differentiated rotation, contralateral short step and a humerus that lags behind. Ideally, for superior performance in throwing activities, all the descriptors of step three must be present. Boys tend to advance to step three much more quickly than girls. Neurological development is affected by amongst others; exercise. Boys on average tend to be more physically active than boys. The neurological development of boys is speeded up by physical activity (Heyward and Getchell, 2001).

*b) Age and maturation*

The shaping of human development is demonstrated by the orderly sequence of events which occur throughout an individual’s development process (Shea and Wright, 1997). Muscular strength and the proficiency of gross motor skills improve with advancing chronological age throughout childhood and adolescence, with the gender difference in performance tending to favour that of males (Rarick, 1980). Literature confirms that motor skill acquisition is often influenced by intellectual, affective and cultural factors and also varies with age (Schmidt and Wrisberg, 2000). Research by Krombholz (1997) showed that an increase in physical growth is mostly related to an increase in physical as well as cognitive performance. Measurements of physical fitness and body coordination also increased with increasing age.

Maturation contributes to controlling our body’s internal environment (Charteris .et al., 1976). Hormones play a major role in controlling physical growth and initiating puberty, and they regulate the body’s metabolism and ability to utilise chemistry sources of energy for growth, maturation, adaptation and learning. In their study, Van Aken et al. (2007) compared the motor development of primary school children (5-14 years) with a 22q11

deletion (del22q11) to a control group. Chromosome 22 is the second smallest autosome, a chromosome that is not a sex chromosome and is considered to be very gene rich, with approximately 679 genes. People with 22q11 deletion have a tiny piece of the chromosome 22 missing. Skeletal differences are possible, including mild short stature and, less frequently, abnormalities of the spinal bones. Many children with 22q11.2 deletion syndrome have motor developmental delays and learning disabilities. The results of the study demonstrated that the del22q11 group showed a significant deficit in motor functioning compared with the control group ( $p < 0.01$ ). In another study (Connolly and Michael, 1986), the gross and fine motor skills of children with mental retardation were examined. Motor skill levels of children with Down's syndrome and without Down's syndrome were compared using the Bruininks-Oseretsky Test of Motor Proficiency. The children with Down's syndrome performed significantly lower than the children without Down's syndrome in the areas of running speed, balance, strength and visual motor control. The gross motor and fine motor skill composite scores were also significantly lower for the children with Down syndrome than for the children without Down syndrome.

c) *Genetics*

Genetics drive a very orderly and sequenced pattern of growth (Heyward and Getchell, 2001). Genetic or extrinsic factors may lead to abnormal growth and development. Extrinsic factors such as the abnormal pressure applied to the mother during pregnancy, presence of certain viruses and drugs in the mother's bloodstream and lack of proper nutrition may lead to abnormal growth and development (Heyward and Getchell, 2001). Ornoy (2001) investigated the relationship between genetics and motor proficiency. The neurobehavioral effects that pre-gestational and gestational diabetes might have on offspring at school age were studied. Neurobehavioral function at school-age of children born to 48, well-controlled diabetic mothers and of children born to 32 women with gestational diabetes was studied. Their development was compared with control children matched by age, birth order and parental socio-economic status, using a number of cognitive, behavioural, sensory and motor neurological tests. No differences were found between the experimental groups in various sensory-motor functions in comparison to controls. However, both experimental groups' children performed worse than controls in

fine and gross motor functions as observed on the Bruininks-Oseretsky test of motor proficiency. The logical conclusion is that children born to mothers who might pass genetic abnormalities to them might lead to abnormal growth and development.

### **3.5.2 Environmental factors**

#### *a) Expertise*

Expertise refers to the amount of knowledge one has about the movement task (Haywood, 1993; Haywood and Getchell, 2001). Individuals have varying amounts of knowledge about a movement task. At any given age, knowledge about an activity facilitates performance and an increased knowledge base facilitates remembering information about that topic (Chi, 1981). The development of expertise goes hand in hand with the process of growth and maturation. Children undoubtedly have a smaller base of knowledge than adults as they have had fewer experiences (Haywood, 1993; Haywood and Getchell, 2001). Older children, on average, perform motor skills better than younger children (Papalia et al., 2006). A recent study (Stefanidis et al., 2007) assessed whether expertise has an influence on the performance of the task. The objective of the study was to assess whether a visual-spatial task that measures spare attentional capacity would distinguish among individuals with different levels of laparoscopic expertise. The performance of novices, surgery residents, laparoscopy experts and individuals previously trained to proficiency in laparoscopic suturing on simulators but without operative experience (trained individuals), were measured. Experts and trained individuals outperformed both the residents and novices on suturing task ( $p < 0.01$ ). In another study, McPherson (1989) found that experts regardless of age performed better than novices on tennis skill and knowledge. The experts' decisions and actions were better during tennis game performance.

Research by Thomas and Thomas (1999) suggests that practice alone does not assure expertise; the quality of practice is what is essential. They encourage children to practice correctly, practice the “right” things, practice a lot and practice as they will perform (specificity). Practicing of motor skills, whether gross or fine, could be done using mental techniques. Rogers (2006) explored the idea of using mental imagery in helping surgeons

learn surgical skills. He argues that learning surgical skills involves both fine and gross motor skills and necessitates performance in stressful situations. This he argues is similar to the environment in which an athlete performs. He cited a number of articles showing promise on the use of mental imagery as another tool to teach technical skills.

*b) Physical factors*

Malnutrition, season of birth, and the number of people living in a household are examples of physical factors that influence motor development of young children (Cintas, 1995). Malnutrition may affect motor development by affecting the stature or physical growth and energy levels of children. In a study conducted in Cleveland, America, a follow-up evaluation of a group of Costa Rican children whose iron status and treatment were documented during infancy was conducted. Eighty four percent (161) of the 191 children in the original group underwent comprehensive clinical, nutritional and psychoeducational assessments at five years of age. The motor proficiency levels were assessed using the Bruininks-Oseretsky test. Children who had moderately severe iron-deficiency anaemia as infants, with haemoglobin levels less than or equal to 100g per litre, had lower scores on tests of mental and motor functioning (Lozoff et al., 1991). Reduced levels of iron content of the red blood cells, reduces the blood's oxygen-carrying capacity and correspondingly reduces a person's capacity for sustaining physical activity (Mcardle et al., 2006).

In environments where chaotic or crowded conditions exist, opportunities for motor skill development may be restricted for the young child. Crowded and chaotic environments are associated with poor socio-economic backgrounds. In London, the trends in physical activity and sedentary behaviour in British adolescents in relation to gender, ethnicity and socio-economic status were investigated. Marked reductions in physical activity and increases in sedentary behaviour were noticed between the ages 11 to 12 and 15 to 16 years. Reduction in physical activity was greater in girls (46%) than in boys (23%). Further, levels of sedentary behaviour were greater in respondents from lower socio-economic status. Asian students were less active than Whites and this was also true for Black girls but not boys (Brodersen et al., 2007). In the National Longitudinal Study of Adolescent Health in America, Black and Hispanic adolescent girls reported lower levels

of physical activity than White adolescent girls (Richmond et al., 2006). The lower physical activity levels were largely attributable to the (poorer) schools they attended. The poorer schools are largely attended by minority groups in America and are likely to influence the physical activity levels of the children that enroll in that school. There are many possible explanations put forward for this. One is that, poorer schools are likely to receive fewer resources for non-academic facilities (such as sport fields, pools and gymnasiums). Another possible explanation may be different cultural norms leading to lower levels of physical activity or fewer appropriate role models providing good examples of physically active adults. The last possible explanation is the poorer school inability to provide a buffer to negative community influences for learners growing up in impoverished communities (Richmond et al., 2006).

*c) Social factors*

Children learn certain behaviours by observing others who serve as role models, and by internalising those behaviours. Role models, especially those significant to the child, can encourage or discourage behaviours by either engaging in them or not, or by how they are labeled. The process of social learning extends throughout life as other people and situations influence individuals (Haywood, 1993; Davis et al., 2000; Haywood and Getchell, 2001). This social learning involves many types of behaviour including social skills, physical skills, traits, values, knowledge, attitudes, and dispositions. Socialisation is critical for motor development, because motor experiences are vital to the full development of motor skills (<http://www.thefamily.org/dossier/statements/socialisation.htm>; Davis et al., 2000).

Children who are socialised into motor experiences are more likely to learn motor skills (Davis et al., 2000; Haywood and Getchell, 2001). In a study conducted in America, the long-term motor, cognitive and adaptive functioning of a sample of adolescents with Down's Syndrome who had experienced an early intervention programme, were assessed using the Bruininks-Oseretsky Test. An age-matched group of children with Down's Syndrome who had not experienced an early intervention programme served as a comparison group. The early intervention group recorded higher mean gross motor skills than their counterparts. The early intervention group subjects also did not show the

decline typically seen with age in adaptive functioning in individuals with Down's Syndrome (Connolly et al., 1993).

Furthermore, increased proficiency in motor skill performance is rewarding which in turn promotes continued participation. In a study conducted in Greece, a school-based intervention programme was applied to 6<sup>th</sup> grade primary school children (experimental group) to assess the short term effects of a health education programme on the attitudes towards physical activity (Christodoulos et al., 2006). The results were compared to that of children from the 6<sup>th</sup> grade in another primary school where the intervention programme was not implemented (control group). Pupils who took part in the intervention had a more positive attitude towards physical activity than the control group. The experimental group scored significantly higher in their intention to participate in physical activity. Moreover, the experimental group reported more hours per week spent on organised physical activities than pupils in the control group. Finally, a higher proportion of pupils in the experimental group matched the daily recommendations of 60 minutes of moderate to vigorous physical activity recommended by American College of Sports Medicine (ACSM) (2006, 2010).

The next section deals with physical fitness:

### **3.6 PHYSICAL FITNESS**

Physical fitness is a combination of several aspects rather than a single characteristic (Corbin et al., 2006). Physical fitness is the capability of the individual to meet the varied physical and physiological demands made by a sporting activity without reducing the person to an excessively fatigued state (Davis et al., 2000). Heyward (2002) describes physical fitness as “the ability to perform occupational, recreational and daily activities without becoming unduly fatigued”. Corbin and Lindsey (2006) define physical fitness as, “the ability to function efficiently and effectively”. ACSM (2010) describes physical fitness as “a set of attributes or characteristics that people have or achieve that relates to the ability to perform physical activity”. It would therefore seem that physical fitness entails the optimal functioning of the body and its ability to exert itself without

unnecessary over-expenditure of energy. Physical fitness can be divided into two types: health-related and motor fitness (Davis et al., 2000; ACSM, 2006; ACSM, 2010).

*a) Health-related Fitness*

Health-related fitness aims to look at anatomical and physiological components that determine a persons' physical performance capacity. Health-related physical fitness (Figure 1) includes five components: muscular strength, cardiorespiratory endurance, muscular endurance, flexibility and body composition (Davis et al., 2000; ACSM, 2006; ACSM, 2010).

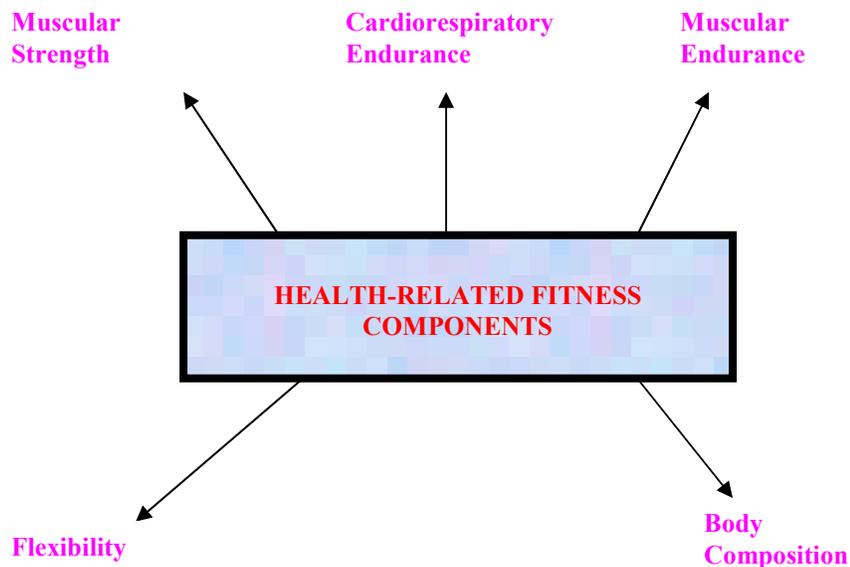


Figure 1: Components of health-related fitness - (Adapted from Davis et al., 2000)

*b) Motor fitness*

Motor fitness encapsulates neuromuscular components of physical fitness and therefore considers skill-related exercises and the capacity of the individual to repeat a particular exercise (Davis et al., 2000). Motor fitness is also referred to as skill-related physical fitness or sports fitness (Corbin et al., 2006). Motor fitness (Figure 2) includes six components: agility, balance, coordination, power, reaction time and speed (Davis et al., 2000; ACSM, 2006; ACSM, 2010).

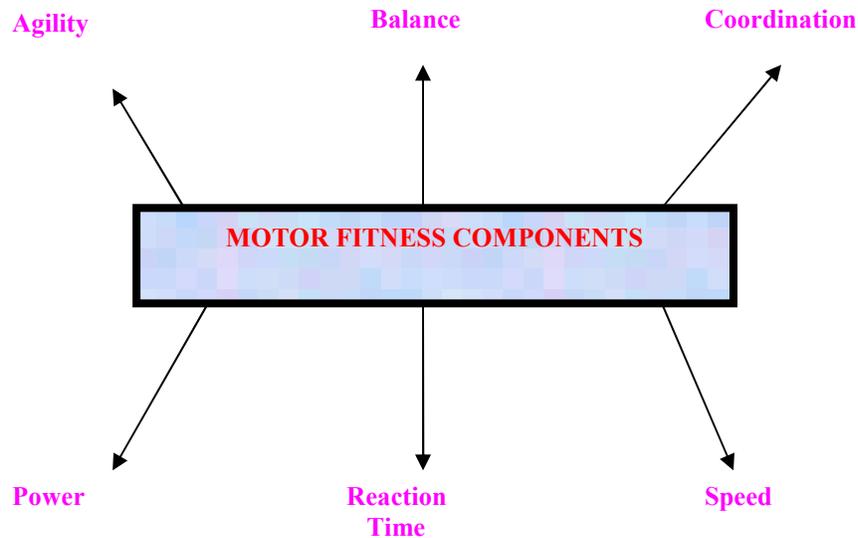


Figure 2: Components of motor fitness (Adapted from Davis et al., 2000)

### 3.6.1 Components of health-related physical fitness

#### a) *Muscular Strength*

Muscular strength is defined as the force exerted by muscle groups during a single maximal muscle contraction (Siff and Verkhoshansky, 1998; Davis et al., 2000; ACSM, 2010). Heyward (2002) defines it as, “the ability of a muscle group to develop maximal contractile force against a resistance in a single contraction.” Corbin et al. (2006) define muscular strength as, “the ability to exert an external force or lift a heavy load.”

Muscular strength can be assessed both statically and dynamically (Heyward, 2002). If the resistance is immovable, the muscle is static or isometric and there is no visible muscle or limb movement. Dynamic contractions, in which there is visible muscle or limb movement, are either concentric or eccentric. If the resistance is less than the force exerted by the muscle group, the contraction is said to be concentric, allowing the muscle to shorten as it exerts tension to move the bony lever. If the muscle produces a braking force to decelerate rapidly moving body segments or resist gravity, the contraction is said to be eccentric, allowing the muscle to lengthen as it exerts tension to decelerate or resist gravity. Isokinetic contraction refers to contraction of a muscle group at a constant

velocity. Usually, static strength is measured using dynamometers, cable tensiometers and load cells. Free weights, constant-resistance, variable-resistance and isokinetic machines are used to determine dynamic strength (Sharkey, 1990; Heyward, 2002, ACSM, 2006; McArdle et al., 2010; ACSM, 2010).

**b) *Cardiorespiratory Endurance***

Cardiorespiratory endurance refers to, “the ability of the heart, blood vessels, blood and respiratory system to supply fuel and oxygen to the muscles and the ability of the muscles to utilise fuel to allow sustained exercise,” (ACSM, 2010). Cardiorespiratory endurance can also be described as the ability to perform dynamic exercise involving large muscle groups at moderate-to-high intensity for prolonged periods (ACSM, 2000).

Maximum oxygen consumption ( $VO_2\text{max}$ ) or the rate of oxygen utilisation of the muscles during aerobic exercise is used to assess cardiorespiratory endurance (Heyward, 2002; ACSM, 2006). Usually, cardiorespiratory endurance is measured using maximal or submaximal tests using the bicycle ergometer or the treadmill and a metabolic analyser. The results obtained are referred to as direct as they reflect what occur at cellular level. However, a number of tests have been designed to measure cardiorespiratory fitness of large groups in a field situation. These tests are practical, inexpensive, less time consuming than the metabolic analyser tests and easy to administer. The results obtained are referred to as indirect as they do not directly reflect what occurs at cellular level. Usually, indirect measurement of cardiorespiratory endurance is done through step tests, distance run tests and walking tests. The Harvard Step test, the MultiStage Shuttle Test, the Cooper Test and the 1.5 Mile Run/Walk Test to mention but a few (Heyward, 2002, ACSM, 2006; ACSM, 2010).

**c) *Muscular Endurance***

Muscular endurance is the ability of a muscle group to exert sub-maximal force for extended periods. Muscular endurance can be assessed; statically and dynamically. Usually, static endurance is measured using the flexed-arm hang or bridging. Curl-ups,

dips and ninety-degree push-ups are used to determine dynamic strength (Siff and Verkhoshansky, 1998; Heyward, 2002, ACSM, 2006; ACSM, 2010).

*d) Flexibility*

Flexibility is the ability to move a joint through its complete range of motion (Siff and Verkhoshansky, 1998; ACSM, 2010). The full motion possible in a joint is referred to as the range of motion (ROM) (Corbin and Lindsey, 2006). When an activity moves the structures of a joint beyond the joint's range of motion, tissue damage can occur (ACSM, 2010). Flexibility could be both static as well as dynamic. Static flexibility entails all stretching exercises which are not produced by forceful voluntary muscular contractions. Static flexibility is a measure of the total range of motion at the joint and is limited by the extensibility of the musculotendinous unit. Static flexibility refers to flexibility exercises which use the weight of the body or its limbs to load the soft tissue. Static flexibility includes two distinct types: free static which is gravity assisted and passive where a partner or an apparatus assists with the stretching (Siff and Verkhoshansky, 1998). Dynamic flexibility on the other hand, refers to stretching exercises executed while one deliberately concentrates on progressively contracting and relaxing the muscle complex being stretched (Siff and Verkhoshansky, 1998). Dynamic flexibility includes four distinct types: ballistic stretching which imposes passive momentum to exceed static range of motion on a relaxed and contracted muscle, active stretching which entails continuous muscle activity to exceed the static range of motion, proprioceptive neuromuscular facilitation (PNF) that involves intermittent or continuous phases of static or dynamic muscle action, as well as relaxation or passive movement in specific patterns of activation and relation and plyometric stretching that involves rapid termination of eccentric loading followed by a brief isometric phase and an explosive rebound relying on stored elastic energy and powerful reflex muscle contraction (Siff and Verkhoshansky, 1998).

Flexibility can be assessed both directly as well as indirectly. Direct measurements entail measuring the amount of joint rotation in degrees using a goniometer, flexometer and inclinometer. Indirect measurements measure the linear distance between two body parts or segments and express them in centimeters or inches rather than degrees. Common tests

used to test flexibility indirectly include the sit and reach and the toe touch test. The sit and reach test was introduced in 1952 and over the years, there are many variations of this test that have been introduced by different authors to improve on the reliability of the test (De Araujo, 2004).

e) *Body composition*

Body composition refers to the relative percentage of muscle, fat, bone and other tissues of which the body is composed (Heyward, 2002). There is a desirable range of fatness for good health. People with high physical fitness levels have lower body fat and higher fat free mass (FFM). Acceptable body fat percentage is between ten and twenty two percent for males and twenty and thirty percent for females (Sharkey, 1990; McArdle et al., 2010; ACSM, 2010). Too much body fat may be associated with degenerative diseases, health problems and even shortened life span. Obesity (too much body fat), is a serious health problem that reduces life expectancy by increasing one's risk of developing coronary artery disease, hypertension, type II diabetes, obstructive pulmonary disease, osteoarthritis and certain types of cancer (Heyward, 2002). In laboratory and clinical settings, densitometry, dual-energy X-ray absorptiometry, hydrostatic weighing and air displacement plethysmography are used to measure body density. These methods are collectively referred to as direct (Heyward, 2002). The only problem is that direct methods are time-consuming and very expensive.

Indirect methods such as skinfolds are then preferred. A skinfold indirectly measures the thickness of subcutaneous adipose tissue. It is assumed that one-third of the total body fat is located subcutaneously in men and women (Lohman, 1981, McArdle et al., 2010; ACSM, 2010). Research has demonstrated that subcutaneous fat assessed by skinfolds, measures a common body fat factor (Jackson and Pollock, 1976, Jackson and Pollock, 1985; McArdle et al., 2010; ACSM, 2010). Skinfold measurements can be used as an indicator of body fatness. Bioelectrical impedance method is another indirect method for estimating body fatness. With this method, a low level electrical current is passed through the clients' body, and the impedance or opposition to the flow of current is measured with bioelectrical impedance. The resistance to current flow is greater in individuals with large amounts of adipose tissue (Heyward, 2002, McArdle et al., 2010; ACSM, 2010). Other

anthropometric measurements can also be used to estimate body fatness. Anthropometrical indices such as body mass index (BMI) and waist-to-hip ratio to mention but a few are used as screening tools to identify individuals at risk for disease (Heyward, 2002, McArdle et al., 2010; ACSM, 2010).

### **3.6.2 Components of Motor Fitness**

#### ***a) Agility***

Agility is the physical ability that enables a person to rapidly change position and direction in a precise manner (Davis et al., 2000). Corbin et al. (2006) define agility as, “the ability to rapidly and accurately change the direction of the movement of the entire body in space.” Agility is usually assessed with an Illinois Agility Run or a T-test (Corbin and Lindsey, 2006). The Bruininks-Oseretsky test of Motor Proficiency explained in Chapter 4 has a test for agility.

#### ***b) Balance***

Balance is defined as “the ability to retain the centre of mass of the body above the base of support” (Davis et al., 2000). It is the awareness of the body’s position in space and depends upon coordination between the inner ear, brain and receptors at joints, muscles and skin. Corbin and Lindsey (2006) define balance as “the maintenance of equilibrium while stationery or while moving”. Balance can be assessed both under static and dynamic conditions. Static balance is the ability to hold a position in a stationary position; dynamic balance is the ability to maintain balance under changing conditions of body movement, shape and orientation (Davis et al., 2000). Static balance is usually assessed by a Stork Stand whereas dynamic balance is assessed by the Bass test (Corbin et al., 2006). The Bruininks-Oseretsky test of Motor Proficiency explained in Chapter 4 has tests for both static and dynamic balance.

*c) Coordination*

Coordination is the ability to perform smooth and accurate motor tasks, involving the use of the senses and a series of coordinated muscular contractions that affect a range of joints and therefore relative limb and body positions (Davis et al., 2000). Coordination can be sub-divided into foot-eye and hand-eye coordination. The Bruininks-Oseretsky test of Motor Proficiency explained in chapter 4 - has tests for both foot-eye and hand-eye coordination.

*d) Power*

Power is a combination of strength and speed (Davis et al., 2000). Power is defined as “the ability to transfer energy into force at a fast rate” (Corbin et al., 2006). Power is usually assessed by a Vertical Jump Test (Corbin et al., 2006) or the Broad Jump as explained in the Bruininks-Oseretsky test of Motor Proficiency explained in Chapter 4.

*e) Reaction time*

Davis et al. (2000) define reaction time as, “the interval of time between the presentation of a stimulus and the initiation of the muscular response to that stimulus.” Corbin et al. (2006) seem to be in agreement that reaction time is “time elapsed between stimulation and the beginning of reaction to that stimulation”. The Bruininks-Oseretsky test of Motor Proficiency explained in Chapter 4 contains a test for reaction time.

*f) Speed*

Speed is the maximum rate at which a person is able to move his/her body between two points. In physical terms, speed is the distance moved per second. In physical performance terms, speed refers to the speed of coordinated joint actions and whole-body movements (Davis et al., 2000). Usually, speed is assessed by time taken to cover a certain distance. A test can be done over 10 metres, 20 metres and so on (Corbin et al., 2006). The Bruininks-Oseretsky test of Motor Proficiency explained in Chapter 4 of this study does have a test for speed.

The next section deals with reasons preventing development of motor proficiency and health-related physical fitness in children in South Africa:

### **3.7 REASONS PREVENTING DEVELOPMENT OF MOTOR PROFICIENCY AND HEALTH-RELATED PHYSICAL FITNESS IN CHILDREN IN SOUTH AFRICA**

Before the democratic dispensation in 1994, Education Departments in South Africa functioned, to a large extent, independently of one another and there was no significant indication of a common curriculum (Teacher's Guide for the development of Learning Programmes for the Life Orientation Learning Programme, 2003). The different education systems resulted in Physical Education (PE) and sport in South Africa being a case of extremes and inequities (Amusa, 2004). Walter (1994) observed that "White schools are relatively problem free, whereas Black schools have been adversely affected by the past government's apartheid and separate development policies". This resulted in the inequality of opportunities for learners in South African schools. Not all schools had equal amenities and funding. Some schools had well-developed facilities, while the majority had next to nothing. The lack of facilities resulted in some schools especially historically Black schools, to only offer a limited number of movement activities whereas White schools on the other hand offered a wide variety of activities (Amusa, 2004). In some provinces, the lack of facilities resulted in the exclusion of Physical Education as a subject from the curriculum altogether (Keim and Zinn, 1998).

During the post-apartheid period in South Africa several transformations and curriculum-related reforms have been issued to try and democratise education and eliminate inequalities in the post-apartheid education (Jansen, 1997). Physical education has found itself as a subject without its own identity. It is now housed within the learning area called Life Orientation. Life Orientation as a learning area is offered in three phases in the curriculum: the foundation phase, the intermediate phase, and the senior phase (Department of Education, 2002b). Physical Education (physical development and movement as it is known) is one of only five focus areas within life orientation. If the scope which entails recreation and physical activity, personal wellness, citizenship education and social justice, careers and career choice is considered, physical activity gets a mere two hours a week within life orientation (Revised National Curriculum

Statement, 2002). Two hours is clearly not enough to teach learners a wide variety of motor skills and equip them for meaningful and successful living in a rapidly changing and transforming society (Roux, 2006).

Moreover, the majority of schools with life orientation have shifted to more classroom-based and academic-based educational content, which has led to a lack of participation in physical activity (Roux, 2006). Generally, there are two schools of thought around the status of Physical Education: the first is that Physical Education should be an essential part of the core curriculum and the second being Physical Education, while important to a child's development, is regarded as being of secondary importance to the core academic curriculum (Gabbard, 2000). Physical Education is therefore "activities carried out to keep children busy from serious academic work" (Amusa, 2004). Seemingly, the latter thinking seems to inform current policy and decision makers in South Africa.

There have been concerns in recent years about the growing incidence of physical inactivity among South African children. This is attributed to the absence of formal Physical Education in schools and the negative impact of television and computer games on the fitness and health of the youth ([http://www.health24.com/fitness/fitness\\_charter/16-3171.asp](http://www.health24.com/fitness/fitness_charter/16-3171.asp)). The lack of Physical Education in schools has led to an increase in the incidence of hypokinetic disease in children (Amusa, 2004). Research suggests that schools and community programmes that promote regular participation in physical activity and optimal nutritional choices could be amongst the most effective strategies for reducing the public health burden of chronic diseases associated with sedentary lifestyles. Programmes that provide children and youth with the knowledge, attitudes, motor skills, behavioural skills and confidence to participate in physical activity may establish a lifelong commitment to an active lifestyle ([http://www.health24.com/fitness/fitness\\_charter/16-3171.asp](http://www.health24.com/fitness/fitness_charter/16-3171.asp)).

Numerous programmes and initiatives have been implemented in order to try and promote physical activity in the youth. In 2004, a national consultative workshop was organised by the University of Cape Town. Facilitated by Prof. TD Noakes, the aim of the workshop was to develop a fitness charter of physical activity and sports for South African children ([http://www.health24.com/fitness/fitness\\_charter/16-3171.asp](http://www.health24.com/fitness/fitness_charter/16-3171.asp)). The

fitness charter was proposed to facilitate the development of national policies aimed at promoting physical activity and sport among South African children and the youth (Amusa, 2004). “Let’s Play” (Siyadlala) is a corporate social responsibility initiative developed in 2005 by SuperSport International and partners in response to a national need (lack of home and school based physical activity). Through media campaigns and close associations with organisations that target children, attempts are being made to increase awareness and encourage play, (physical) activity and sport in schools and home (<http://www.letsplay.org/default.asp>). This noble initiative has found recognition from the United Nation’s Children Foundation (UNICEF) which is the driving force that helps build a world where the rights of every child are realised. UNICEF has the global authority to influence decision-makers, and a variety of partners at grassroots level to turn the most innovative ideas into reality. They believe that nurturing and caring for children are the cornerstones of human progress (<http://www.unicef.org/>). Realising the error of eradicating Physical Education in schools, the government through the Department of Sport and Recreation launched Siyadlala (Mass Participation Programme) in 2005 (<http://www.info.gov.za/aboutsa/sport/htm>). The aim of the programme is to facilitate access to sport and recreation by as many South Africans as possible, especially those from historically disadvantaged communities. How successful this programme has been, is still very much debatable.

Another problem brought about by the introduction of Life Orientation as learning area in schools is that many educators are not qualified to teach the subject (Amusa, 2004; Van Deventer, 2008; Van Deventer 2009). The language of innovation associated with outcomes-based education is too complex, confusing and at times contradictory. An educator attempting to make sense of outcomes-based education will not only have to come to terms with more than fifty different concepts and labels but also keep track of the changes in meaning and priorities afforded to these different labels over time (Jansen, 1997). Curriculum 2005 refers to Physical Education for example as ‘physical development and movement’ (Amusa, 2004; Van Deventer, 2008; Van Deventer 2009). This is bound to create a conceptual confusion amongst the already confused educators. Moreover, in many schools, principals, parents and even Departments of Education see provision for Physical Education and sport in school as a waste of resources or the least

in terms of priority funding (Amusa, 2004). Educators consequently pay lip service to the teaching of the subject (Roux, 2006; Van Deventer, 2008; Van Deventer 2009).

The Constitution of the Republic of South Africa (Act 108 of 1996) provides the basis for curriculum transformation and development in South Africa. The preamble to the Constitution states that the aims of the Constitution are to:

- heal the divisions of the past and establish a society based on democratic values, social justice and fundamental human rights;
- improve the quality of life of all citizens and free the potential of each person;
- lay the foundations for a democratic and open society in which government is based on the will of the people and every citizen is equally protected by law; and
- build a united and democratic South Africa able to take its rightful place as a sovereign state in the family of nations.

Education and the curriculum have an important role to play in realising these aims. Sage (1993) observes that the focus of education and the curriculum should be contextualised to provide impetus for transcending the classroom, playgrounds and for becoming involved in constructing our society for the future. South African academics and their African counterparts have to a large extent become consumers, rather than producers of knowledge, resulting in a legacy of an impoverished knowledge base (Amusa, 1999). This knowledge base has to a large extent been reflecting Western paradigms. The indigenous knowledge system relating to movement phenomena has largely remained an untapped resource (Burnett and Hollander, 2004). South African tradition of collective association, has been largely neglected (Walter, 1994). In view of the increased acculturation and globalisation of modern sport, many forms of traditional activities are disappearing, leaving a 'vacuum' to be filled with 'cultural imperialism' (Western imported games and sport) (Burnett, 2001). Burnett and Hollander (2004) suggest that schools, churches and urbanisation may also lead to the process of acculturation. This has provided strong enough motivation for a possible inclusion of stick fighting as a traditional activity as well as other activities/games in the physical education curriculum of South African schools.

The next section deals with the potential benefits of Zulu stick fighting:

### **3.8 POTENTIAL BENEFITS OF ZULU STICK FIGHTING**

Zulu stick fighting is an indigenous martial art form. It is tentatively suggested that just like any physical activity or sport, the components of this activity might develop certain aspects of motor proficiency and physical fitness. This martial art form requires (and thus presumably develops) motor proficiency skills such as coordination, speed, anticipation, reaction time, agility and balance. However, there seem to be a paucity of research done on Zulu males who engage in stick fighting. Information about stick fighting has not been well documented (Coetzee, 1996). Since there are no studies that have been done on Zulu stick fighting as a skill (in relation to motor performance), other forms of martial arts provide a platform whereby the potential benefits of stick fighting may be drawn. As such, information shall be drawn from other forms of martial arts (tai chi, taekwondo, judo and karate).

#### *a) Bone Development*

Throughout life the body maintains a balance between the loss of bone and the creation of new bone (Harris et al., 2006). Strains on bone greater than that needed for steady state re-modelling will cause a modelling response that increases bone mass to meet the increasing load requirement (Snow-Harte et al., 1991; Grimston et al., 1993; Umemura et al., 1997, Frost, 2000). The adaptive (modelling) response occurs primarily during periods of growth and development (Bailey et al., 2000; Snow-Harter et al., 1991; Faulkner et al., 1993). In youth, new bone is formed faster than older bone, allowing bone to grow (Haywood, 1993; Haywood and Getchell, 2001). Children attain 50% of their peak bone mass by 10 years of age and an additional 40% by age 20 (Cech and Martin, 2002). Bones remain stronger if they are used in daily weight-bearing activities such as walking or lifting weights. Bone mineral content increases more before puberty than at any other time in life (Cech and Martin, 2002). Lack of exercise increases the speed of bone loss (Harris et al., 2006). Bailey et al. (1996), Kemper (2000) and Janz et al. (2001) have shown that physical activity, particularly weight-bearing and strength-training activity, has a positive effect on bone acquisition during circumpubertal years. However, very few studies have examined the role of physical activity on bone development in younger children (Janz et al., 2001).

In two separate studies (Chan et al. 2004; Qin et al., 2005), statistically significant improvements in bone mass and mineral density were observed in postmenopausal women. In Chan et al. (2004) postmenopausal women underwent a 12 month Tai Chi intervention programme and they were compared to sedentary controls. In Qin et al. (2005) postmenopausal women who had been regularly practicing Tai Chi exercise for more than 3 hours a week were compared to age- and sex-matched sedentary controls. The conclusion from the two studies is that martial arts (Tai Chi) is beneficial for slowing bone loss in weight-bearing bones thus improving bone mineral density in early postmenopausal women. Qin et al. (2005) measured the bone mineral density (BMD) in the lumbar spine and the proximal femur of the non-dominant leg (femoral neck, greater trochanter and Ward's triangle) of regular Tai Chi practitioners, whereas Chan et al. (2004) measured bone mineral density using the same sites and also added the distal tibia and used a group that underwent an intervention programme.

Qin et al. (2005) found higher bone mass density at all measurement sites with significant differences found at the spine (7.1%), greater trochanter (7.2%) and Ward's triangle (7.1%) of the proximal femur ( $p < 0.05$ ). Chan et al (2004) found a significant 2.6- to 3.6-fold retardation of bone loss ( $p < 0.01$ ) in both the trabecular and cortical compartments of the distal tibia. A total of 4 fracture cases were documented during follow-up, including 3 subjects in the control group and only one in the experimental group (Tai Chi group). The conclusion from these studies is that martial arts may lead to higher bone mass density and possibly bone development.

#### ***b) Flexibility***

The range of motion possible at any joint depends on that joints' bone structure and the soft tissue's resistance to movement (Haywood, 1993; Haywood and Getchell, 2001). In children, flexibility is a big problem after periods of skeletal growth. Bone growth precedes muscle growth making it challenging to obtain the full range of motion in a joint (Cech and Martin, 2002). Habitual use and exercise preserve the elastic nature of the soft tissues, whereas disuse is associated with a loss of elasticity (Haywood and Getchell, 2001; Heyward, 2002; Corbin et al., 2006). Developmentally, flexibility is fairly stable in boys from age 5 to 8 years and then decreases slightly until age 12 to 13 years. After that

time, it again increases slightly until age 18y. In girls, flexibility is stable from age 5 to 11 years and then increases until age 14y. After that, flexibility reaches a plateau. However, at all ages, females are more flexible than males (Cech and Martin, 2002). Undoubtedly one factor contributing to the loss of flexibility is the limited range of motion required in everyday life. Individuals not engaged in regular exercise routine for flexibility seldom move through a full range of motion (Haywood and Getchell, 2001; Corbin and Lindsey, 2006 & Heyward, 2002). Taylor-Pillae et al. (2006b) investigated the effects of engaging in a 12-week Tai Chi intervention programme. A statistically significant improvement was observed in the flexibility measurements of all the subjects that took part in the study.

*c) Strength*

The development of muscle strength in children is related to age, body size, and previous level of physical activity and various phases of growth (Benjamin and Glow, 2003). Muscle strength is developed in childhood through participating in vigorous activities of daily living. Strength is developed every time muscle exertion is near maximum, as in lifting, pushing, pulling, holding or carrying a heavy object (Sherrill, 1993; Sherrill, 2003). The amount of force a muscle group exerts depends on the fibres neurologically activated and on the leverage. In turn, the number of fibres activated depends on the neural stimulation of the muscle and the degree of co-ordination in activating the fibres. The cross-sectional area of muscle increases with growth, this means strength increases as muscles grow (Haywood, 1993; Haywood and Getchell, 2001). Age and gender differences in strength parallel changes in muscle mass. Females tend to show a steady increase in strength until about the age of 30y. Males likewise, increase steadily but demonstrate a sudden, rapid increase at puberty which is associated with the hormone testosterone (Sherrill, 1993; Haywood, 1993; Haywood and Getchell, 2001, Sherrill, 2003). Often, children who participate regularly in physical activity and sport are stronger than those who do not. Bigger, mature children may experience more success in physical activities than other children and consequently pursue regular physical activity participation (Haywood and Getchell, 2001).

The effect of martial arts (Tai Chi) on lower extremity strength has been investigated amongst postmenopausal women (Qin et al., 2005), the elderly (Xu et al., 2006), residents living independently at a continuing care retirement community (Wallsten et al., 2006) and in adults with at least one cardiovascular risk factor (Taylor-Pillae et al., 2006). All studies suggest that martial arts lead to increased lower extremity strength. Qin et al. (2005) measured quadriceps (extensors) strength of the non-dominant leg of postmenopausal women who regularly participated in Tai Chi exercises. Functional test revealed an average 43.3% significantly greater quadriceps strength for the postmenopausal women who regularly participated in Tai Chi exercises when compared to age- and sex-matched sedentary controls. Xu et al. (2006) used an isokinetic machine to measure maximum concentric strength of both the knee flexors and extensors at angular speeds of 30 and 120 degrees per second. The results indicated that the strength of knee extensors and flexors in the group that participated in a Tai Chi programme were significantly higher than those who participated in the jogging programme and the sedentary counterparts.

Wallsten et al. (2006) also found similar results in a group of residents living independently at a continuing care retirement community when they had undergone a 20-week Tai Chi intervention programme. Taylor-Pillae et al. (2004) report similar results amongst adults with at least one cardiovascular disease risk factor that participated in a 60-minute Tai Chi class three times a week. Statistically significant improvements were observed in muscular strength after the sixth and the twelfth week respectively.

#### *d) Osteoarthritis*

Osteoarthritis is a disease that degenerates articular cartilage and can cause reductions in muscular strength and aerobic capacity (Casper and Berg, 1998). The cartilage thins and clefts, cracks form leaving the surface uneven and unable to efficiently provide frictionless joint motion. The bone becomes exposed to mechanical stress, resulting in pain (Cech and Martin, 2002). Treatment for osteoarthritis is limited to the prevention of affected joints from undue stress (resulting from exercises that put high loads on the cartilage), minimising loss of joint range of motion, and relief of pain (Cech and Martin, 2002). Treatment for osteoarthritis of the knee also includes exercise as an important

nonpharmacologic approach (Hochberg et al., 1995). However, Kujala et al. (1995) alleged a possible negative relation between physical activity and knee osteoarthritis. Petrella and Petrella (2001) found evidence of a small to moderate beneficial effect of exercise treatment.

Recently, Brismee et al. (2006) investigated the effect of Tai Chi on knee osteoarthritis. The elderly group with knee osteoarthritis participated in the Tai Chi instruction programme for six weeks. This was followed by another six weeks of home-based Tai Chi training. The results of the study revealed significant reductions in mean overall knee pain ( $p = 0.0078$ ), maximum knee pain ( $p = 0.0035$ ) and the WOMAC subscales of physical function ( $p = 0.0075$ ) and stiffness ( $p = 0.0206$ ) compared to their baseline (0 weeks). No significant changes of any other outcome measures were noted in the control group throughout the study.

*e) Coordination, Fine Motor Control and Motor Skills*

Coordination implies that various muscles are working together to produce a movement (Cech and Martin, 2002). Another way of looking at it is to consider it as the function that constrains the body's limitless movement possibility into one efficient functional unit (Cratchfield et al., 1989). Coordination, fine motor control and motor skills have been discussed extensively in earlier sections of this chapter (Section 3.6.2; Section 3.3). There are no studies currently available on the effect of any form of martial arts on coordination, fine motor control and motor skills. This therefore necessitates a strong need for research to be undertaken in this field hence the current study. The researcher is trying to fill up the vacuum that exists especially on the three parameters. It has been indicated in earlier sections (Section 3.8) that no studies have been undertaken on the effect of Zulu stick fighting on these parameters. However, it is a general understanding amongst Human Movement practitioners, that Zulu stick fighting requires, and presumably enhances, motor proficiency skills such as coordination, fine motor control and motor skills.

*f) Balance*

Balance is considered both a perceptual-motor ability and a component of motor fitness (Sherrill, 1986; Haywood, 1993 & Haywood and Getchell, 2001). To control balance, motor response patterns continually change to the perceptual information that specifies the environment and the body's orientation in it (Haywood, 1993; Haywood and Getchell, 2001). Vestibular impulses are carried via the vestibular nerve (eighth cranial) to four vestibular nuclei (clumps of gray matter) in the medulla (brain stem). The medulla then generates motor impulses to control balance (Sherrill, 1993; Sherrill, 2003). Even the auditory system can contribute information about balance (Horak and MacPherson, 1995). Balance performance improves on a variety of balance tasks from 3 to 19 years of age (Haywood, 1993; Haywood and Getchell, 2001; Cech and Martin, 2002).

Girls perform better than boys in balance activities (Cech and Martin, 2002). There are a number of factors that are widely recognised as determinants of whether a body can maintain balance or not: Some of these include the mass of the body, the height of the centre of gravity, the size and base of support and friction to mention but a few (Shea and Wright, 1997). The one factor that seems to favour girls in terms of performance in balance activities when compared to boys is the height of the centre of gravity. The centre of gravity (CG) or center of mass (COM), which acts vertically downwards (towards the centre of the earth) is at fifty five percent (55%) for girls and fifty seven percent (57%) of the total height for boys. The lower centre of gravity in girls allows them to perform better in balance activities compared to boys.

The effect of exercise on balance and balance disorders has been studied by several authors (Van Gheluwe, 1994; Sisto et al., 1996; Clapp, 1999). Tsang et al. (2004) investigated the effects of Tai Chi on balance control. Subjects were asked to stand under reduced or conflicting somatosensory, visual and vestibular conditions. Results indicated that elderly Tai Chi practitioners had significantly better balance control when compared to the sedentary counterparts. In fact, Tai Chi practitioners achieved the same level of balance control as did the young, healthy subjects. Thornton et al. (2004) recorded significantly improved dynamic balance following a Tai Chi intervention programme amongst normotensive women aged 35 to 55 years. Fong and Ng (2006) investigated the

effect of exercise on balance amongst long-term Tai Chi practitioners. The Tai Chi group achieved significantly longer times on a tilt board ( $p < 0.000$ ) than the short-term Tai Chi practitioners and non-practitioners respectively.

*g) Proprioception*

Proprioception is the afferent information that contributes to conscious sensation (muscle sense), total posture (postural equilibrium) and segmental posture (joint stability) (Lephart et al., 1997). The kinesthetic or proprioceptive system is important in physical activity as it yields information on the relative position of the body parts to each other, the position of the body in space, the body's movements and the nature of objects with which the body comes into contact (Haywood, 1993; Haywood and Getchell, 2001). One strategy to retain good proprioception is engaging in regular exercise. Exercise can help improve a number of sensorimotor systems that contribute to good proprioception or kinesthetic awareness (Xu et al., 2004).

Tsang and Hui-Chan (2004) examined the effects of Tai Chi on joint balance sense in the elderly group. They compared experienced elderly Tai Chi practitioners, with experienced elderly golfers, healthy elderly subjects, and young university students, using: a) a passive knee joint repositioning test to assess their joint proprioceptive acuity and b) limits of stability test to assess their ability to voluntarily weight shift within their base of support. They found that the Tai Chi group had better knee joint proprioceptive acuity. In the limits of stability test, the Tai Chi group had similar reaction time, leaned further without losing stability and showed better control of leaning trajectory ( $p < 0.05$ ) as did the experienced golfers. Xu et al. (2004) investigated the effects of Tai Chi on proprioception of ankle and knee joints in old people. The elderly group that regularly participated in Tai Chi showed better proprioception at the ankle and the knee joints than the sedentary controls. In another study, Xu et al. (2005) found that the neuromuscular reaction performance of the older group that participated in Tai Chi was similar to that of elderly long-term joggers. Significant differences in the activation of the rectus femoris and the tibialis anterior were reported. The muscles were activated significantly faster in the Tai Chi and joggers group than those in the control group. In another study, Qin et al. (2005) found a 67.8% significantly longer single-leg stance time in the Tai Chi group of

postmenopausal women who had been regularly practicing Tai Chi for more than three hours a week when neuromuscular function was evaluated using the single-leg stance time of the non-dominant leg when they were compared to age- and sex-matched sedentary controls.

*h) Cardiorespiratory health*

Of all the fitness components, cardiorespiratory health has the greatest implications for health (Haywood, 1993; Haywood and Getchell, 2001). Cardiorespiratory efficiency contributes to an individual's level of physical fitness (Cech and Martin, 2002). The efficiency of the cardiorespiratory system is reflected but not limited to measures such as cardiac output and maximal oxygen consumption (Cech and Marin, 2002). Maximal oxygen consumption ( $VO_{2max}$ ) or the rate of oxygen utilisation of the muscles during aerobic exercise is used to assess cardiorespiratory health (Heyward, 2000). Exercise and training have been found to improve body system function (including cardiorespiratory system) and levels of fitness (Cech and Martin, 2002). Cardiorespiratory adaptation as a result of exercise and training includes inter alia, hypertrophy of the heart muscle, increased cardiac contractility, increased cardiac output, decreased peripheral resistance, decreased blood pressure, increased blood flow to the skeletal muscles, increased ability to extract oxygen from the blood as reflected by a widening of the arterial-venous difference (a- $V_{O_2}$  difference) and increased venous return. (Cech and Martin, 2002; McArdle et al., 2006).

The maximal oxygen uptake can be limited by a number of factors namely the pulmonary diffusing capacity, the cardiovascular system, the oxygen-carrying capacity of the blood and the muscle oxidative characteristics (Vinet et al. 2011). Absolute values (excluding body mass) of maximal oxygen uptake increase linearly in children from the age of four until late adolescence in boys and until age 12y or 13y in girls (Haywood and Getchell, 2001). The increase with age is related to the growth of pulmonary musculature, the lungs and the heart (Cech and Martin, 2002). When expressed in absolute and relative (including body mass) terms, one's body size becomes a critical determinant of maximal oxygen uptake. In young boys and girls, anthropometric and physiologic differences are not large enough to result in significant differences in maximal oxygen uptake (ACSM,

2006) though Turkey and Wilmore (1997) reported lower values for girls which they attributed to differences in body composition values in prepubertal boys and girls of 7y to 9y. Compared to adults, children tend to have lower maximal oxygen uptake values (Cech and Martin, 2002). There are many reasons why children record lower values when compared to adults. The pulmonary system of children is not fully developed thereby limiting airflow (McArdle et al., 2010). The underdevelopment of the pulmonary system in children is compensated by a higher breathing frequency leading to increased work of breathing (Cech and Martin, 2002). This leads to poorer ventilatory efficiency. The heart size is smaller leading to lower cardiac output which is termed hypokinetic circulation (Haywood and Getchell, 2001). Children also have less hemoglobin levels resulting in reduced oxygen-carrying capacity and a reduced  $\dot{a}\text{-VO}_2$  value (McArdle et al., 2010; Haywood and Getchell, 2001; Cech and Martin, 2002). Children also have a lower mechanical efficiency due to shorter legs which requires that the frequency at which the legs are moved is higher than that of an adult (Cech and Martin, 2002).

A high percentage of children already exhibit one or more of the risk factors for coronary heart disease and children in poor physical condition are likely to maintain that status throughout their adult lives (Haywood, 1993; Haywood and Getchell, 2001; Cech and Martin, 2002). South Africa is no exception. More than 40% of young people in South African (grades 4-5) do not regularly engage in vigorous physical activity (Birth to Twenty, 2002). Research on the effect of Tai Chi; and Taekwondo on cardiorespiratory health has reported contradictory results on their effects on maximal oxygen uptake. Melhin (2001) found no significant differences in both resting heart rate and aerobic power amongst taekwondo practitioners. Several researchers (Tsai et al., 2003; Thornton et al., 2004; Ko et al., 2006) have however reported positive relationships between martial arts and cardiorespiratory health. Tsai et al. (2004) used healthy subjects with blood pressure at high-normal or stage 1 hypertension and recorded statistically significant decreases in systolic and diastolic blood pressure. Serum total cholesterol decreased, whereas high density lipoproteins (associated with good cardiorespiratory health) increased. Thornton et al. (2004) also recorded significant decreases in both mean systolic and diastolic blood pressure after 12 weeks of Tai Chi training amongst middle-aged women. Extended positive benefits have also been recorded. Ko et al. (2006) reported not only statistically significant differences in the systolic blood pressure, but

also in total cholesterol and low-density lipoproteins. In the same study by Ko et al. statistically significant differences were also reported for vitality and mental health (health related quality of life) in women who participated in a 10-week Tai Chi intervention programme.

*i) Self esteem / Body Image*

All individuals evaluate themselves in different areas such as physical ability, physical appearance, academic ability and social skills. These self-judgements are called by many names inter alia self-esteem, self-concept, self-image, self-worth and self-confidence (Haywood, 1993; Haywood and Getchell, 2001). For the purposes of this chapter, only self-esteem, body image and self-concept shall be adopted. Self-esteem can influence behaviour as people tend to act in ways that confirm their beliefs of themselves. A low perceived competency accompanied by low self-esteem surrounding the ability to perform a skill may lead to a performance with low competency (Haywood, 1993; Sherrill, 1993; Haywood and Getchell, 2001; Sherrill, 2003). In two separate studies, the effect of martial arts on self-concept and self-confidence was studied. Duthie et al. (1978) reported that students of martial arts recorded higher self-confidence than those who didn't participate in a martial arts programme. Finkenber (1990) reported significant differences in total self-concept of college women who had participated in Taekwondo classes compared with those who had not.

*j) Psychosocial Development*

Psychosocial is derived from the two source words namely psychological (or the root, 'psycho' relating to the mind, brain, personality, etc) and social (external relationships and environment) (Haywood and Getchell, 2001). Psychosocial development has to do with an individual's response to any demand either psychological or physical made upon the human body. Physical activity has been found to be able to decrease the likelihood of stress disorders and reduces the intensity of stress response (Corbin and Lindsey, 2006). Regular exercise can be of benefit even for a Type A personality (Corbin et al., 2006). Type A personalities are stress-prone individuals with greater than normal incidence of diseases (Corbin and Lindsey, 2006). Taylor-Pillae et al. (2006b) investigated the effects

of martial arts (Tai Chi) on psychosocial development of ethnic Chinese. Statistically significant improvements in all measures of psychosocial status were found ( $p \leq 0.05$ ) following a 12-week intervention programme. Statistically significant improvements in mood state and reductions in perceived stress were also found. Li et al. (2001a) presented a series of reports examining the extent to which Tai Chi enhanced older adults' multidimensional psychological well-being and health-related quality of life. In a six month randomised controlled trial, healthy older adults were randomly assigned to either a control condition (wait-list) or Tai Chi intervention programme twice a week. Results indicated that Tai Chi participants reported higher levels of health perceptions, life satisfaction positive affect and decreased psychological distress.

*k) Socialisation*

Socialisation refers to man's adjustment to his culture (Davis et al. 2000). Physical activity and sport have a variety of positive social effects: they build character, encourage teamwork and team spirit, develop the notion of fairness, teach adherence to rules and provide an opportunity to utilise extra energy and display aggressive feelings in socially acceptable ways (Davis et al. 2000). In two separate studies (Kurian et al. 1993; Kurian et al. 1994) statistically significant reductions in aggression with advanced American Taekwondo Association (ATA) group rankings were recorded. Longer times in Taekwondo training were associated with more socially acceptable behaviour (Kurian et al. 1994).

*l) Cancer*

Cancer represents a group of diseases collectively characterised by excessive, uncontrolled cellular proliferation and the potential for these cells to spread to distant anatomical sites (ACSM, 2003; McArdle et al., 2006). Regular physical activity exerts the following effects that thwart cancerous tumour growth namely, lowered circulating levels of blood glucose and insulin, increased corticosteroid hormones, increased anti-inflammatory cytokines, augmented insulin receptor expression in cancer fighting T cells, improved interferon production and the stimulation of glycogen synthetase (McArdle et al., 2006). All individuals with cancer can benefit from rehabilitation and exercise

(ACSM, 2003). Potential benefits include improved functional ability, improved mood and the quality of life, improved range of motion, improved ability to maintain body weight, enhanced body-image and a sense of control (ACSM, 2003).

Mustian et al. (2004) investigated the effects of martial arts (Tai Chi) on the health-related quality of life and self-esteem among women diagnosed and treated for breast cancer. The Tai Chi group demonstrated significant improvements in the health-related quality of life when compared to the group that attended psychosocial support sessions. Additionally, the Tai Chi group exhibited statistically significant improvements in self-esteem when compared to the psychosocial group.

*m) Acquired Immunodeficiency Syndrome*

Acquired Immune Deficiency Syndrome (AIDS) is a disease caused by a retrovirus, the human immunodeficiency virus (HIV) (Mars, 2001; Scanga, 2001; ACSM, 2003). HIV infection can lead to loss of muscle strength and reduced aerobic capacity. Deconditioning often becomes more severe as the disease progresses in HIV patients (Mars, 2001; Scanga, 2001; ACSM, 2003). Regular participation in moderate intensity aerobic activity (60-80% of maximum heart rate) results in an improved immune function (Mars, 2001). Aerobic and progressive resistance exercise programs can improve skeletal muscle mass and function, mood state and endurance capacity (Mars, 2001; Scanga, 2001; ACSM, 2003). These changes may result in an improved quality of life for the HIV positive individual. Exercise may thus offer an additional therapeutic technique for the management of HIV infected individuals.

Galantino et al. (2005) investigated the usefulness of two interventions in a group rehabilitation medicine setting to determine strategies and exercise guidelines for long-term care of the HIV/AIDS population. Three groups were recruited for the study. One group engaged in Tai Chi, the other aerobic exercise, and the third group acted as the control for eight weeks. Results of the study showed statistically significant changes in both exercise groups in overall functional measures ( $p < 0.001$ ). Statistically significant differences were also recorded on the quality of life ( $p = 0.04$ ) as well the profile of mood states ( $p = 0.005$ ).

#### *n) Brain Injury*

Brain injury refers to brain damage caused by concussion, contusion, assaults, falls and haemorrhage (Sherrill, 1993; Sherrill, 2003). Many of the victims of brain injury survive with severe impairments that prevent independent living and live with altered sensation, perception, emotion, cognition and most importantly, motor function (Sherrill, 2003). The primary factors that limit a person's return to independence following brain injury are mostly behavioural and cognitive namely, agitation, confusion, impulsiveness, inattention, memory disturbances, apathy, and learning deficits that may all occur as acute or long-term deficits following brain injury (ACSM, 2003). The role of martial arts (Tai Chi) in individuals with brain injury was investigated by Gemmell and Leathem (2006). The results of the study indicated significant improvements on all Visual Analogue Mood Scales (VAMS) scores for the Tai Chi group that underwent a three week intervention programme when compared to a control group that was placed on a waiting list. The Tai Chi group showed significant decreases in sadness, confusion, anger, tension, fear and increases in energy and happiness though there were no significant improvements recorded for fatigue.

The next section deals with the conclusion:

### **3.9 CONCLUSION**

It is clear from the literature that there are many benefits associated with having good levels of motor proficiency. Motor proficiency plays a significant role in the development of fundamental motor skills upon which more complex movement skills are built. Motor proficiency can also lead to good health (Janz et al., 2000; Smith and O'Keefe, 1999). Good motor proficiency can also help improve academic achievements (Shepard, 1997) and can also develop a child psychologically and socially (Haywood, 1993; Sherrill, 1993; Haywood and Getchell, 2001; Sherrill, 2003). Many Children today are inactive resulting in a lack of motor proficiency (Haywood, and Getchell, 2001). This level of inactivity has also led to an increase in hypokinetic disease (Amusa, 2004; Noakes, 2004).

The acquisition of motor proficiency can only be accomplished if motor skills are adequately developed (Haywood, 1993; Sherrill, 1993; Haywood and Getchell, 2001; Sherrill; 2003). Seven main categories of motor skills were identified and only two were considered relevant for this study namely fine and gross motor skills (Davis et al., 2000). The development especially of the two motor skills can only be achieved if children are exposed to physical education at an early age. According to the literature, it has been found that there is no better place than the school environment to expose children to physical education (Amusa, 2004; Roux, 2006). According to Van Deventer (2008, 2009) and Amusa (2004), not a lot of time has been allocated to physical education since the transition period, and it seems to only exist on the timetable with no formal teaching.

According to Roux (2006), a school curriculum model should be incorporated into the conceptual framework with the emphasis on an understanding that the learner is a unique individual. Barrow and Brown (1988) argue that the ultimate purpose of education is the perpetuation of a specific society's social and cultural heritage. Youth should be socialised, educated and trained for future occupations whilst their health, fitness and welfare should be promoted as part of a holistic approach. According to Roux (2006), their modes of thinking, judgement and behaviour should be cultivated. The inclusion of traditional/indigenous activities such as Zulu stick fighting in the curriculum could go a long way in terms of bridging the gap that currently exists in terms of developing good motor proficiency levels.

This researcher argues that since culture is cumulative, through education, both formal and informal, each new generation has the potential of standing on the proceeding one. According to Andersen and Taylor (2004), this formal and informal education includes teaching knowledge such as reading, writing, arithmetic, new movement skills as well as the conveyance of morals, values and ethics through enculturation. Since indigenous games are symbolic representations of cultural expressions from a specific society, children are the bearers and creators of culture through these games and game culture (Burnett and Sierra, 2003). An indigenous activity such as Zulu stick fighting can also be adopted to satisfy a variety of physical, psychological, social as well as cultural needs.

Due to limited information regarding the health and fitness benefits of Zulu stick fighting, the potential benefits have been based on martial arts which are related to stick fighting in terms of technique. According to the literature, bone development, flexibility, strength, coordination, motor control and skills, balance, proprioception, cardiorespiratory health, self-esteem/self-image, psychosocial development and socialisation are all the health and fitness benefits that were positively influenced by martial art-like activities. The assumption from this literature finding can thus be that Zulu stick fighting may or can improve or influence the same health and fitness benefits.

The next chapter will focus on the methods and procedures for the study:

# **CHAPTER FOUR**

## **METHODS AND PROCEDURES**

### **INTRODUCTION**

Literature reviewed in the previous chapters revealed that stick fighting (martial art) could be very beneficial for motor skill development, improvement of physical fitness and health. There is however no study that has been conducted to determine the influence of Zulu stick fighting, specifically on the motor proficiency of young people. This study investigated the effect of a 10-week stick fighting intervention programme on motor proficiency of prepubescent Zulu boys who received training in stick fighting. These results were compared to motor proficiency of prepubescent Zulu boys who had not received training in stick fighting. The first aim was thus to determine whether traditional Zulu stick-fighting training would have an influence on motor proficiency. The second aim of the study was to establish whether participating in a stick fighting intervention programme would benefit and lead to anthropometrical improvements and health-related physical fitness parameters such as body composition, cardiovascular fitness, flexibility, muscular endurance and muscular strength.

This chapter provides the aims of the study, the study hypotheses, a description of participants, the approval of the study and the training of research assistants. The research design followed in the study is explained in detail. The research instruments used in the study are also explained. The chapter ends off with a theoretical background on the Bruininks-Oseretsky Test of motor proficiency, the health-related physical fitness and how statistical analysis and treatment of data was done.

The next section deals with aims of the study:

#### **4.1 AIMS OF THE STUDY**

The following specific aims were formulated:

To determine whether differences exist between Zulu children who have been trained in the martial art of stick fighting and Zulu children who have not:

- 4.1.1            **with regards to anthropometric measures (body mass),**
- 4.1.2            **with regards to motor proficiency,**
- 4.1.3            **with regards to health-related physical fitness parameters.**

The next section deals with formulation of hypotheses:

## **4.2    FORMULATION OF HYPOTHESES**

The following hypotheses were postulated to fulfil the aims of the investigation:

- 4.2.1            There will be significant differences in selected anthropometric measures between Zulu children who have been trained in traditional martial arts of stick fighting and Zulu children who have not.
- 4.2.2            There will be significant differences in motor proficiency between Zulu children who have been trained in the traditional martial arts of stick fighting and Zulu children who have not.
- 4.2.3            There will be significant differences in health-related physical fitness parameters between Zulu children who have been trained in traditional martial arts of stick fighting and Zulu children who have not.

The next section deals with subjects:

## **4.3    PARTICIPANTS**

The participants (n = 44) came from two rural schools (Ofasimba Primary School and Mngampondo Combined Primary School) in the Ndlangubo Reserve, in the Biyela Tribal Authority. This falls under the eMlalazi Municipality and within the Uthungulu District Municipality. The two schools are five kilometres apart from each other. They were specifically selected due to their similarities in their socio-economic background as well

as offerings in physical activities. Participants between the ages 9.5y and 10.5y were recruited for the study. Ofasimba Primary school provided a control group (n = 23) who did not participate in the 10-week stick fighting programme. Mngampondo Combined Primary school provided participants for the experimental group (n = 21) that participated in the 10-week stick fighting intervention programme. Originally, the control group had 27 participants and the experimental group had 25 participants giving a combined total of 52 subjects. Subjects dropped out of the study due to the nation wide public sector strike organised by the Confederation of South African Trade Unions (COSATU) from 1 to 28 June 2007. In the end, the experimental group was left with 22 participants and the control group with 23 giving a combined total of 45 subjects. Rural schools were selected for their close proximity to the researcher's home. This ensured better control and made it easier to convince the principals of the two schools as well as participants to participate in the study. Moreover, the two schools were selected to avoid exorbitant costs of transporting the two stick fighting trainers.

Potential participants for both the experimental and control group needed to have had no previous experience of stick fighting. Any participant who had been exposed to stick fighting was excluded from the study. The potential impact of other learning/movement experiences that participants may have had was identified by the researcher with the help of the principals before any of the subjects were recruited for the study. The two schools run a traditional Zulu dancing group for young boys. All potential participants who were also part of the traditional dancing group were excluded from the study. Potential participants who appeared to have high activity levels or did activities that may influence the results of the study were also excluded. Only healthy participants were allowed to take part in the study. Participants with a history or symptoms of chronic conditions such as cardiovascular, pulmonary, metabolic and immunological diseases which could hamper their ability to partake in the intervention programme were excluded. Participants with a history of neurological disorders affecting the upper and lower extremities, vestibular dysfunctions, balance disorders or any other motor-related disorders were also excluded. An interview with the respective class teachers was conducted to establish the medical history of each participant before any of the subjects was enrolled into the intervention programme. In terms of the regulations of the Department of Education on

inclusive education, the class teachers are required to know more or less the medical history of each child to afford necessary academic support should the need arise.

The next section deals with approval of the study:

#### **4.4 APPROVAL OF THE STUDY**

Approval for the study was obtained from the University of Zululand's Ethics and Higher Degrees Committees. The researcher approached the principals of the two schools and a full explanation of the purpose of the study and what it hopes to achieve was provided. An approved proposal of the study was supplied to the two principals for perusal and further discussions. The principals contacted the parents/guardians of each child in a form of a letter informing them about the study. The parent or guardian had to sign the letter as proof that he/she agreed that his/her child could participate in the study. A copy of a letter written by one of the two principals appears as Appendix A. The study only commenced after all parents/guardians had signed the letter agreeing that the child could participate in the study. Prior to the commencement of the study, informed consent from the child and the parents or legal guardians of the child was obtained (Appendix B). A Zulu translation of the informed consent was done for those parents who could not read English as most were isiZulu speakers (Appendix C).

The next section deals with training of research assistants:

#### **4.5 TRAINING OF RESEARCH ASSISTANTS**

Three undergraduate students (Two Biokinetics and Sport Science and one Biochemistry and Microbiology) were trained to assist with the collection of data. Due to the fact that the three assistants had limited previous experience with measurements of human movement parameters as well as the Bruininks-Oseretsky Test for Motor Proficiency, the researcher felt that their involvement should only be limited to directing participants to the correct testing stations and data collection. They were trained in the meaning of the different parameters and what to write on the Bruininks-Oseretsky Test for Motor Proficiency score sheet (Appendix D).

The next section deals with research design:

## 4.6 RESEARCH DESIGN

This study followed a quasi-experimental design (Thomas et al., 2005; Kervin, 2006). In a quasi-experimental design, the researcher treats a given situation or problem as an experiment even though it is not wholly by design (<http://writing.colostate.edu/guides/research/experiment/pop3e.cfm>). The experimental and control groups are not randomised or matched to try to fit the design to the settings of the real world (Shadish et al., 2002; Thomas et al., 2005). Experimental designs are rarely used in school-based research because the requirements of an experimental design (that participants need to be randomly assigned to either the experimental or the control groups) is difficult to implement and would make the study unrealistic (Kervin, 2005). Much of the research done in schools is done at a class or school level rather than individual level. This arrangement in schools makes it virtually impossible to randomly assign subjects to groups (Kervin, 2005). The benefits of a quasi-experimental design are that the researcher is afforded the opportunity to still control as many of the threats to internal validity as possible (Thomas et al., 2005; Kervin, 2006). The study followed the time line as shown in Table 2:

**Table 2: An overview for the timeline of the study**

14 Weeks															
0	1	2	3	4	5	6	7	8	9	10		11	12	13	14
<b>Pre Test</b>	Stick Fighting Intervention Programme										<b>Post Test</b>	Retention Period			<b>Post-Post Test</b>
												<i>No contact</i>			

### 4.6.1 Pre-test procedures

The pre test was conducted over three days (one two hour session per day from 13h00-15h00). The pre test was conducted to measure the status of the dependant variables (motor proficiency, anthropometrical measures and health-related fitness parameters). All testing was done in the school's hall except for station 1 of the Bruininks-Oseretsky Test

(running speed and agility T-test) as well as the 20 Multi-Stage Fitness test (20 MST). Both were conducted on the sports fields as more space was required. The researcher handled all the testing himself with the help of three thoroughly trained research assistants. A thorough check of the state of equipment to be used for testing was done and an equipment check list was filled in to ensure that all the testing equipment was included before leaving the department.

On arrival at the school on day one, the participants were assembled in the school's hall. A "Research in Progress – Please Do not Disturb" sign was placed on the door. A Zulu translation of the sign was provided underneath the English version. All the participants were seated on pre-placed chairs and the hall door was left ajar for some fresh air. The participants had been instructed via the principals to wear a t-shirt, shorts and exercise shoes. Testing order followed that of the attached proforma (Appendix E): biographical information, anthropometrical measures, skinfolds, waist-to-hip ratio, grip dynamometer, push-ups, sit-ups and the modified sit and reach. The researcher performed all the measurements and the three research assistants recorded all the information on the proforma.

On day two, the participants were again assembled in the school hall. They were all seated on chairs. Different testing stations were set-up. The researcher manned three stations (Running Speed and Agility, Strength and Upper Limb Coordination). Another three (Balance, Bilateral Coordination and Response Speed) were manned by Dr GK Longhurst, a movement practitioner trained in administering the Bruininks-Oseretsky test. The stations on visual motor control and upper limb speed and dexterity were conducted by the researcher and Dr Longhurst with the help of the three research assistants. At the start of the testing, each participant was handed a Bruininks-Oseretsky Test individual score sheet. The participants were then asked to carry the score sheet from one test station to another where the tester (either the researcher or Dr Longhurst) conducted each test and the research assistants recorded the subject's score. An oral description of the different tests was provided at each testing station. Only one participant, the tester and the recorder were allowed to be at a sub-station at one time. The rest of the participants had to remain seated throughout until it was their turn to be

tested. During the testing, each item (test) was demonstrated and a trial attempt where appropriate was afforded to the participants.

On day three, the participants were assembled on the school's soccer field. The 20m field had already been measured out with cones indicating the starting line and the finish. An oral description of the test was provided by the researcher. Each participant had his own recorder whose task was to tick off each shuttle level completed by the subject, record the heart rate at the end of each level and then record the level and the number of shuttles finally completed when the subject withdrew. The participants performed the 20 MST test running in random groups of four.

#### **4.6.2 Intervention programme**

In order to minimise disruption to the normal running of the school programmes, the intervention programme was administered after school hours (13h30-14h30). The intervention was conducted for a period of 10 weeks. The programme was run twice a week on Tuesday and Thursday afternoons for an hour. Due to the nationwide public sector strike organised by the Confederation of South African Trade Unions (COSATU) the seventh week the intervention could not be administered as the learners weren't at school. The two lost sessions were recovered on the eighth week when the intervention was administered daily from Monday to Thursday afternoon. The researcher transported each participant from home to the school. The principal of the school was very helpful, she gave the researcher unlimited access to the school during the strike. Those learners staying far from the school dropped out from the study during this period. In the ninth week, the intervention programme was again offered twice a week (Tuesday and Thursdays afternoon).

Two experienced adult stick fighters administered the intervention programme. The two stick fighters were selected with careful consideration. They had to have had at least 15 years of stick fighting experience, be able to work with children and be available for all the contact sessions. The stick fighters were instructed to engage kids all the time. Each subject had his own pair of sticks (an offensive and a parrying stick). Shields used mainly by kids (shields for kids are smaller and lighter compared to the ones used by adults and

do not have a long parrying stick) were bought from Shakaland Zulu Village, in Eshowe. The shields were only introduced in the fourth week of the intervention.

All sessions began with the signing of the attendance register. The signing of the attendance register was followed by a proper warm-up, stretching exercises, the intervention and ended off with a cool-down. In the initial phases (the first two weeks) of the intervention programme, the general warm up and cool down were used. The warm-up included light to moderate intensity as per ACSM (2006) guidelines of locomotory activities for three to five minutes. The body parts or muscles that were stretched (in the order of sequence) included the neck, the shoulders, the triceps, side stretcher, the quadriceps, the hamstrings, the hip flexors and the calves. The stretching component lasted for ten minutes (ACSM, 2006). The intervention programme lasted for 40 minutes. The cool down included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes. Later on, a specific warm up (related to stick fighting) designed by the two stick fighting trainers and a normal cool down were used. The researcher was present at all the sessions to monitor conditions. The researcher conducted the warm up session, stretches and a cool down in the earlier phases of the intervention. Later on, the two stick fighters conducted a specific stick fighting warm up and the researcher only conducted the stretching and a cool down session. The details of the intervention programme appear on Appendix F. With the help of the two trainers, a schedule of the intervention programme was designed (Table 3).

**Table 3: A schedule of the intervention programme**

<b>WEEK</b>	<b>SKILL</b>
<b>Week 1</b>	Stance
<b>Week 2</b>	Handling the sticks
<b>Week 3</b>	Different offensive shots
<b>Week 4</b>	Introduction of the shield
<b>Week 5</b>	Using the shield to fend off blows
<b>Week 6</b>	Ukungweka (Mini sparring)
<b>Week 7</b>	Ukungweka (Mini sparring)

<b>Week 8</b>	Ukugiya (War dance)
<b>Week 9</b>	Ukugiya (War dance)
<b>Week 10</b>	Amabutho (War regiments)

In stick fighting, blows are normally delivered to the legs and head. Participants were instructed not to land blows above the heart. Those areas, which are likely to be hurt like the lower extremity, were covered with protective equipment. Shin guards mainly used by soccer players were used to minimise any chance of injury.

#### **4.6.3 Post-test**

The participants (n = 44) completed the post test three days after the end of the intervention programme. The exact same procedures followed in the pre test were repeated for the post test.

#### **4.6.4 Post-post test**

Post-post testing was conducted exactly four weeks after the post-testing. Only motor proficiency was tested. The other tested variables especially the aerobic fitness components of health-related physical fitness declines as soon as one becomes inactive. The maximal oxygen uptake of an individual can vary by between five to 20 percent depending on the fitness of the individual at the time of measurement (McArdle, Katch and Katch, 2010). Research also indicates a 6% (Coyle et al., 1986) and a 6-10% (<http://www.copacabanarunners.net/i-detraining.html>) decline of the maximal oxygen uptake with a 2-4 week detraining period. The motor-proficiency or skill on the other hand tends to be retained for a longer period after being mastered. The decision was taken in conjunction with the study supervisors not to test health-related fitness components during post-post testing.

The next section deals with research instruments.

## **4.7 RESEARCH INSTRUMENTS**

Morphological measures included stature, body mass, waist-to-hip ratio and percentage body fat. Percentage body fat was calculated from skinfold measures of four sites: biceps, triceps, supraspinale and subscapular according to the procedure described by Durnin and Womersley (1974).

The next section deals with stature:

### **4.7.1 Stature**

Stature was recorded in centimetres to the nearest 0.1 centimetre using a stadiometer (Detecto, 3P7044 Medical Equipment Services Incorporated (Inc.), MES). The participant stood erect and barefoot, with the weight evenly distributed on both feet, and the head in the Frankfurt Plane. The Frankfurt plane was considered as the orbitale (lower edge of the eye socket) being in the same horizontal plane as the tragion (notch superior to the tragus of the ear). The arms hung freely at the sides of the trunk with the palms facing the thighs. The heels were placed together, with the gluteus, scapulae and posterior cranium in contact with the stadiometer. Before taking the measurement the participant was instructed to inhale deeply and stretch upward to the fullest extent. The vertical distance from the vertex in the mid-sagittal plane to the floor was measured.

The next section deals with body mass:

### **4.7.2 Body mass**

Body mass was measured with a Detecto (3P7044, Medical Equipment Services Inc., MES) calibrated scale and recorded to the nearest 0.1 kilograms.

The next section deals with body composition: skinfolds:

### **4.7.3 Body composition: skin folds**

The following measurement technique was applied for all sites using a Lange (Cambridge Scientific Industries, Inc., Cambridge, MD) spring-loaded skinfold caliper: all measurements were recorded in millimetres. The thumb and index finger of the left hand were used to elevate the double fold of skin and subcutaneous adipose tissue one centimetre proximal to the site at which the skinfold was measured. The jaws of the caliper were applied at right angles to the site, and spring-loaded handles were fully released. Once full pressure was applied and a maximum period of three second had passed, the measurement was taken. Two measures were taken and recorded to the nearest 0.5 mm. If the difference was greater than five percent of the first skinfold, then a third measurement was taken and the mean of the closest two was recorded. All measurements were taken on the participants's right hand side (Marfell-Jones et al., 2006). The researcher personally performed all the measurements and one research assistant recorded all the information on the proforma (Appendix E).

#### **4.7.3.1 Triceps skinfold**

This is a vertical fold, measured on the posterior surface of the unclothed pendant arm at a level midway between the acromion and the olecranon processes with the arm held freely on the side of the body.

#### **4.7.3.2 Subscapular skinfold**

This is a diagonal fold (at 45° angle), measured 1 to 2 cm below the inferior border of the scapula, with the participant standing erect and the upper limbs pendent.

#### **4.7.3.3 Biceps skinfold**

This is a skinfold measurement taken parallel to the longitudinal axis of the arm on the anterior surface in the mid-line at the level of the mid-acromiale-radiale landmark .

#### 4.7.3.4 Supraspinale skinfold

This is a diagonal fold in line with the natural angle of the iliac crest, taken in the anterior axillary line, 3 cm superior to the anterior superior iliac spine (ASIS).

#### 4.7.3.5 Percentage body fat

The four skinfolds were added: triceps, subscapular, biceps and supra iliac. Using the equations derived from Durnin and Womersley (1974) the density was calculated from a linear regression, which estimate density from the logarithm of skinfold thickness:

$$\text{Body density (BD)} = c - m * \log \text{ skinfold}$$

where "c" and "m" refers to standard age and sex-specific coefficients

thus

$$\text{BD} = 1.1765 - 0.0744 (\log_{10} X_1)$$

where  $X_1$  refers to the sum of four skinfolds

The formula for estimating percentage of body fat is the Siri equation:

$$\% \text{ fat} = (495 / \text{body density}) - 450$$

(Durnin and Womersley, 1974; Jackson and Pollock, 1985, Heyward, 2002; ACSM, 2006; ACSM, 2010).

The next section deals with waist-to-hip ratio.

#### 4.7.3.6 Waist-to-Hip Ratio

Scientific evidence suggests that the way people store fat affects the risk for disease. Individuals with more fat on the trunk, especially abdominal fat are at increased risk for hypertension, type II diabetes, hyperlipidemia, coronary artery disease and premature death (Corbin et al., 2006).

Waist-to-hip ratio (WHR) looks at the proportion of fat stored on the body around the waist and hips. Most people store their body fat in two distinct ways: around the middle (apple shape) and around the hips (pear shape). Typically (though not always), excess fat in women tends to collect in the hips and buttocks, resulting in a so-called "pear" shape.

In men, excess fat often tends to collect in the abdomen area, resulting in what is called an "apple" shape (ACSM, 2010; McArdle et al., 2010).

The waist measurement was taken using a non-distensible measuring tape on the waist at the point of smallest circumference to the nearest 0.1 cm. The hip measurement was taken at the buttocks at the point of greatest circumference to the nearest 0.1 cm. The waist measurement was then divided into the hip measurement. Men should lose weight if the waist-to-hip ratio is 1.0 or higher. Women need to lose weight if the ratio is .85 or higher (ACSM, 2010; McArdle et al., 2010).

$$\text{Waist-to-Hip ratio} = \frac{\text{Waist Circumference}}{\text{Hip Circumference}}$$

The next section deals with motor proficiency: the Bruininks-Oseretsky test of Motor Proficiency (BOTMP):

#### **4.8 THE BRUININKS-OSERETSKY TEST OF MOTOR PROFICIENCY (BOTMP)**

In South Africa, there are only two paediatric motor proficiency assessment and evaluation tools that are usually employed for scientific as well as clinical study: the movement assessment battery for children (Movement ABC) and the Bruininks-Oseretsky test for motor proficiency (BOTMP). The Movement ABC is designed to provide a standardised assessment of the everyday motor competence of children between the ages of 4 and 12 years. The test takes 20 minutes to administer (Henderson and Sugden, 1992). The Bruininks-Oseretsky test is an individually administered test that assesses the motor functioning of children from 4.5 years to 14.5 years of age. The test also takes 20 minutes to administer. It is considered to be fun and interesting for children. The instructions and trials are useful in gauging the individual's understanding of the motor task to be assessed (Connolly & Michael, 1986). It has been described as the most outstanding instrument of its kind, and one which fills a clinical void (Sabatino, 1987). After a review of both test batteries and lengthy discussions with Dr Longhurst, a movement practitioner, the researcher chose the Bruininks Oseretsky test over the Movement ABC as it offers more and specific tests to the study.

Burton and Davis (1992) states that the Bruininks-Oseretsky test battery is the most commonly used multipurpose motor assessment tool. This statement has been proven true in numerous surveys conducted for Physical Educators, Paediatric (Sherrill, 1998), Occupational and Physical therapists (Crowe, 1989; Gowland et al., 1991; Rodger, 1994; Yack, 1989)]. This test has wide clinical and educational acceptance because it measures skills important to children's development. It is also perceived to have good psychometric properties, and until recently few other tests existed for the school age child (Wilson et al., 2000). The BOTMP was developed for use by clinicians, educators and researchers. Recommended uses include making decisions about educational placements, screening as part of psychological test batteries, and for assessing neurological development (Wilson et al., 2000).

The original form of this test was developed by Oseretsky in Russia in 1923, after extensive observations in children. The tests underwent revisions resulting in the Lincoln-Oseretsky Motor Development Scale (Sloan, 1955), and finally the Bruininks-Oseretsky Test of Motor Proficiency (Bruininks, 1978) which is based on the original Oseretsky test.

The test includes both the long and the short form. It includes 46 items, comprising of 8 sub tests. These include: running speed and agility, balance, bilateral coordination, response speed, visual-motor control and upper-limb speed and dexterity. Items are arranged into 3 categories and produce a detailed index of motor proficiency as well as separate rating of fine and gross motor skills. Normalised standard scores are available for the sub-test scores. The short form was used to test motor proficiency. The short form - 14 items from the complete battery - provides a brief survey of general motor proficiency. These 14 items are selected from the complete battery (6 items from gross domain, 6 from fine domain and 2 from gross and fine domain. The administration of the short form requires 15 to 20 minutes whereas the complete battery requires 45 to 60 minutes which would not have been possible for this study due to time constraints. Full details for administration and scoring appear in the examiner's manual which is available at the Human Movement Science Department, University of Zululand. All the measurements were recorded on the Bruininks-Oseretsky Test of Motor Proficiency

scoresheet that appears on Appendix D. Table 4 lists all the items and their domains used for this study:

**Table 4: Bruininks-Oseretsky Short Form: Items and their Domains**

<b>Station</b>	<b>Gross Motor Domain</b>
	<b>Subtest 1</b> Running speed and agility
Station 1	Item A. Running speed and agility
	<b>Subtest 2</b> Balance
Station 2	Item A. Standing on preferred leg on Balance Beam
	Item B Walking forward heel-to-toe on Balance beam
	<b>Subtest 3</b> Bilateral co-ordination
Station 3	Item A. Tapping feet alternately while making circles with fingers.
	Item B. Jumping and clapping hands.
	<b>Subtest 4</b> Strength
Station 4	Item A Standing broad jump
	<b>Gross and Fine Motor Domain</b>
	<b>Subtest 5</b> Upper-limb co-ordination
Station 5	Item A Catching a tossed ball with both hands
	Item B Throwing a ball at a target with preferred hand
	<b>Fine Motor Domain</b>
	<b>Subtest 6</b> Response speed
Station 6	Item A Response speed
	<b>Subtest 7</b> Visual-motor control
Station 7	Item A. Drawing a line through a straight path with preferred hand.
	Item B Copying a circle with preferred hand.
	Item C Copying overlapping pencils with

preferred hand.

**Subtest 8** Upper-limb speed and dexterity

Station 8

Item A Placing pennies in a box with preferred hand.

Item B Making dots in circles with preferred hand.

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A detailed description of each test of the Bruininks-Oseretsky Test of Motor Proficiency appears below:

□ **Subtest 1: Running speed and agility**

Two lines 16 yards (14.63 metres) apart are marked; a block is placed on the far line. A short line, the “timing line”, is marked 1 yard (0.91 metres) in front of the first line. The subject begins at the first line, runs to the far line, picks up the block, and then runs back across the first line as fast as possible. The subject is timed to the nearest 0.2 second between the first and the last crossings of the timing line. Two trials are taken and the best score is recorded.

□ **Subtest 2: Balance**

*Standing on the preferred leg on balance beam.* The subject stands on the preferred leg on the balance beam, looking at a wall target, with hands on hips, and free leg held up with thigh parallel to the floor. The score is the time the subject can maintain the balance position to a maximum of 10 seconds. A second trial is given if the subject does not score the maximum on the first trial.

*Walking forward heel-to-toe on balance beam.* The subject walks forward on the balance beam heel-to-toe, with hands on hips. The recorder keeps track of the correct and incorrect steps on 6 steps. The subject must make 6 consecutive steps correctly to achieve maximum score. A second trial is given if the subject does not score the maximum on the first trial.

### □ **Subtest 3: Bilateral Coordination**

*Tapping feet alternately while making circles with fingers.* The subject sits on a chair and attempts to tap feet alternatively while simultaneously making inward to outward circles with the index fingers. This item is scored pass or fail. The subject is given 90 seconds to complete 10 consecutive foot taps correctly.

*Jumping up and clapping hands.* The subject jumps as high as possible and attempts to clap hands as many times as possible before landing. The score is the number of claps; a maximum score is 5. A second trial is given if the subject does not score the maximum on the first trial.

### □ **Subtest 4: Strength**

After warming up which might include jogging on the spot or doing few laps between two points, the subject assumes a bent-knee position, and then does a standing long jump. The subject's score is the longest jump of three trials, recorded to the nearest number on the specialized test kit measuring tape.

### □ **Subtest 5: Upper-limb Coordination**

*Catching a tossed ball with the preferred hand.* The subject stands on a test kit mat and the assessor slowly tosses the ball underhand from the three metre tape mark from the subject. The subject is given one practice trial. The number of correct catches made by the subject in 5 trials is recorded.

*Throwing a ball at a target with the preferred hand.* With the preferred hand the subject throws a tennis ball overhand at a target from a distance 1.5m. The subject is given one practice trial. The number of correct throws –which hit the target- in 5 trials, is recorded.

□ **Subtest 6: Response speed**

*Response speed.* The subject sits on a chair next to a wall and the tester holds the response speed stick vertically against the wall next to the subject (at the level of the eyes of the subject) and drops it. The subject reacts as fast as possible, uses the thumb of the preferred hand to stop the response speed stick as it drops. The response speed stick number that is at or just above the tape strip when the stick is dropped is the trial score. The subject is given seven trials to try to stop the response speed stick. The seven trial scores are then ranked from the highest to the lowest in the boxes provided in the Bruininks-Oseretsky Test of Motor Proficiency scoresheet (appendix D). The point score for this subtest is the median (middle score), or fourth score from the top.

□ **Subtest 7: Visual-Motor Control**

*Drawing a line through a straight path with preferred hand.* The subject attempts to draw a line through a straight path. The subject starts on the “start” point and must follow through a straight path until the “home” is reached. The number of errors (how many times the subject jumps out of the straight path or touches the lines) is recorded as the final score.

*Copying a circle with preferred hand.* The subject attempts to draw a circle that closely resembles the one on the Bruininks-Oseretsky Test of Motor Proficiency scoresheet (appendix D). The score is either a one or two based on the subjective rating by the tester of the circle drawn by the subject using exemplars given on the Bruininks-Oseretsky Test of Motor Proficiency examiner's manual for this test.

*Copying overlapping pencils with preferred hand.* The subject attempts to draw overlapping pencils that closely resembles the one on the Bruininks-Oseretsky Test of Motor Proficiency scoresheet (appendix D). The score is either a one or two based on the subjective rating by the tester of the overlapping pencils drawn by the subject using exemplars given on the Bruininks-Oseretsky Test of Motor Proficiency examiner's manual for this test.

#### □ **Subtest 8: Upper-Limb Speed and Dexterity**

*Placing pennies in a box with preferred hand*\*. The subject sits on a chair. On a table are pennies in a container and a box with holes. The subject attempts to place as many as possible pennies in a box. . The subject is given fifteen seconds to complete the test. The subject is given only one trial. The point score for this item is the number of pennies in a box at the end of the fifteen seconds time period which is recorded on the scoresheet.

\*This test is not part of the Short Form protocol of the Bruininks-Oseretsky Test of Motor Proficiency as explained in the examiner's manual. The test kit at the researcher's disposal did not have the items for the original test: *Sorting shape cards with preferred hand*. On advice by the movement practitioner who felt the reliability of the subtest won't be compromised, a decision was taken to substitute the original test with this one.

*Making dots with preferred hand*. The subject sits on a chair. On a score sheet, are a number of dots. The subject attempts to make dots in circles. . The subject is given fifteen seconds to complete the test. The point score for this item is the number of dots in circles at the end of the fifteen seconds time period which are recorded in the scoresheet. The subject is given only one trial. The subject is given a fifteen second practice trial before completing the actual test.

The next section deals with health related physical fitness:

### **4.9 HEALTH -RELATED PHYSICAL FITNESS**

Physical fitness is described as the body's ability to function efficiently and effectively (Corbin et al., 2006). It consists of health-related and skill-related physical fitness, which have at least eleven different components, each of which contributes to total quality of life. Body composition, cardiovascular fitness, flexibility, muscular endurance and strength are referred to as health-related components of physical fitness (ACSM, 2010).

The next section deals with body composition:

### **4.9.1 Body composition**

Body composition is described as the relative percentage of muscle, fat, bone and other tissues of which the body is composed (McArdle et al., 2010). Body composition was assessed using skinfolds as described earlier in this chapter

The next section deals with cardiovascular fitness:

### **4.9.2 Cardiovascular fitness**

Commonly also referred to as cardiorespiratory endurance, cardiovascular fitness is the ability of the heart, blood vessels, blood and respiratory system to supply fuel, especially oxygen to the muscles and the ability of the muscles to utilise fuel to allow sustained exercise (Corbin et al., 2006). Cardiorespiratory endurance is described as the ability to perform dynamic exercise involving large muscle groups at moderate-to-high intensity for prolonged periods (ACSM, 2000). Maximal oxygen uptake is widely used as a measure of one's fitness levels. Cardiovascular fitness was assessed by means of the 20 MST test. The 20 MST has become one of the most popular field-tests for predicting maximal oxygen uptake ( $VO_2\text{max}$ ) (Tomkinson et al., 2003). Many authors in different countries (Van Machelen et al., 1986; Mahoney, 1992; Wong et al., 2001; Tomkinson et al., 2003; Suminski et al., 2004; Dencker et al., 2008; Cairney et al., 2010) have used the 20 MST test in children with great successes.

The equipment for the test included a measuring tape, four cones, 20 m Multi-Stage Fitness Test audio CD and four F11 Polar Heart rate monitor (Polar Electro Oy, FIN-90440 KEMPELE, Finland). A 20 m track was measured and the ends marked with cones. Subjects had been instructed not to participate in any form of exercise three hours prior the 20 MST.

The following procedure was adhered to all the time: basic warm-up was done followed by stretching exercises in preparation for the test. The warm-up included light intensity activities for three to five minutes. The subjects were instructed to jog on the spot, jog from one end to the other whilst clapping hands, hop from one end to the other whilst

touching their thighs with their hands, do side running whilst swinging arms medially and laterally, do side running with a turn whilst swinging arms medially and laterally, jogging touching heels with the tips of the fingers and the session was ended off with a moderate intensity jog from one end to the other. The body parts or muscles that were stretched (in the order of sequence) included the neck, the shoulders, the triceps, side stretcher, the quadriceps, the hamstrings, the hip flexors and the calves. At the end of the stretching exercises, the subjects were requested to stand behind the “start” mark. The audio CD was then started. The CD begins with a verbal explanation of the test itself, leading to a four second countdown to the start of the test. The CD thereafter emits a single bleep at regular intervals. The participant aimed to be at the opposite end of the start by the time the first bleep sound. The participant continued to run at this speed, being at one end or the other each time the bleep was emitted (Leger and Lambert, 1982).

After each minute, the time interval between the bleeps decreased making it necessary for the subject to increase his running speed. The first running speed was  $8.5 \text{ km}\cdot\text{hr}^{-1}$  and is referred to as 'Level 1'. The next stage is referred to as 'Level 2' and each new level was characterised by a  $0.5 \text{ km}\cdot\text{hr}^{-1}$  increase in running speed. Each level lasted approximately one minute and the CD continued up to level 23. The end of each shuttle was denoted by a single bleep, and a triple bleep. A formal statement by the commentator on the CD denoted the end of each level (Leger and Lambert, 1982).

Participants were advised that the running speed at the start of the test is very slow and they should pace themselves accordingly. Participants had 9 seconds in which to complete each 20m shuttle of level 1. Participants were required to place one foot either on or behind the 20m mark at the end of each shuttle. The participants were further instructed that if they arrived a fraction earlier than the bleep, they had to wait for the bleep before they could resume running and adjust the running speed accordingly. Each participant was encouraged to run as long as possible until he could no longer keep up with the speed set by the CD, at which point the participant was withdrawn from the test (Leger and Lambert, 1982). Each participant had his own recorder whose task was to tick off each shuttle level completed by the participant, and then record the level and the number of shuttles finally completed when the participant withdrew (Appendix G). The

session was ended off with a cool down session which included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes.

The next section deals with flexibility:

### **4.9.3 Flexibility**

Flexibility is the ability of a joint or series of joints to move through a full range of motion (Heyward, 2002). Static flexibility is a measure of the total range of motion at the joint and is limited by the extensibility of the musculotendinous unit. Dynamic flexibility is a measure of the rate of torque or resistance developed during stretching throughout the range of motion (Heyward, 2002). For the purpose of this research, only static flexibility was measured. The modified sit-and-reach test as first described by Hopkins and Hoeger (1986) was used to assess static flexibility.

The modified sit-and-reach test uses a 12-inch (30.5cm) sit-and-reach box. The participant sat on the floor with buttocks, shoulders and head in contact with the wall, knees extended and soles of the feet placed against the box. A yardstick was placed on top of the box with the zero toward the participant. Keeping the head and shoulders in contact with the wall, the participant reached forward with one hand on top of the other and the yardstick was positioned so that it touched the fingertips. This procedure established the relative zero point for each participant. As the tester firmly held the yardstick in place, the participant reached forward slowly, sliding the fingers along the top of the yardstick. The score (in centimetres) was recorded as the most distant point on the yardstick contacted by the fingers.

The next section deals with muscle endurance:

### **4.9.4 Muscle endurance**

Muscular endurance is described as the ability of muscles to repeatedly exert themselves (Corbin et al., 2006). Muscular endurance can be assessed for static and dynamic muscular contraction. If the resistance is immovable, the muscle contraction is said to be

static or isometric ("iso; " same; "metric," length) and there is no visible movement in the joint. Dynamic contraction involves contraction in which there is visible joint movement. For the purpose of this study, the push-up and the situp tests were used to test dynamic muscular endurance. The push-up was performed as follows: the participant (male in this instance) assumed a standard push-up position, with thumbs shoulder width apart. Keeping the back and body straight, participants descended to the tester's fist, placed below the sternum and ascended until elbows were fully extended (straightened) (ACSM, 2000). This was performed for one minute. The maximal number of push-ups performed in one minute is recorded as the final score. If the participant did not adhere to these specifications, the repetition was not counted. The test is stopped if the subject strains forcibly and cannot continue.

For the sit up test, the following procedure was followed: the participant lied on grass with knees flexed at 90 degrees. Each participant was assisted by a fellow participant who anchored the feet to the ground. The hands were placed behind the ears. The participant was instructed to raise the trunk in a smooth motion, keeping the arms in position, curling up the desired amount. The trunk was lowered back to the floor so that the shoulder blades or upper back touch the floor. The maximal number of sit ups performed in one minute is recorded as the final score (ACSM, 2006).

The next section deals with muscular strength:

#### **4.9.5 Muscle strength**

Muscular strength is defined as the ability of a muscle group to develop maximal force against a resistance in a single contraction (Heyward, 2002). Again, muscular strength just like muscular endurance can be assessed for static and dynamic contraction. Static strength was assessed for the purpose of this study. Static strength was assessed by the hand grip test.

The hand grip test was performed with the hand grip dynamometer. The participant stood erect, with the arm and forearm positioned as follows: the participant kept the arm of the dominant hand straight and slightly abducted. The participant squeezed the dynamometer

as hard as possible using one brief maximal effort but without any extraneous body movement. Three trials allowing a 1-minute rest between trials were done. The participant's best effort was recorded (Canadian Society for Exercise Physiology, 2003).

The next section deals with statistical analysis and treatment of data:

#### **4.10 STATICAL ANALYSIS AND TREATMENT OF DATA**

Data was analysed using Microsoft Excel. All results are expressed as means  $\pm$  standard deviation, difference and percentage change. A Bonferonni post hoc test was performed to identify where significant differences lie (i.e. to compare a pre to post and post-post testing) for the motor proficiency results. Additionally, a Cronbach's Alpha was computed to assess consistency of results across items within the eight motor proficiency subtests. This is referred to as the internal consistency of the items in a test. Ideally, an internal consistency value of 0.70-0.90 is considered acceptable (Aron and Aron, 1997; Thomas et al., 2005). An inter-item correlation which indicates whether the total score is reliable was also computed for motor proficiency results at pre-, post-, and post-post intervention. Ideally, a value of between 0.15 and 0.5 is considered acceptable. The Cronbach's Alpha internal consistency and inter-item correlation values appear on Appendix H. A one way ANOVA and ANCOVA where the two groups' post test means were compared but adjusting them for the pretest (as covariate) were computed to determine if group/time differences exist for all the health-related physical fitness components. A dependent t-test was then performed for the two groups to identify significant differences between pre and post intervention means of the health related physical fitness components. According to Thomas et al., (2005), a t-test is a statistical technique used to assess differences between dependent samples (the groups at pre and post testing). Significance was set at ( $p < 0.05$ ).

The next chapter deals with results:

## **CHAPTER FIVE**

### **RESULTS**

#### **INTRODUCTION**

The first area of focus of this study was to investigate the effect of a 10-week stick fighting intervention programme on motor proficiency of prepubescent Zulu boys who received training in stick fighting. These results were compared to motor proficiency of prepubescent Zulu boys who had not received training in stick fighting. The aim was to determine whether traditional Zulu stick-fighting training has an influence on motor proficiency. The second area of focus of the study was to establish whether participating in a stick fighting intervention programme would benefit and lead to anthropometrical improvements and health-related physical fitness parameters such as body composition, cardiovascular fitness, flexibility, muscular endurance and muscular strength.

The subjects of this study were purposively labelled as either experimental or control group. The two groups were treated identically except that the experimental group underwent a 10-week Zulu stick fighting intervention programme. A major concern for the researcher was to adequately demonstrate that the two groups were comparable at pre-intervention testing. This concern was adequately handled by firstly, comparing the group's pre-intervention physical characteristics, pre-intervention motor proficiency and health-related physical fitness scores. The results and discussion are arranged under the following main headings to facilitate clarity of thought and ease data presentation: physical characteristics (anthropometry), motor proficiency and health-related physical fitness.

## 5.1 PHYSICAL CHARACTERISTICS OF EXPERIMENTAL AND CONTROL GROUP

The physical characteristics of both the experimental (n = 22) and control group (n = 23) at pre-intervention testing are presented in Table 5.

**Table 5: PHYSICAL CHARACTERISTICS OF THE EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) AT PRE-INTERVENTION TESTING**

Characteristic	Test	Data	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Age (years)	Pre		9.80 $\pm$ 0.64	10.09 $\pm$ 0.73	+ 0.29	2.96	p = 0.1645
		Min-Max	8.60-11.10	8.43-11.70			
Stature (cm)	Pre		129.93 $\pm$ 6.16	132.78 $\pm$ 5.52	+ 2.85	2.19	p = 0.1105
		Min-Max	113.0-139.50	123.50-144.00			
Mass (kg)	Pre		27.16 $\pm$ 2.99	29.16 $\pm$ 4.48	+ 2	7.36	p = 0.0852
		Min-Max	20.70-34.20	21.20-39.10			

\* statistically significant (p < 0.05)

At pre-intervention testing, the mean age of the control group was 10.09  $\pm$  0.73 years, the youngest being 8.43 years and the oldest being 11.70 years. The mean age of the experimental group was 9.80 years, the youngest being 8.60 years and the oldest being 11.10 years. There were no significant differences in age between the experimental and the control group at pre-intervention testing. The control group were on average taller at 132.78  $\pm$  5.52 cm than the experimental group who measured 129.93  $\pm$  6.16 cm. There were no significant differences in stature between the experimental and the control group. The control group were on average heavier at 29.16  $\pm$  4.48 kg than the experimental group who measured 27.16  $\pm$  2.99 kg. There were no significant differences in terms of

mass between the experimental and the control group. The main objective of the pre-intervention tests was to determine whether any significant differences were present in the physical characteristics between the groups which would make it difficult to do comparisons with results of the post-intervention test. The absence of significant differences at pre-intervention testing is due to the selection of subjects from communities with similar socio-economic conditions and the strict adherence to the age targeted at the commencement of the study.

## **5.2 MOTOR PROFICIENCY**

### **5.2.1 Running speed and agility subtest**

No significant differences were found in the pre-intervention running speed and agility subtest of the experimental and control groups (Table 6). The post-intervention results indicated a significant difference between the experimental and control group of 19.18%. No significant differences were found in the post-post intervention test scores. The Cronbach's Alpha values for running speed and agility at pre-intervention are 0.18 for the experimental group, 0.41 for the control group. At post-intervention, the Cronbach's Alpha values are 0.32 and 0.49 respectively. At post-post intervention, the values are 0.47 for the experimental group and 0.56 for the control group.

**Table 6: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS AT PRE, POST AND POST-POST INTERVENTION: RUNNING SPEED AND AGILITY**

<b>Test Interval</b>	<b>Experimental Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
<b>PRE</b>	7.18 ± 1.10	7.39 ± 1.16	+ 0.21	2.93	p = 0.5368
<b>POST</b>	7.77 ± 1.69	9.26 ± 0.96	+ 1.49	19.18	<b>p = 0.0007*</b>
<b>POST-POST</b>	9.00 ± 1.66	8.35 ± 1.34	0.65	7.22	p = 0.1530

\* statistically significant (p < 0.05)

The running speed and agility subtest of the experimental group indicated no significant difference between the pre-intervention and post-intervention scores (Table 7). The post-intervention and post-post intervention test scores indicated a significant difference of 15.83%. The analyses of pre-intervention and post-post intervention test scores resulted in a significant difference of 25.35%.

**Table 7: COMPARISON OF EXPERIMENTAL (n = 22) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: RUNNING SPEED AND AGILITY**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
7.18 ± 1.10	7.77 ± 1.69		+ 0.59	8.22	p = 0.6430
	7.77 ± 1.69	9.00 ± 1.66	+ 1.23	15.83	<b>p = 0.0366*</b>
7.18 ± 1.10		9.00 ± 1.66	+ 1.82	25.35	<b>p = 0.0010*</b>

\* statistically significant (p < 0.05)

The running speed and agility subtest of the control group indicated significant differences between the pre-intervention and post-intervention scores (Table 8). The post-intervention and post-post intervention test scores indicated a significant difference of 9.83%. The analyses of pre-intervention and post-post intervention test scores resulted in a significant difference of 12.99%.

**Table 8: COMPARISON OF CONTROL (n = 23) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: RUNNING SPEED AND AGILITY**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
7.39 ± 1.16	9.26 ± 0.96		+ 1.87	25.30	<b>p = 0.0000*</b>
	9.26 ± 0.96	8.35 ± 1.34	0.91	9.83	<b>p = 0.0421*</b>
7.39 ± 1.16		8.35 ± 1.34	+ 0.96	12.99	<b>p = 0.0309*</b>

\* statistically significant (p < 0.05)

### **5.2.2 Balance subtest**

The balance subtest scores of the experimental and control groups indicated significant differences at all test intervals (Table 9). The Cronbach's Alpha values for balance at pre-intervention are 0.38 for the experimental group, 0.44 for the control group. At post-intervention, the Cronbach's Alpha values are 0.45 and 0.44 respectively. At post-post intervention, the values are 0.47 for the experimental group and 0.40 for the control group.

**Table 9: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS AT PRE, POST AND POST-POST INTERVENTION: BALANCE**

<b>Test Interval</b>	<b>Experimental Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
<b>PRE</b>	6.86 ± 2.51	8.61 ± 1.85	+ 1.75	20.51	<b>p = 0.0109*</b>
<b>POST</b>	10.05 ± 0.49	7.52 ± 1.33	2.53	25.17	<b>p = 0.0000*</b>
<b>POST-POST</b>	9.91 ± 0.75	7.91 ± 0.29	2	20.18	<b>P = 0.0000*</b>

\* statistically significant (p < 0.05)

The balance pre-intervention and post intervention subtest scores of the experimental group indicated a significant difference of 46.50% (Table 10). No significant differences between the post-intervention and post-post intervention were found. An analysis of the pre-intervention and post-post intervention yielded a significant difference of 44.46%.

**Table 10: COMPARISON OF EXPERIMENTAL (n = 22) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKSS-OSERETSKY MOTOR PROFICIENCY RESULTS: BALANCE**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
6.86 ± 2.51	10.05 ± 0.49		+ 3.19	46.50	<b>p = 0.0000*</b>
	10.05 ± 0.49	9.91 ± 0.75	0.14	1.39	p = 1.0000
6.86 ± 2.51		9.91 ± 0.75	+ 3.05	44.46	<b>p = 0.0000*</b>

\*statistically significant (p < 0.05)

The balance pre-intervention and post intervention subtest scores of the control group indicated a significant difference of 12.66% (Table 11). No significant differences between the post-intervention and post-post intervention were found. An analysis of the pre-intervention and post-post intervention yielded no significant differences.

**Table 11: COMPARISON OF CONTROL (n = 23) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: BALANCE**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
8.61 ± 1.85	7.52 ± 1.33		1.09	12.66	<b>p = 0.0164*</b>
	7.52 ± 1.33	7.91 ± 0.29	+ 0.39	5.19	p = 0.8961
8.61 ± 1.85		7.91 ± 0.29	0.70	8.13	p = 0.2046

\*statistically significant (p < 0.05)

### **5.2.3 Bilateral coordination subtest**

No significant differences were found in the pre-intervention bilateral coordination subtest between the experimental and control groups (Table 12). The post-intervention results indicated a significant difference between the experimental and control group of 17.43%. The analyses of post-post intervention test scores resulted in a significant difference of 15.65%. The Cronbach's Alpha values for bilateral coordination at pre-intervention are 0.35 for the experimental group, 0.48 for the control group. At post-intervention, the Cronbach's Alpha values are 0.46 and 0.49 respectively. At post-post intervention, the values are 0.34 for the experimental group and 0.36 for the control group.

**Table 12: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS AT PRE, POST AND POST-POST INTERVENTION: BILATERAL COORDINATION**

Test Interval	Experimental Mean ± SD	Control Mean ± SD	Diff	% Diff	Statistical Difference
PRE	2.73 ± 0.98	2.52 ± 0.51	0.21	7.69	p = 0.3812
POST	3.27 ± 0.83	2.70 ± 0.56	0.57	17.43	<b>p = 0.0085*</b>
POST-POST	3.45 ± 0.67	2.91 ± 0.67	0.54	15.65	<b>p = 0.0095*</b>

\*statistically significant (p < 0.05)

The bilateral coordination pre-intervention and post intervention subtest scores of the experimental group indicated no significant differences (Table 13). No significant differences between the post-intervention and post-post intervention were found. A significant difference of 26.37% was found between the pre-intervention and post-post intervention scores of the experimental group.

**Table 13: COMPARISON OF EXPERIMENTAL (n = ) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: BILATERAL COORDINATION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
2.73 ± 0.98	3.27 ± 0.83		+ 0.54	19.78	p = 0.0717
	3.27 ± 0.83	3.45 ± 0.67	+ 0.18	5.51	p = 1.0000
2.73 ± 0.98		3.45 ± 0.67	+ 0.72	26.37	<b>p = 0.0096*</b>

\*statistically significant (p < 0.05)

The bilateral coordination pre-intervention and post intervention subtest scores of the control group indicated no significant differences (Table 14). No significant differences between the post-intervention and post-post intervention were found. An analysis of the pre-intervention and post-post intervention yielded no significant differences.

**Table 14: COMPARISON OF CONTROL (n = 23) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS; BILATERAL COORDINATION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
2.52 ± 0.51	2.70 ± 0.56		+ 0.18	7.14	p = 0.8458
	2.70 ± 0.56	2.91 ± 0.67	+ 0.21	7.78	p = 0.5407
2.52 ± 0.51		2.91 ± 0.67	+ 0.39	15.48	p = 0.0548

\* statistically significant (p < 0.05)

#### **5.2.4 Strength**

The strength subtest scores of the experimental and control groups indicated no significant differences at all test intervals (Table 15). The Cronbach's Alpha values for strength at pre-intervention are 0.29 for the experimental group, 0.46 for the control group. At post-intervention, the Cronbach's Alpha values are 0.55 and 0.46 respectively. At post-post intervention, the values are 0.35 for the experimental group and 0.42 for the control group.

**Table 15: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS AT PRE, POST AND POST-POST INTERVENTION: STRENGTH**

<b>Test Interval</b>	<b>Experimental Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
<b>PRE</b>	5.73 ± 2.35	5.35 ± 1.67	0.38	6.63	p = 0.5345
<b>POST</b>	7.18 ± 3.59	7.39 ± 1.16	+ 0.21	2.93	p = 0.7918
<b>POST-POST</b>	7.64 ± 1.40	8.17 ± 1.11	+ 0.53	6.94	p = 0.1601

\* statistically significant (p < 0.05)

The strength pre-intervention and post intervention subtest scores of the experimental group indicated no significant differences (Table 16). No significant differences between the post-intervention and post-post intervention were found. An analysis of the pre-intervention and post-post intervention yielded a significant difference of 33.33%.

**Table 16: COMPARISON OF EXPERIMENTAL (n = 22) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: STRENGTH**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
5.73 ± 2.35	7.18 ± 3.59		+ 1.45	25.31	p = 0.1576
	7.18 ± 3.59	7.64 ± 1.40	+ 0.46	6.41	p = 1.0000
5.73 ± 2.35		7.64 ± 1.40	+ 1.91	33.33	<b>p = 0.0366*</b>

\*statistically significant (p < 0.05)

The strength pre-intervention and post intervention subtest scores of the control group indicated significant differences (Table 17). No significant differences between the post-intervention and post-post intervention were found. An analysis of the pre-intervention and post-post intervention yielded a significant difference of 52.71%.

**Table 17: COMPARISON OF CONTROL (n = 23) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: STRENGTH**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
5.35 ± 1.67	7.39 ± 1.16		+ 2.04	38.18	<b>p = 0.0000*</b>
	7.39 ± 1.16	8.17 ± 1.11	+ 0.78	10.56	p = 0.0697
5.35 ± 1.67		8.17 ± 1.11	+ 2.82	52.71	<b>p = 0.0000*</b>

\* statistically significant (p < 0.05)

### **5.2.5 Upper limb coordination**

No significant differences were found in the pre-intervention upper limb coordination subtest of the experimental and control groups (Table 18). The post-intervention results indicated a significant difference between the experimental and control group of 19.94%. The analyses of post-post intervention test scores resulted in no significant differences. The Cronbach's Alpha values for upper limb coordination at pre-intervention are 0.33 for the experimental group, 0.47 for the control group. At post-intervention, the Cronbach's Alpha values are 0.46 and 0.47 respectively. At post-post intervention, the values are 0.45 for the experimental group and 0.40 for the control group.

**Table 18: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS AT PRE, POST AND POST-POST INTERVENTION: UPPER LIMB COORDINATION**

<b>Test Interval</b>	<b>Experimental Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
<b>PRE</b>	3.82 ± 0.85	3.74 ± 0.75	0.08	2.09	p = 0.7428
<b>POST</b>	3.41 ± 0.80	4.09 ± 0.79	+ 0.68	19.94	<b>p = 0.0064*</b>
<b>POST-POST</b>	4.73 ± 1.08	4.83 ± 1.34	+ 0.10	2.11	p = 0.7866

\* statistically significant (p < 0.05)

The upper limb coordination pre-intervention and post intervention subtest scores of the experimental group indicated no significant differences (Table 19). The post-intervention results indicated a significant difference of 38.71%. An analysis of the pre-intervention and post-post intervention yielded a significant difference of 23.82%.

**Table 19: COMPARISON OF EXPERIMENTAL (n = 22) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: UPPER LIMB COORDINATION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
3.82 ± 0.85	3.41 ± 0.80		0.41	10.73	p = 0.5042
	3.41 ± 0.80	4.73 ± 1.08	+ 1.32	38.71	<b>p = 0.0001*</b>
3.82 ± 0.85		4.73 ± 1.08	+ 0.91	23.82	<b>p = 0.0098*</b>

\* statistically significant (p < 0.05)

The upper limb coordination pre-intervention and post intervention subtest scores of the control group indicated no significant differences (Table 20). The post-intervention results indicated a significant difference of 18.09%. An analysis of the pre-intervention and post-post intervention yielded a significant difference of 29.14%.

**Table 20: COMPARISON OF CONTROL (n = 23) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: UPPER LIMB COORDINATION**

PRE Mean ± SD	POST Mean ± SD	POST-POST Mean ± SD	Diff	% Diff	Statistical Difference
3.74 ± 0.75	4.09 ± 0.79		+ 0.35	9.36	p = 0.6180
	4.09 ± 0.79	4.83 ± 1.34	+ 0.74	18.09	<b>p = 0.0273*</b>
3.74 ± 0.75		4.83 ± 1.34	+ 1.09	29.14	<b>p = 0.0006*</b>

\* statistically significant (p < 0.05)

### 5.2.6 Response speed

The response speed subtest scores of the experimental and control groups indicated no significant differences at all test intervals (Table 21). The Cronbach's Alpha values for response speed at pre-intervention are 0.05 for the experimental group, 0.39 for the control group. At post-intervention, the Cronbach's Alpha values are 0.48 and 0.39 respectively. At post-post intervention, the values are 0.13 for the experimental group and 0.00 for the control group.

**Table 21: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS AT PRE, POST AND POST-POST INTERVENTION: RESPONSE SPEED**

<b>Test Interval</b>	<b>Experimental Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
<b>PRE</b>	8.45 ± 3.33	9.35 ± 2.55	+ 0.9	10.66	p = 0.3171
<b>POST</b>	8.05 ± 3.50	7.83 ± 3.28	0.22	2.73	p = 0.8292
<b>POST-POST</b>	9.52 ± 2.27	9.48 ± 3.04	0.04	0.42	p = 0.9557

\* statistically significant (p < 0.05)

The response speed pre-intervention and post intervention subtest scores of the experimental group indicated no significant differences (Table 22). The post-intervention and post-post results indicated a significant difference of 18.26%. The analyses of pre intervention and post-post intervention test scores resulted in no significant differences.

**Table 22: COMPARISON OF EXPERIMENTAL (n = 22) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SOCRES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: RESPONSE SPEED**

PRE Mean ± SD	POST Mean ± SD	POST-POST Mean ± SD	Diff	% Diff	Statistical Difference
8.45 ± 3.33	8.05 ± 3.50		0.4	4.73	p =1.0000
	8.05 ± 3.50	9.52 ± 2.27	+ 1.47	18.26	<b>p = 0.0495*</b>
8.45 ± 3.33		9.52 ± 2.27	+ 1.07	12.66	p =0.2727

\* statistically significant (p < 0.05)

The response speed pre-intervention and post intervention subtest scores of the control group indicated no significant differences (Table 23). The post-intervention and post-post results indicated no significant difference. The analyses of pre intervention and post-post intervention test scores resulted in no significant differences.

**Table 23: COMPARISON OF CONTROL (n = 23) PRE AND POST; POST AND POST-POST AND PREA AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: RESPONSE SPEED**

PRE Mean ± SD	POST Mean ± SD	POST-POST Mean ± SD	Diff	% Diff	Statistical Difference
9.35 ± 2.55	7.83 ± 3.28		1.52	16.26	p = 0.0909
	7.83 ± 3.28	9.48 ± 3.04	+ 1.65	21.07	p = 0.0577
9.35 ± 2.55		9.48 ± 3.04	+ 0.13	1.39	p = 1.0000

\* statistically significant (p < 0.05)

### 5.2.7 Visual motor control

No significant differences were found in the pre-intervention visual motor control subtest of the experimental and control groups (Table 24). The post-intervention results indicated a significant difference between the experimental and control group of 10.09%. The analyses of post-post intervention test scores resulted in a significant difference of 15.11%. The Cronbach's Alpha values for visual motor control at pre-intervention are 0.32 for the experimental group, 0.52 for the control group. At post-intervention, the Cronbach's Alpha values are 0.47 and 0.45 respectively. At post-post intervention, the values are 0.41 for the experimental group and 0.42 for the control group.

**Table 24: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS AT PRE, POST AND POST-POST INTERVENTSION: VISUAL MOTOR CONTROL**

<b>Test Interval</b>	<b>Experimental Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
<b>PRE</b>	6.09 ± 1.27	5.52 ± 0.85	0.57	9.36	p = 0.0825
<b>POST</b>	5.45 ± 0.96	6.00 ± 0.74	+ 0.55	10.09	<b>p = 0.0381*</b>
<b>POST-POST</b>	5.36 ± 1.09	6.17 ± 0.65	+ 0.81	15.11	<b>p = 0.0040*</b>

\* statistically significant (p < 0.05)

The visual motor control pre-intervention and post intervention subtest scores of the experimental group indicated no significant differences (Table 25). The post-intervention and post-post intervention results indicated no significant difference. The analyses of pre intervention and post-post intervention test scores resulted in a significant difference of 11.99%.

**Table 25: COMPARISON OF EXPERIMENTAL (n = 22) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: VISUAL MOTOR CONTROL**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
6.09 ± 1.27	5.45 ± 0.96		0.64	10.51	p = 0.0943
	5.45 ± 0.96	5.36 ± 1.09	0.09	1.65	p = 1.0000
6.09 ± 1.27		5.36 ± 1.09	0.73	11.99	<b>p = 0.0441*</b>

\* statistically significant (p < 0.05)

The visual motor control pre-intervention and post intervention subtest scores of the control group indicated no significant differences (Table 26). The post-intervention and post-post intervention results indicated no significant difference. The analyses of pre intervention and post-post intervention test scores resulted in a significant difference of 11.78%.

**Table 26: COMPARISON OF CONTROL (n = 23) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: VISUAL MOTOR CONTROL**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
5.52 ± 0.85	6.00 ± 0.74		+ 0.48	8.70	p = 0.0680
	6.00 ± 0.74	6.17 ± 0.65	+ 0.17	2.83	p = 1.0000
5.52 ± 0.85		6.17 ± 0.65	+ 0.65	11.78	<b>p = 0.0072*</b>

\* statistically significant (p < 0.05)

### **5.2.8 Upper limb speed and dexterity**

No significant differences were found in the pre-intervention upper limb dexterity subtest of the experimental and control groups (Table 27). The post-intervention results indicated a significant difference between the experimental and control group of 24.17%. The analyses of post-post intervention test scores resulted in no significant difference. The Cronbach's Alpha values for upper limb speed and dexterity at pre-intervention are 0.32 for the experimental group, 0.38 for the control group. At post-intervention, the Cronbach's Alpha values are 0.36 and 0.42 respectively. At post-post intervention, the values are 0.39 for the experimental group and 0.26 for the control group.

**Table 27: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS AT PRE, POST AND POST-POST INTERVENTION: UPPER LIMB SPEED DEXTERITY**

<b>Test Interval</b>	<b>Experimental Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
<b>PRE</b>	5.91 ± 2.07	6.17 ± 1.64	+ 0.26	4.40	p = 0.6358
<b>POST</b>	8.77 ± 2.62	6.65 ± 1.94	2.12	24.17	<b>p = 0.0034*</b>
<b>POST-POST</b>	8.68 ± 2.34	8.39 ± 2.15	0.29	3.34	p = 0.6661

\* statistically significant (p < 0.05)

The upper limb speed dexterity pre-intervention and post intervention subtest scores of the experimental group indicated a significant difference of 48.39% (Table 28). The post-intervention and post-post intervention results indicated no significant difference. The analyses of pre intervention and post-post intervention test scores resulted in a significant difference of 46.88%.

**Table 28: COMPARISON OF EXPERIMENTAL (n = 22) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS: UPPER LIMB SPEED DEXTERITY**

<b>Pre Mean ± SD</b>	<b>Post Mean ± SD</b>	<b>Post-Post Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
5.91 ± 2.07	8.77 ± 2.62		+ 2.86	48.39	<b>p = 0.0000*</b>
	8.77 ± 2.62	8.68 ± 2.34	0.09	1.03	p = 1.0000
5.91 ± 2.07		8.68 ± 2.34	+ 2.77	46.88	<b>p = 0.0000*</b>

\* statistically significant (p < 0.05)

The upper limb speed dexterity pre-intervention and post intervention subtest scores of the control group indicated no significant differences (Table 29). The post-intervention and post-post intervention results indicated a significant difference of 26.16%. The analyses of pre intervention and post-post intervention test scores resulted in a significant difference of 35.98%.

**Table 29: COMPARISON OF CONTROL (n = 23) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN SCORES FOR THE BRUINNINKS OSERETSKY MOTOR PROFICIENCY RESULTS: UPPER LIMB SPEED DEXTERITY**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
6.17 ± 1.64	6.65 ± 1.94		+ 0.48	7.78	p = 0.9188
	6.65 ± 1.94	8.39 ± 2.15	+ 1.74	26.16	<b>p = 0.0014*</b>
6.17 ± 1.64		8.39 ± 2.15	+ 2.22	35.98	<b>p = 0.0000*</b>

\* statistically significant (p < 0.05)

### **5.2.9 Motor proficiency composite scores**

No significant differences were found in the pre-intervention Bruininks-Oseretsky composite scores of the experimental and control groups (Table 30). The post-intervention results indicated a significant difference between the experimental and control group of 7.63%. The analyses of post-post intervention test scores resulted in a significant difference of 5.48%. The inter-item correlation value at pre-intervention is 0.06. At post-intervention, the value is 0.08. At post-post intervention, the value is 0.07.

**Table 30: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY COMPOSITE SCORE AT PRE, POST AND POST-POST INTERVENTION**

Test Interval		Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Pre		46.77 $\pm$ 6.66	48.64 $\pm$ 5.65	+ 1.87	3.99	p = 0.3124
	Min- Max	36.00-66.00	41.00-61.00			
Post		55.68 $\pm$ 8.16	51.43 $\pm$ 5.56	4.25	7.63	<b>p = 0.0465*</b>
	Min- Max	41.00-71.00	41.00-62.00			
Post-Post		59.68 $\pm$ 5.63	56.41 $\pm$ 5.85	3.27	5.48	<b>p = 0.0493*</b>
	Min- Max	47.00-71.00	44.00-68.00			

\* statistically significant (p < 0.05)

The pre-intervention and post-intervention mean composite scores of the experimental group indicated significant differences of 19.05% (Table 31). The post-intervention and post-post intervention results indicated a significant difference of 7.18%. The analyses of pre intervention and post-post intervention test scores resulted in a significant difference of 27.60%.

**Table 31: COMPARISON OF EXPERIMENTAL (n = 22) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN COMPOSITE SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
46.77 ± 6.66	55.68 ± 8.16		8.91	19.05	<b>p = 0.0000*</b>
	55.68 ± 8.16	59.68 ± 5.63	4.00	7.18	<b>p = 0.0332*</b>
46.77 ± 6.66		59.68 ± 5.63	12.91	27.60	<b>p = 0.0000*</b>

\* statistically significant (p < 0.05)

The pre-intervention and post-intervention mean composite scores of the experimental group indicated no significant differences (Table 32). The post-intervention and post-post intervention results indicated a significant difference of 9.68%. The analyses of pre intervention and post-post intervention test scores resulted in a significant difference of 15.98%.

**Table 32: COMPARISON OF CONTROL (n = 23) PRE AND POST; POST AND POST-POST AND PRE AND POST-POST INTERVENTION MEAN COMPOSITE SCORES FOR THE BRUINNINKS-OSERETSKY MOTOR PROFICIENCY RESULTS**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>POST-POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
48.64 ± 5.65	51.43 ± 5.56		2.79	5.74	p = 0.0593
	51.43 ± 5.56	56.41 ± 5.85	4.98	9.68	<b>p = 0.0004*</b>
48.64 ± 5.65		56.41 ± 5.85	7.77	15.98	<b>p = 0.0000*</b>

\* statistically significant (p < 0.05)

## **5.3 HEALTH RELATED PHYSICAL FITNESS**

### **5.3.1 Body composition**

The body fat percentage of the experimental and control groups indicated significant differences between the body fat post-test means after adjusting for the experimental group pre-test values (Table 33).

**Table 33: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR BODY FAT % AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Pre	Body fat percentage (%)	12.43 $\pm$ 1.83	12.07 $\pm$ 3.43	0.36	2.90	<b>p = 0.0397*</b>
	Min-Max	8.80-15.80	8.80-22.40			
Post	Body fat percentage (%)	11.61 $\pm$ 2.62	12.38 $\pm$ 3.15	+ 0.69	5.94	
	Min-Max	7.70-18.07	8.32-22.30			

\* statistically significant ( $p < 0.05$ )

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 6.60% (Table 34).

**Table 34: EXPERIMENTAL (n = 22) MEAN SCORES FOR BODY FAT AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
12.43 ± 1.83	11.61 ± 2.62	0.82	6.60	p = 0.2370

The pre-intervention and post-intervention mean composite scores of the control group indicated non-significant differences of 2.57% (Table 35).

**Table 35: CONTROL (n = 23) MEAN SCORES FOR BODY FAT AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
12.07 ± 3.43	12.38 ± 3.15	+ 0.31	2.57	p=0.7523

The sum of skinfolds of the experimental and control groups indicated significant differences between the sum of skinfolds post-test means after adjusting for the experimental pre-test values (Table 36).

**Table 36: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR SUM OF SKINFOLDS AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Pre	Sum of Skinfolds (mm)	28.70 $\pm$ 5.23	28.89 $\pm$ 10.48	+ 0.19	0.66	<b>p = 0.0183*</b>
	Min-Max	19.00-38.00	38.00-65.00			
Post	Sum of Skinfolds (mm)	27.32 $\pm$ 4.70	29.52 $\pm$ 9.67	+ 2.19	8.05	
	Min-Max	19.00-36.00	20.00-64.50			

\* statistically significant ( $p < 0.05$ )

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 4.81% (Table 37).

**Table 37: EXPERIMENTAL (n = 22) MEAN SCORES FOR SUM OF SKINFOLDS AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
28.70 ± 5.23	27.32 ± 4.70	1.38	4.81	p = 0.3001

The pre-intervention and post-intervention mean composite scores of the control group indicated non-significant differences of 2.18% (Table 38).

**Table 38: CONTROL (n = 23) MEAN SCORES FOR SUM OF SKINFOLDS AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
28.89 ± 0.48	29.52 ± 9.67	+ 0.63	2.18	p = 0.8330

The lean body mass of the experimental and control groups indicated significant differences between the lean body mass post-test means after adjusting for the experimental pre-test values (Table 39).

**Table 39: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR LEAN BODY MASS (LBM) AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Pre	Lean Body Mass (kg)	23.75 $\pm$ 2.34	25.53 $\pm$ 3.31	+ 1.78	7.50	<b>p = 0.0001*</b>
	Min-Max	18.44-28.79	18.99-30.61			
Post	Lean Body Mass (kg)	24.66 $\pm$ 1.93	26.41 $\pm$ 3.42	+ 1.75	7.09	
	Min-Max	20.30-28.02	20.05-30.97			

\* statistically significant ( $p < 0.05$ )

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 3.83% (Table 40).

**Table 40: EXPERIMENTAL (n = 22) MEAN SCORES FOR LEAN BODY MASS AT PRE AND POST INTERVENTION**

PRE Mean $\pm$ SD	POST Mean $\pm$ SD	Diff	% Diff	Statistical Difference
23.75 $\pm$ 2.34	24.66 $\pm$ 1.93	+ 0.91	3.83	p = 0.1682

The pre-intervention and post-intervention mean composite scores of the control group indicated non-significant differences of 3.45% (Table 41).

**Table 41: CONTROL (n = 23) MEAN SCORES FOR LEAN BODY MASS AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
25.53 ± 3.31	26.41 ± 3.42	+ 0.88	3.45	p = 0.3797

The fat mass of the experimental and control groups indicated significant differences between the fat mass post-test means after adjusting for the experimental pre-test values (Table 42).

**Table 42: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR FAT MASS AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Pre	Fat mass (kg)	3.40 $\pm$ 0.79	3.61 $\pm$ 1.57	+ 0.21	6.18	<b>p = 0.0275*</b>
	Min-Max	2.25-5.40	1.57-2.20			
Post	Fat mass (kg)	3.29 $\pm$ 1.01	3.83 $\pm$ 1.51	+ 0.54	16.41	
	Min-Max	1.69-6.17	1.51-2.14			

\* statistically significant ( $p < 0.05$ )

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 3.24% (Table 43).

**Table 43: EXPERIMENTAL (n = 22) MEAN SCORES FOR FAT MASS AT PRE AND POST INTERVENTION**

PRE Mean $\pm$ SD	POST Mean $\pm$ SD	Diff	% Diff	Statistical Difference
3.40 $\pm$ 0.79	3.29 $\pm$ 1.01	0.11	3.24	p = 0.6875

The pre-intervention and post-intervention mean composite scores of the control group indicated non-significant differences of 6.09% (Table 44).

**Table 44: CONTROL (n = 23) MEAN SCORES FOR FAT MASS AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
3.61 ± 1.57	3.83 ± 1.51	+ 0.22	6.09	p = 0.6391

The body mass index of the experimental and control groups indicated no significant differences between the body mass index post-test means after adjusting for the experimental pre-test values (Table 45).

**Table 45: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR BODY MASS INDEX AT PRE AND POST INTERVENTION**

<b>Test Interval</b>	<b>Data</b>	<b>Experimental Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
Pre	Body Mass Index (kg.m <sup>-2</sup> )	16.07 ± 1.21	16.50 ± 2.19	+ 0.43	2.68	p=0.5213
	Min-Max	13.85-18.14	18.14-18.25			
Post	Body Mass Index (kg.m <sup>-2</sup> )	16.24 ± 1.12	16.51 ± 2.03	+ 0.27	1.66	
	Min-Max	13.99-23.67	13.88-23.49			

\* statistically significant (p < 0.05)

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 1.06% (Table 46).

**Table 46: EXPERIMENTAL (n = 22) MEAN SCORES FOR BODY MASS INDEX AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
16.07 ± 1.21	16.24 ± 1.12	+ 0.17	1.06	p = 0.6275

The pre-intervention and post-intervention mean composite scores of the control group indicated non-significant differences of 0.06% (Table 47).

**Table 47: CONTROL (n = 23) MEAN SCORES FOR BODY MASS INDEX AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
16.50 ± 2.19	16.51 ± 2.03	0.01	0.06	p = 0.9903

The waist-to-hip ratio of the experimental and control groups indicated no significant differences between the waist-to-hip post-test means after adjusting for the experimental pre-test values (Table 48).

**Table 48: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR WAIST TO HIP RATION AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Pre	Waist to Hip ratio	0.82 $\pm$ 0.07	0.79 $\pm$ 0.04	0.03	3.66	p = 0.6129
	Min-Max	0.70-1.00	0.70-0.90			
Post	Waist to Hip ratio	0.80 $\pm$ 0.05	0.79 $\pm$ 0.03	0.01	1.25	
	Min- Max	0.70-0.90	0.70-0.80			

\* statistically significant ( $p < 0.05$ )

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 2.44% (Table 49).

**Table 49: EXPERIMENTAL (n = 22) MEAN SCORES FOR WAIST -TO-HIP RATION AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
0.82 ± 0.07	0.80 ± 0.05	0.02	2.44	p = 0.2268

The pre-intervention and post-intervention mean composite scores of the control group indicated non-significant differences (Table 50).

**Table 50: CONTROL (n = 23) MEAN SCORES FOR WAIST-TO-HIP RATIO AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
0.79 ± 0.04	0.79 ± 0.03	0	0	p= 1

The body mass of the experimental and control groups indicated no significant differences between the body mass post-test means after adjusting for the experimental pre-test values (Table 51).

**Table 51: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR BODY MASS AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean ± SD	Control Mean ± SD	Diff	% Diff	Statistical Difference
Pre	Mass (kg)	27.16 ± 2.99	29.16 ± 4.48	2	7.36	p = 0.2187
	Min-Max	20.70-34.20	21.20-39.10			
Post	Mass (kg)	27.96 ± 2.68	30.25 ± 4.55	2.29	8.19	
	Min- Max	22.00-34.20	22.40-39.70			

p < 0.05

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 2.95% (Table 52).

**Table 52: EXPERIMENTAL (n = 22) MEAN SCORES FOR BODY MASS AT PRE AND POST INTERVENTION**

PRE Mean ± SD	POST Mean ± SD	Diff	% Diff	Statistical Difference
27.16 ± 2.99	27.96 ± 2.68	+ 0.80	2.95	p = 0.3558

The pre-intervention and post-intervention mean composite scores of the control group indicated non-significant differences of 3.74% (Table 53).

**Table 53: CONTROL (n = 23) MEAN SCORES FOR BODY MASS AT PRE AND POST INTERVENTION**

PRE Mean ± SD	POST Mean ± SD	Diff	% Diff	Statistical Difference
29.16 ± 4.48	30.25 ± 4.55	+ 1.09	3.74	p = 0.4151

### 5.3.2 Cardiovascular fitness

The shuttle levels of the experimental and control groups yielded a significant difference between the shuttle levels post-test means after adjusting for the experimental pre-test values (Table 54).

**Table 54: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR MST SHUTTLE LEVELS AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean ± SD	Control Mean ± SD	Diff	% Diff	Statistical Difference
Pre	Shuttle level	5.18 ± 1.13	4.38 ± 0.48	0.80	15.44	<b>p = 0.0000*</b>
	Min-Max	2.30-7.20	3.20-5.20			
Post	Shuttle level	7.87 ± 1.41	5.20 ± 0.93	2.67	33.93	
	Min- Max	7.80-10.90	2.80-6.90			

\* statistically significant (p < 0.05)

The pre-intervention and post-intervention mean composite scores of the experimental group indicated significant differences of 51.93% (Table 55).

**Table 55: EXPERIMENTAL (n = 22) MEAN SCORES FOR 20 MST SHUTTLE LEVELS AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
5.18 ± 1.13	7.87 ± 1.41	+ 2.69	51.93	<b>p = 0.0000*</b>

The pre-intervention and post-intervention mean composite scores of the control group indicated significant differences of 3.74% (Table 56).

**Table 56: CONTROL (n = 23) MEAN SCORES FOR 20 MST SHUTTLE LEVELS AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
4.38 ± 0.48	5.20 ± 0.93	+ 0.82	18.72	<b>p = 0.0004*</b>

The predicted maximal oxygen uptake of the experimental and control groups yielded a significant difference between the predicted maximal oxygen uptake post-test means after adjusting for the experimental pre-test values (Table 57).

**Table 57: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR PREDIDTED MAXIMAL OXYGEN UPTAKE AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Pre	Predicted maximal oxygen uptake (kg.ml.min <sup>-1</sup> )	30.41 $\pm$ 3.76	27.58 $\pm$ 1.66	2.83	9.31	<b>p = 0.0029*</b>
	Min- Max	20.43-37.00	23.41-30.25			
Post	Predicted maximal oxygen uptake (kg.ml.min <sup>-1</sup> )	39.11 $\pm$ 5.50	30.40 $\pm$ 3.13	8.71	22.27	
	Min- Max	27.22-49.54	22.63-36.20			

\* statistically significant (p < 0.05)

The pre-intervention and post-intervention mean composite scores of the experimental group indicated significant differences of 28.61% (Table 58).

**Table 58: EXPERIMENTAL (n = 22) MEAN SCORES FOR PREDICTED MAXIMAL OXYGEN UPTAKE AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
30.41 ± 3.76	39.11 ± 5.50	+ 8.70	28.61	<b>p = 0.0000*</b>

The pre-intervention and post-intervention mean composite scores of the control group indicated significant differences of 10.55% (Table 59).

**Table 59: CONTROL (n = 23) MEAN SCORES FOR PREDICTED MAXIMAL OXYGEN UPTAKE AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
27.58 ± 1.66	30.40 ± 3.13	+ 2.82	10.22	<b>p = 0.0004*</b>

### 5.3.3 Flexibility

The flexibility of the experimental and control groups yielded a significant difference between the post-test means after adjusting for the experimental pre-test values (Table 60).

**Table 60: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR FLEXIBILITY AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Pre	Flexibility (cm)	5.25 $\pm$ 5.10	6.37 $\pm$ 4.78	+ 1.12	21.33	<b>p = 0.0014*</b>
	Min	-4.00-17.00	-3.00-17.00			
Post	Flexibility (cm)	6.55 $\pm$ 5.07	6.85 $\pm$ 4.59	+ 0.30	4.58	
	Min-Max	-3.00-19.00	-3.50-17.50			

\* statistically significant ( $p < 0.05$ )

The pre-intervention and post-intervention mean composite scores of the experimental group indicated significant differences of 24.76% (Table 61).

**Table 61: EXPERIMENTAL (n = 22) MEAN SCORES FOR FLEXIBILITY AT PRE AND POST INTERVENTION**

PRE Mean $\pm$ SD	POST Mean $\pm$ SD	Diff	% Diff	Statistical Difference
5.25 $\pm$ 5.10	6.55 $\pm$ 5.07	+ 1.30	24.76	p = 0.4044

The pre-intervention and post-intervention mean composite scores of the control group indicated significant differences of 7.55% (Table 62).

**Table 62: CONTROL (n = 23) MEAN SCORES FOR FLEXIBILITY AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
6.37 ± 4.78	6.85 ± 4.59	+ 0.48	7.54	p = 0.7310

#### **5.3.4 Muscle endurance**

The muscle endurance (sit ups) of the experimental and control groups yielded no significant differences between the muscle endurance (sit ups) post-test means after adjusting for the experimental pre-test means (Table 63).

**Table 63: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR SIT UPS AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean ± SD	Control Mean ± SD	Diff	% Diff	Statistical Difference
Pre	Sit-ups (maximum in 60 seconds)	21.73 ± 5.12	26.22 ± 5.81	+ 4.49	20.66	p = 0.0647
	Min-Max	12.00-29.00	15.00-40.00			
Post	Sit-ups (maximum in 60 seconds)	21.20 ± 5.94	26.13 ± 6.30	+ 4.93	23.26	
	Min-Max	9.00-32.00	13.00-36.00			

p < 0.05

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 2.44% (Table 64).

**Table 64: EXPERIMENTAL (n = 22) MEAN SCORES FOR SIT UPS AT PRE AND POST INTERVENTION**

PRE Mean ± SD	POST Mean ± SD	Diff	% Diff	Statistical Difference
21.73 ± 5.12	21.20 ± 5.94	+ 0.53	2.44	p = 0.7590

The pre-intervention and post-intervention mean composite scores of the control group indicated non-significant differences of 0.34% (Table 65).

**Table 65: CONTROL (n = 23) MEAN SCORES FOR SIT UPS AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
26.22 ± 5.81	26.13 ± 6.30	0.09	0.34	p=0.9613

The muscle endurance (push ups) of the experimental and control groups yielded no significant differences between the muscle endurance (push ups) post-test means after adjusting for the experimental pre-test means (Table 66).

**Table 66: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR PUSH UPS AT PRE AND POST INTERVENTION**

<b>Test Interval</b>	<b>Data</b>	<b>Experimental Mean ± SD</b>	<b>Control Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
Pre	Push-ups (maximum in 60 seconds)	13.95 ± 4.56	12.91 ± 3.44	1.04	7.46	p = 0.5190
	Min-Max	5.00-21.00	6.00-18.00			
Post	Push-ups (maximum in 60 seconds)	15.79 ± 5.41	14.61 ± 4.22	1.18	7.47	
	Min-Max	7.00-26.00	4.00-27.00			

p < 0.05

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 13.19% (Table 67).

**Table 67: EXPERIMENTAL (n = 22) MEAN SCORES FOR PUSH UPS AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
13.95 ± 4.56	15.79 ± 5.41	1.84	13.19	p = 0.2457

The pre-intervention and post-intervention mean composite scores of the control group indicated non-significant differences of 13.17% (Table 68).

**Table 68: CONTROL (n = 23) MEAN SCORES FOR PUSCH UPS AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
12.91 ± 3.44	14.61 ± 4.22	1.70	13.17	p = 0.1421

### **5.3.5 Muscle strength**

The muscle strength values (grip dynamometer) of the experimental and control group indicated no significant differences between the muscle strength (grip dynamometer) post-test means after adjusting for the experimental pre-test values (Table 69).

**Table 69: COMPARISON OF EXPERIMENTAL (n = 22) AND CONTROL GROUP (n = 23) MEAN SCORES FOR MUSCLE STRENGTH AT PRE AND POST INTERVENTION**

Test Interval	Data	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	Diff	% Diff	Statistical Difference
Pre	Strength (kilograms)	13.61 $\pm$ 2.58	14.07 $\pm$ 1.84	+ 0.46	3.38	p = 0.6270
	Min-Max	10.30-19.30	10.60-17.10			
Post	Strength (kilograms)	12.15 $\pm$ 2.67	12.72 $\pm$ 2.16	+ 0.57	4.69	
	Min-Max	8.20-19.80	9.50-16.00			

\* statistically significant (p < 0.05)

The pre-intervention and post-intervention mean composite scores of the experimental group indicated non-significant differences of 10.73% (Table 70).

**Table 70: EXPERIMENTAL (n = 22) MEAN SCORES FOR MUSCLE STRENGTH AT PRE AND POST INTERVENTION**

PRE Mean $\pm$ SD	POST Mean $\pm$ SD	Diff	% Diff	Statistical Difference
13.61 $\pm$ 2.58	12.15 $\pm$ 2.67	1.46	10.73	p=0.0714

The pre-intervention and post-intervention mean composite scores of the control group indicated significant differences of 9.60% (Table 71).

**Table 71: CONTROL (n = 23) MEAN SCORES MUSCLE STRENGTH AT PRE AND POST INTERVENTION**

<b>PRE Mean ± SD</b>	<b>POST Mean ± SD</b>	<b>Diff</b>	<b>% Diff</b>	<b>Statistical Difference</b>
14.07 ± 1.84	12.72 ± 2.16	1.35	9.60	<b>p = 0.0274*</b>

## **5.5 CONCLUSION**

The answer to the question, “Does a ten week Zulu stick fighting programme result in improvements in motor proficiency of prepubescent Zulu males?” is not straightforward. When considering data from this study, though there are serious questions around the reliability of the results as shown by the Cronbach’s Alpha and inter-item correlation, the results suggest that Zulu stick fighting may be more helpful for certain subtests of motor proficiency than others.

The significant improvements in balance and upper limb dexterity after a 10-week Zulu stick fighting intervention programme suggest that the intervention did have a positive effect on these motor proficiency subtests. The improvements that were observed following a ten week Zulu stick fighting programme were maintained during the retention period (post-post), suggesting that the intervention had a relatively lasting effect.

The results on the other six subtests are not as straightforward. In the running speed and agility subtest, the experimental group performed worse in suggesting that the intervention may have failed to elicit any improvement. In bilateral coordination, the experimental group performed better though the improvement was not statistically significant. Whilst in the strength subtest, the experimental group improved in their performance, the improvement was not statistically significant suggesting that the improvement might have been caused by factors other than the intervention programme. In upper limb coordination subtest, the experimental group deteriorated in performance in

the post-intervention testing though they bettered their score at the post-post intervention testing. The improvements in the post-post intervention can also not be attributed to the effectiveness of the intervention programme. In the response speed subtest, the experimental group did have a non-significant improvement in the post-intervention testing and the performance deteriorated in the post-post intervention testing. Finally, in the visual motor control subtest, the experimental group performed worse in the post-intervention testing. The nature of the visual motor control subtest required that the subjects performed fine motor skills. This particular training received very little attention during the 10 week Zulu stick fighting intervention programme.

Secondly, the answer to the question, “Does a ten week Zulu stick fighting programme result in improvements in health-related physical fitness parameters of prepubescent Zulu males?” is also not straightforward. Data from this study suggests that Zulu stick fighting may be more beneficial for some health-related physical fitness parameters than others.

The significant improvements in the body composition, cardiovascular fitness and flexibility after a 10-week Zulu stick fighting intervention programme suggest that the intervention did have a positive effect on these variables. The results for the other two health-related physical fitness parameters namely, muscle endurance and muscle strength, did not show any significant improvements. For muscle endurance, the experimental group performed worse in their sit-ups. Their push-ups performance under the same health-related physical fitness parameter improved. Given that the performance in one test (sit-ups) under muscle endurance deteriorated whilst the other test (push-ups) recorded improvements, led the researcher to conclude that there was no significant improvement in the muscle endurance of prepubescent Zulu males after a 10-week Zulu stick fighting intervention programme. For muscle strength, the experimental group’s performance deteriorated.

The 10-week Zulu stick fighting intervention programme yielded some positive outcomes, however, due to the size of the study group, the dynamics of working with a population sample consisting of young subjects, differing motivation levels thus leading to lack of maximum exertion at different testing intervals, and also the influence of external factors which the researcher tried to control but couldn’t the researcher is of the

opinion that the study should be replicated before a wider generalisation is made about the overall effectiveness of Zulu stick fighting on motor proficiency health-related physical fitness. The results of the study especially on motor proficiency can not be considered as being reliable.

## **CHAPTER SIX**

### **DISCUSSION**

#### **INTRODUCTION**

The primary focus of this study was to investigate the effect of a 10-week stick fighting intervention programme on motor proficiency of prepubescent Zulu males. These results were compared to motor proficiency of prepubescent Zulu boys who had not received training in stick fighting. The aim was to determine whether traditional Zulu stick-fighting training has an influence on motor proficiency. The second area of focus of the study was to establish whether participating in a stick fighting intervention programme would lead to improvements in anthropometrical and health-related physical fitness parameters such as body composition, cardiovascular fitness, flexibility, muscular endurance and muscular strength.

This chapter provides the discussion of results, linking them with previous research. The discussion is arranged under the following main headings to facilitate clarity of thought: motor proficiency and health-related physical fitness; the intervention programme, the effect of the intervention programme on motor proficiency, the effect of the intervention programme on health-related physical fitness, limitations of the study and conclusion.

The next section deals with motor proficiency and physical fitness:

#### **6.1 MOTOR PROFICIENCY AND HEALTH-RELATED PHYSICAL FITNESS**

The development of motor proficiency has health implications and is largely determined by the five health-related physical fitness components (MacInnis, 2008). Children who are physically active on a regular basis are healthier than those who are sedentary (Gannotii et al., 2007). Until recently, the role that ‘deficiencies’ in motor proficiency plays as a barrier to physical activity has been overlooked (Hay et al., 2003). Motor

proficiency levels affect physical activity patterns and physical fitness levels (Cairney et al., 2005). Many modern diseases are due, in part, to a lack of physical activity, the most evident being the lack of exposure at an early age to physical development activities (Corbin and Lindsey, 2006). Physical activity patterns developed in childhood tend to last throughout adulthood. There is a strong link between motor proficiency levels and obesity. Children who exhibit low motor proficiency levels are likely to be overweight or obese placing them at risk for cardiometabolic diseases (Cairney et al., 2005). People are more likely to take up or continue sports or some kind of physical activity if they possess 'acceptable' motor proficiency (MacInnis, 2008).

The motivation to continue with sport or any kind of physical activity is therefore enhanced if motor proficiency levels are at an 'acceptable' level. In her study MacInnis (2008) examined the influence of physical activity behaviour on the relationship between motor proficiency and body composition in children. Results indicated that children with higher levels of motor proficiency were more physically active than children with lower levels of motor proficiency.

The next section deals with the intervention programme:

## **6.2 THE INTERVENTION PROGRAMME**

The intervention programme was conducted after school hours from 14h30-15h30. The intervention was run twice a week for an hour over a 10-week period. In a previous study investigating motor proficiency in children with disabilities the intervention lasted for 8 weeks (Scheepers, 2002). Another study (Joubert, 2004) had an intervention of eight weeks. In another unrelated study on core stability by Stanton et al. (2004), the intervention programme lasted for 6 weeks. Therefore, the current study had a longer intervention programme than previous studies in this field of study.

Two experienced adult stick fighters who had to have at least 15 years of stick fighting experience conducted the intervention programme. All sessions began with a proper warm-up, stretching exercises and ended off with a cool-down. In the initial phases of the intervention programme, a general warm up and cool down were used. Later on, specific

warm-up (related to stick fighting) and cool down were used. The researcher conducted the warm-up session, stretches and a cool down in the earlier phases of the intervention. Later on, the two stick fighters conducted a specific stick fighting warm-up and the researcher only conducted the stretching and a cool down session. The full details of the intervention programme appear on Appendix F.

With the help of the two trainers, a schedule for the intervention programme was drawn up. The movements and the skills taught in the programme were selected according to activity specific demands placed on stick fighters. Therefore, all the movements and skills that the subjects were asked to do are movements and skills critical for Zulu stick fighting. Movements and skills became more advanced as the programme progressed. The movements and skills were changed every two weeks. The reason for the changes was to ensure that all aspects of Zulu stick fighting were attended to. The first five weeks involved basic movements such as the stance, the different offensive strokes and the defensive manoeuvres using the shield. The last five weeks of the programme involved sparring and the social use of stick fighting in the isiZulu culture.

The next section deals with the effect of the intervention programme on motor proficiency:

### **6.3 THE EFFECT OF THE INTERVENTION PROGRAMME ON MOTOR PROFICIENCY**

In chapter three of this study, the researcher indicated that there are no studies that have been undertaken to investigate the effect of any martial arts on co-ordination, fine motor control and motor skills. The only motor skill that has been researched is balance and the effect martial arts has on falling patterns in the elderly (incidence of falling). As such, the discussion to follow will not link all the current findings with previous research except in the case of balance as there are no studies that have been undertaken in this area.

#### **6.3.1 Running speed and agility subtest**

There was a 2.93% non-significant difference between the experimental ( $7.18 \pm 1.10$ ) and the control group ( $7.39 \pm 1.16$ ) at pre-intervention testing. During post-intervention

testing, there was a 19.18% significant difference ( $p < 0.05$ ) between the two groups. Both groups speed and agility worsened but the decline was more notable in the control group which had a significant 25.30% decline ( $p < 0.05$ ) from their pre to post intervention scores. The experimental group had a non-significant decline of 8.22%. During post-post intervention testing there was a non-significant difference of 7.22% between the groups. The experimental group recorded a 15.83% decline in performance from the post to post-post intervention score. The control group had a significant improvement ( $p < 0.05$ ) of 9.83% in performance.

Although speculative, the decline at post and post-post intervention for the experimental group could be attributed to one factor. Within the discipline of biomechanics, speed is defined as the rate at which work is done (McGinnis, 1999; Hall, 2007). The formula for calculating speed is:

$$\text{Average speed} = \frac{\text{Distance}}{\text{Time}}$$

Whereas distance is a straight line connecting the starting and the final position of an object (Hall, 2007), agility is the physical ability that enables a person to rapidly change position and direction in a precise manner (Davis et al., 2000). It is thus clear that for the experimental group to improve this subtest, displacement involving rapid change of position and direction should have been included in the intervention programme. The researcher is of the firm opinion that there was no such activity in the intervention programme which would have enabled the experimental group to improve on the pre intervention score. Whilst Zulu stick fighting involves forward displacement and position and directional changes, these were limited in the intervention programme. The researcher did highlight in the methodology chapter (chapter 4) that the subjects did not engage in real fights. Real fighting may have afforded the subjects greater forward displacement and agility. All the 'fights' the subjects engaged in were sparring fights. Sparring fights or *ukungcweka* have a distinct characteristic that makes them different from a fully fledged fight in that most of the offensive shorts and parrying thereof occurs from a stationary base, with limited displacement. Sparring fights might be a session between an elder and a young boy, or boys of the same age trying to hone each other's

fighting skills. Fighters engaged in a sparring match do not land blows as such limiting some of the benefits of Zulu stick fighting.

The significant improvement at post-intervention for the control group was a turnaround after recording a significant decline at post intervention. Two factors which may explain this observation could be the activities outside the intervention programme that the subjects may have participated in and the inconsistent exertion by the subjects. Though attempts were made to control external influences there was no guarantee that the subjects did not participate in 'extra' activities. After all, these are kids, they are expected to be relatively active (Heyward and Getchell, 2001; Cech and Martin, 2002). It would seem after post intervention testing, that the control group resumed whatever activities they were engaged in before the start of the research. Another factor could be inconsistent exertion by the subjects due to fluctuating motivation levels. This phenomenon has been observed by many authors amongst children (Heyward and Getchell, 2001; Cech and Martin, 2002; Cairney et al., 2005; Black, 2009). Whilst this might sound as a failure on the side of the researcher to keep the testing environment the same all the time, the researcher did observe that the subjects level of motivation fluctuated from low to high, and *vice versa* in between testing intervals. The results of the current study contrast Scheepers (2002) who reported improved running speed and agility in children with disabilities who had undergone an 8-week intervention programme when compared to a control group.

In summary, the results showed that despite the 10 week Zulu stick fighting intervention, running speed and agility failed to improve.

### **6.3.2 Balance subtest**

There was a 20.51% significant difference ( $p < 0.05$ ) between the experimental ( $6.86 \pm 2.51$ ) and the control group ( $8.81 \pm 1.85$ ) at pre-intervention testing. The control group scored better than the experimental group at pre-intervention testing. During post-intervention testing, there was a 25.17% significant difference ( $p < 0.05$ ) between the groups. The experimental group had a 46.50% significant improvement ( $p < 0.05$ ) from their pre to post- intervention test score. In a stick fighting match, fighters keep the torso

forward and bring the non-dominant leg forward. This action transfers the centre of gravity forward making the body unstable and as such easier for the fighter to advance forward. To counteract the instability, stick fighters bring their leading leg forward because the larger the base of support, the more stable the body becomes (Shea and Wright, 1997). It is therefore not surprising that the experimental group recorded substantial improvements in the balance subtest as the basis for any stick fight match is a stable base. The control group experienced a significant decline ( $p < 0.05$ ) of 12.66% from their pre to post-intervention test scores. A significant decline for the control group can be attributed to fluctuating motivation levels similar to what the researcher has already highlighted in the previous section.

During post-post intervention, there was a significant difference ( $p < 0.05$ ) of 20.18% between the groups. Both the experimental and the control group declined in the balance scores, with the control group scoring inferiorly overall. Though the experimental group declined, it was a non-significant difference of 1.39% from their post to post-post intervention score. One could therefore conclude that the slight decline for the experimental group is an indication that the group was able to retain their balance skills following a four week 'break' during which no intervention was practiced.

Results for balance are in keeping with previous research (Scheepers, 2002; Thornton et al., 2004; Tsang et al., 2004; Fong and Ng, 2006). Scheepers (2002) reported improved balance skills in children with disabilities who had undergone an 8-week intervention programme when compared to a control group. Thornton et al. (2004), Tsang et al. (2004), Fong and Ng, (2006) reported a positive relationship between martial arts (Tai Chi) and balance.

In summary, the results showed that a 10 week Zulu stick fighting intervention programme led to an improvement in balance for the experimental group whilst balance in the control group declined.

### **6.3.3 Bilateral coordination subtest**

There was a 7.69% non-significant difference between the experimental ( $2.73 \pm 0.98$ ) and the control group ( $2.52 \pm 0.51$ ) at pre-intervention testing. During post-intervention

testing, there was a 17.43% significant difference ( $p < 0.05$ ) between the two groups. The experimental group had a 19.78% non-significant ( $p = 0.07$ ) improvement from their pre to post intervention score. The control group experienced a non-significant improvement of 7.14%. Any person engaged in martial arts of any form is likely to have above average bilateral coordination. Activities that make up the bilateral coordination subtest in the Bruininks-Oseretsky test of motor proficiency (Short Form) provides 'specificity' to Zulu stick fighting. Although non-significant, this may have led to the experimental group having a larger improvement. The  $p$  value of the experimental group when comparing the pre and post intervention scores is fractionally higher ( $p = 0.0717$ ) than the significance set for this study ( $p < 0.05$ ). With a bigger population sample, the researcher feels that the results may have come out as significant. The results of the current study are in contrast with those of other researchers (Scheepers, 2002; Joubert, 2004) who reported significant improvements.

During post-post intervention testing there was a significant difference ( $p < 0.05$ ) of 15.65% between the groups. The experimental group recorded a 5.51% non-significant improvement in their performance from the post to post-post intervention score. The control group had a non-significant improvement of 7.78% from the post-intervention score. Though the improvement scored by the control group is slightly better than that of the experimental group at post-post intervention, overall, the control group performed lower than the experimental group in the bilateral coordination subtest at post-post intervention. The Cronbach's Alpha values (Appendix H) for bilateral coordination subtest at the three testing intervals (pre-, post- and post-post testing) is relatively very low to be considered reliable results. Therefore, the results of this test should be interpreted with caution especially when post-post intervention score is taken into consideration.

In summary, the results showed that despite a 10 week Zulu stick fighting bilateral coordination failed to improve.

### 6.3.4 Strength subtest

There was a 6.63% non-significant difference between the experimental ( $5.73 \pm 2.35$ ) and the control group ( $5.35 \pm 1.67$ ) at pre-intervention testing. During post-intervention testing, there was a 2.93% non-significant difference between the two groups. The experimental group had a 25.31% non-significant improvement from their pre-intervention score. The control group experienced a significant improvement ( $p < 0.05$ ) of 38.13% from their pre-intervention score. The non-significant, though large improvement, recorded by the experimental group could be due to an observed large standard deviation at post-intervention. This indicates a large inter-subject variability in performance thus casting doubt on the internal consistency of the subtest. In a bigger group, the inter-subject variability would have 'cancelled' the limitations imposed by the smaller sample size thus improving the internal consistency of the subtest and may have resulted in significant improvements. The results of the current study are in contrast with those of other researchers (Scheepers, 2002; Joubert, 2004) who reported significant improvements.

The improvements in the pre to post-intervention scores of both groups lead the researcher to speculate that the improvements were as a result of factors other than the intervention programme. One such factor could be maturation. The other one could be natural growth. Burton and Miller (1998) point out that one of the weaknesses of the Bruininks-Oseretsky test of motor proficiency is that it does not take into consideration the biological age and maturation of subjects. As subjects mature, they generally become more proficient. As the subject grows, more forces are generated by the musculoskeletal system enabling the subject to perform better. To this end, the performance of the subjects may have been due to these factors and the Bruininks-Oseretsky test would not be able pinpoint these.

During post-post intervention testing there was a non-significant difference of 6.94% between the groups. The experimental group recorded a 6.41% non-significant improvement in their performance from the post to post-post intervention score. The control group scored a non-significant improvement of 10.56% from the post-intervention score. Taking into consideration the Cronbach's Alpha values (Appendix H)

which is lower than the required 0.70, the conclusion by the researcher is that this subtest did not have the internal consistency as expected. This therefore forces the researcher to pronounce the results of this subtest as being unreliable

In summary, the results showed that despite a 10 week Zulu stick fighting intervention, strength failed to improve.

### **6.3.5 Upper limb coordination subtest**

There was a 2.09% non-significant difference between the experimental ( $3.82 \pm 0.85$ ) and the control group ( $3.74 \pm 0.75$ ) at pre-intervention testing. During post-intervention testing, there was a 19.94% significant difference ( $p < 0.05$ ) between the two groups. The experimental group scored a 10.73% non-significant decline from their pre-intervention score. The control group experienced a non-significant improvement of 9.36% from their pre-intervention score. The results of the current study are in contrast with those of other researchers (Scheepers, 2002; Joubert, 2004) who reported significant improvements. The non-significant improvement registered by the experimental group may look surprising taking into consideration the nature of Zulu stick fighting and martial arts in general. That is, they involve a lot of upper limb coordination. One would have expected the experimental group to at least record significant improvements. However, a closer look at the activities that make up the upper limb coordination subtest in the Bruininks-Oseretsky test leads the researcher to speculate that the specificity of this test for Zulu stick fighting might be questionable.

Activities such as catching a tossed ball with both hands and throwing a ball at a target with the preferred hand are gross motor skills that 8.5 to 9.5 year olds growing in a normal environment should have been exposed to. Zulu stick fighting cannot be considered an ideal activity to develop those motor skills as there is hardly any tossing or catching of any object. During post-post intervention testing there was a non-significant difference of 2.11% between the groups. The experimental group recorded a 38.71% significant improvement ( $p < 0.05$ ) in their performance from the post to post-post intervention score. The control group scored a significant improvement ( $p < 0.05$ ) of 18.09% from the post-intervention score. Whilst in the above discussion, the researcher

strongly argued that the activities done in this subtest may not be specific to Zulu stick fighting, it would seem that both the experimental and control group might have benefitted from having to do the test three times. The researcher is of the opinion that too much should not be read into the improved performance of both groups other than to say, at post-post intervention, the subjects were more familiar with the test and possibly more motivated. The low internal consistency results (Appendix H) makes the researcher to declare the results of this subtest as being unreliable.

In summary, the results showed that despite a 10 week Zulu stick fighting intervention, upper limb coordination failed to improve.

### **6.3.6 Response speed subtest**

There was a 10.66% non-significant difference between the experimental ( $8.45 \pm 3.33$ ) and the control group ( $9.35 \pm 2.55$ ) at pre-intervention testing. During post-intervention testing, there was a 2.73% non-significant difference between the two groups. The experimental group had a 4.73% non-significant improvement from their pre-intervention score. The control group experienced a non-significant improvement of 16.26% from their pre-intervention score. The results of the current study are in contrast with those of other researchers (Scheepers, 2002; Joubert, 2004) who reported significant improvements. There is no logical or physiological explanation as to why the experimental group performed worse post-intervention. Again, the fluctuating motivation levels among the subjects as well as the lack of specific activities that targets this subtest in the intervention programme may have led to the observations in this subtest.

During post-post intervention testing there was a non-significant difference of 0.42% between the groups. The experimental group recorded an 18.26% significant decline ( $p < 0.05$ ) in their performance from the post-intervention score. The control group performed slightly worse when they experienced a non-significant decline of 21.07% from the post to post-post intervention score. The Cronbach's Alpha values (Appendix H) of 0.05 for the experimental group, 0.39 for the control group at pre-intervention, 0.48 and 0.39 respectively at post-intervention and values of 0.13 for the experimental group and 0.00 for the control group can not be considered as reliable data.

In summary, the results showed that despite a 10 week Zulu stick fighting intervention, response speed failed to improve.

### **6.3.7 Visual motor control subtest**

There was a 9.36% non-significant difference between the experimental ( $6.09 \pm 1.27$ ) and the control group ( $5.52 \pm 0.85$ ) at pre-intervention testing. During post-intervention testing, there was a 10.09% significant difference ( $p < 0.05$ ) between the two groups. The experimental group had a 10.51% non-significant decline in performance from their pre-intervention score. The control group experienced a non-significant improvement of 8.70% from their pre-intervention score. During post-post intervention testing there was a non-significant difference of 15.11% between the groups. The experimental group recorded a 1.65% non-significant decline in performance from the post-intervention score. The control group experienced a non-significant improvement of 2.83% from the post-intervention score.

In summary, the results showed that despite a 10 week Zulu stick fighting intervention visual motor control failed to improve. The visual motor subtest is a fine motor skill i.e. involves the usage of small muscle groups. Stick fighting on the other hand is predominantly a gross motor skill involving the usage of bigger muscle groups. It was therefore expected that the experimental group would have minimal or no improvements in this subtest. The control group on the other hand, recorded improvements from the pre-intervention to post-intervention score and from a post-intervention to post-post intervention score respectively. The improvements of the control group were statistically non-significant. Refinement of motor skills is dependant on the amount of practice invested on the skill (Duger, et al., 1999). The researcher is of the opinion that the improvement by the control group at post-post intervention maybe be due to better refinement of this skill as a result of practice prior or during the intervention programme. Again, the lower internal consistency values (Appendix H) suggest that the result of this subtest must be interpreted with caution.

### **6.3.8 Upper limb speed and dexterity subtest**

There was a 4.40% non-significant difference between the experimental ( $5.91 \pm 2.07$ ) and the control groups ( $6.17 \pm 1.64$ ) at pre-intervention testing. During post-intervention testing, there was a 24.17% significant difference ( $p < 0.05$ ) between the two groups. The experimental group experienced a 48.39% significant improvement ( $p < 0.05$ ) from their pre to post intervention score. Similarly, the control group experienced a non-significant improvement of 7.78%. During post-post intervention testing there was a non-significant difference of 3.34% between the groups. The experimental group recorded a 1.03% non-significant decline in their performance from the post to post-post intervention score. The control group performed better when they scored a significant improvement of 26.16% from the post-intervention score. Upper limb speed and dexterity seems to increase with age as the upper extremities are more used in the activities of daily living in the school activities (Duger, et al., 1999). The control group is slightly older than the experimental group, it would therefore be expected that their superior age should give them an edge over the experimental group.

In summary, the results showed that a 10 week Zulu stick fighting intervention programme led to significant improvements in upper limb speed and dexterity score in the experimental group. Stick fighting ‘engages’ upper body parts the most with offensive shots, and requires good upper body movement to parry shots from an opponent using a parrying shot and a shield. The improvement at post-intervention by the experimental group is testimony to this. The experimental group also demonstrated an ability to retain their upper body dexterity when they experienced only 1.03% loss between post-intervention and post-post invention testing. Similarly, lower internal consistency values (Appendix H) suggest that the result of this subtest must be interpreted with caution.

### **6.3.9 Motor proficiency composite scores**

There was a 3.99% non-significant difference between the experimental ( $46.77 \pm 6.66$ ) and the control group ( $48.64 \pm 5.65$ ) at pre-intervention testing. During post-intervention testing, there was a 7.63% significant difference ( $p < 0.05$ ) between the two groups. The experimental group experienced a 19.05% significant improvement ( $p < 0.05$ ) from their pre to post intervention score. The control group experienced a non-significant improvement of 5.74%. During post-post intervention testing there was a significant difference ( $p < 0.05$ ) of 5.48% between the groups. The experimental group recorded a 7.18% significant improvement ( $p < 0.05$ ) in their performance from the post to post-post intervention score. The control group performed better when they scored a significant improvement ( $p < 0.05$ ) of 9.68% from the post-intervention score. However, the low internal consistency values for all the eight subtests and a lower inter-item correlation suggests that the motor proficiency section of the study might not be a reliable true reflection of Zulu males who participate in Zulu stick fighting. The motor proficiency component of the study might need to be replicated with better reliability values.

## **6.4 SUMMARY**

In summary, the results showed that a 10 week Zulu stick fighting intervention programme led to significant improvements in the post-intervention motor proficiency composite mean scores (balance and upper limb dexterity if the post-intervention score is considered without the post-post intervention score) of the experimental group, whereas the control group did not exhibit significant improvements in any of the tests (if the post-intervention score is considered without the post-post intervention score). Overall, the experimental group experienced an 11.62% improvement in their motor proficiency mean scores relative to the control group when the pre-intervention and the post-post intervention scores were compared. However, caution must be practiced when using these set of data as lower internal consistency values suggest that there are problems with the reliability of the data. Although Zulu stick fighting failed to improve some subtests of the Bruininks-Oseretsky test of motor proficiency and doubts exist over the reliability of the data, the researcher is of the opinion that Zulu stick fighting, just like any form of physical activity, may improve the motor skills and overall motor proficiency of children.

The next section deals with the effect of the intervention programme on health-related physical fitness:

## **6.5 THE EFFECT OF THE INTERVENTION PROGRAMME ON HEALTH-RELATED PHYSICAL FITNESS**

### **6.5.1 Body composition**

#### **6.5.1.1 PERCENTAGE BODY FAT**

Calculated body fat values indicated that there was a 5.94% significant difference ( $p < 0.05$ ) between the experimental ( $11.61 \pm 2.62\%$ ) and the control group ( $12.38 \pm 3.15\%$ ) post-intervention means. The experimental group decreased their pre-intervention body fat whilst the control group recorded an increase from their pre-intervention score. The experimental group had a 6.60% non-significant decline in their post-intervention mean score. The control group recorded a 2.57% non-significant increase in their post-intervention score.

#### **6.5.1.2 SUM OF SKINFOLDS**

There was an 8.05% significant difference ( $p < 0.05$ ) between the experimental ( $27.32 \pm 4.70\text{mm}$ ) and the control group ( $29.52 \pm 9.67 \text{ mm}$ ) post-intervention means for the sum of skinfolds. The experimental group recorded a 4.81% non-significant decrease in the post-intervention sum of skinfolds score. The control group recorded a 2.18% non-significant increase in their pre-intervention sum of skinfolds score. The increase for the control group could be attributed to an overall increase in their body fat values as discussed above.

#### **6.5.1.3 LEAN BODY MASS**

There was a 7.09% significant difference ( $p < 0.05$ ) between the experimental ( $24.66 \pm 1.93 \text{ kg}$ ) and control groups ( $26.41 \pm 3.42 \text{ kg}$ ) post-intervention means. Although non-significant, the experimental group and the control group increased their pre-intervention lean body mass values, though the increase for the experimental group (0.91 kg) was

slightly higher than that of the control group (0.88 kg). The increase in the lean body mass for both groups was non-significant. The increase which was slightly higher for the experimental group could be attributed to an overall decrease in their post-intervention body fat values.

#### **6.5.1.4 FAT MASS**

Fat mass also exhibited a 16.41% significant difference ( $p < 0.05$ ) between the experimental ( $3.29 \pm 1.01$  kg) and the control groups ( $3.83 \pm 1.51$  kg) post-intervention mean scores. The experimental group had a 3.24% non-significant decline in their post-intervention mean score. The control group recorded a 6.09% non-significant increase in their post-intervention score. What is critical about the fat mass data is that whilst the lean body mass might not have given a conclusive answer regarding the effectiveness of the Zulu stick fighting intervention programme, the values for fat mass supports the percentage body fat and sum of skinfolds results. The experimental group dropped their pre-intervention fat mass. The control group recorded an increase in their fat mass. With a post-intervention increase in total body fat score for the control group, it was to be expected that the fat mass would also increase. Skinfolds, from which body fat values are derived, measure the relative distribution of subcutaneous fat at a number of sites and make a prediction of the relative distribution of fat in the body using a formula (Jackson and Pollock, 1976, Jackson and Pollock, 1985; Heyward, 2002; McArdle et al., 2010; ACSM, 2010).

#### **6.5.1.5 BODY MASS INDEX**

There was a 1.66% non-significant difference between the experimental ( $16.24 \pm 1.12$  kg.m<sup>-2</sup>) and the control group ( $16.51 \pm 2.03$  kg.m<sup>-2</sup>) post-intervention means for body mass index after adjusting for the pre-intervention experimental mean. The experimental group had a 1.06% non-significant increase in their post-intervention mean score. The control group recorded a 0.06% non-significant increase in their post-intervention score. Earlier in this section it was discussed that the lean body mass values were found to have increased similarly for both groups. It is therefore not surprising that there was only a 1.66% difference between the groups and that the overall result is that the differences are not statistically significant. To further support the body mass index values, waist-to-hip

ratio recorded a 1.25% non-significant difference between the experimental ( $0.80 \pm 0.05$ ) and the control group ( $0.79 \pm 0.03$ ) post-intervention means after adjusting for the pre-intervention experimental mean. The experimental group recorded a 2.44% non-significant decline in their post-intervention mean score whilst the control group recorded no change in their post-intervention score.

#### **6.5.1.6 BODY MASS**

Body mass values indicated that there was a 8.19% non-significant difference between the experimental ( $27.96 \pm 2.68$  kg) and the control group ( $30.25 \pm 4.55$  kg) post-intervention means. Both the experimental group and the control group recorded an increase from their pre-intervention body mass score. The experimental group had a 2.95% non-significant increase in their post-intervention mean score. The control group recorded a 3.74% non-significant increase in their post-intervention score. The increase in body mass for the experimental group is clearly a healthy increase in that it is due to an increase in their lean body mass whilst reducing their overall fat mass. The control group on the other hand recorded an increase which can be considered unhealthy. Whilst it could be argued that the control group also recorded a similar increase in their lean body mass score, the important fact to consider is that their fat mass mean score also increased. The increase in fat mass for the control group resulted in an overall increase in their body fat values as discussed in previous sections above.

Previous studies (Lan et al., 1996; Yu et al., 2007; & Tsang et al., 2009) produced results that are in line with the results of the current study with regards to body composition. The studies support the assertion that martial arts lead to improved body composition. In a study by Lan et al. (1996), reduced biceps and subscapular skinfolds in Tai Chi practitioners resulted in lower percentage body fat and increased lean body mass in comparison with their sedentary counterparts. In a study by Yu et al. (2007), the bioelectrical impedance analysis system was used. There was significantly less impedance at the abdomen ( $p = 0.011$ ) and thigh ( $p < 0.001$ ) of the Tai Chi group compared with a control group signifying less subcutaneous adipose tissue. Tsang et al. (2008) reported increased lean body mass, triglycerides and total cholesterol in a group of overweight adolescent who underwent a six months Kung Fu or placebo (Tai Chi). Lan et

al. (2008) reported slightly different results. The Tai Chi group did not have a decrease in body fat. Instead, the Tai Chi group recorded a smaller increase in the body fat ratio when compared to sedentary controls. The slightly different results by Lan et al. (2008) could be attributed to a different research design. They did a longitudinal study over five years among elderly individuals. Elderly individuals have been known to increase their body fat values due to the decreased metabolic rate (Heyward, 2002; McArdle et al., 1996).

In summary, the results showed that a 10 week Zulu stick fighting intervention programme led to an improvement in body fat percentage, lean body mass, fat mass and body mass whilst the body mass index and waist-to-hip ratio post-intervention means showed non-significant improvements.

### **6.5.2 Cardiovascular fitness**

There was a 33.93% significant difference ( $p < 0.05$ ) between the experimental ( $7.87 \pm 1.41$  shuttles) and the control group ( $5.20 \pm 0.93$  shuttles) post-intervention means for the multistage fitness test scores. Both the experimental group and the control group increased on their pre-intervention shuttle levels values, though the increase for the experimental group (2.69) was higher than that of the control group (0.82). The experimental group registered a 51.93% significant ( $p = 0.0000$ ) increase in their post-intervention mean score. The control group recorded an 18.72% significant increase in their post-intervention score. The sizeable increase for the experimental group can also be observed in the range of scores for the experimental group. At pre-intervention, the minimum-maximum values were 2.30 - 7.70 shuttles, at post-intervention the same data has values ranging from 7.80 to 10.90.

Calculated predicted maximal oxygen uptake values indicated that there was a 22.27% significant difference ( $p < 0.05$ ) between the experimental ( $39.11 \pm 5.50$ ) and the control group ( $30.40 \pm 3.13$ ) post-intervention means. Both the experimental group and the control group increased on their pre-intervention predicted maximal oxygen uptake scores. The increase for predicted maximal oxygen uptake score for the experimental group was slightly higher than that of the control group. The experimental group had a 28.61% significant improvement ( $p < 0.05$ ) in their post-intervention mean score. The

control group recorded a 10.55% significant increase ( $p < 0.05$ ) in their post-intervention score. The substantial increase for the experimental group can also be observed in the groups range of scores. At pre-intervention, the minimum-maximum values were 20.43 - 37.00 kg.ml.min<sup>-1</sup>, at post-intervention; the same data has values ranging from 27.22 - 49.54 kg.ml.min<sup>-1</sup>. The control group on the other hand had minimum-maximum scores of 23.41 - 30.25 kg.ml.min<sup>-1</sup> at pre-intervention, and at post-intervention the same data has values ranging from 22.63 - 36.20 kg.ml.min<sup>-1</sup>.

The significant improvements in both the experimental and the control groups at post intervention are slightly higher than those reported in literature. As early as 1978, Kobayashi et al. (1978) reported a 15.8% increase in aerobic power (cardiovascular fitness) with training between the ages of 14 and 17y. Pate and Ward (1993) reported increases in oxygen uptake with training of 10.4% for the experimental group and 2.7% for the control group. Improvements of less than 10% increase in aerobic capacity (maximal oxygen uptake) were reported in 8y to 14y children who had undergone endurance exercise (Krakenbuhl et al., 1995; Rowland and Boyajian, 1995). Despite improvements of this magnitude being reported within the literature and even though the experimental group recorded an 18.05% increase over the control group, the researcher is of the opinion that these results should be accepted. Many authors (Taylor et.al, 1963; Wyndham, 1967; Davies, 1968; Mahoney, 1992; Rowland, 1996; Heyward and Getchell, 2001; Cech and Martin, 2002; Dencker et al., 2008; Black, 2009, McArdle et al., 2010) have all argued against the use of indirect measurements that involve running performance to measure maximal oxygen uptake.

Field tests have been criticised for lack of accuracy, motivation problems, variation with age and gender and difficulties of interpretation of results (Taylor et.al, 1963; Wyndham, 1967; Davies, 1968). Indirect measurements for maximal oxygen uptake have been purported to introduce errors which might dilute any relationship between fitness and the risk factor under scrutiny (Rowland, 1996). Running performance in children has been linked to anaerobic measures in children rather than aerobic measures (Heyward and Getchell, 2001). It has also been stated that maximal oxygen uptake measurements in children are inaccurate as it is difficult to ensure that they work to full capacity of both the cardiovascular and pulmonary systems (Cech and Martin, 2002; Black, 2009).

Expecting children to demonstrate maximal effort is a fallacy. This was even observed by Dencker et al. (2008) with a direct measurement which is considered very accurate. In their study, only seventy seven percent of the subjects (children) reached ninety percent of predicted maximal heart rate. Even more important, very few children reached a respiratory exchange ratio (RER) of 1 which is an indication that their maximum effort was not reached.

McArdle et al. (2010) argue that in most tests where running performance is a predictor of maximal oxygen uptake, two things are likely to happen: some individuals may pace themselves optimally and other individuals may begin too slow causing the final performance scores to reflect inappropriate pacing or motivation rather than physiologic capacity. What might therefore be seen as astronomical improvements for both the experimental and the control group in this study is actually a combination of the factors mentioned above. The researcher is of the firm opinion that indifferent motivation levels played a significant role in the running performances of the subjects. This must be said taking into consideration that the researcher conducted the test himself and together with the student assistants, offered constant motivation to the subjects.

The results observed for cardiovascular fitness are in keeping with previous research (Tsai et al., 2003; Thornton et al., 2004; & Ko, et al., 2006) which reported a positive relationship between martial arts (Tai Chi) and cardiovascular fitness. It must be said though that Melhin (2001) failed to find any positive relationship between martial arts and cardiovascular fitness amongst taekwondo practitioners. The researcher will also like to highlight that the cardiovascular fitness results for this study are slightly lower than the expected maximal oxygen uptake for children of the same age ( $40\text{-}50 \text{ kg}\cdot\text{ml}\cdot\text{min}^{-1}$ ). The experimental group recorded  $30.41\pm 3.76 \text{ kg}\cdot\text{ml}\cdot\text{min}^{-1}$  at pre-intervention and  $39.11\pm 5.50 \text{ kg}\cdot\text{ml}\cdot\text{min}^{-1}$  at post-intervention, an improvement of 28.61 percent. The control group recorded  $27.58\pm 1.66 \text{ kg}\cdot\text{ml}\cdot\text{min}^{-1}$  at pre-intervention and  $30.40\pm 3.13 \text{ kg}\cdot\text{ml}\cdot\text{min}^{-1}$  at post-intervention, an improvement of 10.22 percent. The results of the study are in line with previous research (Gutin et al., 1991, Pivarnik et al., 1993; Pivarnik et al., 1995; Arslanian et al., 1997; Trowbridge et al., 1997; Ku et al., 2000; Wong et al., 2001; Andreacci et al., 2004; Suminski et al., 2004) conducted in non-Caucasian children.

Wong et al. (2001) recorded values ( $30.3 \text{ kg.ml.min}^{-1}$  for boys,  $28.6 \text{ kg.ml.min}^{-1}$  for girls) which were considered low. These they attributed to lower physical activity levels amongst Hong Kong Chinese children. Andreacci et al. (2004) investigated aerobic fitness amongst Hispanic children of 10y to 12y. The reported findings ( $45.1 \text{ kg.ml.min}^{-1}$ ) are lower than the expected maximal oxygen uptake of children in the same age group. Suminski et al. (2004) found the maximal oxygen uptake values for Black children eighteen percent lower in prepubertal and nineteen percent lower in pubertal children when compared to White peers. Reasons that have been given for the difference in maximal oxygen uptake results include, haemoglobin levels that are lower than White children (Pivarnik et al., 1995), higher body fat values which negatively correlate with aerobic fitness (Nelson and Barondess, 1997), lower physical activity levels associated with poor socio-economic backgrounds (Andreacci et al., 2004; Richmond et al., 2006) and higher percentages of fast-twitch glycolytic fibres among Black children (Suminski et al., 2000). The results observed in this study could have been as a result of a combination of the above-mentioned factors. However, the researcher is of the opinion that it will be greatly unfair to pin-point the reason for this on this particular set of data as no scientific measurements were done on the possible reasons for the subjects' poor performance. Any pronouncement on the cardiovascular fitness results for this group will be merely speculative.

In summary, the results showed that a 10 week Zulu stick fighting intervention programme led to an improvement in the cardiovascular fitness post-intervention means though the results need to be interpreted with caution as many factors might have led to these results not necessarily the physiological processes of the body.

### **6.5.3 Flexibility**

Flexibility results indicated that there was a 4.58% significant difference ( $p < 0.05$ ) between the experimental ( $6.55 \pm 5.07 \text{ cm}$ ) and the control group ( $6.85 \pm 4.59 \text{ cm}$ ) post-intervention means. Both the experimental group and the control group managed to increase their pre-intervention flexibility scores. The increase in flexibility score for the experimental group (1.3 cm) was slightly higher than that of the control group (0.48 cm). The experimental group recorded a 24.76% significant improvement in their post-

intervention mean score. The control group registered a 7.54% improvement in their post-intervention score. This study supports previous research in reporting a significant increase in the flexibility of the control group. Following a 12 week Tai Chi intervention programme, Taylor-Pillae et al. (2006a) reported similar results in that the subjects in the control group registered significant improvements in the flexibility measurements.

In summary, the results showed that a 10 week Zulu stick fighting intervention programme led to a significant improvement in hamstring flexibility in the experimental group.

#### **6.5.4 Muscle endurance**

##### **6.5.4.1 SIT UPS**

There was a 23.26% non-significant difference between the experimental ( $21.20 \pm 5.94$  repetitions per minute) and the control group ( $26.13 \pm 6.30$  repetitions per minute) post-intervention means for maximum sit ups. Both the experimental group and the control group recorded a decline on their pre-intervention scores for abdominal muscle endurance (sit ups). The experimental group exhibited a 2.44% non-significant deterioration in their post-intervention mean score. The control group also recorded a 0.34% non-significant decline in their post-intervention score. The decline in the post-intervention means for both the experimental group and the control group can also be observed in the groups' minimum-maximum scores. At pre-intervention, the minimum-maximum values for the experimental group were 12-29, at post-intervention, the same data had values ranging from 9-32. The control group on the other hand had minimum-maximum scores of 15-40 at pre-intervention, at post-intervention, the same data had values ranging from 13-36.

##### **6.5.4.2 PUSH UPS**

Push ups results indicated a 7.47% non-significant difference between the experimental ( $15.79 \pm 5.41$  repetitions per minute) and the control group ( $14.61 \pm 4.22$  repetitions per minute) post-intervention means. Though not statistically significant, both the experimental group (13.19%) and the control group (13.17%) recorded an increase in

their pre-intervention scores for upper body muscle endurance. The improvements in the post-intervention means for both the experimental group and the control group can also be observed in the groups' minimum-maximum scores. At pre-intervention, the minimum-maximum values for the experimental group were 5-21, at post-intervention the same data had values ranging from 7-26. The control group on the other hand had minimum-maximum scores of 15-40, at post-intervention the same data had values ranging from 13-36. The increase for both groups, which is within range of each other, leads the researcher to conclude that the improvements for the experimental group could have been as a result of external factors (i.e. maturation and activities done outside the intervention programme) and not necessarily the intervention programme.

The current study contradicts previous research in reporting no change in muscle endurance of the control group especially for the sit-ups test. Following a 6 month Tai Chi intervention programme, Ching Lan et al. (2000) reported increases in the muscle endurance of the control group by up to 18.8% in men and 14.6% in women. The contradictory results could be attributed to the different tests used to test muscle endurance. Whereas in the current study, a push up and a sit-up were used, in the study by Ching Lan et al. (2000), the isokinetic dynamometer was used. In addition to that, the knee extensors and flexors were tested instead of the upper body, abdominal and hip flexor muscles. The researcher is of the opinion that there was no training of the upper body, abdominal and hip flexor muscle groups in the intervention programme. This may explain the lack of improvement post-intervention.

In summary, the results showed that a 10 week Zulu stick fighting intervention programme failed to improve upper body muscle endurance.

### **6.5.5 Muscle strength**

Strength results indicated a 4.69% non-significant difference between the experimental ( $12.15 \pm 2.67$  kg) and the control group ( $12.72 \pm 2.16$  kg) post-intervention means. Both the experimental group and the control group recorded a decline in their pre-intervention scores for muscle strength. The experimental group exhibited a 10.73% non-significant deterioration in their post-intervention mean score. The control group also recorded a

9.60% non-significant decline in their post-intervention score. Previous studies (Ching Lan et al., 2000; Qin et al, 2005; Taylor-Pillae et al., 2006; Wallsten et al., 2006 & Xu et al., 2006) looking at the effectiveness of Tai Chi on the muscle strength found contradictory results to that of the current study. All the studies suggest that martial arts lead to increased muscle strength. It must be pointed out that all the studies mentioned investigated lower muscle strength (knee extensors and flexors). Although Zulu stick fighting can be classified in the same category of martial arts as Tai Chi, it must be pointed out, that unlike Tai Chi, a Zulu stick fighter predominantly uses the upper body; this could explain why the results have contradicted previous studies. The researcher has observed in many stick fight matches that he has witnessed that in a stick fighting match, the critical component of success is rather the speed at which the sticks are manoeuvred rather the strength that a fighter possesses.

In summary, the results showed that a 10 week Zulu stick fighting intervention programme failed to lead to an improvement in the forearm muscle strength.

## **6.6 SUMMARY**

In summary, the results of this study indicate that Zulu stick fighting leads to significant changes in body composition, cardiovascular fitness and flexibility. The intervention programme failed to elicit changes in specific muscle endurance and strength.

The next section deals with the limitations of the study:

## **6.7 LIMITATIONS OF THE STUDY**

In the previous chapter, the concluding remarks alluded to the fact that the effect of Zulu stick fighting on motor proficiency and physical fitness though positive for selected measures, are not straightforward and must be interpreted with caution as the motor proficiency results exhibit low internal consistency and inter-item correlation results. The following limitations may have contributed to this state of affairs:

- For any intervention programme based study, the sample is better if it is bigger. The sample for this study was small. The small sample might have had a limiting effect on the statistical power, thus resulting in inability to generalise results for a larger population sample.
- The lack of specificity in some of the Bruininks-Oseretsky subtests may have led to non-significant results. Some of the items in the Bruininks-Oseretsky subtests are activities that one would not expect only a stick fighter to perform, rather, every growing child is expected to demonstrate. This therefore led to insignificant results even where they could have been significant. Whereas only a select subtests relevant to stick fighting could have been used which might have yielded better results, the whole Short Form test battery was used.
- Morphological differences made it difficult to pair children accordingly. Though a statistical adjustment was made by the statistician to minimise the differences, they did have an effect on the results.
- Inability to control other factors that might have had an influence on the performance of the subjects i.e. maturation. Tests such as balance largely depend to some extent to the development of the nervous system which is in turn dependent on the age of the child. The older the child, the better the development will be. In this study, the control group was slightly older than the experimental group. Though a statistical adjustment was made by the statistician to minimise the difference, the researcher is of the opinion that age did have an effect on the results.
- Lack of scientific documentation of factors that could have an effect on the results i.e. the activities that the subjects participated in outside the intervention programme. By nature, growing children are very active, baseline data on their activity levels before, during and after the intervention programme should have been established.
- The nature of the research design. The idea of a “retention” period in theory sounds great, however, the practicality of the whole process proved to be the biggest challenge for the study. Due to the very nature of children, the retention period results can be considered as being outside what would be considered “normal” results.

- The nature of the subjects i.e. children, makes it impossible to say the results are a true reflection of their maximal effort. Fluctuating motivation levels during testing sessions were observed. The age group that served as subjects for this study are known to be easily bored by monotonous tasks. Whilst the Bruininks-Oseretsky test might not be monotonous, the fact that they were tested at three different intervals might have led to familiarisation with the tests which subsequently led to poor motivation levels.
- The use of an indirect measurement to test maximal oxygen uptake that requires subjects to maximally exert themselves throughout the whole testing period proved to be a challenge. Whilst indirect measurement are easy to conduct and one can test many people at the same time, a different indirect measurement such as a step test could have been a better option considering the dynamics of the population group.

## **6.8 CONCLUSION**

This study is a first of its kind in South Africa. No study has attempted to look at the potential benefits of Zulu stick fighting on motor proficiency and physical fitness. Whilst the motor proficiency results might need to be replicated taking into consideration the limitations that have been outlined in this chapter, there is no doubt that Zulu stick fighting does present health and motor skills benefits for growing children.

The next chapter deals with conclusions and recommendations:

## **CHAPTER SEVEN**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **INTRODUCTION**

The primary focus of this study was to investigate the effect of a 10-week Zulu stick fighting intervention programme on motor proficiency of prepubescent Zulu boys. These results were compared to motor proficiency of prepubescent Zulu boys who had not received training in stick fighting. The aim was to determine whether traditional Zulu stick fighting training has an influence on motor proficiency. The second area of focus of the study was to establish whether participating in a stick fighting intervention programme would lead to improvements in anthropometrical and health-related physical fitness parameters such as body composition, cardiovascular fitness, flexibility, muscular endurance and muscular strength.

This chapter provides the conclusions, recommendations and ends off with concluding remarks.

The next section deals with conclusions:

#### **7.1 CONCLUSIONS**

Three out of the eight motor proficiency subtests demonstrated significant improvements after a 10-week Zulu stick fighting intervention programme. However, the other five subtests did not show significant improvements. Three out of the five health-related physical fitness components also recorded significant improvements after a 10-week Zulu stick fighting intervention programme. However, the other two motor proficiency components got worse.

The results of the study lead to the following three conclusions:

- 1 A 10-week stick fighting intervention programme leads to significant improvements in the anthropometrical measures (mass) of prepubescent Zulu males.
- 2 A 10-week stick fighting intervention programme leads to significant improvements in selected motor proficiency subtests in prepubescent Zulu males though the internal consistency of the results are low.
- 3 A 10-week stick fighting intervention programme leads to significant improvements in selected health-related physical fitness components in prepubescent Zulu males.

Each of these general conclusions will be discussed separately in the following section:

### **7.1.1 Anthropometrical measures**

Significant ( $p < 0.05$ ) decreases in the pre-intervention body fat scores were observed for the experimental group whilst the control group recorded a non-significant increase. The experimental group also registered a slightly higher increase in their pre-intervention lean body mass values though this was not significant. Non-significant decline in fat mass was recorded for the experimental group whereas the control group had a non-significant increase. Overall, both groups had non-significant increases in their body mass, however, the increase for the experimental group could be considered a healthy increase as it was a result of an increase in lean body mass rather fat mass as it was the case with the control group.

### **7.1.2 Motor Proficiency**

Significant ( $p < 0.05$ ) improvements were recorded in the motor proficiency subtests namely, balance and upper limb dexterity. The control group failed to register any significant improvements in their post-intervention scores in all the subtests of motor proficiency. The experimental group managed to maintain improvements in the two subtests for four weeks post-intervention thus making a strong case for the lasting effects of the training programme. Of course, the results of the retention period make the data set to be rendered unreliable as low internal consistency values and inter-item correlation

make it difficult to confidently adopt these results as a true reflection of the motor proficiency performance of Zulu males engaged in Zulu stick fighting. However, the positives that could be taken from the study is the fact that just like any physical activity, Zulu stick fighting, an indigenous game, has a potential of having the same benefits that one would derive from doing any type of physical activity.

### **7.1.3 Health-related physical fitness**

When post-intervention means are compared adjusted with pre-intervention mean when running an ANCOVA analyses, significant ( $p < 0.05$ ) improvements in body composition, cardiovascular fitness and flexibility of the experimental group were recorded after a 10-week Zulu stick fighting intervention programme. If the pre-intervention and post-intervention means of the experimental group are compared using a two tailed t-test, no significant improvements are observed. The control group registered significant improvements in their post-intervention score of the predicted maximal oxygen uptake when compared to their pre-intervention score and no significant improvements were recorded in all the other health-related physical fitness components. The significant improvement in the predicted maximal oxygen uptake for the control group is really a non event. The test used for testing predicted maximal oxygen uptake does have the potential of producing inaccurate results owing to the motivation levels of the subjects. Not a lot should be read into the recorded improvements. The possible reasons for this result were explained in the previous chapter (chapter 6). Muscle endurance and muscle strength did not show any significant improvements in both the experimental and control group.

In light of these results the following conclusions can be drawn:

**Hypothesis One:** A rejection of the null hypothesis. The findings of this study lead the researcher to accept the alternative hypothesis as follows: There are significant differences in selected anthropometric measures between Zulu children who have been trained in traditional martial arts of stick fighting compared to Zulu children who have not been trained in the traditional martial art of stick fighting.

**Hypothesis Two:** An acceptance of the null hypothesis. The findings of this study lead the researcher to accept the null hypothesis as follows: There are no significant differences in motor proficiency between Zulu children who have been trained in the traditional martial art of stick fighting and Zulu children who have not.

**Hypothesis Three:** A rejection of the null hypothesis. The findings of this study lead the researcher to accept the alternative hypothesis as follows: There are significant differences in health-related physical fitness parameters (body composition, cardiovascular fitness and flexibility) between Zulu children who have been trained in the traditional martial art of stick fighting and Zulu children who have not.

The next section deals with recommendations:

## **7.2 RECOMMENDATIONS**

The current study has pointed out some of the potential benefits of engaging in Zulu stick fighting. Based on the findings of this study, the following recommendations are made for future research:

- 1 Future research studies in this area of study need to use a controlled randomised matched or paired research design which might increase the reliability of the study. This will allow for an easier interpretation of results.
- 2 The running of a pilot study before the main study is conducted is recommended. This will minimise some of the problems experienced by the researcher with this study especially when it comes to internal consistency of the results.
- 3 The use of a simple pretest-posttest design might yield better results. The retention period (post-post intervention) is very difficult to practically apply in a study like this one where subjects' motivation levels fluctuate all the time.
- 4 The use of a larger population sample for both the experimental and the control groups in order to gain further insight on the effectiveness of the

intervention programme, and thus an increased probability to generalise the findings of the study.

- 5 The inclusion of effect size as a statistical analysis. For this study, the results of the internal consistency ran on the data did not make it prudent to run such a statistical analysis.
- 6 The use of other movement batteries such as the Movement ABC to test motor skills of Zulu males who engage in Zulu stick fighting might improve the specificity to Zulu stick fighting. The Bruininks-Oseretsky test battery did have subtests that were not specific to Zulu stick fighting.
- 7 The use of a sample that might not be familiar with Zulu stick fighting such as an urban population.
- 8 The use of longer term and larger intervention programmes such as in longitudinal study designs to see if the effectiveness of the intervention programmes will improve. The inclusion of Zulu stick fighting and other indigenous games as part of a Life Orientation intervention programme such as the one observed in Australia 'Move it Groove it' in primary schools whereby the changes over a number of years on motor proficiency and health-related physical fitness might be tracked, might prove a valuable source of helpful data.

The next section deals with the conclusion:

### **7.3 CONCLUDING REMARKS**

In conclusion; selected components of motor proficiency (balance and upper limb dexterity) and health-related physical fitness (body composition, cardiovascular fitness and flexibility) can be positively influenced through participation in traditional Zulu games such as Zulu stick fighting.

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## APPENDICES

Appendix A	Copy of a letter by the Principal
Appendix B	Informed Consent (English)
Appendix C	Informed Consent (isiZulu)
Appendix D	Bruininks-Oseretsky Test of Motor Proficiency Scoresheet
Appendix E	Proforma
Appendix F	Copy of the stick fighting intervention
Appendix G	20 MST recording sheet
Appendix H	Cronbach's Alpha values of reliability

APPENDIX A

DEPARTMENT OF EDUCATION & CULTURE  
 UFASIMBA PRIMARY SCHOOL  
 P.O. BOX 60887  
 2007-04-20  
 EMPANGENI, 3880  
 KWAZULU-NATAL GOVT - SERVICES

UFASIMBA Primary School  
 P.O. Box 60887  
 EMPANGENI  
 3880  
 20 April 2007

Mzal ka Sibusiso

Uyacelwa ukuba unike isikole indume yakuse  
 Xhosa umntwana wakho o weni izweni  
 okuqala ekusekhenzisweni kwezindleku nama  
 ukunqweba ngazo (Research on usage of  
 traditional sticks)

Lolu cwangciso luzothetha izisuku ezimbili (2) abu  
 ngu Msambulu ka Molwesibili. Kokho buya thatha  
 ukhona no hafa (1/2 hours) emva kokuba phuma  
 kwenkole vutwana. Nokho bayabuthola  
 okakuthisa indlela kuleso sibhathi.

Umntwana akagukule kakhulu kumelobho uzo  
 zuzi ngokwempirala. Sizo uba imvume yakho  
 uzal wakhe ngo ku Zayna ngazangi buye izi  
 inkolemu.

Obhekhe:  
 R.m. Jaka Cuthusombul

Mina, T. MKHWANAZI (igama lombongo)  
 No Sibusiso MKHWANAZI (igama lengane)  
 ukuba abe yingxenye yo cwangciso.  
 Signature: [Signature] Date: 20-04-07

## **APPENDIX B**

**The influence a 10 week Zulu stick fighting intervention programme has on the motor proficiency and health-related physical fitness parameters of prepubescent Zulu males.**

### **INFORMATION SHEET FOR CHILDREN, TEACHERS or PARENTS/CAREGIVERS**

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you of any kind and we thank you for considering our request.

This project is being undertaken as part of the requirements for the Master of Science Degree in the Human Movement Science Department at the University of Zululand. The main aim of this study is find out if participation in a stick fighting intervention programme for 10 weeks will have any significant influence on Zulu children's motor proficiency, anthropometric measures and health-related physical fitness parameters.

Only Zulu boys are trained in the art of stick fighting and because the study is comparative, only males will be used as subjects. Children who are 10 years old are the only ones that can participate in the study.

#### **TESTING PROCEDURES**

##### Motor proficiency:

The Bruininks-Oseretsky Test for motor proficiency (Short form) will be used to test motor proficiency.

##### Anthropometric measures:

Stature and body mass will be determined using calibrated scales. Percentage body fat will be assessed by the measurement of skinfolds at four selected sites including triceps, subscapular, biceps and supra-iliac.

#### Health-related Fitness:

Health-related fitness will be assessed by measuring predicted maximal oxygen uptake with a 20 m Multi-Stage Fitness Test; a modified sit-and-reach test for flexibility; a push-up test for muscular strength and a hand grip dynamometer test for muscular endurance.

### **RISKS AND BENEFITS**

The risks you may encounter during this experiment are minimal. However, there exists the possibility of certain changes occurring during the test. These may include laboured breathing, feelings of fatigue and exhaustion, post-test muscle stiffness (residual muscle soreness) and if you have any underlying cardiac abnormalities it is possible that it may become manifest during the test. Every effort will be made to minimise these risks by evaluation of information relating to your health and fitness and by observations. Trained personnel are available to deal with any unusual situations that may arise.

Your prompt reporting of feelings with effort during the testing itself is of great importance. You are responsible to disclose such information when requested by the researchers.

As you are volunteering for this research, you shall not be paid or your participation. However, you will accrue useful information on your motor skills; health-related physical fitness; predicted maximal oxygen uptake; anthropometric measures as well as your tolerance for exercise. In conclusion you will be providing a valuable service to the advancement of our knowledge in this area of human performance.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind. You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

Results of this project may be published but any data included will in no way be linked to any specific participant. You are most welcome to request a copy of the results of the project should you wish. The data collected will be securely stored. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

Any questions about this project are encouraged.

**The influence a 10-week Zulu stick fighting intervention programme has on the motor proficiency and health-related physical fitness parameters of prepubescent Zulu males.**

CONSENT FORM FOR

***CHILDREN, TEACHERS or PARENTS / CAREGIVERS***

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that: -

1. my participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage;
3. the data, *video-tapes* will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed;
4. I am fully aware of the procedures involved, as well as the potential risks and benefits attended to my participation as explained to me verbally and in writing. I realise that it is necessary for me to promptly report to the researcher any signs or symptoms indicating any abnormality or distress.
6. the results of the project may be published but my anonymity will be preserved.

I have read the foregoing and understand it. I have been given the opportunity to ask questions and any questions that may have occurred to me have been answered to my satisfaction. I agree to take part in this project.

**CHILD**

.....  
Print name                      Signature of participant                      Date

**PERSON ADMINISTERING INFORMED CONSENT**

.....  
Print name                      Signature of participant                      Date

**WITNESS**

.....  
Print name                      Signature of participant                      Date

|

## APPENDIX C

### IFOMU LOKUVUMA

**UKUVUMA OKWAZISIWE: IZINGANE NABAZALI/ABABUKELELI  
ABAGUNYAZIWE**

Isihloko socwaningo : **Imithelela yokudlala izinduku kumakhono okusebenza  
kwezitho**

**zomzimba kanye nempilo kubafana bamaZulu  
abangathombi**

Inamba yethu : .....

### ISITATIMENDE SENGANE/UMZALI/UMBUKELELI OGUNYAZIWE:

Mina, osayine lapha ngezansi,

.....[ID.....]

wakwa (indawo yokuhlala)

.....

.....

.....ngiy

aqinisekisa ukuthi:

1. Ngiceliwe ukuthi ngizibandakanye nalolu cwaningo olubhalwe ngenhla olwenziwa uphiko lokuzivocavoca ngomzimba lwase Nyuvesi yakwaZulu.
2. Ngichazelwe lokhu okulandelayo:
  - 2.1 Izinhlalo zocwaningo ukuthola ukuthi ukhona yini umehluko phakathi kwabafana abadlala izinduku nalabo abangazidlali:
    - kumakhono okusebenza kwezitho zomzimba
    - izilinganiso zomzimba
    - isimo sempilo

- 2.2 Kulolu cwaningo ngizothola ulwazi olwazisiwe ngamakhono okusebenza kwezitho zami, impilo, isilinganiso somoya osetshenziswa umzimba uma uzivocavoca kanye nokuthi umelana kanjani nokuzivocavoca umzimba wami.
- 2.3 Ngizozibandakanya nokuhlolwa okuzohlukaniswa kwenziwe izigaba ezintathu:
  - 2.3.1 Inani lamafutha nobubanzi bezitho kuzokalwa ukuze kubonakale isimo somzimba.
  - 2.3.2 Amakhono okusebenza kwezitho zomzimba kuyobhekwa kusetshenziswa iBruininks-Oseretsky Test.
  - 2.3.3 Isimo sempilo siyohlolwa kusetshenziswa i20M Multi-Stage Fitness Test kukalwe isilinganiso somoya osetshenziswa umzimba uma uzivocavoca, ukululeka nokushoda kwamalunga omzimba kuyobhekwa ngesit-and-reach, ukubekezela kwezicubu khona kuyobhekwa ngamapush-ups, amandla ayobhekwa ngegrip dynamometer kuthi inani lamafutha libhekwe ngamaskinfolds.
3. Ngixwayisiwe ukuthi kungase kwenzeke kube nokuxineka nokungaphatheki kahle uma sengenza i20M Multi-Stage Fitness Test. Lokhu kungaba ukukhathala ngenxa yokugijima, ubuhlungu bezicubu uma sengiqedile kanye nokuzabalaza ukuphefumula. Ngiyazi ukuthi ngingamisa ucwaningo nanoma yini uma kuvela ezinye zalezi zimpawu.
4. Ngiyavuma ukuthi umcwaningi/ababukeleli bocwaningo/iNyuvesi yakwaZulu angeke ngibathwese cala uma ngilimala ngenkathi kuhlolwa kulolu cwaningo.
5. Ngazisiwe ukuthi ulwazi oloholakala ngalolu cwaningo luyogcinwa luyimfihlo kodwa imiphumela ingashicilelwa emiqulwini yolwazi.
6. Konke lokhu okungenhla kuchazwe kimi ngesiZulu ngu..... Ngingekeziwe nethuba lokubuza imibuzo nemibuzo yami iphendulwe ngendlela enganelisayo.

7. Ngazisiwe ukuthi ukuzibandakanya kulolu cwaningo kungokuzithandela nokuthi ngingayeka kulolu cwaningo nanoma yinini ngaphandle kwenzondo. Ngiyaqonda nokuthi umcwaningi angangiyekisa ukuzibandakanya nocwaningo uma ebona kufanele noma kuphoqa isimo sempilo.
8. Ngazisiwe ukuthi akukho zindleko engizozithwala noma ngilindeleke ukuzikhokha ngokuzibandakanya nocwaningo.

**Ngiyavuma ngokuzithandela** ukuzibandakanya kulolu cwaningo.

Kusayiniwe \_\_\_\_\_ lapha \_\_\_\_\_ (indawo)  
 .....ngomhlaka.....20.....

**INGANE/UMZALI/UMBUKELELI OGUNYAZIWE**

**UFAKAZI**

**ISITATIMENDE SOMCWANINGI**

Mina, .....ngiyavuma ukuthi:

1. Ngimchazele u.....ngakho konke okukuleli pheshana.
2. Ngimcelile ukuthi abuze imibuzo uma kukhona okungacacile.
3. Le nkulumo yenzeke ngolimi lwesiZulu.

Kusayinwe \_\_\_\_\_ lapha \_\_\_\_\_ (indawo)  
 .....ngomhlaka.....20.....

**UMCWANINGI**

**UFAKAZI**

# APPENDIX D

## Bruininks-Oseretsky Test of Motor Proficiency

Robert H. Bruininks, Ph.D.

## INDIVIDUAL RECORD FORM

Complete Battery  
and Short Form

NAME \_\_\_\_\_ SEX: Boy  Girl  GRADE \_\_\_\_\_  
 SCHOOL/AGENCY \_\_\_\_\_ CITY \_\_\_\_\_ STATE \_\_\_\_\_  
 EXAMINER \_\_\_\_\_ REFERRED BY \_\_\_\_\_  
 PURPOSE OF TESTING \_\_\_\_\_

**Arm Preference:** (circle one)  
 RIGHT LEFT MIXED

**Leg Preference:** (circle one)  
 RIGHT LEFT MIXED

Year Month Day  
 Date Tested \_\_\_\_\_  
 Date of Birth \_\_\_\_\_  
 Chronological Age \_\_\_\_\_

### TEST SCORE SUMMARY

SUBTEST	POINT SCORE Maximum Subject's	STANDARD SCORE Test Composite (Table 23) (Table 24)	PERCENTILE RANK (Table 25)	STANINE (Table 25)	OTHER
<b>Complete Battery:</b>					
<b>GROSS MOTOR SUBTESTS:</b>					
1. Running Speed and Agility	15				
2. Balance	32				
3. Bilateral Coordination	20				
4. Strength	42				
<b>GROSS MOTOR COMPOSITE</b>		*	*	*	*
		SUM			
5. Upper-Limb Coordination	21				
<b>FINE MOTOR SUBTESTS:</b>					
6. Response Speed	17				
7. Visual-Motor Control	24				
8. Upper-Limb Speed and Dexterity	72				
<b>FINE MOTOR COMPOSITE</b>		*	*	*	*
		SUM			
<b>BATTERY COMPOSITE</b>		*	*	*	*
		SUM			
*To obtain Battery Composite: Add Gross Motor Composite, Subtest 5 Standard Score, and Fine Motor Composite. Check result by adding Standard Scores on Subtests 1-8.					
<b>Short Form:</b>					
SHORT FORM	98	*	*	*	*
		SUM			

### DIRECTIONS

#### Complete Battery:

1. During test administration, record subject's response for each trial.
2. After test administration, convert performance on each item (item raw score) to a point score, using scale provided. For an item with more than one trial, choose best performance. Record item point score in circle to right of scale.
3. For each subtest, add item point scores; record

total in circle provided at end of each subtest and in Test Score Summary section. Consult *Examiner's Manual* for norms tables.

#### Short Form:

1. Follow Steps 1 and 2 for Complete Battery, except record each point score in box to right of scale.
2. Add point scores for all 14 Short Form items and record total in Test Score Summary section. Consult *Examiner's Manual* for norms tables.

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**SUBTEST 1: Running Speed and Agility**

**1. Running Speed and Agility<sup>SF\*</sup>**

TRIAL 1: \_\_\_\_\_ seconds      TRIAL 2: \_\_\_\_\_ seconds

Raw Score	Above 11.0	10.9-11.0	10.5-10.8	9.9-10.4	9.5-9.8	8.9-9.4	8.5-8.8	7.9-8.4	7.5-7.8	6.9-7.4	6.7-6.8	6.3-6.6	6.1-6.2	5.7-6.0	5.5-5.6	Below 5.5
Point Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

**SUBTEST 2: Balance**

**1. Standing on Preferred Leg on Floor (10 seconds maximum per trial)**

TRIAL 1: \_\_\_\_\_ seconds      TRIAL 2: \_\_\_\_\_ seconds

Raw Score	0	1-3	4-5	6-8	9-10
Point Score	0	1	2	3	4

**2. Standing on Preferred Leg on Balance Beam<sup>SF</sup> (10 seconds maximum per trial)**

TRIAL 1: \_\_\_\_\_ seconds      TRIAL 2: \_\_\_\_\_ seconds

Raw Score	0	1-2	3-4	5-6	7-8	9	10
Point Score	0	1	2	3	4	5	6

**3. Standing on Preferred Leg on Balance Beam—Eyes Closed (10 seconds maximum per trial)**

TRIAL 1: \_\_\_\_\_ seconds      TRIAL 2: \_\_\_\_\_ seconds

Raw Score	0	1-3	4-5	6	7	8	9	10
Point Score	0	1	2	3	4	5	6	7

**4. Walking Forward on Walking Line (6 steps maximum per trial)**

TRIAL 1: \_\_\_\_\_ steps      TRIAL 2: \_\_\_\_\_ steps

Raw Score	0	1-3	4-5	6
Point Score	0	1	2	3

**5. Walking Forward on Balance Beam (6 steps maximum per trial)**

TRIAL 1: \_\_\_\_\_ steps      TRIAL 2: \_\_\_\_\_ steps

Raw Score	0	1-3	4	5	6
Point Score	0	1	2	3	4

**6. Walking Forward Heel-to-Toe on Walking Line (6 steps maximum per trial)**

TRIAL 1: [ ] [ ] [ ] [ ] [ ] [ ] = \_\_\_\_\_ steps      TRIAL 2: [ ] [ ] [ ] [ ] [ ] [ ] = \_\_\_\_\_ steps

Raw Score	0	1-3	4-5	6
Point Score	0	1	2	3

**7. Walking Forward Heel-to-Toe on Balance Beam<sup>SF</sup> (6 steps maximum per trial)**

TRIAL 1: [ ] [ ] [ ] [ ] [ ] [ ] = \_\_\_\_\_ steps      TRIAL 2: [ ] [ ] [ ] [ ] [ ] [ ] = \_\_\_\_\_ steps

Raw Score	0	1-3	4	5	6
Point Score	0	1	2	3	4

**8. Stepping Over Response Speed Stick on Balance Beam**

TRIAL 1: Fail Pass      TRIAL 2: Fail Pass

Raw Score	Fail	Pass
Point Score	0	1

RECORD POINT SCORES FOR COMPLETE BATTERY

POINT SCORE SUBTEST 1 (Max: 15)

POINT SCORE SUBTEST 2 (Max: 32)

\*SF and the box in left-hand margin indicate Short Form items.

**SUBTEST 3: Bilateral Coordination**

1. Tapping Feet Alternately While Making Circles with Fingers<sup>SP</sup> (90 seconds maximum)

* Raw Score	Fail	Pass
Point Score	0	1

2. Tapping—Foot and Finger on Same Side Synchronized (90 seconds maximum)

* Raw Score	Fail	Pass
Point Score	0	1

3. Tapping—Foot and Finger on Opposite Side Synchronized (90 seconds maximum)

* Raw Score	Fail	Pass
Point Score	0	1

4. Jumping in Place—Leg and Arm on Same Side Synchronized (90 seconds maximum)

* Raw Score	Fail	Pass
Point Score	0	1

5. Jumping in Place—Leg and Arm on Opposite Side Synchronized (90 seconds maximum)

* Raw Score	Fail	Pass
Point Score	0	1

6. Jumping Up and Clapping Hands<sup>SP</sup>

TRIAL 1: \_\_\_\_\_ claps      TRIAL 2: \_\_\_\_\_ claps

Raw Score	0	1	2	3	4	Above 4
Point Score	0	1	2	3	4	5

7. Jumping Up and Touching Heels with Hands

TRIAL 1: Fail Pass      TRIAL 2: Fail Pass

Raw Score	Fail	Pass
Point Score	0	1

8. Drawing Lines and Crosses Simultaneously (15 seconds)

NUMBER OF PAIRS CORRECT: \_\_\_\_\_

Raw Score	0	1	2-3	4-5	6-7	8-9	10-11	12-14	15-17	Above 17
Point Score	0	1	2	3	4	5	6	7	8	9

**SUBTEST 4: Strength**

1. Standing Broad Jump<sup>SP</sup> (record number from tape measure)

TRIAL 1: \_\_\_\_\_ TRIAL 2: \_\_\_\_\_ TRIAL 3: \_\_\_\_\_

Raw Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Point Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

2. Sit-ups (20 seconds)

NUMBER: \_\_\_\_\_

Raw Score	0	1-2	3-4	5-6	7-8	9-10	11-12	13-15	16-18	19-20	Above 20
Point Score	0	1	2	3	4	5	6	7	8	9	10

3a. Knee Push-ups (For Boys Under Age 8 and All Girls) (20 seconds)

NUMBER: \_\_\_\_\_

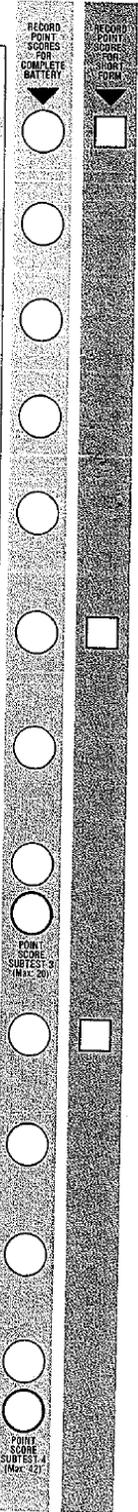
Raw Score	0	1-2	3-5	6-7	8-9	-	-	10-12	-	-	13-15	-	16-18	-	-	19-20	Above 20
Point Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

3b. Full Push-ups (For Boys Age 8 and Older) (20 seconds)

NUMBER: \_\_\_\_\_

Raw Score	0	-	-	-	1-5	6-9	-	10-11	12-13	-	14-15	-	16-17	18-20	-	Above 20	
Point Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

<sup>SP</sup>For Subtest 3, circle pass or fail in Items 1-5.



**SUBTEST 5: Upper-Limb Coordination**

**1. Bouncing a Ball and Catching It with Both Hands (5 trials)**

NUMBER OF CATCHES: \_\_\_\_\_

Raw Score	0	1-2	3-4	5
Point Score	0	1	2	3

**2. Bouncing a Ball and Catching It with Preferred Hand (5 trials)**

NUMBER OF CATCHES: \_\_\_\_\_

Raw Score	0	1-2	3-4	5
Point Score	0	1	2	3

**3. Catching a Tossed Ball with Both Hands<sup>SP</sup> (5 trials)**

NUMBER OF CATCHES: \_\_\_\_\_

Raw Score	0	1-2	3-4	5
Point Score	0	1	2	3

**4. Catching a Tossed Ball with Preferred Hand (5 trials)**

NUMBER OF CATCHES: \_\_\_\_\_

Raw Score	0	1-2	3-4	5
Point Score	0	1	2	3

**5. Throwing a Ball at a Target with Preferred Hand<sup>SP</sup> (5 trials)**

\_\_\_\_\_ = HITS

Raw Score	0	1-2	3-4	5
Point Score	0	1	2	3

**6. Touching a Swinging Ball with Preferred Hand (5 trials)**

NUMBER OF HITS: \_\_\_\_\_

Raw Score	0	1-2	3-4	5
Point Score	0	1	2	3

**7. Touching Nose with Index Fingers—Eyes Closed (90 seconds maximum)**

\* Raw Score

Fail	Pass
0	1

**8. Touching Thumb to Fingertips—Eyes Closed (90 seconds maximum)**

\* Raw Score

Fail	Pass
0	1

**9. Pivoting Thumb and Index Finger (90 seconds maximum)**

\* Raw Score

Fail	Pass
0	1

**SUBTEST 6: Response Speed**

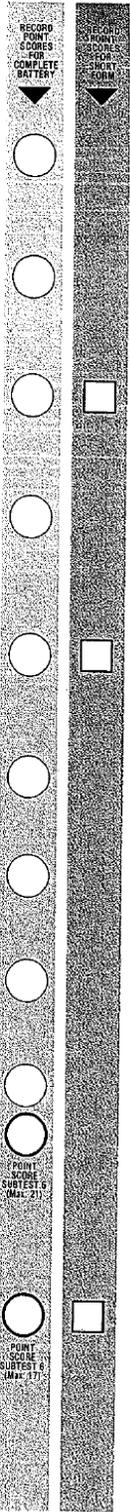
**1. Response Speed<sup>SP</sup>**

TRIAL	SECONDS TO WAIT	SCORE <sup>1</sup>	RANKED TRIAL SCORES <sup>2</sup>
Practice 1	1	XXXX	
Practice 2	3	XXXX	
1	2	_____	HIGHEST
2	3	_____	
3	1	_____	MEDIAN
4	3	_____	
5	2	_____	
6	1	_____	
7	1	_____	LOWEST

<sup>1</sup>Record number from response speed stick in this column.

<sup>2</sup>Rank all seven trial scores, highest to lowest, in boxes provided. The point score for Subtest 6 is the median (middle), or fourth, score from the top.

<sup>3</sup>For Subtest 5, circle pass or fail in Items 7-9.



**SUBTEST 7: Visual-Motor Control**

**1. Cutting Out a Circle with Preferred Hand**

NUMBER OF ERRORS: \_\_\_\_\_

Raw Score	Above 10	10	8-9	3-7	0-2
Point Score	0	1	2	3	4

**2. Drawing a Line Through a Crooked Path with Preferred Hand**

NUMBER OF ERRORS: \_\_\_\_\_

Raw Score	Above 5	6	2-5	1	0
Point Score	0	1	2	3	4

**3. Drawing a Line Through a Straight Path with Preferred Hand<sup>SP</sup>**

NUMBER OF ERRORS: \_\_\_\_\_

Raw Score	Above 5	6	2-5	1	0
Point Score	0	1	2	3	4

**4. Drawing a Line Through a Curved Path with Preferred Hand**

NUMBER OF ERRORS: \_\_\_\_\_

Raw Score	Above 6	6	2-5	1	0
Point Score	0	1	2	3	4

**5. Copying a Circle with Preferred Hand<sup>SP</sup>**

SCORE: \_\_\_\_\_

Raw Score	0	1	2
Point Score	0	1	2

**6. Copying a Triangle with Preferred Hand**

SCORE: \_\_\_\_\_

Raw Score	0	1	2
Point Score	0	1	2

**7. Copying a Horizontal Diamond with Preferred Hand**

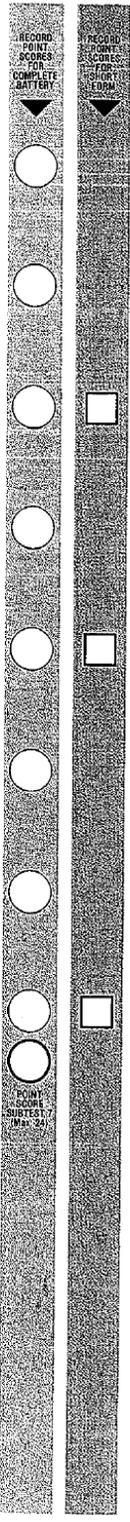
SCORE: \_\_\_\_\_

Raw Score	0	1	2
Point Score	0	1	2

**8. Copying Overlapping Pencils with Preferred Hand<sup>SP</sup>**

SCORE: \_\_\_\_\_

Raw Score	0	1	2
Point Score	0	1	2



<sup>SP</sup>See scoring criteria for Items 5-8 in Appendix A of Examiner's Manual.

**SUBTEST 8: Upper-Limb Speed and Dexterity**

**1. Placing Pennies in a Box with Preferred Hand (15 seconds)**

NUMBER OF PENNIES: \_\_\_\_\_

Raw Score	0-5	6-10	11-13	14-15	16-17	18-19	20-21	22-23	24
Point Score	0	1	2	3	4	5	6	7	8

**2. Placing Pennies in Two Boxes with Both Hands (50 seconds maximum for seven correct pairs)**

PAIRS CORRECT: \_\_\_\_\_ TIME IN SECONDS: \_\_\_\_\_

Raw Score	Above 49	41-49	31-40	28-30	21-25	18-20	16-17	14-15	12-13	10-11	Below 10
Point Score	0	1	2	3	4	5	6	7	8	9	10

**3. Sorting Shape Cards with Preferred Hand<sup>SP</sup> (15 seconds)**

NUMBER OF CARDS: \_\_\_\_\_

Raw Score	0	1-8	9-12	13-15	17-20	21-25	26-29	30-33	34-37	38-41	Above 41
Point Score	0	1	2	3	4	5	6	7	8	9	10

**4. Stringing Beads with Preferred Hand (15 seconds)**

NUMBER OF BEADS: \_\_\_\_\_

Raw Score	0-1	2-4	5	6	7	8	9	Above 9
Point Score	0	1	2	3	4	5	6	7

**5. Displacing Pegs with Preferred Hand (15 seconds)**

NUMBER OF PEGS: \_\_\_\_\_

Raw Score	0	1-5	6-7	8-9	10-11	12-13	14-15	16-18	19-20
Point Score	0	1	2	3	4	5	6	7	8

**6. Drawing Vertical Lines with Preferred Hand (15 seconds)**

NUMBER OF LINES: \_\_\_\_\_

Raw Score	0	1-3	4-6	7-9	10-12	13-16	17-20	21-24	25-35	Above 35
Point Score	0	1	2	3	4	5	6	7	8	9

**7. Making Dots in Circles with Preferred Hand<sup>SP</sup> (15 seconds)**

NUMBER OF CIRCLES WITH DOTS: \_\_\_\_\_

Raw Score	0	1-10	11-15	16-20	21-25	26-30	31-35	36-40	41-50	51-60	Above 60
Point Score	0	1	2	3	4	5	6	7	8	9	10

**8. Making Dots with Preferred Hand (15 seconds)**

NUMBER OF DOTS: \_\_\_\_\_

Raw Score	Below 10	10-25	26-35	36-45	46-55	56-65	66-75	76-85	86-95	96-105	Above 105
Point Score	0	1	2	3	4	5	6	7	8	9	10

**NOTES/OBSERVATIONS**

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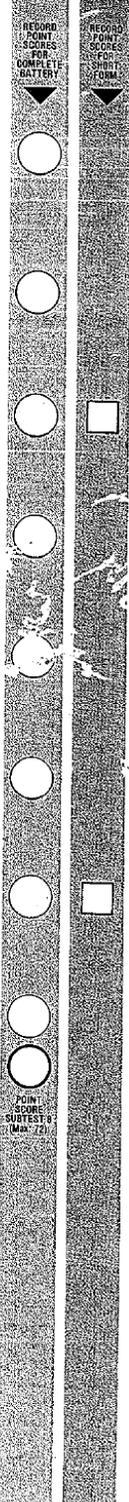


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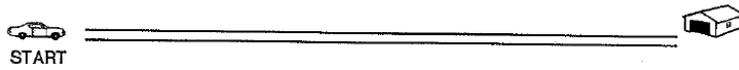
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For additional forms, call or write AGS, 4201 Woodland Road, Circle Pines, MN 55014-1796; toll-free 1-800-328-2560. Ask for item 1584, B.O. Record Forms (25 per package).



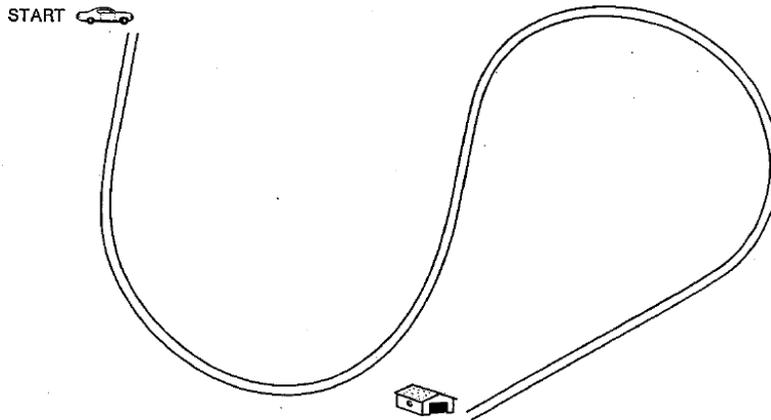
**SUBTEST 7: Visual-Motor Control**

Item 3<sup>RF</sup> / Drawing a Line Through a Straight Path with Preferred Hand



Number of Errors

Item 4 / Drawing a Line Through a Curved Path with Preferred Hand

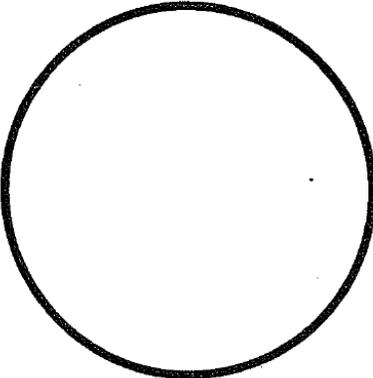
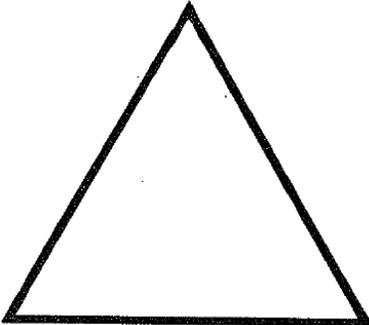


Number of Errors

**SUBTEST 7: Visual-Motor Control**

Item 5<sup>SP</sup> / Copying a Circle  
with Preferred Hand

Item 6 / Copying a Triangle  
with Preferred Hand

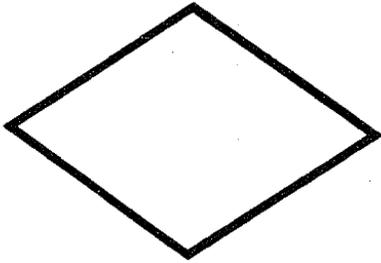
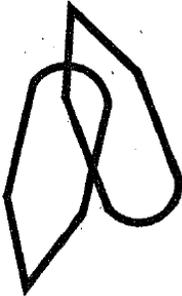
Score

Score

**SUBTEST 7: Visual-Motor Control**

Item 7 / Copying a Horizontal Diamond  
with Preferred Hand

Item 8<sup>sf</sup> / Copying Overlapping Pencils  
with Preferred Hand

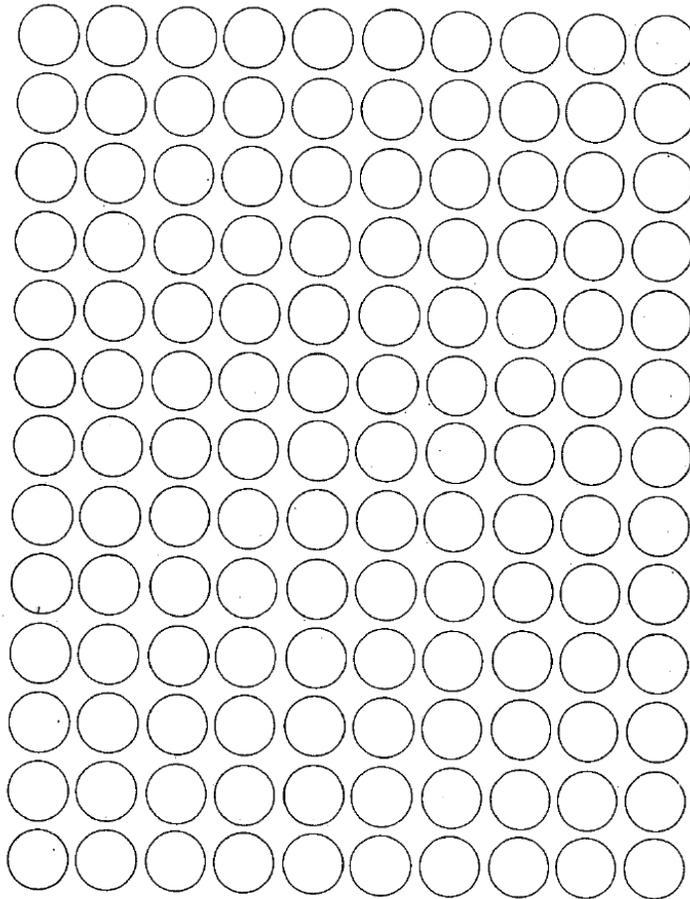
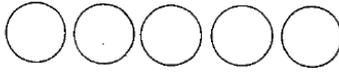
Score

Score

**SUBTEST 8: Upper-Limb Speed and Dexterity**

Item 7<sup>SF</sup> / Making Dots in Circles with Preferred Hand

Practice:



Number  
Correct

**APPENDIX E**

**UNIVERSITY OF ZULULAND**

**DEPARTMENT OF HUMAN MOVEMENT SCIENCE**

**NAME** : .....

**GROUP** : Experimental or Control

**AGE (Years and months)** : .....

**STATURE (m)** : .....

**MASS (kg)** : .....

**SKINFOLDS (mm)**

- **Biceps** : .....
- **Triceps** : .....
- **Subscapular** : .....
- **Suprailiac** : .....
- **Body fat (%)** : .....

**WHR (m)**

- **Hip circumference** : .....
- **Waist circumference:** .....

**RATING** : .....

**FLEXIBILITY (cm)**

- **Sit-and-reach** : .....

**RATING** : .....

**STRENGTH (kg)** : .....

- **Grip dynamometer** : .....

**RATING** : .....

**ENDURANCE**

- **Sit-ups** : .....

**RATING** : .....

- **Push-ups** : .....

**RATING** : .....

## **APPENDIX F**

### **WEEK 1 (STANCE)**

#### **1. WARM-UP ACTIVITIES (3-5 Minutes)**

Subjects were instructed to do the following:

- Jog on the spot,
- Jog at light intensity of maximum effort from one end of the area to the other,
- Jog from one end of the area to the other whilst clapping hands,
- Hop from one end to the other whilst touching their thighs with their hands,
- Do side running whilst swinging arms medially and laterally,
- Jog at moderate intensity of maximum effort from one end of the area to the other,
- Do side running with a turn whilst swinging arms medially and laterally,
- Jogging touching heels with the tips of the fingers,
- Jog at moderate to vigorous intensity of maximum effort from one end of the area to the other.

#### **2. STRETCHING EXERCISES (3-5 Minutes)**

The body parts or muscles that were stretched (in the order of sequence) included:

- the neck,
- the shoulders,
- the triceps,
- side stretcher,
- the quadriceps,
- the hamstrings,
- the hip flexors,
- and the calves.

#### **3. WORKOUT/EXERTION (40 Minutes)**

Subjects were instructed to do the following:

- Standing with feet shoulders width, bring the feet together. Repeat ten times.

- Standing with feet shoulders width, bring the right foot out (forwards). Repeat ten times.
- Standing with feet shoulders width, bring the left foot out (forwards). Repeat ten times.
- In pairs. One subject standing with feet together, the other subject tries to push the subject. The subject must respond by bringing the right foot out to balance. Repeat ten times.
- In pairs. One subject standing with feet together, the other subject tries to push the subject. The subject must respond by bringing the left foot out to balance. Repeat ten times.
- In pairs, put the hands on the partner's shoulders and the right foot out, push the partner as hard as possible. Repeat ten times.
- In pairs, put the hands on the partner's shoulders and the left foot out, push the partner as hard as possible. Repeat ten times.
- In pairs, put the right hand on the partner's shoulders and the right foot out, push the partner as hard as possible. Repeat ten times.
- In pairs, put the left hand on the partner's shoulders and the right foot out, push the partner as hard as possible. Repeat ten times.
- Engage in a human tug of war. Each subject to hold the next around the abdominal area. Two groups to try and pull one another.

#### 4. COOL-DOWN (3-5 Minutes)

The cool down included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes.

## WEEK 2 (HANDLING THE STICKS)

### 1. WARM-UP ACTIVITIES (3-5 Minutes)

Subjects were instructed to do the following:

- Jog on the spot,
- Jog at light intensity of maximum effort from one end of the area to the other,
- Jog from one end of the area to the other whilst clapping hands,
- Hop from one end to the other whilst touching their thighs with their hands,
- Do side running whilst swinging arms medially and laterally,
- Jog at moderate intensity of maximum effort from one end of the area to the other,
- Do side running with a turn whilst swinging arms medially and laterally,
- Jogging touching heels with the tips of the fingers from one end to the other.
- Jog at moderate to vigorous intensity of maximum effort from one end of the area to the other,

### 2. STRETCHING EXERCISES (3-5 Minutes)

The body parts or muscles that were stretched (in the order of sequence) included:

- the neck,
- the shoulders,
- the triceps,
- side stretcher,
- the quadriceps,
- the hamstrings,
- the hip flexors,
- and the calves.

### 3. WORKOUT/EXERTION (40 Minutes)

#### 3.1 SKILL DEVELOPMENT (20-25 Minutes)

Subjects were instructed to do the following:

- Standing in a proper Zulu stick fighting stance, pretend to land a straight offensive shot in the air. Repeat ten times.

- Standing in a proper Zulu stick fighting stance, pretend to land an offensive shot in the air to right. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, pretend to land an offensive shot in the air to the left. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, pretend to land an oblique shot in the air to the right. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, pretend to land an oblique shot in the air to the left. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to landing a straight offensive shot to the partner. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to landing a straight offensive shot to right side of the partner. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to land an offensive shot in the air to right. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to land an offensive shot in the air to the left. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to land an oblique shot in the air to the right. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to land an oblique shot in the air to the left. Repeat ten times.

### 3.2 SKILL APPLICATION (15 Minutes)

- Subjects were instructed to engage in a mock fight, trying to use all the offensive shots that they have learned.

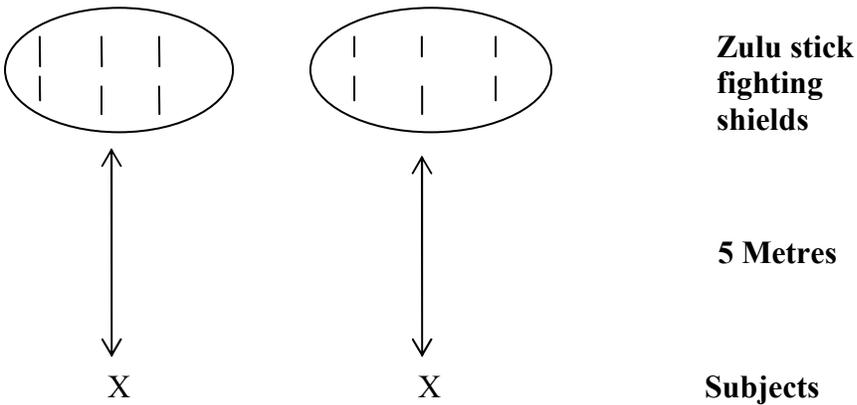
### 4. COOL-DOWN (3-5 Minutes)

The cool down included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes.

## WEEK 3 (DIFFERENT OFFENSIVE SHOTS)

### 1. WARM-UP ACTIVITIES (3-5 Minutes)

Subjects were instructed to do the following specific stick fighting war-up activity as designed by the two trainers:



Subjects were instructed to stand in a horizontal line. They were then instructed to place their shields and the sticks 5 metres away from them. They were instructed to do the following:

- Jog forwards at light intensity of the maximum effort, when the shield is reached, jump forwards and backwards and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the outside once and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the inside and the outside and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the left hand side and reverse back to the original position.

- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the left hand side and reverse back to the original position.

## 2. STRETCHING EXERCISES (3-5 Minutes)

The body parts or muscles that were stretched (in the order of sequence) included:

- the neck,
- the shoulders,
- the triceps,
- side stretcher,
- the quadriceps,
- the hamstrings,
- the hip flexors,
- and the calves.

## 3. WORKOUT/EXERTION (40 Minutes)

### 3.1 SKILL DEVELOPMENT (20-25 Minutes)

Subjects were instructed to do the following:

- Standing in a proper Zulu stick fighting stance, pretend to land a straight offensive shot in the air. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, pretend to land an offensive shot in the air to right. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, pretend to land an offensive shot in the air to the left. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, pretend to land an oblique shot in the air to the right. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, pretend to land an oblique shot in the air to the left. Repeat ten times.

- Standing in a proper Zulu stick fighting stance, jump to the right and land a shot in the air to the right. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, jump to the right and land a shot in the air to the left. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, move the hand holding the shield to the right and land a shot in the air to the right. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, move the hand holding the shield to the left and land a shot in the air to the left. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to landing a straight offensive shot to the partner. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to landing a straight offensive shot to right side of the partner. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to land an offensive shot in the air to right. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to land an offensive shot in the air to the left. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to land an oblique shot in the air to the right. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, pretend to land an oblique shot in the air to the left. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, jump to the right and land a shot in the air to the right. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, jump to the right and land a shot in the air to the left. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, move the hand holding the shield to the right and land a shot in the air to the right. Repeat ten times.
- In pairs. Standing in a proper Zulu stick fighting stance, move the hand holding the shield to the left and land a shot in the air to the left. Repeat ten times.

### 3.2 SKILL APPLICATION

- Subjects were instructed to engage in a mock fight, trying to use all the offensive shots that they have learned.

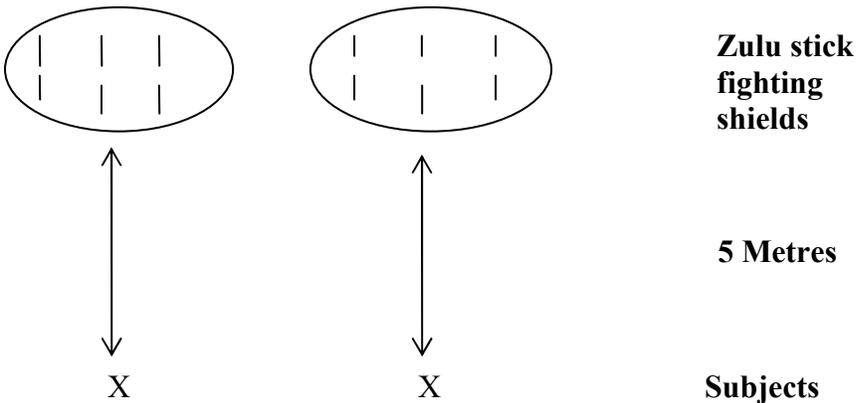
#### 4. COOL-DOWN (3-5 Minutes)

The cool down included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes.

## WEEK 4 (INTRODUCTION OF THE SHIELD)

### 1. WARM-UP ACTIVITIES (3-5 Minutes)

Subjects were instructed to do the following specific stick fighting war-up activity as designed by the two trainers:



Subjects were instructed to stand in a horizontal line. They were then instructed to place their shields and the sticks 5 metres away from them. They were instructed to do the following:

- Jog forwards at light intensity of the maximum effort, when the shield is reached, jump forwards and backwards and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the outside once and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the inside and the outside and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the left hand side and reverse back to the original position.

- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the left hand side and reverse back to the original position.

## 2. STRETCHING EXERCISES (3-5 Minutes)

The body parts or muscles that were stretched (in the order of sequence) included:

- the neck,
- the shoulders,
- the triceps,
- side stretcher,
- the quadriceps,
- the hamstrings,
- the hip flexors,
- and the calves.

## 3. WORKOUT/EXERTION (40 Minutes)

### 3.1 SKILL DEVELOPMENT (20-25 Minutes)

Subjects were instructed to do the following:

- Standing in a proper Zulu stick fighting stance, to lift both the shield and the sticks. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to bring the shield towards the body, pretend to land a shot to the right side and lift the shield. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to bring the shield towards the body, pretend to land a shot to the left side and lift the shield. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift both the shield and the sticks. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to bring the shield towards the body, pretend to land a shot and lift the shield. Repeat five times.

- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and return to original position. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield oblique and return to original position. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and move the shield to the right of the body. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and move the shield to the left of the body. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and move the shield medially. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and pretend to land a shot to the right side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and pretend to land a shot to the left side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to jump backwards, lift the shield and pretend to land a shot to the right side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to jump backwards, lift the shield and pretend to land a shot to the left side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to jump sideways, lift the shield and pretend to land a shot to the right side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to jump sideways, lift the shield and pretend to land a shot to the left side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to hit the shield on the inside and pretend to land a shot to the right side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to hit the shield on the inside and pretend to land a shot to the left side. Repeat five times.

### 3.2 SKILL APPLICATION

- Subjects were instructed to engage in a mock fight, trying to use all the offensive shots that they have learned.

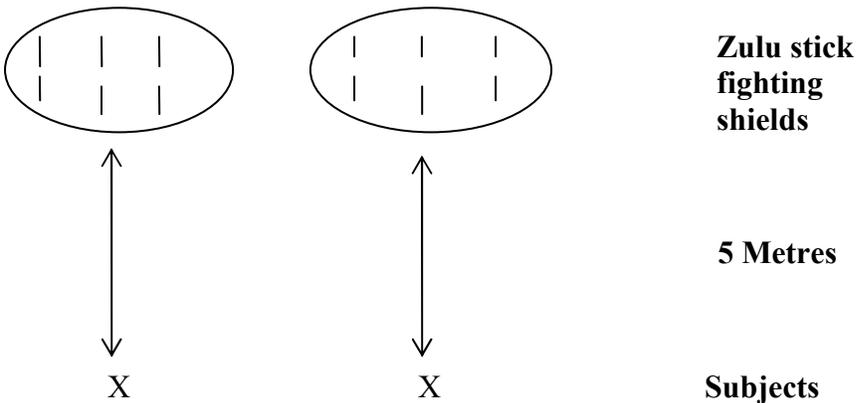
5. COOL-DOWN (3-5 Minutes)

The cool down included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes.

## WEEK 5 (USING THE SHIELD TO FEND OFF BLOWS)

### 1. WARM-UP ACTIVITIES (3-5 Minutes)

Subjects were instructed to do the following specific stick fighting war-up activity as designed by the two trainers:



Subjects were instructed to stand in a horizontal line. They were then instructed to place their shields and the sticks 5 metres away from them. They were instructed to do the following:

- Jog forwards at light intensity of the maximum effort, when the shield is reached, jump forwards and backwards and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the outside once and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the inside and the outside and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the left hand side and reverse back to the original position.

- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the left hand side and reverse back to the original position.

## 2. STRETCHING EXERCISES (3-5 Minutes)

The body parts or muscles that were stretched (in the order of sequence) included:

- the neck,
- the shoulders,
- the triceps,
- side stretcher,
- the quadriceps,
- the hamstrings,
- the hip flexors,
- and the calves.

## 3. WORKOUT/EXERTION (40 Minutes)

### 3.1 SKILL DEVELOPMENT (20-25 Minutes)

Subjects were instructed to do the following:

- Standing in a proper Zulu stick fighting stance, to lift both the shield and the sticks. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to bring the shield towards the body, pretend to land a shot to the right side and lift the shield. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to bring the shield towards the body, pretend to land a shot to the left side and lift the shield. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift both the shield and the sticks. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to bring the shield towards the body, pretend to land a shot and lift the shield. Repeat five times.

- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and return to original position. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield oblique and return to original position. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and move the shield to the right of the body. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and move the shield to the left of the body. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and move the shield medially. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and pretend to land a shot to the right side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to lift the shield in a straight line and pretend to land a shot to the left side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to jump backwards, lift the shield and pretend to land a shot to the right side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to jump backwards, lift the shield and pretend to land a shot to the left side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to jump sideways, lift the shield and pretend to land a shot to the right side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to jump sideways, lift the shield and pretend to land a shot to the left side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to hit the shield on the inside and pretend to land a shot to the right side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to hit the shield on the inside and pretend to land a shot to the left side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to drop the shield and the sticks and pick them up straight away. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to drop the shield and the sticks, pick them up straight away and pretend to land a shot to the right side. Repeat five times.

- Standing in a proper Zulu stick fighting stance, to drop the shield and the sticks, pick them up straight away and pretend to land a shot to the left side. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to drop the shield and the sticks, pick them up straight away and pretend to land an oblique shot. Repeat five times.
- Standing in a proper Zulu stick fighting stance, to use the shield to parry off the shots on the left and the right sides of the body. Repeat ten times.
- Standing in a proper Zulu stick fighting stance, to use the shield to parry off the shots on the upper and lower sides of the body. Repeat ten times.

### 3.2 SKILL APPLICATION

- Subjects were instructed to engage in a mock fight, trying to use all the offensive shots that they have learned.

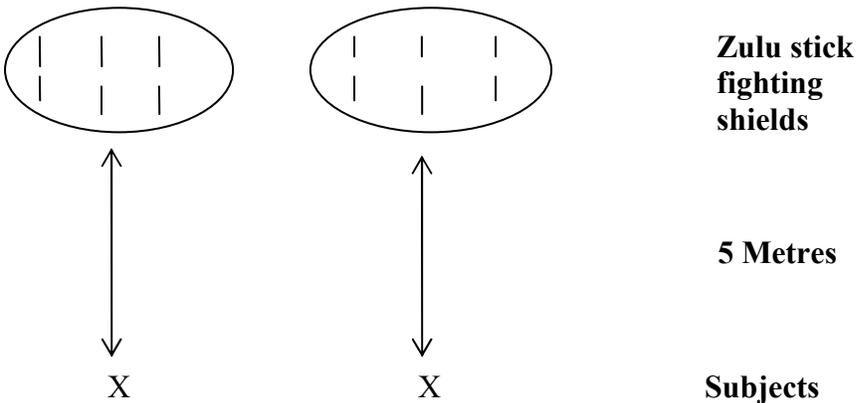
#### 6. COOL-DOWN (3-5 Minutes)

The cool down included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes.

## WEEK 6 AND 7 (MINI SPARRING)

### 1. WARM-UP ACTIVITIES (3-5 Minutes)

Subjects were instructed to do the following specific stick fighting war-up activity as designed by the two trainers:



Subjects were instructed to stand in a horizontal line. They were then instructed to place their shields and the sticks 5 metres away from them. They were instructed to do the following:

- Jog forwards at light intensity of the maximum effort, when the shield is reached, jump forwards and backwards and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the outside once and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the inside and the outside and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the left hand side and reverse back to the original position.

- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the left hand side and reverse back to the original position.

## 2. STRETCHING EXERCISES (3-5 Minutes)

The body parts or muscles that were stretched (in the order of sequence) included:

- the neck,
- the shoulders,
- the triceps,
- side stretcher,
- the quadriceps,
- the hamstrings,
- the hip flexors,
- and the calves.

## 3. WORKOUT/EXERTION (40 Minutes)

### 3.1 SKILL DEVELOPMENT

Subjects were instructed to do the following:

- Engage in a simulated stick fight contest, trying to use all the skills that they have learned. The intensity at which this activity was done was moderate to vigorous intensity.

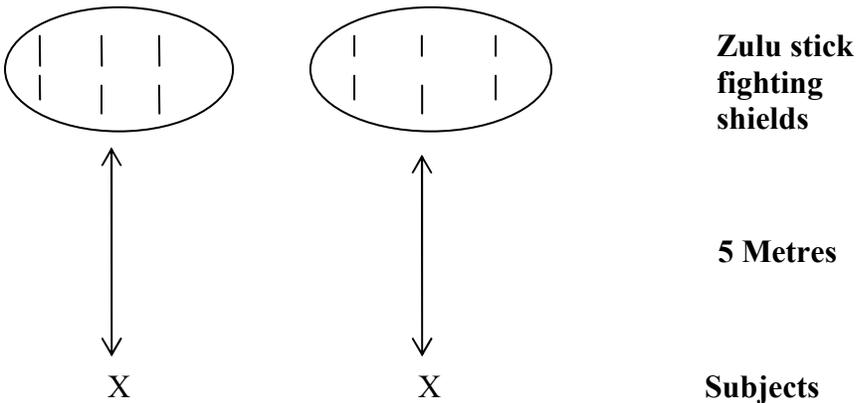
## 4. COOL-DOWN (3-5 Minutes)

The cool down included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes.

## WEEK 8 AND 9 (WAR DANCE)

### 1. WARM-UP ACTIVITIES (3-5 Minutes)

Subjects were instructed to do the following specific stick fighting war-up activity as designed by the two trainers:



Subjects were instructed to stand in a horizontal line. They were then instructed to place their shields and the sticks 5 metres away from them. They were instructed to do the following:

- Jog forwards at light intensity of the maximum effort, when the shield is reached, jump forwards and backwards and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the outside once and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the inside and the outside and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the left hand side and reverse back to the original position.

- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the left hand side and reverse back to the original position.

## 2. STRETCHING EXERCISES (3-5 Minutes)

The body parts or muscles that were stretched (in the order of sequence) included:

- the neck,
- the shoulders,
- the triceps,
- side stretcher,
- the quadriceps,
- the hamstrings,
- the hip flexors,
- and the calves.

## 3. WORKOUT/EXERTION (40 Minutes)

### 3.1 SKILL DEVELOPMENT

Subjects were instructed to do the following:

- Sit on top of their shields and sticks, take turns to do the war dance. The intensity at which this activity was done was moderate to vigorous intensity.  
**(The researcher cannot explain the process of war dance in words)**

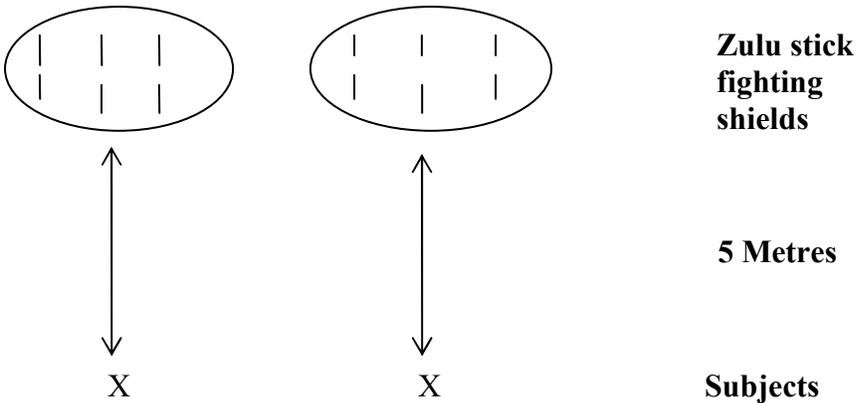
## 4. COOL-DOWN (3-5 Minutes)

The cool down included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes.

## WEEK 10 (WAR REGIMENTS)

### 1. WARM-UP ACTIVITIES (3-5 Minutes)

Subjects were instructed to do the following specific stick fighting war-up activity as designed by the two trainers:



Subjects were instructed to stand in a horizontal line. They were then instructed to place their shields and the sticks 5 metres away from them. They were instructed to do the following:

- Jog forwards at light intensity of the maximum effort, when the shield is reached, jump forwards and backwards and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the outside once and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the shield on the inside and the outside and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air on the left hand side and reverse back to the original position.

- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the right hand side and reverse back to the original position.
- Jog forwards at light intensity of the maximum effort, when the shield is reached, pick up the shield and the sticks, hit the air with an oblique shot on the left hand side and reverse back to the original position.

## 2. STRETCHING EXERCISES (3-5 Minutes)

The body parts or muscles that were stretched (in the order of sequence) included:

- the neck,
- the shoulders,
- the triceps,
- side stretcher,
- the quadriceps,
- the hamstrings,
- the hip flexors,
- and the calves.

## 3. WORKOUT/EXERTION (40 Minutes)

### 3.1 SKILL DEVELOPMENT

Subjects were instructed to do the following:

- To form a war regiments, sing Zulu songs sung by war regiments and participate in simulated war activities. The intensity at which this activity was done was moderate to vigorous intensity.

**(The researcher can not explain the process of war regiments in words)**

## 4. COOL-DOWN (3-5 Minutes)

The cool down included a light intensity jog from one point to the end repeated twice which lasted for three to five minutes.

# APPENDIX G

## 20 MST DATA FORM

NAME: \_\_\_\_\_

GROUP: EXP CONTROL

DATE: \_\_\_\_\_

HR	LEVEL	HR	LEVEL	HR	LEVEL
0	1	60	81	120	121 13
2	3 1	62	63	122	123
4	5	64	65	124	125
6	7	66	67 8	126	127
8	9	68	69	128	129
10	11 2	70	71	130	131
12	13	72	73	132	133
14	15	74	75	134	135 4
16	17	76	77	136	137
18	19 3	78	79 9	138	139
20	21	80	81	140	141
22	23	82	83	142	143
24	25	84	85	144	145
26	27 4	86	87	146	147 15
28	29	88	89 10	148	149
30	31	90	91	150	151
32	33	92	93	152	153
34	35	94	95	154	155
36	37 5	96	97	156	157
38	39	98	99	158	159
40	41	100	101 11	160	161 16
42	43	102	103	162	163
44	45 6	104	105	164	165
46	47	106	107	166	167
48	49	108	109	168	169
50	51	110	111 12	170	171
52	53	112	113	172	173
54	55 7	114	115	174	175 17
56	57	116	117	176	177
58	59	118	119	178	179

## APPENDIX H

GROUP=EXP					
Summary for scale: Mean=46.7727 Std.Dv.=6.66142 Valid N:2 Cronbach alpha: .324890 Standardized alpha:					
variable	Mean if	Var. if delete	StDv. if	Itm-Totl Correl.	Alpha if deleted
Running_Speed_Agility_Pre	39.5909	34.6053	5.88263	0.523655	0.183334
Balance_Pre	39.9090	36.2644	6.02199	0.002236	0.385255
B_Coordination_Pre	44.0454	42.0433	6.48408	-0.049017	0.351107
Strength_Pre	41.0454	33.4979	5.78774	0.134110	0.295031
Response_Speed_Pre	38.3181	20.6714	4.54659	0.373864	0.054573
Upper_Limb_Coordination_Pre	42.9545	41.3161	6.42776	0.032406	0.330216
Visual_Motor_Control_Pre	40.6818	39.7624	6.30574	0.067654	0.322265
Upper_Limb_Speed_Dexterity_Pre	40.8636	36.2995	6.02491	0.081126	0.323524

GROUP=CTRL					
Summary for scale: Mean=48.6522 Std.Dv.=5.65371 Valid N:23 (SNX Cronbach alpha: .488544 Standardized alpha: .459968					
variable	Mean if	Var. if delete	StDv. if delete	Itm-Totl Correl.	Alpha if deleted
Running_Speed_Agility_Pre	41.2608	25.3232	5.03222	0.348407	0.419254
Balance_Pre	40.0434	23.0850	4.80469	0.241728	0.447866
B_Coordination_Pre	46.1304	29.5916	5.43982	0.134959	0.486372
Strength_Pre	43.3043	24.6465	4.96452	0.201654	0.464054
Response_Speed_Pre	39.3043	16.9943	4.12241	0.357419	0.392436
Upper_Limb_Coordination_Pre	44.9130	28.6011	5.34800	0.182195	0.474686
Visual_Motor_Control_Pre	43.1304	30.4612	5.51917	-0.062520	0.522444
Upper_Limb_Speed_Dexterity_Pre	42.4782	22.2495	4.71694	0.379357	0.383999

GROUP=EXP					
Summary for scale: Mean=55.5909 Std.Dv.=8.12790 Valid N:22 (S Cronbach alpha: .483339 Standardized alpha: .615796					
variable	Mean if	Var. if delete	StDv. if delete	Itm-Totl Correl.	Alpha if deleted
Running_Speed_Agility_Post	47.8181	46.7851	6.83996	0.600626	0.327062
Balance_Post	43.8181	58.3305	7.63744	0.309021	0.453245
B_Coordination_Post	52.3181	59.5805	7.71884	0.226588	0.466877
Strength_Post	48.4090	45.7871	6.76662	0.103997	0.553615
Upper limb coordination_Post	52.1818	59.6033	7.72031	0.237333	0.466214
Response_speed_Post	47.5454	42.0661	6.48584	0.210100	0.481336
Visual_motor_control_Post	50.2272	59.0847	7.68665	0.172661	0.470632
Upper_Limb_Speed_Dexterity_Post	46.8181	43.5123	6.59639	0.385584	0.366287

GROUP=CTRL					
Summary for scale: Mean=51.6087 Std.Dv.=5.92943 Valid N:23 (S Cronbach alpha: .495431 Standardized alpha: .509386					
variable	Mean if	Var. if delete	StDv. if delete	Itm-Totl Correl.	Alpha if deleted
Running_Speed_Agility_Post	42.3478	31.4442	5.60751	0.122672	0.492786
Balance_Post	44.0869	28.2533	5.31538	0.274306	0.447745
B_Coordination_Post	48.9130	32.4272	5.69449	0.145173	0.491994
Strength_Post	44.2173	29.5614	5.43704	0.226340	0.465384
Upper limb coordination Post	47.5217	31.2930	5.59401	0.200054	0.478817
Response_speed_Post	43.7826	13.1266	3.62307	0.437599	0.390457
Visual_motor_control_Post	45.4347	30.5066	5.52328	0.386899	0.453567
Upper_Limb_Speed_Dexterity_Post	44.9565	24.2155	4.92092	0.309597	0.423133

GROUP=EXP					
Summary for scale: Mean=60.1429 Std.Dv.=5.47983 Valid N:21 ( Cronbach alpha: .430610 Standardized alpha: .462022					
variable	Mean if deleted	Var. if deleted	StDv. if deleted	Itm-Totl Correl.	Alpha if deleted
Running_Speed_Agility_Postpost	51.04762	25.66440	5.066004	0.022929	0.472934
Balance_Postpost	48.42857	28.43537	5.332483	-0.071090	0.471132
B_Coordination_Postpost	56.71429	24.58503	4.958330	0.546854	0.341542
Upper_Limb_Coordination_Postpost	55.42857	27.48299	5.242423	-0.003620	0.459159
Strength_Postpost	52.57143	23.00680	4.796541	0.284635	0.357382
Response_speed_Postpost	50.61905	14.61678	3.823190	0.534734	0.136467
Visual_motor_control_Postpost	54.61905	26.52154	5.149907	0.134619	0.418747
Upper_Limb_Speed_Dexterity_Postpost	51.57143	19.10204	4.370588	0.215746	0.395537

GROUP=CTRL					
Summary for scale: Mean=56.0435 Std.Dv.=5.62040 Valid Cronbach alpha: .427999 Standardized alpha: .409694 Average inter-item corr.: .084177					
variable	Mean if	Var. if deleted	StDv. if deleted	Itm-Totl Correl.	Alpha if deleted
Running_Speed_Agility_Postpost	47.6956	33.60302	5.796812	-0.336393	0.569682
Balance_Postpost	48.1304	28.98299	5.383585	0.380081	0.409079
B_Coordination_Postpost	53.1304	26.98299	5.194515	0.413121	0.367965
Upper_Limb_Coordination_Postpost	51.2173	26.34405	5.132645	0.161155	0.405353
Strength_Postpost	47.8695	27.85255	5.277552	0.102240	0.424732
Response_speed_Postpost	46.5652	8.59357	2.931480	0.731453	0.000000
Visual_motor_control_Postpost	50.0434	29.08507	5.393057	0.078128	0.429481
Upper_Limb_Speed_Dexterity_Postpost	47.6521	18.74858	4.329963	0.387837	0.265141

Summary for scale: Mean=47.7333 Std.Dv.=6.16957 Valid N:45 (S Cronbach alpha: .378678 Standardized alpha: .360763					
variable	Mean if deleted	Var. if deleted	StDv. if delete	Itm-Totl	Alpha if deleted
Running_Speed_Agility_Pre	40.44444	30.55802	5.52793	0.4434	0.263424
Balance_Pre	39.97778	29.53284	5.43441	0.0912	0.396289
B_Coordination_Pre	45.11111	36.76543	6.06345	-	0.395711
Strength_Pre	42.20000	30.24889	5.49989	0.1360	0.360434
Upper_Limb_Coordination_Pre	43.95555	35.77580	5.98128	0.0877	0.375254
Response_Speed_Pre	38.82222	19.03506	4.36291	0.3763	0.166649
Visual_Motor_Control_Pre	41.93333	36.50667	6.04207	-	0.409152
Upper_Limb_Speed_Dexterity_Pre	41.68889	29.76987	5.45617	0.2066	0.321954

Summary for scale: Mean=53.5556 Std.Dv.=7.29120 Valid N:45 (S Cronbach alpha: .392997 Standardized alpha: .416870 Average inter-item corr.: .086919					
variable	Mean if deleted	Var. if deleted	StDv. if delete	Itm-Totl Correl.	Alpha if deleted
Running_Speed_Agility_Post	45.02222	46.42173	6.81334	0.15458	0.368279
Balance_Post	43.95555	42.97580	6.55559	0.10529	0.395717
B_Coordination_Post	50.57778	48.59950	6.97133	0.27202	0.361260
Strength_Post	46.26667	41.88445	6.47181	0.10156	0.403139
Upper limb coordination_Post	49.80000	50.56000	7.11055	0.05827	0.396250
Response_speed_Post	45.62222	30.81284	5.55093	0.27630	0.291648
Visual_motor_control_Post	47.77778	50.21728	7.08641	0.06111	0.395880
Upper_Limb_Speed_Dexterity_Post	45.86666	34.51556	5.87499	0.38699	0.222404

Summary for scale: Mean=53.5556 Std.Dv.=7.29120 Valid N:45 (S Cronbach alpha: .392997 Standardized alpha: .416870 Average inter-item corr.: .086919					
variable	Mean if deleted	Var. if deleted	StDv. if deleted	Itm-Totl Correl.	Alpha if deleted
Running_Speed_Agility_Post	45.02222	46.42173	6.813349	0.154584	0.368279
Balance_Post	43.95555	42.97580	6.555593	0.105290	0.395717
B_Coordination_Post	50.57778	48.59950	6.971334	0.272023	0.361260
Strength_Post	46.26667	41.88445	6.471819	0.101568	0.403139
Upper limb coordination_Post	49.80000	50.56000	7.110556	0.058274	0.396250
Response_speed_Post	45.62222	30.81284	5.550931	0.276309	0.291648
Visual_motor_control_Post	47.77778	50.21728	7.086415	0.061114	0.395880
Upper_Limb_Speed_Dexterity_Post	45.86666	34.51556	5.874994	0.386993	0.222404

## RESEARCH OUTPUTS EMANATING FROM THIS WORK

### 1. CONFERENCES

SABELO A NXUMALO AND PROF MARIUS F COETSEE. *The effect Zulu stick fighting has on health-related physical fitness of prepubescent Zulu males*. Paper presented at an International Council for Physical Activity and Fitness Research (ICPAFR) international conference in Ithala Game Reserve 16-20 August 2010.

SABELO A NXUMALO AND PROF MARIUS F COETSEE. *The effect of Zulu stick fighting on health-related physical fitness of prepubescent Zulu males*. Paper presented at the Faculty of Science and Agriculture Masters and PhD Symposium, 30 November 2010.

### 2. SCIENTIFIC PAPERS

NXUMALO, S. & SEMPLE, S.J. The effect of a 10-week Zulu stick fighting intervention programme on body composition of prepubescent Zulu males (Under review).

NXUMALO, S., COETSEE, M.F., SEMPLE, S.J & LONGHURST, G.K. The effect of Zulu stick fighting on health-related physical fitness of prepubescent Zulu males (Under review).