# Motor proficiency and physical fitness in active and inactive girls aged 12 to 13

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B.A. Hons

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**Monique de Milander**

**November 2008**

# Declaration

I declare that this dissertation hereby submitted by me for the Masters degree at the University of the Free State is my own independent work, except to the extent indicated in the reference citatians.

Signed on this 8th day of December 2008.

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# Abstract

## MOTOR PROFICIENCY AND PHYSICAL FITNESS IN ACTIVE AND INACTIVE GIRLS AGED 12 TO 13


### Introduction

Research done by Spinks et al., (2007:161) clearly states that 14.7% of the children do not meet the minimum daily recommended physical activity requirements expected from them outside school hours. In addition boys participate in significantly more moderate-to-vigorous physical activity and vigorous physical activity compared to girls (Pate et al., 2004:1258).

Powers and Howley (2007:321) state that physical activity is related to physical fitness. A decrease in physical activity levels causes health-related fitness risks such as overweight and obesity, hypertension and diabetes influencing the physical fitness status among girls (Pate et al., 2004:1258). Alternatively children need to acquire the necessary fundamental movement skills to be able to participate successfully in physical activities (Hands, 2008:155).

Therefore it is obvious that a decrease in physical activities contribute to a lack of preparation time for the development of movement skills and results in decreased physical fitness (Bouffard et al., 1996:148).

**Problem statement**

Children, especially girls, are less active due to modern lifestyles. A decrease in physical activity results in fewer opportunities to acquire acceptable levels of motor proficiency abilities so as to aid them in successful sport participation and recreational activities. A decrease in physical activity levels also contribute to lower fitness levels leading to health problems. For this reason it would be advisable to determine strategies to facilitate girls to stay active and at the same time improve their motor proficiency abilities and health status.

**Aims**

To determine if there is a significant difference (P <0,05) between active and inactive girls aged 12 to 13 regarding motor proficiency.

To determine if there is a significant difference (P <0,05) between active and inactive girls aged 12 to 13 regarding physical fitness.

To determine if there is a significant difference between physical fitness performance (HFZ versus NTIZ) of active and inactive girls at different motor proficiency categories.

**Method**

The particpants were 12 to 13 years old girls and consisted of 50 girls who were identified as active by means of participation in various sports provided by the school and 50 girls who are inactive participating in cultural activities. Activity levels were measured by means of the Activity logging chart (The Cooper Institute, 2005:1).

There after, the BOTMP-Short Form was used to assess the girl's motor proficiency (skill-related fitness). The 8 subtests assess gross motor development, including running speed and agility, balance, bilateral coordination, and strength; gross and fine motor development, including upper limb coordination; and fine motor development, including response speed, visual-motor control, and upper-limb speed and dexterity (Bruininks, 1978:45).

The Fitnessgram is a complete battery of health-related items such as cardiovascular fitness, muscle strength and muscular endurance, flexibility and body composition. To establish if the participants fell in the Healthy Fitness Zone the tests were scored through the Fitnessgram software programme (The Cooper Institute, 2005:3). Standards are age and gender related and are established on the basis of how fit children should be to enjoy good health.

**Data analyzis**

Data was analized using the SAS Version 9.1.3. Frequincies and percentages where calculated for categorical data. Medians and percentiles or means and standard deviations were calculated for numerical data. The Chi-square test was used to compare the results of the active and inactive group for categorical data. The Kruskal-Wallis test and t-test was used to compare the results of the active and inactive group for numerical data. A significance level of $\alpha = 0,05$ was used to test significant differences between the groups.

**Summary**

According to the results hypothesis 1 is accepted regarding a significant difference in motor proficiency between active and inactive girls aged 12 to 13. Hypothesis 2 is partially accepted regarding a significant difference in physical fitness between active and inactive girls aged 12 to 13. This comparative study rejects hypothesis 3 and revealed that there was no significant difference

between physical fitness performance (HFZ versus NTIZ) of active and inactive girls at different motor proficiency categories.

The research clearly indicates the importance of improving activity levels among girls by means of motor development programs in order to establish fundamental movement skills at a young age. These basic skills will aid girl's in sport participation as well as recreational activities. New and exciting sports can be introduced in schools to attract girls. During sport participation an appropriate training program can improve health status overall.

**Key words:** Physical activity, Motor Proficiency, Physical Fitness, Healthy Fitness Zone, Health-Related Fitness, Skill-Related Fitness, Activitygram, Bruininks-Oseretsky Test Battery – Short Form, Fitnessgram.

# Opsomming

## MOTORIESE VAARDIGHEID EN FISIEKE FIKSHEID IN AKTIEWE EN ONAKTIEWE 12- 13 JARIGE MEISIES


### Inleiding

Navorsing gedoen deur Spinks et al., (2007:161) meld duidelik dat 14,7% van die kinders nie aan die aanbevole minimum daaglikse fisiekeaktiwiteitsvereistes wat buite skoolure van hulle verwag is, voldoen het nie. Boonop het seuns in vergelyking met meisies aan aansienlik meer matig tot hoë intensiteit fisieke aktiwiteit en hoë intensiteit fisieke aktiwiteit deelgeneem (Pate et al., 2004:1258).

Powers and Howley, (2007:321) meld dat fisieke aktiwiteit aan fisieke fiksheid verwant is. 'n Afname in fisiekeaktiwiteitsvlakke veroorsaak gesondheidsverwante fiksheidsrisiko's soos oorgewig en vetsug, hipertensie en diabetes, wat die fisiekefiksheidstatus van meisies beïnvloed (Pate et al., 2004:1258). Kinders moet die nodige fundamentele bewegingsvaardighede aanleer om in staat te wees om suksesvol aan fisieke aktiwiteite deel te neem (Hands, 2008:155).

Dit is dus duidelik dat 'n afname in fisieke aktiwiteite bydra tot 'n gebrek aan voorbereidingstyd vir die ontwikkeling van bewegingsvaardighede en aanleiding gee tot verminderde fisieke fiksheid (Bouffard et al., 1996:148).

**Probleemstelling**

Kinders, veral meisies, is minder aktief as gevolg van moderne lewenstyle. 'n Afname in fisieke aktiwiteit lei tot minder geleenthede vir die verkryging van aanvaarbare vlakke van motoriesevaardigheidsvermoëns om hulle te help met suksesvolle sportdeelname en rekreasieaktiwiteite. 'n Afname in fisiekeaktiwiteitsvlakke dra ook by tot laer fiksheidsvlakke, wat lei tot gesondheidsprobleme. Om hierdie rede sal dit raadsaam wees om strategieë te bepaal vir die fasilitering daarvan om meisies aktief te hou en om terselfdertyd hulle motoriesevaardigheidsvermoëns en gesondheidstatus te verbeter.

**Oogmerke**

Om vas te stel of daar 'n beduidende verskil ($P < 0,05$) tussen aktiewe en onaktiewe 12 tot 13 jarige meisies met betrekking tot motoriese vaardigheid is.

Om vas te stel of daar 'n beduidende verskil ($P < 0,05$) tussen aktiewe en onaktiewe 12 tot 13 jarige meisies met betrekking tot fisieke fiksheid is.

Om vas te stel of daar 'n beduidende verskil tussen fisiekefiksheidprestasie (HFZ versus NTIZ) van aktiewe en onaktiewe meisies by verskillende motoriesevaardigheidskategorieë is.

**Metode**

Die deelnemers was 12 tot 13 jarige meisies en het bestaan uit 50 meisies wat as aktief geïdentifiseer is deur middel van hul deelname aan verskeie sportsoorte wat deur die skool gebied word en 50 meisies wat onaktief is en aan kulturele aktiwiteite deelneem. Aktiwiteitsvlakke is deur middel van die aktiwiteitaantekeningskaart gemeet (The Cooper Institute, 2005:1).

Daarna is die Bruininks-Oseretsky Toets van Motoriese Vaardigheid Kort Vorm gebruik om die meisies se motoriese vaardigheid (vaardigheidsverwante fiksheid) te bepaal. Die 8 subtoetse evalueer grootmotoriese ontwikkeling, waaronder hardloopspoed en ratsheid, balans, bilaterale koördinasie en krag; groot- en

fynmotoriese ontwikkeling, waaronder boonsteledemaatkoördinasie; en fynmotoriese ontwikkeling, waaronder responsspoed, visuele-motoriese beheer en boonsteledemaatspoed en -behendigheid (Bruininks, 1978:45).

Die *Fitnessgram* is 'n volledige battery van gesondheidsverwante items soos kardiovaskulêre fiksheid, spierkrag en spieruithouvermoë, soepelheid en liggaamsamestelling. Om te bepaal of die deelnemers in die sone van Gesonde Fiksheid geval het, is die toetsresultate aangeteken deur middel van die *Fitnessgram* sagteware (The Cooper Institute, 2005:3). Standaarde is ouderdom- en geslagsverwant en word vasgestel aan die hand van hoe fiks kinders behoort te wees om gesond te wees.

**Data-analise**

Data is geanaliseer met behulp van die SAS Weergawe 9.1.3. Frekwensies en persentasies is vir kategoriese data bereken. Mediane en persentiele of gemiddeldes en standaardafwykings is vir numeriese data bereken. Vir kategoriese data is die Chi-kwadraat toets gebruik om die resultate van die aktiewe en onaktiewe groep te vergelyk. Vir numeriese data is die Kruskal-Wallis toets en die t-toets gebruik om die resultate van die aktiewe en onaktiewe groep te vergelyk. 'n Beduidenheidsvlak van $\alpha = 0,05$ is gebruik om beduidende verskille tussen die groepe te toets.

**Opsomming**

Volgens die uitslae word hipotese 1, rakende 'n beduidende verskil in motoriese vaardigheid tussen aktiewe en onaktiewe 12 tot 13 jarige meisies, aanvaar. Hipotese 2, rakende 'n beduidende verskil in fisieke fiksheid tussen aktiewe en onaktiewe 12 tot 13 jarige meisies, word gedeeltelik aanvaar. Hierdie vergelykende studie verwerp hipotese 3 en toon dat daar geen beduidende verskil tussen fisiekefiksheidprestasie (HFZ versus NTIZ) van aktiewe en onaktiewe meisies by verskillende motoriesevaardigheidskategorieë is nie.

Die navorsing toon duidelik die belang daarvan om aktiwiteitsvlakke onder meisies deur middel van motorieseontwikkelingsprogramme te verbeter ten einde

fundamentele bewegingsvaardighede op 'n jong ouderdom te vestig. Hierdie basiese vaardighede sal meisies help met sportdeelname sowel as rekreasieaktiwiteite. Nuwe en opwindende sportsoorte kan by skole ingevoer word om meisies te lok. Tydens sportdeelname kan 'n gepaste oefenprogram algehele gesondheidstatus verbeter.

**Sleutelwoorde:** Fisieke Aktiwiteit, Motoriese Vaardigheid, Fisieke Fiksheid, Gesondefiksheidsone, Gesondheidsverwante Fiksheid, Vaardigheidsverwante Fiksheid, Activitygram, Bruininks-Oseretsky Toetsbattery - Kort Vorm, Fitnessgram.

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# List of Abbreviations

| | |
|---|---|
| % | Percentage |
| BMI | Body mass index |
| BOTMP | Bruininks-Oseretsky Test of Motor Proficiency |
| cm | Centimetre |
| Fat % | Percentage body fat |
| FG | Fitnessgram |
| HFZ | Healthy fitness zone |
| kg | Kilogram |
| km | Kilometre |
| m | Metre |
| MABC | Movement Assessment Battery for Children |
| max | Maximum |
| min | Minimum |
| min | Minutes |
| n | Total group |
| NTIZ | Needs to improvement zone |
| PACER | Progressive aerobic cardiovascular endurance run |
| sec | Seconds |
| YRBS | Youth Risk Behaviour Survey |

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# CHAPTER 1

# Problem statement and aim of the study



## 1.1 Introduction

In order to determine the relationship between motor proficiency and physical fitness, the role of physical activity needs to be taken into consideration. It is important to note the interwoveness between physical activities and motor proficiency. The decrease in the physical activity levels may be a result of children experiencing motor difficulties. According to Hands (2008:155) *"children with motor difficulties are unable to participate successfully in many physical activities enjoyed by their well-coordinated peers"*. Powers and Howley (2007:321) concur with Hands (2008) by stating that physical activity is related to physical fitness. Fitness components are being compromised by a

lack of reduced activity (Hands, 2008:155). Due to inappropriate low performance scores on fitness tests, Rowland and Freedson (1994:670) describe low fitness scores as a *"fitness crisis"*. These statements reveal the importance of physical activities in order to improve motor proficiency as well as physical fitness.

Physical activity and its impact on motor proficiency and physical fitness in children, especially girls, are the focus of increasing public attention. The increased awareness of the physical activity levels of girls can be found in work done by Pate, Pfeiffer, Trost, Ziegler and Dowda (2004:1258) where the researchers came to the conclusion that boys participated in significantly more moderate-to-vigorous physical activity and vigorous physical activity than did girls, and that the decrease in physical activity levels caused health related risks such as being overweight and obese, influencing the physical fitness status among girls. In addition, Engelbrecht, Pienaar and Coetzee (2004:52) tested 290 girls between the ages of 13 and 15 years; and the researchers concluded their study with the understanding that the total group of girls were classified as low active.

According to a study performed on 52 children between 6 and 9 years of age over a 2 month period during recess time, Bouffard, Watkinson, Thompson, Causgrove Dunn, and Romanow (1996:148) came to the following conclusion:

*"The decrease in the time spent with physical activities leads to a lack of practice time for the development of movement skills and results in decreased physical fitness".*

Spinks, Macpherson, Bain and McClure (2007:161) tested 76 children in an Australian primary school and found that 14.7% of the children did not meet the minimum daily recommended physical activity requirements expected from them outside school hours. Also, due to being inactive, 63% of the children were more likely to be overweight or obese, and more girls than boys in this sample were classified as being overweight.

Research conducted by Chiodera, Volta, Gobbi, Milioli, Mirandola, Bonetti, Delsignore, Bernasconi, Anedda and Vitale (2007:1) at the University of Parma, Italy, found that professionally guided programs of physical education in the primary school leads to a significant progress in the development of conditional and coordinative abilities after testing 4 500 children between the ages of 6 and 10 years.

According to research done in America, Wrotniak, Epstein, Dorn, Jones, and Kondilis (2006:1758) stated that motor proficiency is positively associated with physical activity and inversely associated with sedentary activity in children. Therefore children's motor proficiency may be an appropriate target for increasing physical activity in children.

Hands (2008:155) a researcher from Australia made use of a 5 year longitudinal study in order to document the changes in motor skill and fitness measures among children with high and low motor competence. Poor fitness outcomes have been reported for children with low motor competence and after the 5 year study changes over time were significantly different between groups for cardio-vascular endurance (50m run) and balance, but not for body composition, the overhand throw or standing broad jump. These findings confirm the impact of low motor competence on fitness measures and skill performances over time.

South-African research pertaining to physical fitness and the physical activity status of 15-year-old adolescent's states that technology (television) and commuting distances to school appeared to have moderate influences among children with moderate to low physical activity levels. On the other hand, higher physical fitness values were associated with physical activity (Lennox, Pienaar and Wilders, 2008:59).

Due to the fact that physical activity is related to physical fitness as stated earlier, children participating in physical activity would also experience a healthier lifestyle. The health outcomes of physical activity would be a result of the constancy of physical activity throughout life (Plowman and Smith, 2003:445).

The Youth Risk Behaviour Survey (YRBS) was conducted among 323 high school pupils in South-Africa between 13 and 18 years old. The YRBS measures 6 categories of priority risk behaviours Including unintentional and intentional injuries, the use of tobacco, alcohol as well as other drug use, sexual behaviours, dietary behaviours and physical activity. The results clearly indicate that many pupils in this sample participate in behaviours that place them at risk for serious health problems from age 13 (Coetzee and Underhay, 2003:35).

The following major conclusions were stated on physical activity and health according to the United States Department of Health and Human Services cited in Plowman and Smith, (2003:604):

- Despite age and gender, everyone can benefit from regular physical activity
- Health and quality of life can be improved by increasing daily activity slightly
- Additional benefits on health can be gained through greater amounts of physical activity
- A reduction in premature mortality in general due to physical activity
- Physical activity can prevent diseases such as coronary heart disease, hypertension, cancer, diabetes mellitus, etcetera
- Mental health improves through physical activity, as do muscles, bones and joints (which is associated with health-related fitness)

A clear correlation can be established between physical activity and physical fitness (health-related fitness and skill-related fitness) as well as the importance of physical activity to improve physical fitness as a whole.

## 1.2 Problem Statement

Physical activity and physical fitness describe different concepts and are often confused with one another. To distinguish between these two concepts, various definitions of physical activity and physical fitness were adopted from different sources.

*"Physical"* according to the Oxford Dictionary (2002:670) refers to *"the involvement of a bodily activity"*, and an *"activity"* refers to *"an energetic action (sporting activity) or movement"* (Oxford Dictionary, 2002:8). Another definition regarding *"physical activity"* according to Caspersen, Powell and Christenson (1985:126), *"physical activity"* is *"any bodily movement produced by skeletal muscles that result in energy expenditure"*. McArdle, Katch and Katch (2001:871) view physical activity in a similar manner and define *"physical activity"* as: *"body movement produced by muscle action that increases energy expenditure"*. *"Physical activity"* is also defined as *"any form of muscular activity that results in the expenditure of energy proportional to muscular work"* (Powers and Howley, 2007:321). Taking the above definitions into consideration, physical activity has three basic components, namely muscles; movement by means of an activity, and energy expenditure. Therefore physical activity refers to using muscles in the body to perform an activity resulting in energy expenditure.

Caspersen et al., (1985:127) categorized physical activities into those activities that are of light, moderate or heavy intensity; those that are wilful or compulsory; and those that are weekday or weekend activities. Other acceptable ways of subdividing physical activities refer to activities occurring while working and during leisure, for example sports, conditioning exercises and household tasks.

In order to distinguish between sporting activities and culture activities, the following definitions can be applied. According to Rossman and Schlatter (2000:14) leisure is considered the most general concept consisting of recreation or cultural activities, play, games and sport. Although the various forms of leisure overlap with one another, each form has its unique set of characteristics in order to distinguish the one from the other. Only two forms (sport and cultural) are applicable to the present study and will be addressed.

Sport is leisure and involves institutionalized competitive human physical activity. Therefore activities such as swimming, track and field, tennis, hockey, cross country, and netball are all considered as sport. These sports exhibit human physical exertion;

the participants have to take part according to specific rules and they compete regarding their physical skills (Rossman and Schlatter, 2000:13). Conversely, culture activities are leisure for the attainment of personal and social benefits. Therefore, activities such as dancing and horse riding (although they also relate to sport) in the present study refer to cultural activities. Dancing according to Edginton, Hanson and Edginton (1992:189) can be viewed as art, more specifically performing art, and refers to expression through movement. The girls who participated in these activities did it for personal and social benefits and although it is a form of human physical activity there are no rules involved. In conclusion it is important to distinguish between sport and cultural activities to clarify the participant's goal for participation.

The physical activity pyramid according to Powers and Howley (2007:333) follows a smooth sequence in order to become active and to stay active throughout life. Level 1 recommends walking as a starting point (all of the days and at least 30min) and slowly progressing to level 2 which consists of aerobic activities such as aerobics, jogging and cycling. Level 2 also offers opportunities to take part in active sports, for example tennis, swimming, hockey and netball as well as recreational activities (3 – 6 days a week for at least 20min). As one progress through to level 3, activities to improve flexibility (3 to 7 days a week), strength and muscular endurance (2 – 3 times a week) become important aspects. Level 4 refers to rest or inactivity and includes activities such as reading or watching television, although the time spent on level 4 should be minimized. For the purpose of this study the active girl's fell into level 2, referring to taking part in sports such as netball, hockey, swimming and cross country. Participating in sports will also include flexibility and strengthening exercises referring to level 3. Inactive girls ranged between level 1 and level 4. These girls walk to school and spent more time regarding technology and reading activities.

Spinks et al., (2007:157) recommend that primary school children between the ages of 5 and 12 years should participate in a minimum of 60min of moderate to vigorous intensity activities every day. Activities such as games, free play, sport, walking and

physical education would be adequate and children should also spend less than 2 hours a day using computers or watching television.

In conclusion, physical activity can be viewed as any activity such as everyday life activities for example cleaning the house or working in the garden, to be able to jog, playing sports, stretching as well as weight training, and moving the human body by means of the muscles. A variety of these activities should be performed daily in order to comply with the minimum requirements of being active.

*"Physical fitness"* is defined by McArdle et al., (2001:871) as: *"attributes relating to how well one performs a physical activity"*. On the other hand, Gallahue and Ozmun (2002:474) define *"physical fitness"* as: *"a state of well-being influenced by nutritional status, genetic makeup, and frequent participation in a variety of intense physical activities over time"*. The above mentioned influential factors in conjunction with habitual physical activity have favourable or unfavourable effects on fitness (Bunc, 2000:51).

Caspersen et al., (1985:128) view physical fitness as a singular aspect which can be divided into either health-related fitness or skill-related fitness. The components of health-related fitness (cardio-respiratory endurance, muscular endurance, muscular strength, body composition and flexibility) facilitate day-to-day tasks, while skill-related fitness (agility, balance, coordination, speed, power and reaction time) helps children to excel in sports such as athletics, netball, hockey and swimming. Therefore physical fitness can be viewed as the ability to perform physical activities (daily life activities or sporting activities) to the best of an individual's ability, influenced by certain aspects such as the quantity and quality of nutritional intake, genes, as well as the amount of regular participation in physical activities.

According to The Cooper Institute, (2005:3) health-related fitness refers to cardio-vascular fitness (assessing aerobic capacity by means of the one mile run), muscle strength and muscular endurance (measured by using push-ups and curl-ups to a

specific cadence), flexibility (measured by means of the back-saver sit and reach test) and body composition.

Physical fitness can be viewed as a component to promote the functioning of the cardio-vascular system, the muscles by means of strengthening exercises and stretching in order to improve body composition. The ability to execute various types of physical activity with skill will be influenced by enhanced physical fitness levels.

Motor proficiency focuses on the total development of the child to improve his or her total welfare by means of scientific movement programs for purposes of complying with the requirements of the contemporary age. Total development means to optimally disclose the child's physical, motor, emotional, intellectual and social possibilities (Nel, 1999:54). Motor proficiency forms the basis for physical activities and recreational activities and can only be established if the following aspects are being addressed: running speed and agility, balance, bilateral coordination, strength, visual-motor control and manual dexterity (Bruininks, 1978:45).

In association with the above mentioned statement by Nel, research was conducted by Van Niekerk, Pienaar and Coetzee (2007:159). The researchers applied an intervention program over a 10-week period among 24 children between 7 and 14 years. They came to the conclusion that the intervention program had positive effects regarding motor development, especially the fine motor components among 24 children.

Various test Batteries can be applied in order to determine the motor proficiency abilities of children. The validity of the test Batteries is very important to establish relevant and reliable results. Research according to Groce, Horvat and McCarthy (2001:279) tested the reliability and validity of the Movement Assessment Battery for Children (MABC) on 106 children. The researchers came to the conclusion that the MABC could be applied to measure the motor ability of children. Another study by Hassen (2001:165) regarding the validity and reliability of the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) tested 194 children. Hassen came to the conclusion that the BOTMP could similarly be

applied to the MABC to measure motor abilities. Zhang, Zhang, and Chen (2004:1256) determine the validity and reliability of the Wood Motor Success Screening Tool compared to the BOTMP as a criterion measure. After assessing 66 children with learning and behavioural disabilities the researchers concluded their study with positive results indicating that the Wood Motor Success Screening Tool is valid and reliable.

Important questions that need to be answered are the following: is it more important for children to be physically active or to be physically fit; should more emphasis be placed upon children's activity habits or should attempts be made to improve their physical fitness? Physical activities and physical fitness are probably both important depending on the desired health benefit, but how can motor proficiency influence the child's decision to take part in certain physical activities? A previous study clearly indicates the dominance by boys in terms of an interest in sport as well as participation in sport (Department of Sport and Recreation, South-Africa, 2005:4). One of the major reasons for not taking part in sport is due to the fact that girls are not interested and for this reason we need to determine why girls are not interested in sport (Department of Sport and Recreation, South-Africa, 2005:5). To understand the relationship between these key concepts it is important to define each concept clearly.

Many children are less physically active than recommended and physical activity declines as children get older (Wrotniak et al., 2006:e1759). Research done by Chiodera et al., (2007:1) also indicates that physical activity in schools is declining in many countries and inactivity in childhood has become a recognised risk factor. There are a number of factors positively associated with physical activity among children, including: self efficacy in one's ability to overcome barriers to physical activity (Trost, Pate, Saunders, Ward, Dowda and Felton, 1997:260); perceptions of physical or sport competence (Sallis, Prochaska and Taylor, 2000:965); having positive attitudes toward physical education (United States Department of Health and Human Services cited in Pate, Pheiffer, Trost, Ziegler and Dowda, 2004:1258); enjoying physical activity, (Stuckyropp and DiLorenzo,1993:880), and parent, sibling, and peer support (Sallis et al., 2000:965). An additional determinant of physical activity among children may be the

level of mastery of the movement skills that are a foundation for the skills used in common forms of adult physical activity (Okely, Booth and Patterson, 2001:1901).

### 1.2.1 Summary of problem statement

Children, especially girls, are less active due to modern lifestyles. A decrease in physical activity results in fewer opportunities to acquire acceptable levels of motor proficiency abilities so as to aid them in successful sport participation and cultural activities. A decrease in physical activity levels also contribute to lower fitness levels leading to health problems such as obesity, diabetes and hypertension. For this reason it would be advisable to determine strategies to facilitate girls to stay active and at the same time improve their motor proficiency abilities and health status.

## 1.3 Necessity of the research

According to a survey conducted by the Department of Sport and Recreation (2005:4-5) regarding the participation patterns in sport and recreation/physical activities among children in South-Africa, the following information was stated:

**Table 1.1: Participation in recreation/physical activities by gender**

| | BOYS | GIRLS |
|---|---|---|
| YES | 42.6 % | 11.2 % |
| NO | 57.4 % | 88.8 % |
| TOTAL | 100 % | 100 % |

Participation in sport and recreation/physical activities is clearly dominated by boys, with four in every ten boys likely to participate compared to only one in every ten girls likely to participate in sport and recreation/physical activities.

**Table 1.2: Reasons for non-participation by gender**

| REASONS | BOYS | GIRLS |
|---|---|---|
| Not interested | 18.1 % | 28.1 % |
| Age | 21.7 % | 19.2 % |
| No reason | 14.1 % | 15.8 % |
| Opportunities/facilities | 9.7 % | 11.2 % |
| I am not good at sport | 8.2 % | 6.3 % |
| Health/injury/disability | 9.1 % | 4.9 % |
| Other | 2.5 % | 1.9 % |
| Financial constraints | 1.6 % | 1.1 % |
| Sport is dangerous | .5 % | .2 % |
| Transport problems | .5 % | .1 % |
| Time constraints | 14.0 % | 11.2 % |
| | 100 % | 100 % |

Dominance by boys in terms of an interest in sport is clearly noticeable with 28% of girls but only 18% of boys indicating that they are not interested in sport.

An American survey found that fewer than 25% of surveyed children participate for at least 30min per day in any type of physical activity (Faith, Leone, Ayers, Heo and Pietrobelli, 2002:e24). The steadily decrease in physical activity levels according to Goran, Gower, Nagy and Johnson (1998:890) are more observable among girls than boys throughout adolescence. The Department of Sport and Recreation (2005:4-5) came to the conclusion that some of the main reasons for a decrease in physical activity among girls might be due to: not being interested in sport, some girls don't even have reasons for not participating in physical activity, and others feel that they don't have enough opportunities or facilities to take part in physical activities. Other explanations of the decrease in physical activity among girls according to Goran et al., (1998:891) are the behavioural and environmental changes due to puberty, as well as the possibility that pubertal girls have less access to structured activity. McArdle et al., (2001:873) states a noticeable decrease of participation in all types of physical activity as age and

school grades increases and participation in school physical education programs declines. According to research done in Australia (Naughton, Carlson and Green, 2006:40), a decline in physical activity is a result of the poor quality of physical education in schools, not enough time in family life, new sports not being introduced to the community, which leads to children choosing sedentary activities during recreational time.

Various reasons were stated earlier in this Chapter for not participating in physical activities as well as the positive effects of physical activities on children. Therefore it is important to minimize the reasons by means of new and improved physical activity programs as well as a variety in sports present in our current school and/or community settings. The positive effects of physical activity should be emphasized. Research by Kohl and Hobbs (1997:549) shows the potential for physical activity behaviours that are taught in childhood to be carried through into adulthood and positively affect health, coupled with the age-related declines in physical activity levels from childhood to adolescence (especially girls). The results are crucial in order to understanding the predictors, antecedent, and determinants of such behaviours. Ideally, given a set of such determinants, children should be identified accurately as candidates for intervention. The research has the potential to help us understand the relationship between physical fitness and motor proficiency that could lead to the development of more effective strategies for increasing physical activity among young girls.

## 1.4 Aims

The aims of this study are:

1.4.1 To determine if there is a significant difference ($P < 0,05$) between active and inactive girls aged 12 to 13 regarding motor proficiency.

1.4.2 To determine if there is a significant difference ($P < 0,05$) between active and inactive girls aged 12 to 13 regarding physical fitness.

1.4.3 To determine if there is a significant difference between physical fitness performance (HFZ versus NTIZ) of active and inactive girls at different motor proficiency categories.

## 1.5 Hypotheses

The study is based on the following hypotheses:

- There will be a significant difference between active and inactive girls aged 12 to 13 regarding motor proficiency.
- There will be a significant difference between active and inactive girls aged 12 to 13 regarding physical fitness.
- There will be a significant difference between physical fitness (HFZ versus NTIZ) of active and inactive girls at different motor proficiency categories.

## 1.6 Structure of the dissertation

The dissertation is presented in five main Chapters, namely:

Chapter 1 consists of an introduction and includes the problem statement and the research questions, aims and hypotheses of the study.

In Chapter 2 and 3 a literature review will be used in order to define motor proficiency and physical fitness with the emphasis on the various concepts of motor proficiency and physical fitness.

Chapter 4 deals with the testing procedures and discussion of the results regarding the present study.

Chapter 5 offers an overview of the study and will conclude with recommendations and further research.

Chapter 5 will be followed by a list of appendixes. Each Chapter will include its relevant references according to the Harvard referencing system.

The structure of the dissertation is shown in Figure 1.1.

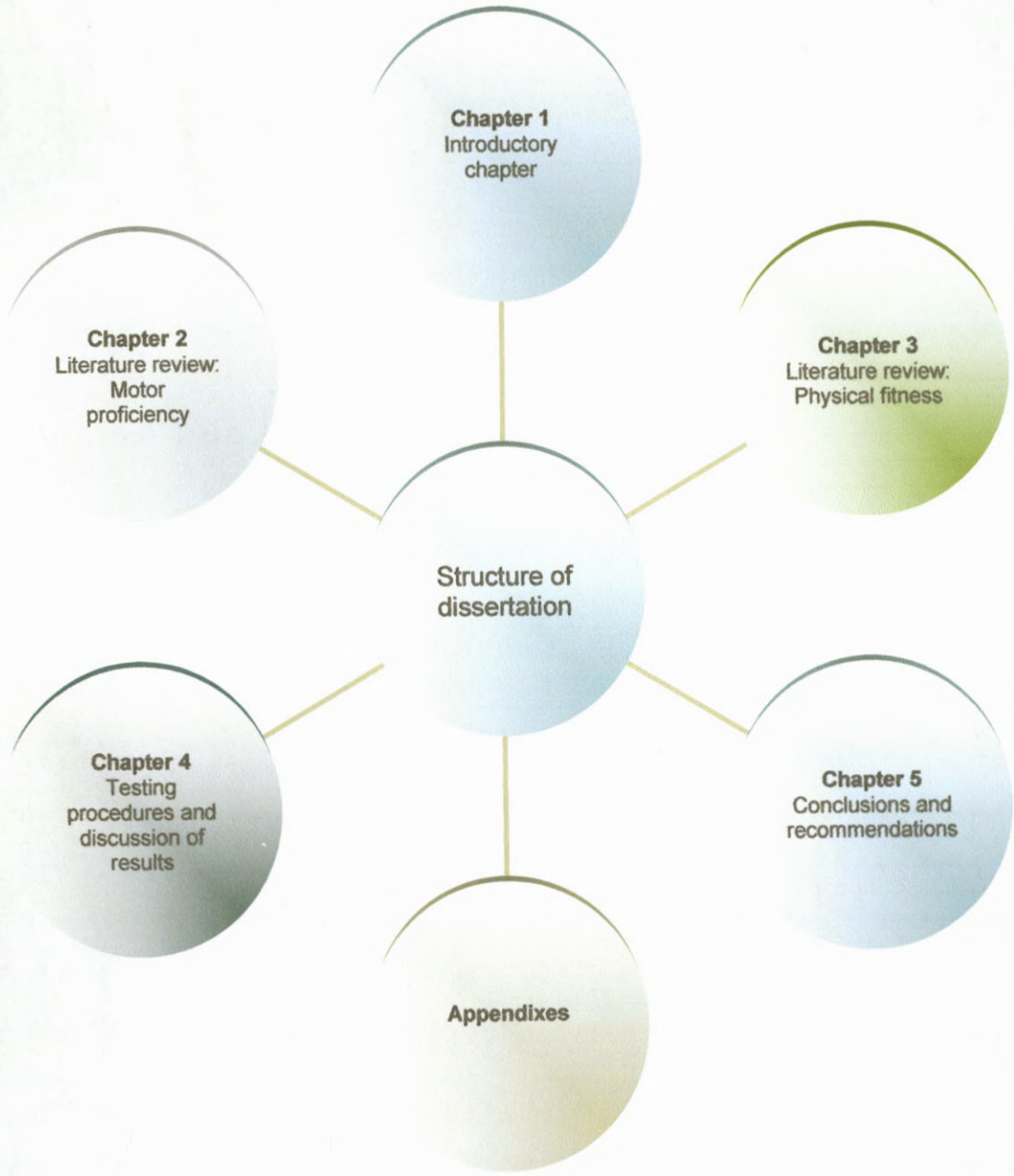


**Figure 1.1: Structure of dissertation**

Chapter 1 clearly indicates the importance of motor proficiency among girls, helping girls to master basic physical activities. These physical activities might range from day-to-day activities to more complex activities such as recreational activities, as well as taking part in sports. Chapter 2 focus on motor development as well as the various aspects girls would need to become motor proficient to improve their total welfare.

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# CHAPTER 2

# Motor proficiency

## 2.1 Introduction

The aim of Chapter 2 is to summarize the main issues regarding motor development. These issues are important in order for girls to develop motor proficiency as well as to improve their motor skills.

Movement skills track low-to-moderate levels of physical activity during childhood (Burton and Miller, 1998:180), thus, greater motor proficiency in children may be predictive of later physical activity. Children with better motor proficiency may find it easier to be physically active and may be more likely to engage in physical activities compared too peers with poorer motor skill competence. Similar research performed by Petrolini, Lughetti and Bernasconi, (1995:928) as well as Wrotniak, Epstein, Dorn, Jones and Kondillis (2006:e1765) states that children with poorer motor proficiency may subsequently choose a more sedentary lifestyle to avoid these movement difficulties. Conversely, children who are the most coordinated may be the most physically active (Fisher, Reilly and Kelly, 2005:646), although research according to Jackson, Ashford and Norsworthy (2006:68) came to the conclusion that despite having the ability to execute skills successfully, children perform sub optimally in stressful situations. Motor skills may also be related to self-efficacy of confidence in physical activity (Hay and Missiuna, 1998:64). According to Bouffard, Watkinson, Thompson, Causgrove and Romanow (1996:148), a decrease in competence and confidence may lead children with movement difficulties to avoid participating in physical activities as a coping strategy.

With the intention of accomplishing motor proficiency it is therefore important that the motor development of the child is stimulated by means of developmental programs to acquire the fundamental movement abilities in the school district. It is interesting to note that work done by Overlock and Yun (2006:30) emphasize the fact that if children do not acquire fundamental motor proficiency they may find it difficult to enjoy physical activities that contribute to healthy active lifestyles. In order to help

children to develop movement skills it is important to understand the concepts of motor proficiency and motor development.

## 2.2 Motor proficiency

Motor proficiency can be defined as two separate nouns. "*Motor*" refers to "*the underlying biological and mechanical factors that influence movement*" (Gallahue and Ozmun, 2002:473) and, according to Chambers-Machmillan South-African Student's Dictionary (1999:766), you are "*proficient*" in something "*when you do it well or with skill*". Therefore motor proficiency refers to the ability to perform a movement with skill although the movement could be influenced by the level of motor development.

## 2.3 Motor development

"*Motor development*" according to Gallahue and Ozmun, (2002:473) can be defined as: "*continuous change in motor behavior throughout the life cycle brought about by interaction among the requirements of the task, the biology of the individual, and the conditions of the environment*". Another definition according to Haywood and Getchell (2005:5) regarding "*motor development*" is: "*a sequential, continuous age-related process whereby movement behavior changes*". Therefore, motor development can be viewed as a process in which movement behavior changes over time and could be influenced by certain factors. A discussion of these factors follows.

## 2.4 Factors affecting motor development

Development throughout life is influenced in various ways, such as factors within the individual, the environment as well as the task (Gallahue and Ozmun, 2002:58; Haywood and Getchell, 2005:7). It is important to take note of these factors in order to understand why girls differ in relation to boys with regard to motor development. An exposition of these factors will now be presented.

### 2.4.1 Factors within the individual

Motor development is affected by factors within the individual (girls) and refers to the genetic inheritance from parents. Each individual has her specific genetic make-up which determines her motor development progress throughout the life cycle. Factors within the individual such as rate of growth, reciprocal interweaving, readiness, critical and sensitive learning periods, individual differences as well as phylogeny and ontogeny can influence motor development (Gallahue and Ozmun, 2002:59-67). A brief discussion of the importance of each factor within the individual will be addressed.

#### 2.4.1.1 Rate of growth

Motor development can be influenced by rate of growth, although all girls follow the same pattern of growth opposed to external influences. Minor interruptions of the normal pace of growth such as weight, length and motor abilities due to inadequate nutrition can be overcome by a process called self-regulatory fluctuation. This process helps a girl with a minor motor deviation to be able to catch up to her peers. On the other hand, the self-regulatory fluctuation is frequently unable to make up for major deviation such as a girl with a low-birth-weight who experiences severe and extended nutritional deficiencies. These girls suffer long-term deficits in height, weight as well as cognitive and motor development (Gallahue and Ozmun, 2002:60; Haywood and Getchell, 2005:43). Prematurity and low birth weights are higher in females over 35 years and under 16 years of age (Gabbard, 2004:143). A girl experiencing a motor development backlog is clearly noticeable in the inability to perform movements associated with her age and will struggle to take part in sporting activities.

#### 2.4.1.2 Reciprocal interweaving

Reciprocal interweaving refers to the coordinated and progressive complicated interweaving of neural mechanisms of opposing muscle systems into an increasingly mature relationship and a characteristic of the developing girl's motor behavior.

Reciprocal interweaving consist of two processes namely, differentiation and integration (Gallahue and Ozmun, 2002:60).

Differentiation refers to the gradual progression from the gross movement patterns of infants to the more refined and functional movements of children. To understand this statement the manipulative behaviors of an infant such as reaching, grasping, and releasing can be compared to that of a child. The infant will demonstrate little control over a movement, but as they develop, control improves (Gallahue and Ozmun, 2002:61; Gabbard, 2004:49). The child on the other hand will be able to differentiate between various muscle groups and control continues to improve with practice until the child can perform precise movements such as playing instruments and throwing a ball.

Integration refers to the ability to convey various opposing muscle and sensory systems into coordinated interaction with one another. The young child will gradually progress from nonspecific movements when attempting to grasp objects to a more mature and visually guided reaching and grasping behaviors. The differentiation of movements of the arms, hands and fingers (various opposing muscles), followed by the integration of the use of the eyes (sensory system) is important to develop eye-hand coordination (Gallahue and Ozmun, 2002:61). Eye-hand coordination is important among sport active girls in order to catch a ball, and for the inactive girls, to play chess, to be able to move the pieces on the board.

#### 2.4.1.3 Readiness

Readiness refers to readiness for learning in conjunction with the task at hand. The biology of the child as well as the conditions of the environment makes mastery of a particular skill appropriate. Readiness is not only dependant on biological maturation, but includes consideration of factors that can be modified to support or encourage learning. Readiness is influenced by physical and mental maturation, interacting with motivation, prerequisite learning, and an enriching environment. For this reason, children will benefit from learning movement activity at the appropriate time (Gallahue and Ozmun, 2002:61; Gallahue and Cleland, 2003:42). Girls between 12 and 13 years will not benefit from readiness at this age because, readiness training

forms part of preschool and primary grade educational programs. The girls should have established the basic movements and at this specific age fall into the specialized movement phase.

#### 2.4.1.4 Critical and sensitive learning periods

Critical and sensitive learning periods are closely related to readiness (Chapter 2, p. 27) and refer to the observation that a child is more sensitive to certain types of stimulation at certain times. It is also believed that a child will struggle to learn new skills if they did not receive proper stimulation during critical periods (Gallahue and Ozmun, 2002:62). According to Zaichkowsky, Zaichkowsky and Martinek (1980:33) learning and training (experience) during the critical formative years help to shape what will become skill behavior. Gabbard (2004:143) defines *"sensitive periods"* as: *"when an organism is most sensitive to certain environmental influences"*.

Critical and sensitive learning periods can explain why some children have inappropriate motor development levels at the age of 12 and 13 years. The girls who experience a lack of appropriate learning experiences (early in life) may have a more negative impact on their development. For this reason it would be beneficial for all children to receive appropriate stimulation early in life to aid motor development as well as taking part in sporting activities with ease in later life.

#### 2.4.1.5 Individual differences

Individual differences refer to each child's uniqueness regarding her timetable for development. Although developmental characteristics follow a predictable sequence of appearance among all girls, the rate of appearance may vary due to individual heredity and environmental influences (Gallahue and Ozmun, 2002:63; Haywood and Getchell, 2005:7). Girls who have parents with sound athletic abilities (heredity) can positively affect their ability to perform well in sport compared to girls who have parents with fewer abilities.

With the intention of demonstrating the role of hereditary on abilities in track and field events, the following examples in the South-African population can be utilized. Ilze

(Venter) Wicksell and her daughter Eugene Wicksell achieved national colors in middle distance (800m). Another motor-daughter combination is Sonja Laxton and Kim Laxton in the 1 500m run. Hanlie Kotze, mother to Marli Kotze and Hennie Kotze also achieved their national colors. Hanlie was a high jumper, her daughter Marli participated in pentathlon (high jump is one of the five sports) and Hennie participates in hurdles. Sarina Cronje and her son Johan Cronje also achieved national colors in the 1 500m run. Hugo and Heibrie Myburg are the parents of Alwen Myburg and this family achieved national colors in the 400m. These examples clearly indicate that hereditary has beneficial influences on children's abilities, although the environment in which the children grew up also facilitated their abilities.

#### 2.4.1.6 Phylogeny and ontogeny

Phylogeny refers to rudimentary abilities along with fundamental abilities and appears automatically in a predictable sequence as children mature. Phylogenic skills are resistant to external environmental influences and refer to stability tasks and locomotor abilities such as walking, jumping and running. Conversely, ontogenetic skills are dependent primarily on learning and environmental opportunities as ontogenetic skills do not appear automatically and require time to practice. Skills such as swimming and cycling are examples of ontogenetic skills (Gallahue and Ozmun, 2002:63).

A maturational perspective regarding phylogeny and ontogeny according to Haywood and Getchell (2001:23) refers to a child's individual development (ontogeny) that will reflect the evolutionary development of the species (phylogeny). Another definition by Gould (1978:483) regarding ontogeny refers to the life history of an individual, both embryonic and postnatal, and phylogenic refers to the conventionally sequence of successive adult changes. The importance of ontogenetic skills among 12 and 13 old girls is obvious. If girls do not get enough exposure to activities relating to ontogenetic skills, they will not be able to practice these skills to facilitate participation in sport.

### 2.4.2 Factors in the environment

An infant is extremely dependant on her/his caregivers and this dependency lasts over an extended period of time. Factors associated with prenatal care by caregivers such as bonding with their child as well as stimulation and deprivation can have positive or negative influences on development in later life (Gallahue and Ozmun, 2002:64-67). A discussion of these factors follows.

#### 2.4.2.1 Bonding

According to Gallahue and Ozmun (2002:64) *"bonding"* refers to: *"a strong emotional attachment that endures over time as well as distance, hardship and desirability"*. The emotional bond begins to develop at birth and may not be fully established due to early separation. Factors contributing to early separation might be a result of low birth weight leading to the incubation of the infant. On the other hand, a large number of adopted children have sufficient motor development although the bonding time was postponed with their new parents.

#### 2.4.2.2 Stimulation and deprivation

Stimulation of experience refers to the stimulation of a child in order to improve the rate of motor development; although maturation will also play an important role in skill acquisition. By contrast, deprivation of experience can have a negative influence regarding the rate of motor development. For this reason, a child will develop as a result of maturation up to a certain stage but if they do not receive additional stimulation (deprivation from experience) the rate of motor development could be negatively influenced (Gallahue and Ozmun, 2002:65; Haywood and Getchell, 2005:17).

According to Zaichkowsky et al., (1980:33) depriving children from stimulation for research purposes are rare. In order to perform research, observations in orphanages where children do not receive stimulation are more applicable and the results clearly indicate backlogs in motor development. Another acceptable way is to conduct co-twin research. Both children receive stimulation because a child can't be

deprived; although one of the twins will receive additional stimulation regarding more advance skills (Zaichkowsky et al., 1980:33; Haywood and Getchell, 2005:17).

The above mentioned statement is clearly noticeable in sport active girls who receive stimulation of additional experience to acquire new skills, compared to inactive girls who are deprived of stimulation experiences to learn new skills.

### 2.4.3 Physical task factors

The lifelong cycle of motor development is also influenced by various factors during infancy, eating disorders among girls, fitness levels as well as biomechanics (Gallahue and Ozmun, 2002:67-78). These factors will be addressed.

#### 2.4.3.1 Prematurity

Factors influencing motor development during infancy refer to prematurity factors such as low birth weight and young-for-date babies. Low birth weight refers to an infant, weighing less than expected for their gestational age. Another term used to describe these infants is small-for-date and implies that the infant had experienced intrauterine growth retardation. A majority of these small-for-date infants survive without any disabilities, contradictory to infants classified with very low birth weight who experience higher incidence of major disabilities.

A young-for-date baby refers to an infant born at the expected birth weight for their gestational age but before full term. A young-for-date baby also exhibits major disabilities and difficulties in motor coordination (Gallahue and Ozmun, 2002:68). These difficulties experienced regarding motor coordination will influence a girl's ability to take part in sporting activities resulting in an inactive lifestyle. For this reason an intervention program should be established as early as possible to overcome this barrier.

### 2.4.3.2 Eating disorders

Eating disorders, such as obesity, binge eating; anorexia nervosa and bulimia nervosa have a negative influence regarding motor development. Obesity occurs when a discrepancy between caloric intake and caloric expenditure arises. The importance of staying active and the restriction of calories on body composition are due to the accumulation of excess fat during childhood (McArdle, Katch and Katch, 2001:512). In other words, girls are eating more and are less active, resulting in obesity. Binge eating is common among obese individuals and refers to having episodes of overeating (Gallahue and Ozmun, 2002:68). For this reason excess weight will influence motor development and girls will struggle to take part in sports requiring running and jumping movements.

Anorexia nervosa and bulimia nervosa are related in terms of the end result namely: to be thin. Anorexia nervosa refers to an individual characterized by a disliking to the consumption of food and the perception that they are too fat, although they are underweight (Gallahue and Ozmun, 2002:72). Shaffer (1999:171) defines "*anorexia*" as: *"a potentially fatal eating disorder without any known organic cause that may affect 1 of every 200 girls"*. Alternatively bulimia nervosa refers to binge eating and purging as well as excessive training in an attempt to be thin (Gallahue and Ozmun, 2002:72). Bulimia results in a decrease of potassium eventually leading to a heart attack (Shaffer, 1999:171).

Motor development is influenced by both these disorders, and preventing or treating these disorders among girls is of utmost importance. Starving one self and being too thin result in a lack of energy in addition to the negative effects associated with health, influencing a girl's ability to take part in sport.

### 2.4.3.3 Fitness levels

Physical fitness consists of health-related fitness and performance- (skill) related fitness. A full discussion regarding physical fitness will be addressed in Chapter 3, (62 - 63) as well as health-related fitness (64 - 79) and skill related fitness (80 - 91).

#### 2.4.3.4 Biomechanics

Mechanical principles influence certain movements such as stability, locomotion and manipulation, and it will be beneficial to understand the effect of these principles (balance, giving force and receiving force) on movement. Balance is influenced by the force of gravity and the principles associated with balance are the center of gravity, line of gravity and the base of support (Gallahue and Ozmun, 2002:75-78; Hamilton, Weimar and Luttgens, 2008:366).

The body is viewed as an asymmetric object, meaning that the centre of gravity changes during various movements. In a stable position (static balance) such as standing in a vertical position the centre of gravity will be approximately at the navel. During activities where the body is transported from one point to another (dynamic balance) the centre of gravity changes in the direction of the movement or the additional weight. Activities such as running, jumping and a forward roll refer to dynamic balance (Gallahue and Ozmun, 2002:75; Hamilton et al., 2008:366). Therefore the inactive girls will mainly use static balance such as sitting up straight to play an instrument or chess. By contrast, the active girls will mainly use dynamic balance, running, jumping and bending the trunk in order to execute movements resulting in the centre of gravity changing constantly throughout participation.

The line of gravity refers to an imaginary line that extends through the center of gravity to the center of the earth. The degree of stability in the body is influenced by the interrelationship of the center of gravity and the line of gravity to the base of support (Gallahue and Ozmun, 2002:75; Hamilton et al., 2008:372). The line of gravity is crucial during sport participation, due to the fact that as soon as the line of gravity moves outside the base of support the participant will rotate her feet (during a hockey or netball match) in an attempt to not fall over.

The base of support refers to the part of the body that comes into contact with a supporting surface. If the line of gravity falls within the base of support the body will be in balance. Greater stability can be maintained if the base of support is wide (Gallahue and Ozmun, 2002:75; Hamilton et al., 2008:370). During a hockey match a

girl can use a wider base of support by spreading her feet in an attempt to maintain balance more effectively if the opposition runs into her.

Giving force is important for a movement to take place and refers to the effort that one mass exerts on another. This exertion can lead to a movement, termination of a movement or resistance to a movement. Important forces relative to the body refer to force produced by muscles, gravitational pull of the earth and momentum. To understand these forces, Newton's three laws of motion (law of inertia, law of acceleration and the law of action and reaction) will be addressed (Gallahue and Ozmun, 2002:77; Hamilton et al., 2008:303).

The *"law of inertia"* states that: *"a body at rest will remain at rest and a body in motion will remain in motion at the same speed in a straight line unless acted upon by an outside force"* (Haywood and Getchell, 2001:105; Gallahue and Ozmun, 2002:77; Hamilton et al., 2008:303). To clarify this definition the following example could be applied. An inactive girl (or any other human in a state of rest) will remain at rest unless she acts upon an outside force to start a movement. During sporting activities an active girl running on the hockey field will keep on running, maintaining her speed unless an outside force (opponent) stops her.

The *"law of acceleration"* states that: *"the change in the velocity of an object is directly proportional to the force producing the velocity and inversely proportional to the object's mass"* (Gallahue and Ozmun, 2002:77; Hamilton et al., 2008:304; Haywood and Getchell, 2001:105). To clarify this definition the following example could be applied: when hitting a heavier object such as a hockey ball compared to a hitting tennis ball, greater force will be required to accelerate or decelerate the hockey ball. The greater the amount of force imparted to the ball, the higher the speed at which the ball will travel.

The *"law of action and reaction"* states: *"that for every action there is an equal and opposite reaction"* (Haywood and Getchell, 2001:106; Gallahue and Ozmun, 2002:77). The principle of counterforce forms the basis for all locomotor movements (Hamilton et al., 2008:307). To clarify this definition the following example could be

applied: girls participating in swimming and athletic events will need to push off (with their feet) from the starting blocks to dive into the pool.

Receiving force refers to absorbing force in an attempt to stop ourselves or a moving object. The greater the distance over which the force is absorbed, the less the impact on the individual or apparatus receiving the force (Gallahue and Ozmun, 2002:77). To clarify this statement the following example could be applied: to minimize the impact on a girl catching a ball during a netball match (receiving force); she could bend her arms while catching the ball.

The direction of a moving object depends on the amount and the direction of all of the forces that have been applied to it (Gallahue and Ozmun, 2002:77; Hamilton et al., 2008:296). To clarify this statement the following example could be applied: the accuracy and distance when a girl throws a ball during a netball match depends on the forces acting on the ball. In order for her to catch the ball she might have to use a vertical jump and use the forces in a vertical direction. During track and field events such as long jump, she would use the forces of a vertical jump in precise conjunction with the forces of a horizontal jump to facilitate the appropriate takeoff angle.

In conclusion, all three aspects (balance, giving force and receiving force) are important with regarding to motor development. Understanding these concepts can aid in motor development programs because, balance, giving force and receiving force form part of everyday life, locomotor and manipulative movement skills.

## 2.5 The importance of developing skills

Sewell, Watkins, and Griffin (2005:404) define a skill as one's proficiency at a particular task. Sewell et al., (2005:393) elaborated on the term "*skills*": *"Skills generally involve achieving some well-define environmental goal by maximizing the achievement certainty, minimizing the physical and mental energy costs of performance and finally minimizing the time used".*

The following example can be applied in order to understand the above mentioned definition of a skill. An environmental goal would be the desire to achieve something like score a goal in netball. Skills consist of movements, but are seen as a different form of movement. The difference between a skill and movement is that a movement does not necessarily have a particular environmental goal. To be skilled in an activity such as in netball, the goal shooter needs to meet the performance goal with maximum certainty and not just by luck. While performing a skill it is of utmost importance to minimize physical and mental energy costs of performance. The reason for this is it allows one to concentrate on other aspects of an activity such as strategies (how to go about to intercept the ball). It would be beneficial for many skills performed in sports such as athletics and swimming if a goal is achieved in a minimum time (Sewell et al., 2005:393).

### 2.5.1 Element of a skill

There are three main features of a skill, combining mental (perception and decision) and motor (activity) processes. Perception would be the ability to perceive the relevant environmental features, decision making implies deciding what to do as well as where and when to do it. Finally activity production refers to activating the muscles to perform the movement. It's important that the three processes are coordinated with one another, because a fraction of a delay can influence the end result (Schmidt, 1991:6). A 12 and 13 year old girl will need the ability to observe the environment during a match (netball and hockey), then decide what she wants to do (defend or attack) and after the decision is made she need to contract the necessary muscles (quadriceps and hamstrings to run and/or the deltoids, biceps and triceps to catch or hit the ball) in order to perform the movement.

### 2.5.2 Skill classifications

Motor skills are classified into various categories: open-closed system (skills are classified by the stability of the environment); discrete, continuous and serial skill classification (skills are categorized by the beginning and end points of the movement); two-dimensional taxonomy (deals with environmental context and

function of the action), and the motor and cognitive skill system (Schmidt and Lee, 2005:20; Sewell et al., 2005:395). The categories will be discussed below.

#### 2.5.2.1 Open-closed system

If the environment is variable and unpredictable during an action it refers to an open system. Wrestling can be used as an example of an open system, because it is difficult to predict the future moves of the opponent (Schmidt and Lee, 2005:20). A synonym to an open skill according to Sewell et al., (2005:395) is the forced-paced skill. The child is forced into action, thus the external source initiates the action.

A closed system according to Schmidt and Lee (2005:20) refers to an environment which is stable and predictable, for example swimming in an empty lane in the pool. A synonym for a closed skill is the term self-paced skill (Sewell et al., 2005:395). The child initiates the action.

These open and closed systems mark the end of a spectrum, with skills lying between having varying degrees of environmental predictability and variability (Schmidt and Lee, 2005:21; Sewell et al., 2005:395).

#### 2.5.2.2 Discrete, continuous and serial skill classification

A discrete skill has an easily defined beginning and end, and the duration of the movement is very brief, for example, kicking and throwing. Discrete skills are particularly important in sport performance, considering the large number of discrete hitting (tennis and hockey), kicking (soccer), throwing and catching (netball) skills that make up many games and sport activities (Gallahue and Cleland, 2003:68; Schmidt and Lee, 2005:20).

In contrast with a discrete skill, a continuous skill has no particular beginning or end and the movement can go on for a couple of minutes for example running and swimming. An important factor in a continuous skill is tracking, in which the performer's limb movements control a lever, wheel or handle to follow the movement of some target track. Steering a bicycle is tracking with steering movements so the

bicycle follows the track defined by the roadway (Gallahue and Cleland, 2003:54; Schmidt and Lee, 2005:20).

According to Schmidt and Lee (2005:20) a serial skill lies between the ends of a discrete skill and a continuous skill. In order to perform a serial skill one needs to take discrete skills and put them together in a series for example gymnastics. A specific series of movements must be performed in a specific order for the proper execution of the skill.

#### 2.5.2.3 Two-dimensional taxonomy

The two-dimensional taxonomy (Carr, Sheperd, Gordon, Gentile and Held, 1987:93) deals with the actions that take part in an environmental context and the interaction between the two leads to a complex range of categories. The environmental context refers to having regulatory conditions, for example, being stationary or in motion, as well as inter-trial variability or no inter-trial variability. The function of movements can be classified as stable or in motion occurring with or without object control.

The closer the skill lies to the top left, the easier the skill. Skills that are more difficult are found to the right and nearer to the bottom. To understand this complexity one can apply hockey as an example: running in hockey would classify as a 15 on Gentile's two-dimensional classification system since the action requires body transport and contains both regulatory variability and context variability. In an actual game, since the manipulation of the ball is required as well as the previous aspects mentioned, according to Gentile's taxonomy it would rate a 16 (Carr et al., 1987:93). Gentile's two-dimensional taxonomy is illustrated in Table 2.1 adapted from Gallahue and Ozmun (2002:18).

## Table 2.1: Gentile's two-dimensional taxonomy

| Environmental Context of the Movement Task | | | Stability without Manipulation | Stability with Manipulation | Locomotion without Manipulation | Locomotion with Manipulation |
|---|---|---|---|---|---|---|
| Stationary regulatory condition* | No inter-trial variability | Completely closed movement task | 1<br>Sitting in a chair<br>Standing in place | 2<br>Striking a ball off a tee<br>Kicking a stationary ball | 3<br>Walking on a flat surface<br>Jumping to a fixed height | 4<br>Walking with a suitcase<br>Rhythmically jumping a self turned rope |
| Stationary regulatory condition* | Inter-trial variability | Moderately closed movement task | 5<br>Sitting in chairs set at varying heights<br>Standing up from chairs set at varying heights | 6<br>Striking a ball off tees set at varying heights<br>Kicking different types of stationary balls | 7<br>Walking on a treadmill<br>Jumping upward to varying heights | 8<br>Walking on a slippery surface with a bag of groceries |
| In motion regulatory condition** | No inter-trial variability | Moderately open movement task | 9<br>Standing on a moving escalator<br>Sitting on a large exercise ball | 10<br>Striking a ball tossed from a pitching machine<br>Kicking a slow rolling ball on a smooth surface | 11<br>Walking onto an escalator<br>Running and jumping up to a fixed height | 12<br>Performing the shot put event in track<br>Throwing the javelin from a run |
| In motion regulatory condition** | Inter-trial variability | Completely open movement task | 13<br>Standing on a moving escalator<br>Sitting on a large exercise ball with both feet raised | 14<br>Striking a pitched ball<br>Kicking a fast moving soccer football | 15<br>Walking across a swinging bridge<br>Running and then jumping up to varying heights | 16<br>Running to catch a fly ball<br>Jumping up to catch a rebounding ball |

* The spatial aspects of the movement are controlled by the requirements of the task, but the temporal aspects of the task are controlled by the mover.

** Both the spatial and temporal aspects of the movement are controlled by the requirements of the task.

Gallahue and Ozmun (2002:20) were also interested in the ways to classify movements, and originally proposed the two-dimensional taxonomy in 1972. In contrast with Gentile's two-dimensional taxonomy, Gallahue's taxonomy deals with the intended function of the movement tasks according to the three movement categories such as stability, locomotion and manipulation, as well as the phases of motor development progressing from the reflexive, rudimentary, fundamental and specialized movement phases. Gallahue's two-dimensional taxonomy is illustrated in Table 2.2, adapted from Gallahue and Ozmun (2002:19).

**Table 2.2: Gallahue's two-dimensional taxonomy**

| Phases of Motor Development | Stability (Emphasis is on body balance in static and dynamic movement situations) | Locomotion (Emphasis is on body transportation from point to point) | Manipulation (Emphasis is on imparting force to or receiving force from an object) |
|---|---|---|---|
| **Reflexive Movement Phase:**<br>Involuntary sub cortically controlled movements in utero and early infancy | Labyrinthine righting reflex<br>Neck righting reflex<br>Body righting reflex | Crawling reflex<br>Primary stepping reflex<br>Swimming reflex | Palmar grasp reflex<br>Plantar grasp reflex<br>Pull-up reflex |
| **Rudimentary Movement Phase:**<br>The maturationally influenced movements of infancy | Control of head and neck<br>Control of trunk<br>Unsupported sitting<br>Standing | Crawling<br>Creeping<br>Upright gait | Reaching<br>Grasping<br>Releasing |
| **Fundamental Movement Phase:**<br>The basic movement skills of childhood | Balancing on 1 foot<br>Walking on a low beam<br>Axial movements | Walking<br>Running<br>Jumping<br>Hopping | Throwing<br>Catching<br>Kicking<br>Striking |
| **Specialized Movement Phase:**<br>The complex skill of later childhood and beyond | Performing a balance beam routine in gymnastics<br>Defending a goal kick in soccer football | Running the 100m or hurdles event in track<br>Walking on a crowded street | Performing a goal kick in soccer or football<br>Striking a pitched ball |

#### 2.5.2.4 Motor and cognitive skill

Sewell et al., (2005:399) stated the following to distinguish between a "*motor skill*" and "*cognitive skill*: *"With a motor skill the primary determinant of success is the quality of the movement itself, where perception and subsequent decisions about which movement to make are nearly absent. Conversely with a cognitive skill the nature of the movement is not particularly important but the decisions about which movement to make are critical. The cognitive skill mainly involves selecting what to do, whereas a motor skill mainly involves how to do it".* Therefore, a motor skill can be viewed as the ability to execute movements physically by means of the muscles and a cognitive skill determines the movement and compares the movement with previous experiences.

## 2.6 Learning

Sewell et al., (2005:399) define "*learning*" as: *"a change in the capability of the individual to perform a skill that must be inferred from a relatively permanent improvement in performance as a result of practice or experience".*

The ability to learn is very important for all children. Learning occurs in a variety of performances for example, cognitive, verbal, interpersonal or social. Learning therefore is seen as a continuous process. Sewell et al., (2005:399) state that learning is the effect of practice or experience, although other factors such as the maturation level of the child and the anxiety-provoking potential of the situation can also influence this process. An example to substantiate this statement would be that as children mature, their capabilities increase and can be defined as maturation and not learning. These growth factors are not evidence of learning, because a child is not able to practice it. Learning is not directly observable, only the outcomes (performance) are (Schmidt and Lee, 2005:302; Sewell et al., 2005:399). In order to learn children need to follow certain stages of learning. A brief discussion follows.

### 2.6.1 Stages of learning

Before learning can occur a child needs to move through several stages of learning. The most accepted approach is Fitts and Posner's (1967:11) three-stage model, often referred to as the classic stages of learning model. The importance of understanding the different stages of learning is to aid children by teaching them new skills, improving from a beginner to a more advance participant. A discussion of the various stages consisting of the verbal/cognitive stage, associative stage and the autonomous stage follows.

#### 2.6.1.1 The verbal/cognitive stage

During the cognitive stage the child will try to understand the task by means of a cognitive plan. Information given to the child during this stage must be done effectively; therefore it would be beneficial to repeat the information. It is important to note that a large number of errors will occur and movements will be poorly timed. Great variability and little consistency are associated with this stage although rapid gains will occur in motor proficiency (Fitts and Posner, 1967:12; Schmidt and Lee, 2005:403). This stage will be crucial for girls learning new motor skills, although sport active girls will have already mastered this stage.

#### 2.6.1.2 The associative (motor) stage

The associative stage lasts for varying periods of time, depending on the complexity of the skill and the extent to which it calls for new subroutines and new integrations. During the associative stage of skill learning, old habits which have been learned as individual units during the cognitive stage of skill learning are tried out and new patterns begin to emerge. A shift in emphasis occurs from cognitive to more pronounced motor activity. The following characteristics are associated with this stage regarding performance: girls will demonstrate fewer errors and greater consistency in performance. The girls will have greater control over their movements resulting in a rapid improvement in their performance (Fitts and Posner, 1967:12; Schmidt and Lee, 2005:403).

#### 2.6.1.3 The autonomous stage

The autonomous stage refers to the final stage of skill learning, with less directly subject to cognitive control, as well as the interference from other ongoing activities or environmental distractions. The following characteristics are associated with this stage regarding performance: errors during this stage are not drastic and a small variability is noticeable in performance. The movements are well-developed and stable although slow performance improvements result due to being capable at the beginning of the autonomous stage (Fitts and Posner, 1967:14; Schmidt and Lee, 2005:403).

In conclusion, girls begin the learning stage through verbal comments while trying to understand the task at hand. If a clear cognitive plan is formulated they execute bodily movements. Girls don't have to use cognitive skill as much as in the beginning and the task becomes easier with fewer errors and better control. The final stage can be viewed as the execution of automatic movements. Girls can perform various movements without being disturbed by external stimuli.

## 2.7 Individual differences in skilled performance

It is important to remember that children differ from one another and therefore individual differences in performance will occur. Abilities are thought to be factors that explain skill differences among children. It is assumed that skills involved in complex motor activities can be described in terms of the abilities that underlie their performance (Schmidt and Lee, 2005:275; Sewell et al., 2005:404).

### 2.7.1 Ability versus skill

According to the South-African pocket Oxford Dictionary (2002:2), *"ability"* refers to *"a talent or the capacity to do something"*. *"Skill"* on the other hand refers to the *"ability to do something well"* (Oxford Dictionary, 2002:845). In order to distinguish between ability and a skill, the differences between these two concepts are as follows: abilities are innate qualities where as a skill develops with practice, abilities

are stable and skills are modified with practice. Abilities are perhaps 50 or more in number and skills have an infinite number. Abilities underlie many skills and skills are depended on several abilities (Schmidt and Lee, 2005:275; Sewell et al., 2005:405).

In summary each girl has inherited abilities and by means of practice, a skill will develop since skills are depended on numerous abilities. Girls need to be active in order to practice their abilities and to acquire movement skills to take part in sporting activities.

## 2.8 Movement skills and movement patterns

Motor development can be divided into four phases namely, reflexive movement phase, rudimentary movement phase, fundamental movement phase, and specialized movement phase (Haubenstricker and Seefeldt, 1986:44-45). Girls between 12 and 13 years participated in the present study and according to Gallahue and Ozmun (2002:45) the girls should be in the specialized movement phase.

### 2.8.1. Specialized movement phase

Gallahue and Ozmun (2002:50) state that during the "*specialized movement phase*", "*movement becomes a tool applied to a variety of complex movement activities for daily living, recreation and sport pursuits. This is a period when fundamental stability, locomotor and manipulative skills are progressively refined, combined, and elaborated upon for use in increasingly demanding situations. The fundamental movements of hopping and jumping, for example, may now be applied to rope jumping activities and triple jump (hop-step-jump) in track and field*".

In addition Haubenstricker and Seefeldt, (1986:45) place a "proficiency barrier" before the specialized movement phase. The reason for this "proficiency barrier" is to emphasize the importance of the acquisition of fundamental movement skills before a child can move on to the specialized movement phase. The specialized phase

consists of a transitional stage, application stage and the lifelong utilization stage. An account of each stage follows.

#### 2.8.1.1 Transitional stage

A transitional skill can be seen as a complex fundamental skill like rope jumping. Transitional skills normally appear between 7 and 8 years of age among children. During the fundamental phases children take part in a variety of activities. This stage is from 11 to age 13 (Gallahue and Ozmun, 2002:50). Haubenstricker and Seefeldt, (1986:45) view the transitional stage as fundamental skills which can be combined in various ways such as using equipment or without equipment, to simulate specific but still simple sport skills.

#### 2.8.1.2 Application stage

The application stage can also be described as the sport-related movement phase because it includes more complex sport skills and the application of these skills in organized sporting activities (Haubenstricker and Seefeldt, 1986:45; Gabbard, 2004:16). During the application stage children's intellectual abilities help them to make decisions about activities they would like to take part in Gallahue and Ozmun (2002:51).

With the purpose of illustrating the application stage an example was adopted from Gallahue and Ozmun (2002:51). A 12 year old girl who is 179cm tall and enjoys team sport and applying strategy to games, exhibits good coordination and agility may choose to specialize in the development of her netball playing abilities. On the other hand, a similarly built girl who prefers individual sports may choose to specialize in a variety of track and field events.

#### 2.8.1.3 Lifelong utilization stage

The final stage is the lifelong utilization stage and refers to the use of all the movements learned in the previous phases throughout life. The level of proficiency attained at each phase will directly influence the success and progress of a child

throughout the phases of motor development (Haubenstricker and Seefeldt, 1986:45). This phase starts at about 14 years. Factor that may influence this stage are time, money, equipment, the availability of facilities as well as physical and mental limitations (Gallahue and Ozmun, 2002:52).

Skills learned during the fundamental stage are crucial in order to move to the specialization stage. These basic movements are important to aid girls in sport participation and will influence the type of sport they will choose to take part in. A combination of the basic individual movements can be applied to execute more complex movements such as running across the tennis court and hitting the ball back to the opponent. Another complex movement refers to running on the netball court, jumping up to catch the ball and after landing, throwing the ball to a teammate.

A majority of girls will keep on participating until adulthood although internal influences such as the inability to take part as well as external influences such as time, money and opportunities might influence the duration of participation.

## 2.9 Categories of movements

In the process of becoming motor proficient children need to move through the different phases of motor development. In this context "*motor development*" according to Gallahue and Ozmun (2002:45) refer to: *"the continuous change in motor behavior throughout the life cycle brought about by interaction about the requirements of the task, the biology of the individual, and the conditions of the environment"*. Haywood and Getchell (2005:5) view "*motor development*" in a similar manner: *"the sequential, continuous age related process whereby movement behavior changes"*. Therefore motor development can be seen as a process throughout life, which could be positively or negatively influenced by the individual, the task at hand as well as the environment leading to changes in movement behavior.

Movement may be grouped into three categories (stability, locomotor and manipulative movement skills) depending on the purpose of the movement. Each category will be addressed.

### 2.9.1 Stability movement skills

The most basic movement will be stabilizing movements (nonlocomotor) and refers to a movement in which one has to gain and maintain equilibrium in relation to the force of gravity. Stability consists of axial movements and refers to the movements of the trunk and limbs while the body remains in a stationary position. Axial movements include twisting, turning, bending, stretching, pushing and pulling movements (Gabbard, 2004:286).

Stability also consists of static (stationary position) and dynamic (moving) balance. Examples of static and dynamic balance are standing, sitting, rolling, dodging as well as beam walking and one-foot balance (Gallahue and Ozmun, 2002:188).

Stability is important for all movements, because all the movements involve an element of stability. During sporting activities axial movements such as turning or stretching will be used in an attempt to catch the ball during a netball match. Dynamic balance will also play an important role through running constantly on the court as well as static balance when standing still to throw the ball to a team mate.

### 2.9.2 Locomotor movement skills

A locomotor movement follows stability and refers to moving the body from one place to another through walking, running, jumping, skipping and hopping. Jumping consists of various movements such as jumping from a height, jumping for height (vertical jump) and jumping for distance (horizontal jump (Gallahue and Ozmun, 2002:200; Gabbard, 2004:285; Haywood and Getchell, 2005:94). According to Hamilton et al., (2008:497) swimming refers to aquatic locomotion and moving the body through water is fundamentally similar to moving on land.

Girls participating in sporting activities will use a variety of locomotor movement skills such as running on the track, a horizontal jump will be used during long jump and a vertical jump for high jump. A more complex locomotor movement skill refers to the ability to take part in triple jump, which consist of a hop, step and jump.

### 2.9.3 Manipulative movement skills

A manipulative movement refers to catching, throwing, punting, striking and kicking movements and refers to the ability to impart force to/or receive force from an object (Gallahue and Ozmun, 2002:46). In addition Gabbard (2004:286) views a manipulative skill as fine motor manual movements as well as gross motor skills that involve the control of objects by means of the hands and feet. Another view regarding manipulative skills according to Haywood and Getchell (2005:112) refers to the application of force to an object in order to project it; also known as ballistic skills or grasping an object with the hands.

Anticipation is an important aspect to perform manipulative tasks and interception skills successfully and refers to the girl's ability to initiate movements well ahead of the time of interception so that the body and hands can be in the proper position when the ball arrives. Anticipation is influenced by the speed of the ball, the trajectory, as well as the size and shape of the ball (Haywood and Getchell, 2005:145).

Girls participating in sport will use a variety of manipulative movement skills such as catching and throwing in netball, and during hockey and tennis an implement (hockey stick or tennis racket) is used to hit the ball.

In conclusion the acquisition of movement skills are essential for motor development. Although the three categories of movement skills are learned separately they work in conjunction with one another to perform complex movements during sport and recreational participation.

## 2.10 Increased motor skills

Motor skills can be divided into fine and gross motor skills. Gledhill et al., (2007:379) defines a fine motor skill as that skill that requires small muscle movements in activities such as writing, drawing and threading, while gross motor skill refers to the use of the large muscle groups in activities such as running, jumping and throwing. Sewell et al., (2005:410) state that not only do skills develop from rudimentary to specialized, but also from gross motor skills to fine motor skills. In order to perform these skills, children need to practice a variety of motor components.

## 2.11 Motor components

Motor development is not a singular aspect, but a composite aspect that consists of various components that are indivisible. According to Nel (1999:71), components such as sensory motor, perceptual motor, laterality, spatial orientation, rhythm, visual suitability, balance, coordination, agility and reaction time are essential for motor development. Note that balance, coordination, agility and reaction time are components of skill-related fitness and a full discussion on each component follows in Chapter 3. The motor components will be addressed.

### 2.11.1 Sensory-motor

A well-developed sensory motor system gives meaning to the information provided by the senses and refers to the visual system, auditory system, olfactory system and the kinesthetic system (vestibular system and the proprioceptive system). The vestibular system refers to the receptors of the inner ear (Cheatum and Hammond 2002:143; Gabbard, 2004:190), and the proprioceptive system refers to the receptors in the muscles, joints and tendons of the various body parts (Cheatum and Hammond, 2000:185; Gabbard, 2004:185).

The senses can work independently from one another (intra-sensory) or in conjunction with one another (inter-sensory). Receiving multiple sets of information

from various sensory receptors refers to inter-sensory integration (Gabbard, 2004:196; Botes, 2007:49).

Inter-sensory integration plays a vital role during sport participation, for example javelin. A girl participating in this event will feel and hear the contact on the track during her run up. In addition she will feel the javelin in her hand and after the throw is completed she will see the trajectory of the javelin through the air, hearing the coach in the background cheering her on. During a cultural activity (inactive) a girl playing the piano will feel the keys underneath her fingers as well as the pedal under her foot. She will see the notes on a sheet of paper and hear the music as she plays the song. In addition she will hear the audience applauding.

### 2.11.2 Perceptual-motor

*"Perceptual-motor"* refers to: *"a process of organizing incoming information with stored information that leads to a movement response"* (Gallahue and Ozmun, 2002:474). A similar definition according to Haywood and Getchell (2005:19) regarding "*perceptual-motor*" is defined when: *"the brain acts like a computer, inputting information, processing it, and outputting movement"*. Therefore, perceptual-motor can be seen as a process in which a movement occurs after information has been received via the senses and successfully processed. Developing perceptual-motor skills regarding the visual system, auditory system and kinesthetic system are vital for participation in sport and cultural activities.

### 2.11.3 Laterality

*"Laterality"* is defined as: *"the awareness that one's body has two distinct sides that can move independently"* (Haywood and Getchell, 2005:165). Another definition according to De Witt and Booysen (2007:93) regarding "*laterality*": *"dit is die innerlike bewustheid van die twee kante van die liggaam, met die middellyn as vertrekpunt, asook die feit dat daar ooreenkomste en verskille tussen die twee kant bestaan"*. Therefore, laterality can be seen as the body's symmetry consisting of a left and right side which can work separately or in conjunction with one another.

Laterality consists of various aspects, such as the inner awareness of left and right, midline crossing, lateral dominance, contralateral movements, unilateral movements and bilateral integration. In order to understand these aspects they will be applied to practical situations.

Inner awareness of left and right is important in order to discriminate between the two sides (Haywood and Getchell, 2005:165). During sporting activities girls will need to run across the field from left to right without being confused. Girls participating in dancing activities (cultural activity) will also need to distinguish between left and right to perform a dance routine.

Girls will need to cross the midline of their body with their hands, feet and eyes (Haywood and Getchell, 2005:165). A girl participating in tennis will need to perform a backhand stroke, following the ball with her eyes resulting in the ability to cross the midline. During a cultural activity such as playing the drums, require midline crossing of the arms.

Lateral dominance refers to the consistent preference for one side of the body, although some girls might be right handed but they kick with the left foot (Haywood and Getchell, 2005:166). During a hockey match, a girl dominant in her right hand will hit the ball harder compared to her left hand. Sports requiring unilateral movements such as tennis (using one limb to execute a movement) illustrate a significant difference in size regarding the dominant arm compared to the non-dominant arm.

Contralateral movements refer to the ability of the limbs to work in opposition to each other (Haywood and Getchell, 2005:165). General contralateral movements are used during running activities and bilateral integration refers to the ability to use both sides of the body to execute a movement such as a butterfly stroke in swimming.

### 2.11.4 Spatial orientation

According to Haywood and Getchell (2005:162) "*spatial orientation*" can be defined as: *"the orientation or position of objects as they are located in space or as a two*

*dimensional drawing".* Another definition according to De Witt and Booysen, (2007:93) *regarding "spatial orientation": "ruimtelike oriëntasie is die bewustheid van watter ruimte die liggaam as sodanig inneem asook die vermoë om die liggaam in 'n gegewe ruimte te manipuleer".* Therefore spatial orientation can be seen as the ability to orientate objects or the body in space.

Spatial orientation consists of various aspects such as body awareness, constancy of size, depth perception, direction awareness and distinguishing between the background and foreground. In order to understand these aspects they will be applied to practical situations.

*"Body awareness"* according to Haywood and Getchell (2005:165) refers to: *"the recognition, identification and differentiation of the location, movement and interrelationships of body parts and joints as well as the awareness of the spatial orientation and perceived location of the body in the environment".* Participation in sporting activities requires the ability to perceive the body's orientation in the environment, such as in front of the tennis court or at the back of the tennis court. Girls participating in culture activities such as playing various instruments will need to understand letter orientation to avoid confusion when reading music notation.

The following aspects (constancy of size, depth perception, directionality and foreground and background) can be incorporated into one example. During a netball match the ball stays the same size over various distances (constancy of size). To catch the ball at the appropriate time the necessary adjustments regarding the distance from the ball (depth perception) as well as where (directionality) to catch the ball has to be established without interference of the opponents or teammates in the background focusing only on the ball in the foreground (Gabbard, 2004:188, Haywood and Getchell, 2005:162).

### 2.11.5 Rhythm

*"Rhythm"* can be defined as: *"the synchronous recurrence of events related in such a manner that they form recognizable patterns"* (Gallahue and Ozmun, 2002:475). In addition, Gabbard (2004:192) views rhythm as creating and maintain a temporal

pattern within a set of movements. Rhythm is essential for all motor activities such as running, swimming, cycling as well as for playing instruments and dancing.

### 2.11.6 Visual suitability

Visual suitability refers to how well the eyes can work, together and individually (Nel, 1999:72). Vision is an important aspect regarding the execution of movements and consists of visualizing, visual concentration, dynamic visual suitability, visual memory and peripheral vision (Gabbard, 2004:174-181).

The aspects regarding visual suitability can be incorporated into one example. Before a hockey game the girls can use visualizing strategies to prepare them for the match; in other words, thinking about the match to come and how they will react in certain situations. During the game visual concentration is needed in order to focus on the task at hand and not to get distracted by the spectators. Dynamic visual suitability refers to the ability to follow an opponent's movement and to be able to remember the movements or positions (visual memory). The importance of visual memory relates to the ability to intercept the ball and as a result of remembering the opponent's position, the girl can run in a different direction. Peripheral vision refers to the ability to see a movement from the corners of the eyes without moving the head, focusing on the field as well as sudden movements from the opponent from the side.

### 2.11.7 Balance

*"Balance"* according to Gallahue and Ozmun (2002:250) can be defined as: *"the ability to maintain the equilibrium of one's body when it is placed in various positions"*. In addition Nel (1999:71) views balance as a condition in which opposing forces match each other exactly. Therefore, balance can be seen as the ability to maintain equilibrium while performing various movements. The complexity of the movement will influence the demand for greater equilibrium. A full discussion regarding balance will be addressed in Chapter 3, (p. 82).

### 2.11.8 Coordination

*"Coordination"* can be defined as: *"the ability to integrate separate motor systems with varying sensory modalities into efficient patterns of movement"* (Gallahue and Ozmun, 2002:249). Schmidt and Lee (2005:267) view coordination as the timing of the upper extremities in conjunction with the lower extremities to execute a movement. Therefore, agility can be seen as the ability to coordinate various limbs and muscles with one another to execute movements successfully. A full discussion regarding coordination will be addressed in Chapter 3, (p. 83).

### 2.11.9 Agility

*"Agility"* according to Gallahue and Ozmun (2002:252) refers to: *"the ability to change the direction of the body rapidly and accurately"*. In addition, Nel (1999:71) views "*agility*" in a similar way: *"the ability to change direction quickly and continuously"*. Therefore, agility can be seen as the ability to run across the field changing direction swiftly and constantly in order to outrun the opposition. A full discussion regarding agility will be addressed in Chapter 3, (81).

### 2.11.10 Reaction time

Haywood and Getchell (2005:226) define "*reaction time*" as: *"the time between the onset of a stimulus and the beginning of a movement response*". In addition Gallahue and Ozmun (2002:251) view "*reaction time*" in a similar manner: *"the time elapsed from the signal go to the first movements of the body"*. Therefore, reaction time can be seen as how quickly a girl responds to a stimulus to perform a movement.

Reaction time consists of simple reaction time or choice reaction time. The following definitions can be applied to distinguish between these two concepts. Simple reaction time refers to the time between the onset of a stimulus (a buzzer) and the beginning of a movement response (diving into the pool). On the other hand choice reaction time requires the earliest possible response to more than one stimulus. Each stimulus normally requires a different response (Haywood and Getchell,

2005:226). A full discussion regarding reaction time will be addressed in Chapter 3, (p. 85).

In conclusion, it is clear that the motor components play a vital role in sport and cultural activities and should be established early in life by means of physical activity (experience) or specific intervention programs.

## 2.12 Summary

Chapter 2 focused on important topics on how to help children become motor proficient. During motor development various factors can influence motor development such as factors within the individual, the environment and physical task factors. It is important to take note of these factors to understand the differences among girls regarding motor development. Skill classifications provide guidance regarding moving from simple to more complex skills. In order for children to learn new skills they need to go through the different stages of learning. A physical educator and kinderkineticist who understands the different stages of learning can teach children new skills quickly and swiftly, helping them more efficiently from being a beginner to a more advance participant.

In the process of becoming motor proficient children also need to move through the phases of motor development, from the reflexive movement phase through to the specialized movement phase. The role of a physical educator and kinderkineticist during the different phases would be to know when to move from the one phase to another and when it would be the most appropriate time to introduce new skills to children (although children will move from one phase to another by means of maturation). During the fundamental movement phase it would be of utmost importance to help children develop until they have reached the mature stage. By achieving this goal the child would have ample opportunities to apply her skills in sport, cultural activities and to use her acquired skills throughout life, leading to a healthy lifestyle.

Improving children's motor proficiency can have a positive influence on multiple levels in a child's life, for example, daily life activities (walking to school and playing with friends), sport (taking part in athletics and netball) and academics (reading and mathematics skills).

Chapter 2 clearly indicates the various aspects regarding motor development in order to become motor proficient and to improve the total welfare of girls. It is important to note that motor proficiency is sometimes also described as skill-related fitness and forms part of physical fitness. In Chapter 3 physical fitness will be fully discussed under two headings, namely health-related fitness and skill-related fitness.

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# CHAPTER 3

# Physical fitness

## 3.1 Introduction

According to Saris, Elvers, van't Hof and Blinkhorst (cited in Rutenfranz et al., 1986:124), physical fitness is used to describe how well a child can perform an exercise task. By this definition, fitness describes a child's score based on age and sex on field exercise tests (1,6 km time, number of sit-ups or chin-ups and flexibility) that are routinely performed in both school physical educational and various sport specific

settings. Caspersen et al., (1985:129) and Powers and Howley, (2007:321) view physical fitness in a similar manner with a greater emphasis on a set of attributes that children have to perform regarding various types physical activity.

According to Gallahue and Ozmun (2002:247), any movement requires some form of cardiovascular fitness, muscular strength, muscular endurance and flexibility. An example to clarify this statement would be to dribble a ball; due to performing the movement task repeatedly a child would require muscular endurance. Changing the movement task to dribbling the ball up and down the court, a child would require cardiovascular endurance as well as flexibility. Therefore all types of physical activity require some degree of health-related fitness.

Nel (1999:14) agrees with Gallahue and Ozmun (2002:247) and states the following: *"The child must have the necessary energy, muscle strength, muscle endurance, speed, explosive force and flexibility to comply with daily demands posed by life, and to participate in physical activities and recreation skills. Physical fitness and motor dexterity is seen as a comprehensive totality concept because movement and dexterity cannot develop without the necessary muscle strength, muscle endurance and energy. On the other hand, a high level of energy and endurance means nothing without a reasonable level of skilled movement".*

In conclusion, skill-related fitness and health-related fitness works in conjunction with one another and form part of physical fitness.

## 3.2 Physical Fitness

The Exercise Teachers Academy (2002:7) distinguishes between two types of physical fitness namely health-related fitness and skill-related fitness. Health related fitness relates to the capacity to perform activities with vigour over a period of time as well as participation in leisure activities. Health-related fitness refers to cardiovascular endurance, muscular strength and muscular endurance, body composition and

flexibility. Skill-related fitness relates to the components of fitness that include motor skills, agility, balance, coordination, reaction time and speed, which are necessary for optimal sport performance.

To illustrate the two components of physical fitness the following figure was compiled in order to distinguish between the various aspects of health-related fitness and skill-related fitness (Figure 3.1). It is interesting to note that Caspersen et al.; (1985:12) viewed reaction time as an aspect of skill-related fitness although Gallahue and Ozmun (2002:251) view reaction time as an important aspect influencing speed.

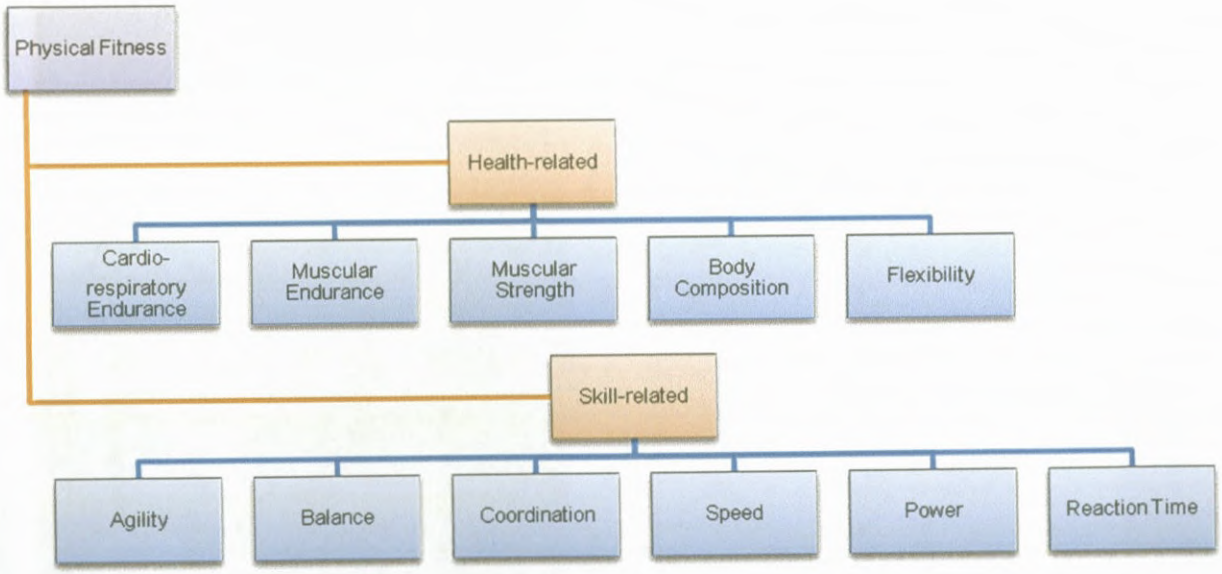


**Figure 3.1: Components of physical fitness**

## 3.3 Components of physical fitness

As stated earlier in Chapter 3 physical fitness can be sub divided into two categories, namely health-related fitness and skill-related fitness. In the following paragraphs the components of each sub category regarding physical fitness will be defined and discussed briefly. The importance of maintaining physical fitness through puberty can be found in work done by Janz, Dawson and Mahoney (2000:1251). The researchers tested 126 children and found that the children who maintained their physical fitness throughout puberty will have favourable health benefits in later years.

### 3.3.1 Health-related fitness

The first category of physical fitness namely health-related fitness consists of five components: cardio respiratory endurance, muscular endurance, muscular strength, body composition and flexibility (The Cooper Institute, 2005:3). The importance of health-related fitness in the present study is to determine health-related fitness among 12 to 13 year old girls. Health-related fitness status among girls was measure by means of the Fitnessgram. A discussion on cardio respiratory endurance regarding health-related fitness will be addressed.

#### 3.3.1.1 Cardio respiratory endurance

Cardio respiratory endurance is an aspect of muscular endurance, specific to certain organs in the body (heart, lungs and vascular system). Endurance has been defined as the ability to persist or to resist fatigue (Sharky and Gaskill, 2006:294). The one mile run (1,6km) was used during the present study to determine the cardio respiratory endurance ($VO_2$ max) among girls, although the progressive aerobic cardiovascular endurance run (PACER) test is the recommended test (The Cooper Institute 2005:27). The cardio respiratory system consists of the cardiovascular system and the respiratory system.

#### 3.3.1.1.1 The cardiovascular system

According to Gledhill et al., (2007:25), the cardiovascular system refers to the heart and is responsible for circulating blood, and maintaining blood pressure throughout the body. By circulating blood through the body the heart ensures that gases and substrates are delivered to tissues, and that gases and metabolites are carried away from tissues. The effect of physical activity on the cardiorespiratory endurance among girls will help to maintain their cardiorespiratory endurance for longer. Staying active will also improve the positive health effects of physical activity on the cardiorespiratory system such as the lowering of systolic and diastolic blood pressure and prevention of heart diseases (McArdle et al., 2001:247). The concern regarding cardiovascular diseases in children is the fact that various diseases begin during childhood and are therefore lifelong processes that need to be prevented (Plowman and Smith, 2003:443).

#### 3.1.1.1.2 The respiratory system

The respiratory system refers to the lungs and the primary function of the lungs is to exchange gas. The lungs also perform other important roles, such as the metabolism of some compounds, filtering of toxic material from the circulation, and serve as a reservoir for blood. The blood-gas barrier is very thin and gas is brought to one side of the barrier by airways and blood to the other side by blood vessels (Sewell et al., 2005:79).

According to Sewell et al., (2005:81) transporting oxygen from the lungs to body tissues is one of the respiratory functions of the blood, and arterializing, or oxygenating mixed venous blood is one of the respiratory functions of the lungs. The amount of oxygen carried by each millilitre of blood and the cardiac output are determined by the amount of oxygen transported by the blood.

The maximal oxygen uptake ($VO_2$ max) refers to a measurement taken in a laboratory to determine how much oxygen an athlete can use during maximal exercise (Prentice, 1999:586). It is a measure of one's ability to transmit oxygen to the tissues of the body.

#### 3.3.1.1.3 Cardiorespiratory endurance among girls

Garcia (2002:248) indicates that maximal oxygen consumption tends to improve as a function of age in both genders. While oxygen consumption starts to level off among girls at about 12 years while, boys have the ability to keep on improving their maximal oxygen consumption. The ability to improve thereafter is dependent on the training habits of girls. On the other hand, maximal heart rate decreases with age. Tan (2002:187) tested 175 rural and 157 urban girls between 6 and 11 years. The test used to determine cardiorespiratory endurance among the girls was the 12min run. There was a significant difference between the two groups. Another study was performed by Dollman and Ridley (2006:191) among 843 children between 10 and 11 years to determine the role of technology regarding cardiorespiratory endurance. The results revealed a significant difference between the girls participating in sport (active) and the inactive group, clearly indicating the negative influence of technology on cardiorespiratory fitness. Marshall, Sarkin, Sallis and McKenzie (1998:910) found that cardiovascular fitness among 201 girls between 9 and 12 years of age may be less likely to track into early adolescence, because cardiovascular fitness is more influenced by changes in physical activity levels.

Longitudinal studies were also performed over the years by various researchers regarding cardiorespiratory endurance. A study by Volbekiene and Grici (2007:235) used the 20m shuttle run over a period of 10 years (1992 to 2002). Results over the 10 year period clearly indicate a decrease in aerobic fitness in 2009 children of both genders aged 12. Similar results reached by Baquet, Twisk, Kemper, Van Praagh and Berthoin (2006:51) who, after testing 158 children, found that boys performed better on the 20m run as well as the 10 x 5m shuttle run compared to girls. The researchers came to the conclusion that the boy's fitness performance improved more over the four year period than that of girls, although both genders showed signs of regression throughout the study. Malina (2007:67) came to the same conclusion as Baquet et al., (2006:51) and Volbekiene and Grici (2007:235) after assessing the aerobic performance by means of the 20m shuttle run, suggesting a decline in the maximal aerobic power

among girls, but suggesting that boys tend to have stable levels. Research according to Chen, Fox, Haase and Wang (2006:1367) determined the effect of obesity pertaining to cardiorespiratory endurance and came to the conclusion that overweight/obese girls tend to have poorer cardiovascular endurance than the normal weight group. A total of 6 904 girls between 6 and 18 years participated in the survey in 1999 whilst 12 219 girls participated in the 2001 survey.

In conclusion, cardiorespiratory endurance according to the above mentioned research clearly indicates that boys perform better when compared to girls. Active girls (participating in sporting activities) outperformed the inactive girls. In today's modern lifestyle, factors such as technology, unhealthy nutritional habits leading to obesity and a sedentary lifestyle contribute to poor cardiorespiratory endurance status. Therefore, sound cardiorespiratory endurance can be maintained through an active lifestyle (minimising time spend with technology as well as inactivity) resulting in the positive health effects associated with cardiorespiratory endurance. Positive effects such as the prevention of chronic diseases (hypertension and heart diseases), maintaining a strong and healthy heart to aid in sporting activities or recreational activities, as well as improving the lung's capacity to transfer sufficient oxygen to various muscles and to remove waste products rapidly would be beneficial. Cardiorespiratory endurance declines every year in children and attempts should be made to improve their endurance, because cardiorespiratory endurance can be improved by means of a specific training program. Subsequently muscular endurance regarding health-related fitness will be elaborated on.

#### 3.3.1.2 Muscular endurance

Muscular endurance relates to the ability of muscle groups to exert external forces for many repetitions or successive exertions, or the ability to sustain sub-maximal contractions (Sharkey and Gaskill, 2006:52). During the present study two tests were used in order to determine muscular endurance namely, curl-ups and push-ups according to a specific cadence (The Cooper Institute 2005:42-47).

The importance of physical activity on muscular endurance is the fact that girls can keep on improving on their muscular endurance if they stay active or take part in training programs. Muscular endurance is an important component for both groups; the active girls (sport) need endurance in order to take part in swimming, running, netball and the inactive girls (cultural) need endurance to either play an instrument or just to walk from their home to the school. The positive effects on health would be to keep muscles healthy as stated in Chapter 1, (p. 4). It is also important to note that caution needs to be exercised during endurance training among young girls who participate in sport as excessive endurance training can lead to demineralization of bones. The demineralization of bones is also related to altered menstrual functioning with excessive endurance training which, in turn, leads to an oestrogen deficit (Powers and Howley, 2007:464).

Muscular endurance differs from whole-body aerobic endurance as it usually involves fine versus gross muscle groups. Moreover, repeated small-muscle contractions do little to improve whole-body endurance. Muscular endurance is an important component in everyday life (typing, playing an instrument and cutting hair), recreational activities and sport (running, cycling and swimming). Muscular endurance can be improved by means of a sport-specific training program that includes power endurance (Sharkey and Gaskill, 2006:51).

Power endurance is defined by Sharkey and Gaskill, (2006:52) as the ability to repeatedly perform a skill with adequate speed and is usually measured by the number of repetitions within a time limit. An example of an endurance activity according to Garcia (2000:242) would be a sit-up. The reason for this would be that the emphasis is on the repetition of the activity and not on the overload of the muscle.

#### 3.3.1.2.1 Muscular endurance among girls

Although girls have lower activity levels than boys (as stated in Chapter 1, 2), girls still tend to have higher activity levels than adults. The differences in their endurance levels

after the body weight adjustments are made often exceed those of adults. Girls tend to make annual improvements regarding muscular endurance measurements and only perform better than boys for a short period of time due to reaching puberty first (Garcia, 2002:242). Boys demonstrate a larger increase regarding muscular endurance between the ages of 12 and 16 years and then only start to level off. Girls indicate no significant increase unless they take part in special training programs (Gallahue and Ozmun, 2002:248). Another study conducted by Tan (2002:188) tested 175 rural and 157 urban girls between 6 and 11 years. The test used to determine muscular endurance among the girls was the sit-up test in 30sec. There was a significant difference between the groups. Marshall et al., (1998:910) found that muscular endurance of 201 girls between 9 and 12 years, may be less likely to track into early adolescence, because muscular endurance is more influenced by changes in physical activity levels.

Longitudinal studies were also performed over the years by various researchers regarding muscular endurance. A study by Baquet et al., (2006:52) found that after testing 158 children between 11 and 16 years, boys performed better than girls in the sit-up test. Over a period of 4 years a regression in muscular endurance was found in boys and girls although Volbekiene and Grici (2007:235) came to the conclusion that both genders over a 10 year period improved on their muscular endurance. Chen et al., (2006:1367) gathered information from 6 904 girls in 1999 and 12 219 girls in 2001 to determine the effect of obesity on muscular endurance and came to the conclusion that overweight/obese girls tend to have poorer muscular endurance than the normal weight group. (Note that the results for push-ups and curl-ups as indicated in muscular endurance are also applicable for muscular strength, because push-ups and curl-ups contain both components in order to execute the test.)

In conclusion, muscular endurance is dominated by boys after reaching puberty. For this reason it would be advisable to motivate girls to participate in sporting activities and to follow a sport specific program for longer, in order to maintain their muscular endurance levels throughout puberty. Bear in mind that the training program should be age related as excessive endurance training leads to a demineralisation of bones.

Muscular endurance declines every year in children and attempts should be made to improve their endurance. The following component, muscular strength as it pertains to health-related fitness will be expounded.

#### 3.3.1.3 Muscular strength

Muscular strength can also be defined as two separate nouns. "*Muscular*" according to the Oxford Dictionary (2002:591) refers to "*muscles or having well developed muscles*". "*Muscle*" is defined as: "*a band of tissue in the body that can contract so as to move or hold the position of a part of the body*". Sharkey and Gaskill, 2006:298) define "*strength*" as: "*the ability of muscles to exert the maximum force during a muscular contraction*". According to Powers and Howley, (2007:4) "*muscular strength*" can be defined as: "*the maximum force generated by a muscle or muscle groups*". To summarise, muscular strength refers to the generation of a great amount of force by means of a muscle or various muscle groups. During the present study two tests were used in order to determine muscular strength, push-up and a curl-up according to a specific cadence (The Cooper Institute 2005:42-47).

Resistance training is not recommended for prepubescent children due to the negative effect on the still-growing epiphyseal growth plates (Gallahue and Ozmun, 2002:246). Regular resistance training in limits can enhance health status due to the improvement in resting blood pressure of borderline hypertensive adolescents as well as in later life (McArdle et al., 2001:249). According to Coetzee (2007:58) resistance training is essential for bone growth and in addition, active children of both sexes generally have more highly mineralised bones.

##### 3.3.1.3.1 Classifications of strength

According to Prentice (1999:586), strength might be classified into isometric strength, isotonic strength and isokinetic strength. In order to perform a push-up or a curl-up (the two tests used during this study) one would mainly use isotonic strength. Prentice

(1999:586) defines isotonic strength as an exercise in which the muscle contracts against resistance and changes in the muscle length occurs. The change in muscle length could refer to either a concentric movement (muscle shortens) or an eccentric movement (muscle lengthens).

#### 3.3.1.3.2 Muscular strength among girls

According to Garcia (2002:242), girls improve their strengthening skills yearly by means of running activities (leg strength) and hanging activities (arm strength). The yearly improvements are a result of size increments, as well as better fundamental movement abilities. Strength improves until 12 years among girls; thereafter strength reaches a plateau or even deteriorates during adolescence. Boys on the other hand are slow in the development of muscular strength before the onset of puberty, and then gain rapidly throughout adolescence. Boys display superior muscular strength when compared to girls at all ages (Gallahue and Ozmun, 2002:248). Marshall et al., (1998:910) found that muscular strength in 201 girls between 9 and 12 years, may be less likely to track into early adolescence because muscular strength is more influenced by changes in physical activity levels.

In longitudinal studies by Chen et al., (2006:1367) regarding muscular strength, information obtained from 6 904 girls between 1999 and 12 219 girls in 2001 to determine the effect of obesity on muscular strength came to the conclusion that overweight/obese girls tend to have poorer muscular strength than the normal weight group. As stated earlier (Chapter 3, p. 68) under muscular endurance it is important to note that the results for push-ups and curl-ups as indicated in muscular endurance are also applicable for muscular strength, because push-ups and curl-ups contain both components in order to execute the test.)

In conclusion, muscular strength according to the above mentioned research clearly indicates that boys perform better regarding muscular strength than girls. Muscular strength is similar to muscular endurance, because in an attempt to improve muscular

strength, girls would need to follow a specific training program. The negative result of weight training prior to puberty influencing the epiphyseal growth plates can be overcome due to the ability to improve strength before puberty without using weights. Girls can improve their muscular strength by means of sporting activities and body weight exercises, promoting the positive health benefits such as bone growth, mineralization of bones as well as improving resting blood pressure. A discussion on the body composition regarding health-related fitness follows.

#### 3.3.1.4 Body composition

Body composition relates to the proportion of lean body mass to fat body mass (Garcia, 2002:243). Plowman and Smith, (2003:616) defined *"body composition"* as: *"the partitioning of body mass into fat-free mass and fat mass"*. Skinfold measurements were used in the present study to determine the fat percentages of girls (The Cooper Institute. 2005:36).

Physical activity can have a positive effect on body fat; being active can reduce fatness. The change in fatness depends mainly on two aspects, the continuity of activities during childhood and the restriction of calorie intake (Coetzee, 2007:95). The importance of staying active and the restriction of calories on body composition are due to the accumulation of excess fat during childhood (McArdle et al., 2001:512). According to Powers and Howley, (2007:493), high levels of body fatness will influence performance in sports such as running and jumping activities where body weight must be carried along. The positive health effects of staying active will lead to a decline in obesity, which is related to heart diseases and diabetes (Powers and Howley, 2007:292).

##### 3.3.1.4.1 Somatotyping

Anthropometry is a term used for the measurement of physical characteristics and basic body composition estimations. By using these estimations of physical characteristics and body composition one could classify a child's somatotype. Somatotyping is

categorized by Gledhill et al., (2007:82) into three basic classifications according to the prominence of different tissue types, namely the mesomorph (refers to a child who is very muscular), the endomorph (usually associated with being fat) and the ectomorph (refers to a skinny child). During the childhood years the measurements of body height and mass are frequently administered to keep track of growth and maturation.

According to a study conducted by Tan (2002:187), 329 children between the ages of 6 and 11 years of both genders and from rural and urban communities were tested to determine the differences in anthropometry, physique and physical fitness. It is interesting to note that there is a difference between rural and urban boys according to somatotype, but not among girls. Endomorphy was negatively correlated to fitness and a variable correlation between mesomorphy and ectomorphy. (No evidence was stated by the researcher on why a difference occurred only between the boys and not the girls).

#### 3.3.1.4.2 Anthropometry measurements

Various anthropometry measurements can be used to determine relative fatness, ranging from simple and inexpensive equipment to expensive equipment only available in exercise and health laboratories. Various anthropometry measurements such as height; seated height; weight; body mass index; girth measurements; skinfold measurements; bioelectrical impedance; hydrostatic measurements and the air displacement plethysmography apparatus can be used to determine fatness. In the next paragraphs a brief discussion will follow on height, body mass index and skinfold measurement because these variables have been used during the present study.

**(a) Height**

The following are simple physical characteristic measurements that can be applied according to Sewell et al., (2005:136). Height refers to the distance from the floor to the vertex of the head and the measurement must be taken up to the nearest 0.01m.

### (b) Body mass index

To determine body mass index (BMI), body mass (kg) is divided by the square of the height (m). The results can establish if a person is below or above a desirable body mass for health purposes. Important aspects to keep in mind with regard to BMI are firstly to note that the results need to be interpreted with caution. The second reason for this is because a muscled individual may fall in the overweight category.

### (c) Skinfold measurement

Skinfold measurement is probably the most popular method to determine body composition. The reason for this could be due to the fact that the procedure is quite simple to perform and the equipment such as a calliper is inexpensive. Sewell et al., (2005:139) suggest that the sum of the skinfolds can be obtained by using the following anatomical sites: biceps; triceps, sub scapular and suprailiac (sum of four skinfolds). In addition, the abdominal site, the medial calf and the anterior thigh (sum of seven skinfolds) can be included. Figure 3.2 illustrates the various skinfold sites. A table can be applied to relate the sum of skinfolds thicknesses to the percentage body fat.

During the present study, measuring the calf, tricep and abdominals was appropriate according to The Cooper Institute (2005:36) in order to determine the fat percentage among girls. It is important to note that the percentage fat can be estimated with a 3% to 4% error. Therefore, the person being measured as 15% body fat, can have a true value as high as 19% or as low as 11% (Houtkooper and Going, 1994:60).


**Figure 3.2: Seven commonly measured skinfold site**

#### 3.3.1.4.3 Body composition among girls

As defined earlier in this Chapter, body composition refers to the amount of lean body mass in relation to fat body mass. Therefore girls who are less active will tend to have more fat mass than their active peers. Research conducted by Pate, Pfeiffer, Trost, Ziegler and Dowda (2004:1258) concluded that boys participated in significantly more moderate-to-vigorous physical activity and vigorous physical activity than did girls. For this reason, lower activity levels result in an increased body fat percentage; therefore, girls achieved higher body composition scores. Active children are leaner than obese children at all ages (Gallahue and Ozmun, 2002:248).

Research conducted by Dollman and Ridley (2006:191) tested 843 children between 10 and 11 years of age. Children from both genders were grouped into an active group "sporties", inactive group "screenies" and a group who took part in sport and who could spend more time in front of the television or computer then the active group namely the "technoactives". Skinfold measurements among girls were higher in the in-active group than in the active group. Waist girth measurements were lower in active boys than in the "technoactives" No comparison was made between genders. Comparisons between genders regarding body fat percentage were made by Hopper, Munoz, Gruber and Nguyen (2005:131). The researchers concluded their study with a significantly higher percentage on skinfold measurement among girls than among boys.

Longitudinal studies regarding body fat percentage conducted by Chen et al., (2006:1367) gathered information from 6 904 girls in 1999 and 12 219 girls in 2001 to determine the effect of obesity on body fat percentage and came to the conclusion that overweight/obese girls tend to have poorer body fat percentages than the normal weight group. Chen et al., (2006:1367) also came to the conclusion that obesity increased over the ten year study in girls from 15.2% up to 16.5%.

In conclusion, obesity is rapidly increasing among children, influencing components such as cardiorespiratory endurance, muscular endurance and muscular strength

negatively with regard to health-relating fitness. A decrease in health-related fitness leads to diabetes, heart diseases and hypertension. According to the above mentioned research, boys indicate lower levels of body fat percentages compared to girls; on the other hand the active girls outperformed the inactive girls. For this reason, body fat percentage can decrease by taking part in various activities. Another important aspect that needs to be considered is nutritional status among girls. Healthy and balanced diets contribute to the prevention of obesity. The final component, flexibility regarding health-related fitness will be addressed.

#### 3.3.1.5 Flexibility

Prentice (1999:585) defines "*flexibility*" as: *"the ability to move the arms, legs and trunk freely throughout a full, non restricted, pain-free range of motion at a joint.*" A joint can be defined as a structure by which two bones fit together (Oxford Dictionary, 2002:485). Gallahue and Ozmun (2002:242) define flexibility as the ability of joints in the body to move through a full range of motion. Three variables were used in the present study to determine flexibility among girls; the back saver sit and reach test; shoulder stretch and the trunk lift (The Cooper Institute, 2005:45-56).

Flexibility can be viewed as an essential component for fitness as flexibility helps prevent injuries and improves the range of motion of certain joints that could enhance performance (Gallahue and Ozmun, 2002:247). To enhance the health status in children appropriate exercises that move through the full range of motion can be used to increase flexibility among boys and girls between 20% and 50%. As children age they become stiffer, resulting in reduced flexibility (McArdle et al., 2001:510).

##### 3.3.1.5.1 Types of flexibility

Flexibility can be divided into several categories, namely: static flexibility; ballistic flexibility; dynamic or functional flexibility; active flexibility and proprioceptive neuromuscular facilitation. Dynamic or functional flexibility is an important aspect in

order to perform physical activity; therefore the following definition was adopted from Alter (1997:1):

*"Dynamic or functional flexibility refers to the ability to use a range of joint movement in the performance of a physical activity at either normal or rapid speed. In contrast to ballistic stretching, it includes no bouncing or jerky movements. Dynamic or functional flexibility directly corresponds to the specificity of the stretching process as it relates to the activity. Dynamic or functional flexibility has the highest correlation to sport achievement".*

#### 3.3.1.5.2 Flexibility among girls

Flexibility can be improved with practice, whilst dynamic flexibility among sedentary girl's decreases with age. Flexibility begins to decline at about 12 years among girls. Girls are superior when compared to boys at all times (Garcia, 2002:248). Similar results were reported by Baquet et al., (2006:51) and concluded from their study of 158 children between the ages of 11 and 16 years, that girls performed better on the back saver sit and reach test than did boys, but girl's scores regressed over the years. Marshall et al., (1998:910) indicated that flexibility test performances are more likely to track during early adolescence among 201 girls between 9 and 12 years.

Longitudinal studies regarding flexibility by Volbekiene and Grici (2007:237) indicated that over the 10 years of studying both genders, flexibility decreases among girls as well as boys. Chen et al., (2006:1367) determined the effect of obesity on flexibility and came to the conclusion that overweight/obese girls did not display a significant difference to the normal weight group.

In conclusion, it is interesting to note that girls outperform the boys on only one health-related component, flexibility. Flexibility decreases as children get older and as a result of inactivity; it is therefore important to inform them of the health benefits. Stretching is

sometimes viewed as unimportant. Stretching should not only be done prior to, or after training sessions, but should form part of their daily training program.

#### 3.3.1.5 Measurement of health-related fitness

Health-related fitness can be measured in various ways. Table 3.1 summarizes common measures of children's health-related fitness and also supplies a synthesis of the findings according to Gallahue and Ozmun (2002:248).

## Table 3.1: Common measures of children's health-related fitness

| Health-Related Fitness Components | Common Tests | Specific Aspect Measured | Synthesis of Findings |
|---|---|---|---|
| **Cardiovascular endurance** | Step test | Physical work capacity | Children can achieve maximum VO2 values at or above adults when corrected for body weight. Maximal heart rates decrease with age. Trend for improved VO2 max values in both boys and girls with age. Girls level off after age 12 and boys continue to improve. |
| | Distance run | Aerobic endurance | |
| | Treadmill stress test | Max VO2 | |
| | Bicycle ergometer | Max VO2 | |
| | Heart rate monitor | Heart rate | |
| | Accelerometer | Heart rate | |
| **Muscular strength** | Hand dynamometer | Isometric grip strength | Annual increase for boys from age 7 and girls tend to level off after age 12. Boy's superior to girls at all ages. |
| | Back and leg dynamometer | Isometric back and leg strength | |
| | Cable tensiometer | Isometric joint strength | |
| **Muscular endurance** | Push-ups | Isotonic upper body endurance | Similar abilities throughout childhood slightly in favour of boys on most items. Large increases in boys from 12. Girls show no significant increases without special training. |
| | Sit-ups | Isotonic abdominal endurance | |
| | Flexed arm hang | Isometric upper body endurance | |
| | Pull-ups | Isotonic upper body endurance | |
| **Flexibility** | Bend and reach | Hip joint flexibility | Flexibility is joint specific. Girls are more flexible than boys and decrease with reduced activity levels. |
| | Sit and reach | Hip joint flexibility | |
| **Body composition** | Hydrostatic weighing | Percent body fat | Modern children have higher percentages of fat compared to children 20 years ago. Active children are leaner. |
| | Skinfold callipers | Estimate of percentage body fat | |
| | Body mass index | Estimate of percentage body fat | |
| | Electrical impedance | Estimate of percentage body fat | |

## 3.3.2 Skill-related fitness

The second category of physical fitness, namely skill-related fitness, consists of the following components: agility; balance; coordination; speed; power and reaction time. To determine the skill-related fitness status among girls the Short form of the BOTMP was used during the present study. It is important to note that although the components of skill-related fitness are described individually, they are sometimes used in conjunction with one another in order to perform certain activities.

To clarify the above mentioned statement the following examples may be used. To determine speed for instance, the girls tested in this study would perform a shuttle-run; this would test their ability pertaining to speed. In addition, the girls need dynamic balance as well as coordination of the arms in order to perform the running speed and agility test. The second example to demonstrate the interaction between the various skill-related components would be to make use of dynamic balance and coordination of the arms and the legs in order to perform the standing broad jump in order to assess power. For this reason, the results of the various components regarding skill-related fitness are applicable to one another. A thorough discussion on the complex relationship of physical fitness between health-related fitness and skill-related fitness follows at the end of Chapter 3. A discussion on agility regarding skill-related fitness follows.

### 3.3.2.1 Agility

Gallahue and Ozmun (2002:467) define agility as changing direction of the entire body while moving from one point to another in a quick and accurate manner. Sharkey and Gaskill, (2006:55) define agility as the ability to change speed and direction quickly with precision while maintaining control of the body. The shuttle run (91.4cm) was used during the present study to determine the agility of the girls, and refers to a gross motor skill (Bruininks, 1978:50).

The importance of agility among girls taking part in sport can be seen in the ability to run fast on the tennis court, netball court or even the hockey field, as well as the ability to change direction to adapt to the direction changes of the ball. During cultural activities a piano player for instance would sometimes need to play a piece of music fast and change direction quickly from side to side, and during horse riding events, girls would need agility to instruct the horse when to change direction in order to execute a movement.

#### 3.3.2.1 Agility among girls

Agility improves annually in both genders and girls tend to lag behind boys throughout childhood (Garcia, 2002:252). After the age of 13 years girls begin to level off whilst, boys keep on improving on their agility skills (Gallahue and Ozmun, 2002:250).

Volbekiene and Grici (2007:235) performed longitudinal studies on boys and girls and used the 20m shuttle run over a period of 10 years (1992 to 2002). Results over a 10 year period indicate a decrease in speed in 2 009 children of both genders aged 12. Similar results were obtained by Baquet et al., (2006:51) after testing 158 children and found that boys performed better on the 10 x 5m shuttle run when compared to girls. The researchers came to the conclusion that the boy's fitness performance improved more over the four year period than that of girls. A five-year longitudinal study by Hands (2008:159) regarding fitness measures among children with high and low motor competence came to the conclusion that both groups improved their agility skills every year. No additional information was found on research specifically relating to agility. According to the definition of agility (changing speed and direction), agility will be necessary in order to complete running tests associated with the skill-related component regarding speed.

In conclusion, although no additional information was found regarding this component, the current research clearly indicates that boys are superior compared to girls. Therefore, is would be beneficial for girls to improve their agility skills by means of

participation in physical activities. Future research regarding agility would be recommended to gain a better understanding of this component. An explanation on the next component, balance regarding skill-related fitness will be addressed.

### 3.3.2.2 Balance

Balance can be defined as maintaining one's equilibrium in relation to the force of gravity in various body positions such as static, dynamic and rotational (Gallahue and Ozmun, 2002:468). According to Sharkey and Gaskill, (2006:54) balance can be defined as the ability to maintain the equilibrium of one's body while stationary (static) or in motion (dynamic). During the present study two tests were utilised in order to determine balance. Static balance was measured by means of standing on the preferred leg on a balance beam and dynamic balance was measured by walking forward heel-to-toe on a line. Balance activities also refer to gross motor skills (Bruininks, 1978:52).

Balance is an important aspect in both the sport and cultural setting. During sport participation dynamic balance is commonly used, for instance, during running, swimming, playing hockey and netball. Although other sports such as shooting sports (archery and pistol shooting) require static balance, they are not commonly found in school settings. Static balance is also important for girls who participate in cultural activities, for example, when singing in a choir or playing in an orchestra, girls need static balance in order to keep the body in the upright position as well as other activities involving playing different instruments. Girls participating in chess would need static balance and stability to sit up straight throughout the game.

### 3.3.2.2 Balance among girls

Balance improves linearly with age and girls perform better than boys before the age of 8, specifically more so in dynamic balance (Gallahue and Ozmun, 2002:250). Both genders improve slowly before reaching a rapid improvement up to age 12 at which

stage their performances remain similar (Garcia, 2002:250). After testing 421 adolescents, Foley, Harvey, Chun and Kim (2008:157), found that an increase in performance of fundamental motor skills had an increased effect on skill-related fitness (fundamental motor skills relating to balance refer to dynamic balance, static balance as well as axial movements). Another study by Overlock and Yun ( 2006:41) regarding the relationship between balance and fundamental motor skills among 5 and 9 year old children concluded their study with the following statement: "*Static balance no doubt influences kicking performance, as children must maintain balance on one leg while striking a ball with the other leg*".

A longitudinal study conducted by Hands (2008:155) on 38 children between 5 and 7 years revealed that children with low motor competence performed poorly on the balancing task (one foot balance) compared to their peers with high motor competence. Both groups improved on their balancing skills every year.

In summation, it is interesting to note that girls outperform the boys on one of the skill-related components, balance. Balance is very important and is used to perform a variety of movements throughout multiple tasks performed daily. Improving balancing skills among girls would aid them to participate in sport, cultural activities as well as everyday life activities. The following component, coordination regarding skill-related fitness, will be addressed.

#### 3.3.2.3 Coordination

Garcia (2002:249) stated that sound coordination is needed to integrate separate motor systems with varying sensory modalities into efficient patterns of movement. Botes (2007:18) states that coordination refers to the conscious and unconscious harmonious collaboration with the different body parts.

Coordination was measured by using various tests in the present study. The gross motor skills were measured by tapping the feet alternately while making circles with the

fingers as well as jumping up and clapping the hands. Upper-limb coordination refers to gross and fine motor skills and was measured by catching a tossed ball with both hands as well as throwing a ball at a target with the preferred hand. Hand-eye-coordination was measured by means of drawing a line through a straight path, copying a circle as well as copying overlapping pencils. All three tests involved hand-eye-coordination, performed with the preferred hand and refer to fine motor skills (Bruininks, 1978:60).
Similar to balance, coordination also plays an important role in both the sport and cultural setting. During sport participation the girls will mainly use gross motor coordination, for example catching and throwing the ball (netball), hitting the ball (hockey and tennis) or using the large muscle groups in order to run or swim. During these sport activities girls also need sound eye-hand coordination. A cultural activity such as playing the violin, guitar or the flute, involves mainly the fine muscle groups to execute more precise en delicate movements. Dancing requires coordination of the gross muscles in order to execute a movement fluently.

#### 3.3.2.3.1 Coordination among girls

Coordination improves with age and in a linear fashion. According to Garcia (2002:249), boys tend to perform better on coordination tasks than girls throughout life. Gallahue and Ozmun (2002:250) state that gross body coordination improves in both genders, but boys outperform girls from the age of 6 years with regard to eye-hand coordination as well as eye-foot coordination. In addition, Wrotniak et al., (2006:e1762) tested 65 children and indicated that boys threw a ball at a target more successfully than did girls.

Longitudinal studies were also conducted over the years. Hands (2008:157) tested the eye-hand coordination skills of children by means of a volleyball bounce and catch. The results clearly indicated that the children with low motor competence were outperformed by their peers with a high motor competence, although both groups improved on their coordination skills every year. (It is interesting to note that in order to bounce and catch a ball another skill-related component, static balance is required to perform the task). Schott, Alof, Hultsch and Meerman (2006:450) conducted research on 118 girls and 143

boys and concluded that the children with developmental coordination disorders are more at risk for poor levels of skill-related fitness than their peers. Coordination was measured by means of throwing a medicine ball.

In conclusion, the above information indicates that girls outperform boys on coordination skills regarding fine motor control, but that boys performed better on coordination skills regarding gross motor control. Similar to balance, coordination is also a very important component used to perform a variety of movements throughout multiple tasks performed on a daily basis. It would be advisable to aid girls in the improvement of their coordination skills to perform better in sporting and cultural activities. A discussion on reaction time with regard to skill-related fitness follows.

#### 3.3.2.4 Reaction time

Caspersen et al., (1985:12) viewed reaction time as an aspect of skill-related fitness and defined reaction time as the time elapsed between stimulation and the beginning of the reaction to it. On the other hand, Gallahue and Ozmun (2002:475) defined reaction time as the delay in time between the presentation of a stimulus and the initial activation of the muscles to carry out the task at hand. Although Gallahue and Ozmun,(2002:475) define reaction time, reaction time is not viewed as an aspect of skill-related fitness, but rather viewed as an important aspect for speed (speed is viewed as a skill-related fitness aspect by both authors).

The Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) uses the response speed test in order to determine reaction time among girls and was used during the present study. The quick response to a moving visual stimulus is a fine motor skill (Bruininks, 1978:86). The importance of reaction time for girls taking part in sport can be seen in the ability to act quickly after hearing the gun shot in order to run or swim a specific distance.

In hockey, reaction time would also be important for a goalkeeper trying to prevent a goal. During netball matches, catching the ball first after a toss-up would be a good example of the importance of sound reaction time. Reaction time is also important for cultural activities such as playing an instrument (piano and guitar); the girls need the ability to change cords quickly. During horse riding events, girls would need reaction time to indicate to the horse when to jump over obstacles in order to execute the movement effectively.

#### 3.3.2.4.1 Reaction time among girls

Reaction time improves yearly, with boys displaying superior reaction speeds when compared to girls at all ages (Gallahue and Ozmun, 2002:251). In addition, Wrotniak et al., (2006:e1762) tested 65 children and the relationship between motor proficiency and physical activity and concluded that boys had greater response speed than girls. In the same study girls outperformed the boys in sorting shape cards. No additional information was found on research specifically relating to reaction time. According to the definition of reaction time (starting to perform an activity as soon as a stimulus has been presented), reaction time will be necessary in order to complete running tests quicker (or any other activities needing to be performed quickly).

To summarise, the above mentioned information clearly indicates that girls outperform the boys regarding reaction time skills associated with fine motor control, but boys performed better on reaction time skills associated with gross motor control. It would be advisable to aid girls in the improvement of their reaction time skills to perform better in sporting and cultural activities and to aid boys improving their reaction time skill associated with fine motor control. Future research regarding reaction time would be recommended to gain a better understanding of this component. An explanation regarding speed associated with skill-related fitness will be discussed.

### 3.3.2.5 Speed

Prentice (1999:587) states that speed refers to the ability to perform a particular movement rapidly. It is a function of distance and time. Speed can also be defined as moving from one point to another in the shortest time possible (Gallahue and Ozmun, 2002:476). Speed can be thought of as the final product of reaction time. Reaction time depends on the speed with which the initial stimulus is processed through the afferent and efferent neural pathways and is integrated with the initial response pattern (Garcia, 2002:251).

To determine the speed abilities among girls, the shuttle run (91.4cm) which refers to a gross motor skill was used in the present study (Bruininks, 1978:50). Fine motor skills were also used in the present study to determine speed, namely sorting shape cards, and making dots in circles with the preferred hand (Bruininks, 1978:96). Speed is commonly associated with gross motor skills.

Sporting activities such as running or swimming fast, running fast to intercept the ball on the netball court or hockey field or to run from the baseline to the net in order to hit the tennis ball back to the opponent are all examples of the importance of speed during sport participation. Fine motor skills can normally be performed at a slower pace such as chess and art, although some cultural activities might require more speed, for example playing an instrument and adapting to the various tempos of songs. Dancing requires various tempos depending on the type of music used during the execution of a movement.

#### 3.3.2.5.1 Speed among girls

Speed improves with age among girls and boys at the same pace up to the age of 6 or 7 years, after age 7 boys tend to make rapid improvements regarding speed in comparison to girls (Gallahue and Ozmun, 2002:250). Boys perform better with running

activities, whilst girls perform better with activities requiring precision and accuracy such as hopping and jumping (Garcia, 2002:252).

A longitudinal study conducted on 3 672 boys over a period of 30 years by Photiou, Anning, Mèszáros, Vajda, Mèszáros, Sziva, Prókai, and Ng, (2008:172) found that there was a significant change in body mass over the years, influencing running performance times. For this reason speed among boys decreased throughout the years due to higher body mass. Baquet et al., (2006:51) tested 158 children and found that boys performed better on the 20m run when compared to girls. The researchers came to the conclusion that the boy's fitness performance improved more over the four year period than that of girls. Hands (2008:157) tested the running speed ability of children by means of a 50m run. The results indicated that the children with low motor competence were outperformed by their peers with a high motor competence, although both groups improved every year. (In order to perform the 50m dash, two other skill-related components, dynamic balance and coordination of the limbs are required).

A cross-sectional study was conducted by Loko, Aule, Sikkut, Ereline and Viru (2000:112) on 11 and 17 year old girls. The 30m dash was used to determine the girls' speed and the researcher established a significant difference between 10 and 12 year old girls. At age 13, the group results were higher than those of 12 years and between 14 and 16 years of age no differences were noticed. (As stated in Chapter 3, 81 under agility, it is important to note that the results for the various shuttle-runs as indicated regarding speed are also applicable regarding agility as shuttle-runs contain both components in order to execute the test).

In conclusion, it is clearly indicated that boys outperform the girls regarding speed. Speed is a component frequently found in sporting activities and improving this specific component will help girls to perform better in sport compared to current results. Although research on other components such as agility and reaction time are not available, an abundance of research is available regarding speed. An exposition of the final component, power regarding skill-related fitness follows.

### 3.3.2.6 Power

*"Power refers to the ability to generate great amounts of force against a certain resistance in a short period of time"* (Prentice, 1999:587). According to Gallahue and Ozmun (2002:475) power is the ability to perform one maximum effort in the shortest time possible, and is also known as explosive strength. The term explosive strength regarding power represents the product of force divided by time. The combination of speed and strength can be seen in activities such as jumping, and throwing for distance. The individual's degree of power is determined by the speed of contraction by the muscles involved as well as the strength and coordinated used of these muscles (Garcia, 2002:252).

The standing broad jump was used during the present study to measure power among girls during this study (Bruininks, 1978:70). The jump is also considered to be a gross motor skill. Sporting activities involving running, jumping, throwing, hitting and catching require a lot of power. Girls participating in sport require power to take part in athletics, such as running and taking off for a long jump or running and throwing a javelin. In netball power is needed to run and jump up into the air to catch the ball. Sporting activities also require the ability to receive the force of power when catching a ball (netball) or hitting the ball back to an opponent and keeping the ball in the court (tennis). During cultural activities such as chess and playing various instruments, power is not that important due to mainly using fine muscles, and the fine muscles cannot generate as much force as the larger muscles of the body. Power would be important for dancing mainly because gross muscles are being used to jump and turn.

#### 3.3.2.6.1 Power among girls

According to Gallahue and Ozmun (2002:250) boys tend to perform much better on activities that requires power than girls do; the difference in power can be seen in leg strength (jumping) as well as in upper-arm strength (throwing a ball). Power appears to improve yearly according to Garcia, (2002:250). In addition, Wrotniak et al.,

(2006:e1762) came to the conclusion that boys outperformed the girls on the standing long jump as well as with the ability to throw a ball further. Research conducted by Schott et al., (2006:450) on 118 girls and 143 boys came to the conclusion that the children with developmental coordination disorders are at risk for poor levels of skill-related fitness in comparison with their peers (power was measured by means of the jump and reach test as well as throwing a 1kg medicine ball).

In a cross-sectional study of 902 Estonian girls between the ages of 10 and 17 years, Loko et al., (2002:112) used three tests to determine power. The first two tests refer to the standing long jump and pushing a medicine ball (2 kilogram). The results were similar and a significant difference between 10 to 12 year old girls was established. At age 13 the group results were higher than those of 12 years and between 14 to 16 years of age no differences was noticed. The final test refers to the vertical jump and similar results regarding the standing long jump was established, the only difference was that the 14 year old girls performed better in the vertical jump than the 13 year old girls.

Longitudinal studies were also performed over the years, by Volbekiene and Grici, (2007:236) regarding power among children between 12 and 16 years of age in Lithuania, and concluded that leg strength of girls decreased slightly, but among boys it remained unchanged. The girls performed better in 1992 compared to 2002, indicating a decrease over the 10 year period. Although both genders improved regarding muscular strength, the boys performed better in the standing broad jump test as well as the handgrip test than the girls did (Baquet et al., 2006:52).

Research conducted by Hands (2008:157) tested power abilities in children using three tests. The single hop for distance, followed by the over hand throw for distance and the final test was the standing broad jump. The results indicated that children with low motor competence were outperformed by their peers with a high motor competence, although both groups improved every year. (It is interesting to note that in order to perform the single hop, another skill-related component, dynamic balance is required. The over

hand throw requires balance as well as coordination and the standing broad jump requires dynamic balance and coordination).

In conclusion, similar to the majority of the other components regarding skill-related fitness, boys outperformed the girls. Therefore, girls performed more poorly when compared to boys on almost all the skill-related fitness components and could be the result of the sex difference between girls and boys. For this reason it would be advisable to help girls improve on all the above mentioned components. As with speed, an abundance of research is available regarding power.

#### 3.3.2.7 Measurements of skill-related fitness

Although skill-related fitness improves primarily through the process of maturation, it would still be necessary to measure the performance-related fitness status of girls. As with health-related fitness, the components that comprise performance-related fitness can also be measured in various ways. Table 3.2 summarizes the common measures of children's skill-related fitness and also supplies a synthesis of the finding according to Gallahue and Ozmun (2002:250).

## Table 3.2: Common measures of children's skill-related fitness

| Motor Fitness Components | Common Test | Specific Aspect Measured | Synthesis of Findings |
|---|---|---|---|
| **Coordination** | Cable jump<br>Hopping for accuracy<br>Skipping<br>Ball dribble<br>Foot dribble | Gross body coordination<br>Gross body coordination<br>Gross body coordination<br>Eye-hand coordination<br>Eye-foot coordination | Annual improvements with age in gross body coordination. Boys are superior from age 6 regarding eye-hand and eye-foot coordination. |
| **Balance** | Beam walk<br>Stick balance<br>One-foot stand<br>Flamingo stand | Dynamic balance<br>Static balance<br>Static balance<br>Static balance | Annual improvements with age. Girls often outperform boys until about 8 years. |
| **Speed** | 20-yard dash<br>30-yard dash | Running speed<br>Running speed | Annual improvements with age. Boys are superior to girls at all ages. |
| **Agility** | Shuttle run<br>Side straddle | Running agility<br>Lateral agility | Annual improvements with age. Girls level off after age 13 and boys continue to improve. |
| **Power** | Vertical jump<br>Standing long jump<br>Distance throw<br>Velocity throw | Leg strength and speed<br>Leg strength and speed<br>Upper-arm strength and speed<br>Upper-arm strength and speed | Annual improvements with age. Boys outperform girls at all ages. |

## 3.4 The complex relationship of physical fitness between health-related fitness and skill-related fitness (motor/performance fitness)

To understand the complex relationship regarding physical fitness between health-related fitness and skill-related fitness, the following definitions in connection with health-related fitness by Prentice (1999:585-586) were adopted, and the examples supplied by the author of this dissertation:

Cardiovascular endurance is defined by Prentice (1999:585) as the ability to perform physical activity that requires oxygen for physical exertion without experiencing fatigue. For example, girls need co-ordination, balance and rhythm as well as cardiovascular endurance to run.

The next component muscle strength refers to the muscle's ability to generate force against resistance (Prentice, 1999:585). Girls need strength to be able to throw a ball together with other motor skills such as co-ordination, laterality and balance.

The following component according to Prentice (1999:586) is muscular endurance which refers to repetitive muscular contractions against some resistance over a period of time. For example, jumping on one leg over a distance of 10 meters implies that girls need endurance as well as co-ordination, balance, rhythm and spatial orientation.

Subsequently body composition refers to the relation of lean body mass to fat body mass. As stated earlier in Chapter 3, girls who are overweight will struggle to perform skill-related activities such as balance and co-ordination as the excess weight will have a negative influence on their physical fitness.

The final component of health-related fitness is flexibility. Flexibility refers to the ability to move the limbs freely throughout a full and pain-free range of motion (Prentice,

1999:586). To be able to move the arms, legs and trunk freely one needs flexibility in conjunction with co-ordination, laterality and spatial orientation.

With the above mentioned in mind, a clear correlation can be established between health-related fitness and skill-related fitness. Therefore, it is important for girls to be active and stay active in order to improve both components of physical fitness so as to facilitate participation in activities with ease as well as for the health benefits.

## 3.5 Summary

This Chapter provides an overview of physical fitness and it's relating components namely, health-related fitness and performance-related fitness. Physical fitness should be viewed as an essential aspect in the lives of girls due to the benefits that may be derived.

Health-related fitness components such as cardiorespiratory endurance, muscular endurance, muscular strength, body composition and flexibility are very important for the improvement of general health, and to meet the daily demands placed on girls. Although girls are smaller than adults, they can use more oxygen than adults and attain these levels through exercising. Being active by means of running, jumping, climbing and throwing objects during childhood, creates opportunities for girls to improve their muscular strength. Activity would also increase their fat free mass and keep them flexible for a longer period.

Skill-related fitness consists of agility, balance, coordination, speed, power and reaction time. It is of interest to note that of all the components relating to performance-related fitness, girls are superior to boys at all ages only in balance. Although girls lag behind on these components, performance-related fitness improves through maturation and therefore girls will show yearly improvements on all the components.

Bearing the afore-mentioned information in mind, a clear relationship can be established between health-related fitness (physical fitness) and skill-related fitness (motor proficiency). If one of these aspects is missing, either in the physical fitness or motor proficiency contexts, girls would not be able to execute and or be able to participate in physical activities and cultural activities with ease.

In Chapter 3, a clear distinction can be made between health-related fitness and skill-related fitness. Due to the fact that these two concepts differ from one another it is important to measure each concept in a different manner. Chapter 4 focuses on the testing procedures regarding health-related fitness (fitness) as well as skill-related fitness (motor proficiency). A discussion of the results and the activity levels among the girls will also be addressed.

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# CHAPTER 4

## Testing procedure and discussion of results

## 4.1 Research design

In an attempt to clarify the difference between motor proficiency and physical fitness, a comparative study using two relevant international test batteries was used. The BOTMP, Short Form was used to measure the motor abilities of 12 and 13 year old girls. Physical fitness levels of the girls were measured by using the Fitnessgram. The results of both the active and inactive groups were processed and compared to one another.

## 4.2 Research method

### 4.2.1 Subjects

The subjects were drawn from a school in Bloemfontein, Free State province, South-Africa. One hundred (N=100) girls between the ages of 12 and 13 took part in this study. Three main factors contributing to the study were the age group, gender, and degree of activity (active and inactive), and are stated in Chapter 1 (4 - 12). Therefore, a summary of the main reasons will be presented in Chapter 4.

The research was conducted on this specific age group (12 and 13 years) as a result of a decline in children's physical activity levels and the decline increases as they get older, leading to health-related diseases such as diabetes, obesity, and hypertension in later life (Wrotniak et al., 2006:e1759). Another reason for this specific age group is because research performed by Loko et al., (2000:109) concluded that the biggest difference in the results of motor ability tests occurred between ages 11 to 12 and 12 to 13. According to Goran et al., (1998:891), behavioural and environmental changes due to puberty also contribute to a lack of physical activity.

The reason why a specific gender (girls) was studied is because physical activity levels decrease more among girls than boys (Goran et al., 1998:890). The Department of Sport and Recreation (2005:4) support these findings, stating that 42.6% of boys compared to 11.2% of girls participate in sport and recreational/physical activities.

The decision to study the level of activity (active and inactive) is because literature findings clearly indicate that physical activity relates to motor proficiency and physical fitness. Therefore, the active group should have greater motor proficiency levels as well as physical fitness levels. Research performed by Baquet et al., (2006:51) clearly states that the fittest girls were those who stayed active for longer periods. Inactivity results in higher levels of obesity and an increase in premature mortality, influencing health-related fitness negatively. Another reason for researching activity levels is because children in general do not meet the recommended physical activity levels as required (Spinks et al., 2007:157) and this could be a result of the decrease in physical education classes in the school environment (Chiodera et al., 2007:1). Establishing motor proficiency abilities and physical fitness levels are unproblematic when the appropriate test Battery is applied; the challenge will be to develop effective strategies with the purpose of increased activity levels among girls.

Since this was a comparative study, there were 50 active girls and 50 inactive girls. The active girls took part in some form of physical activity (swimming, running and cycling), while the inactive girls took part in cultural activities (playing the piano and singing in a choir). A cultural activity refers to activities that require little or no physical effort. It is important to note that the school provided physical education classes. All the girls participated in physical education classes once a week for 30min in swimming activities during summer (the season in which the research took place). The physical education classes provided additional opportunities for the active group to enhance their fitness levels. For some of the inactive girls, this was the only form of physical activity they participated in. The Activitygram – Logging Chart was used to determine activity levels among girls (The Cooper Institute, 2005:79). A full discussion follows on p.128.

Data was analyzed using the SAS Version 9.1.3. Frequency and percentages where calculated for categorical data. Medians and percentiles or means and standard deviations were calculated for numerical data. The Chi-square test was used to compare the results of the active and inactive group for categorical data. The t-test and Kruskal-Wallis were used to compare the results of the active and inactive group for numerical data. A significance level of $\alpha = 0,05$ was used to test significant differences between the groups.

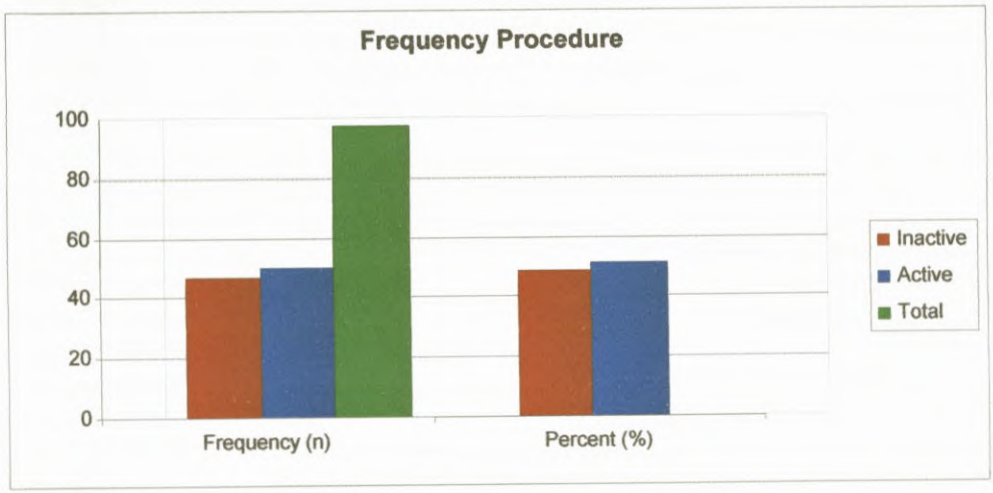


**Figure 4.1: Participation level per group**

The overall participation level in the study was 97 girls (n=97), of whom 48,5% took part in cultural activities (inactive) and 51,5% took part in sporting activities (active). Note that the n value varies for some tables and figures due to girls not completing all the tests as recommended as a result of time constraints as well as other cultural and sporting activities in which they participated in during the testing procedure. The participation level per activity group is indicated in Figure 4.1.

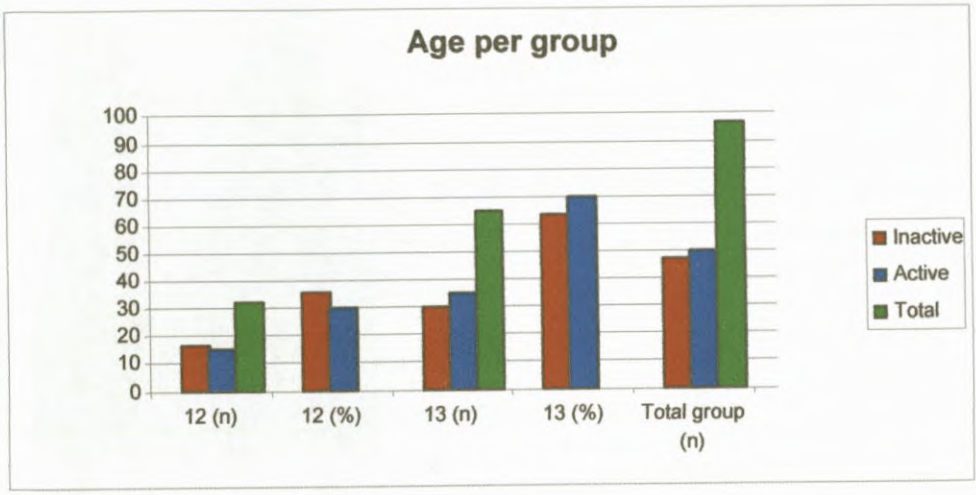


**Figure 4.2: Age per group**

During the study girls between 12 and 13 years of age were tested to determine motor proficiency abilities and physical fitness levels. There were no significant differences between the age groups (p = 0,5183). The age by group is indicated in Figure 4.2.

## 4.2.2 Testing Procedure

After approaching the school involved, 100 volunteers were selected to take part in the study. The testing procedures were conducted over an 8 week period. In this period the subjects were tested on the BOTMP as well as the Fitnessgram. In addition, girls had to complete an Activitygram in which their activity levels could be determined.

## 4.2.3 Instruments

### 4.2.3.1 Bruininks-Oseretsky Test of Motor Proficiency

The BOTMP - Short Form was used to assess the girl's motor proficiency. The short form has been validated against the full scale and consists of 14 items taken from the 8 subtest that correlate highly with the subtest score and the total score. The 8 subtests assess: gross motor development, including running speed and agility, balance, bilateral

coordination, and strength; gross and fine motor development, including upper limb coordination; and fine motor development, including response speed, visual-motor control, and upper-limb speed and dexterity (Bruininks, 1978:45). A total standard score, adjusted for the child's age, will be used to interpret test performance. The BOTMP is a standardized, product-orientated assessment commonly used in the assessment of motor abilities in children. The BOTMP sub tests are illustrated in Figure 4.3.

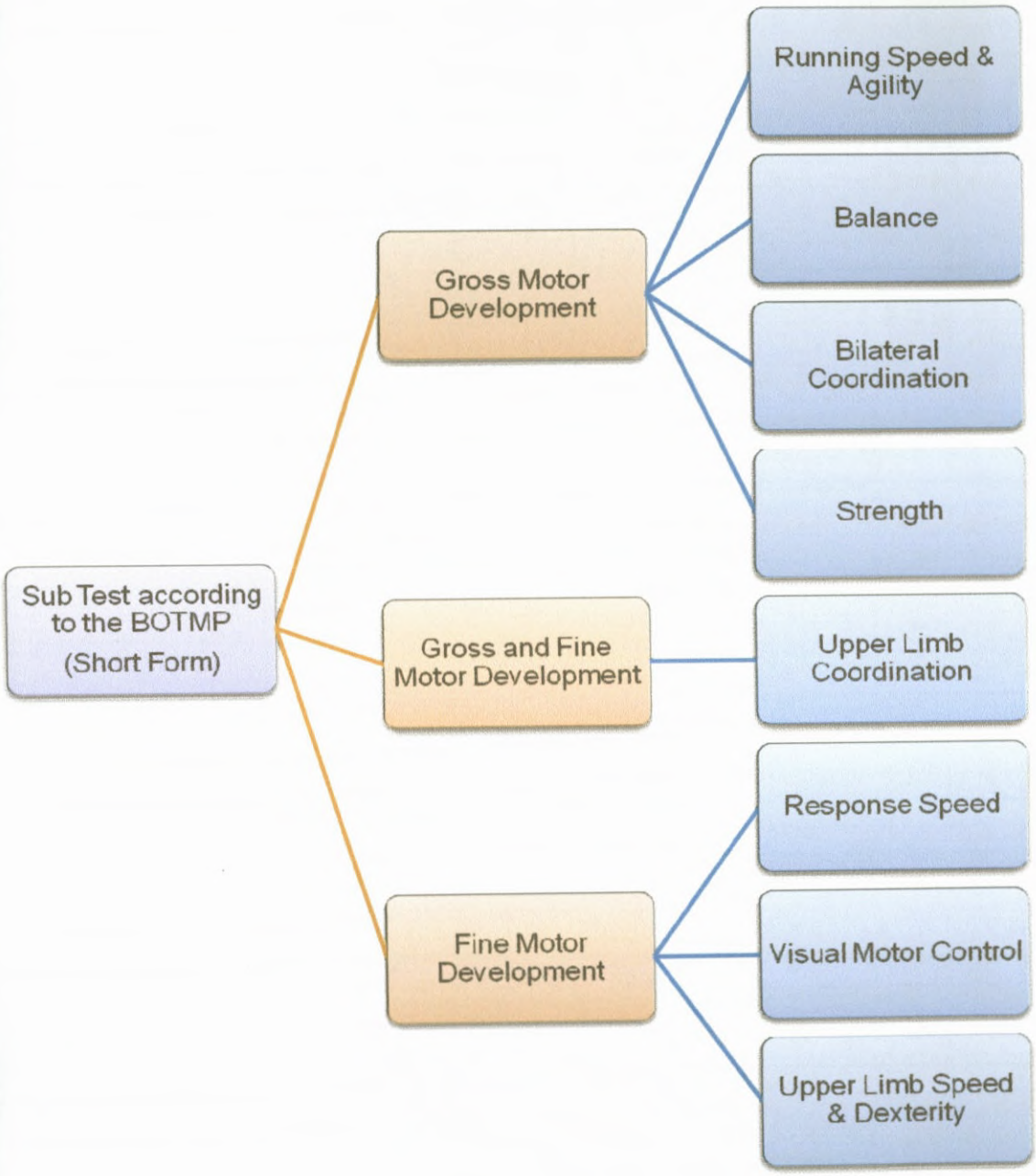


**Figure 4.3: Sub Tests according to the Bruininks-Oseretsky Test battery of Motor Proficiency (BOTMP)**

#### 4.2.3.1.1 Statistical analyzes of motor proficiency data

In order to determine if a statistical significant difference between active and inactive girls aged 12 to 13 regarding motor proficiency, the total BOTMP– Short Form score was used and compared the active and inactive girls.

Children's motor proficiency competence can be classified into three categories: low (<32-42), medium (43-57), and high (58-67>) according to Bruininks (1978:137). Each category can be divided into three smaller segments. Low for example, would be very low (>32), medium low (32-37) and high low (38-42); average can be divided into low average (43-47), medium average (48-52) and high average (53-57) and the final category high into low high (58-62), medium high (63-67) and very high (>67). Motor proficiency levels according to the various segments (categories) among the girls in the different proficiency categories in this study is summarized in Figure 4.4.

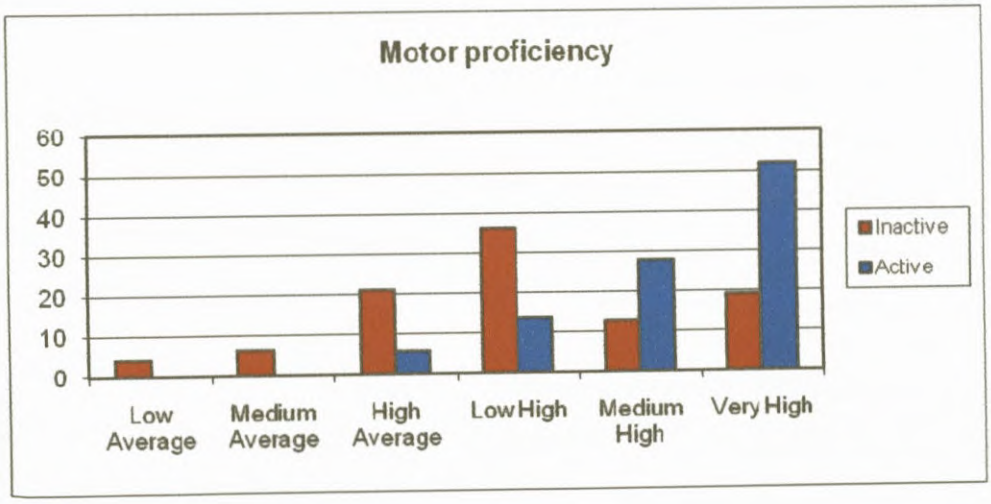


**Figure 4.4: Motor proficiency per group**

The research indicates that only 4,3% of the inactive group falls in the low average segment and 0% of the active group. The low high segment shows 36,2% of inactive girls and only 14% of the active group. The inactive group had 6,4% in the medium average segment and 0% among the active group. The inactive group had 21,3% and

the active group 6% in the high average segment. The final category namely high, indicates that 36,2% of girls from the inactive group and 14% of girls from the active group fall into the low high segment. The medium high segment indicates a relation of 12,8% of the inactive group and 28% of the active group. The final segment refers to the very high segment and comparing the inactive and active group with one another the various percentages are 19,2% and 52% respectively.

In conclusion, although both groups have a majority of girls in the high category, dividing the high category into the smaller segments, the inactive group highest percentage falls in the low high segment with 36,2% of girls. The active group's highest percentage falls into the very high segment with 52% of girls. There is a significant difference ($p = 0,00007^*$) regard to motor proficiency levels between active and inactive girls.

#### 4.2.3.2 The Fitnessgram

The Fitnessgram is a comprehensive health-related fitness and activity assessment system (The Cooper Institute, 2005:1). The Fitnessgram produces individualized reports for each subject. Reports provide feedback based on whether the child achieved the criterion-referenced standards for physical activity or fitness. Use of health-related criteria helps to minimize comparisons between children and emphasize personal fitness for health rather than goals based on performance. This test battery consists of two different assessment modules that can help promote awareness regarding the importance of physical activity and physical fitness (The Cooper Institute, 2005:1).

The Fitnessgram is a complete battery of health-related items that are scored using criterion-referenced standards (The Cooper Institute, 2005:1). Standards are age and gender related and are established on the basis of how fit children should be to enjoy good health. The fitness tests were completed after school hours and administered by students who were familiar with the testing procedures in order to ensure consistency over the 8 weeks. Each test was demonstrated to the participants and each participant

was allowed to practice the test before the actual testing commenced. The test includes health-related tests, for example, cardio-vascular fitness (assessing aerobic capacity by means of the one mile run), muscle strength and muscular endurance (measured by using push-ups and curl-ups to a specific cadence), flexibility (in order to measure hamstring flexibility the back-saver sit and reach test were conducted) and body composition (obtained through height and weight measures and converted to body mass index for scoring). To establish if the participants fell in the Healthy Fitness Zone the tests were scored through the Fitnessgram software programme (The Cooper Institute, 2005:3). Common measures of children's health-related fitness are illustrated in Figure 4.5.

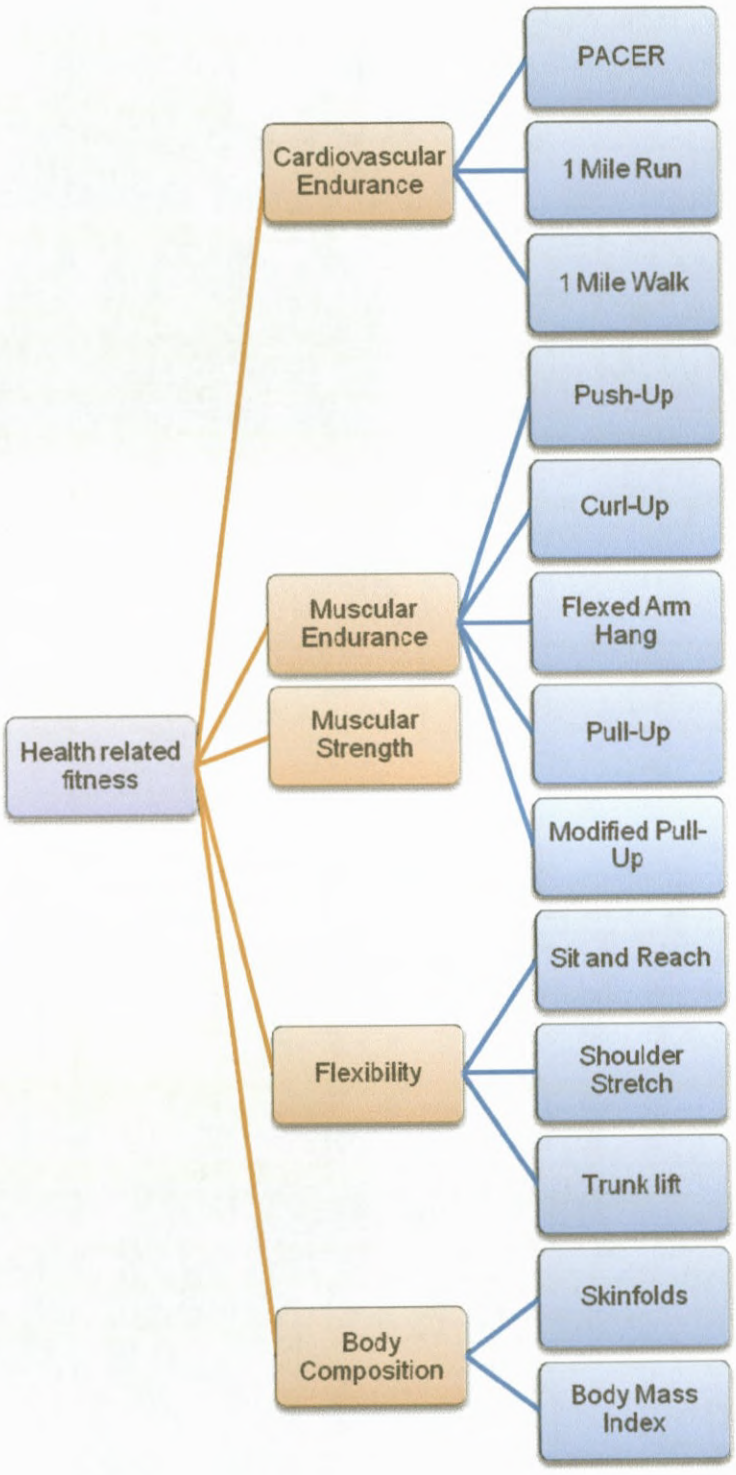


**Figure 4.5: Common Measures of Children's Health-Related Fitness**

#### 4.2.3.2.1 Statistical analyzes of fitness data

In order to determine if a significant difference occurred in fitness levels between the groups, each variable according to the Fitnessgram was used and compared with the active and inactive girls.

The median values, mean values, standard deviation, 25$^{th}$ percentile and the 75$^{th}$ percentile as well as the minimum and maximum values of the active and inactive girls were compared with one another. The variables used during the study are summarized in Table 4.1 for the inactive group and Table 4.2 for the active group. Both groups followed the same procedure.

**Table 4.1: Physical fitness results – Inactive group**

| Variable | n | 25th % | Median | 75th % | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|---|---|---|---|
| Length | 45 | 144.8 | 157.5 | 160 | 154.9 | 7.9 | 139.7 | 167.6 |
| Weight | 45 | 44.9 | 52.6 | 59 | 52.8 | 11.2 | 33.1 | 80.7 |
| Mile run | 45 | 10.2 | 14 | 15.3 | 13.1 | 2.9 | 7.5 | 17.7 |
| Push-up | 45 | 2 | 3 | 5 | 4.2 | 5 | 0 | 27 |
| Curl-up | 45 | 7 | 10 | 20 | 16 | 16 | 2 | 75 |
| Trunk lift | 45 | 22.9 | 27.9 | 30.5 | 26.3 | 4.9 | 10.2 | 30 |
| Sit and reach - left | 45 | 0 | 10.2 | 17.8 | 11.4 | 11.1 | 0 | 30 |
| Sit and reach - right | 46 | 0 | 10.2 | 17.8 | 11.4 | 10.6 | 0 | 30 |

**Abbreviations: n = Girls, % = 25$^{th}$ and 75$^{th}$ percentile, Min = Minimum, Max = Maximum**

Length was measured in centimetres (cm); the mean value was 154,9 cm with a standard deviation of 7,9cm. The shortest girl in the inactive group was 139,7 cm and the tallest girl was 167,6 cm.

Weight was measured in kilograms (kg); the mean value was 52,8 kg with a standard deviation of 11,2 kg. The lightest girl weighed in at 33,1 kg and the heaviest girl weighed in at 80,7 kg.

The one mile run was measured in minutes and seconds; the mean for this variable was 13,1 with a standard deviation of 2,9. During the run the fastest time was 7,5 min and the slowest time was 17,7 min.

The 25$^{th}$ percentile regarding the push-up test was 2 with a median of 3 and the 75$^{th}$ percentile was 5 push-ups. The minimum push-ups performed in the inactive group were 0 and the maximum was 27 push-ups.

Curl-ups had a 25$^{th}$ percentile of 7, a median of 10 and the 75$^{th}$ percentile was 20 curl-ups. The minimum curl-ups performed in the inactive group were 2 and the maximum was 75.

The trunk lift was also measured in cm and the 25$^{th}$ percentile was 22,9 cm the median was 27,9 cm and the 75$^{th}$ percentile was 30,5 cm. The minimum measurement was 10,2 cm with a maximum of 30 cm.

The final variable was the back saver sit and reach test for the left and right leg. The results for the left leg were 0 cm for the 25$^{th}$ percentile, the median 10,2 cm and the 75$^{th}$ percentile 17,8 cm. The minimum measurement was 0 cm and the maximum was 30,5 cm. The right leg was 0cm for the 25$^{th}$ percentile, the median 10,2 cm and the 75$^{th}$ percentile 17,8 cm. The minimum measurement was 0 cm and the maximum was 30,5 cm.

**Table 4.2: Physical fitness results – Active group**

| Variable | n | 25th % | Median | 75th % | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|---|---|---|---|
| Length | 47 | 152.4 | 157.5 | 162.6 | 155.4 | 9.2 | 121.9 | 170.2 |
| Weight | 47 | 43.5 | 50.3 | 59.4 | 51.6 | 1.1 | 31.8 | 88.5 |
| Mile run | 47 | 7.8 | 11 | 14 | 11 | 3.1 | 6.3 | 15.6 |
| Push-up | 47 | 4 | 7 | 15 | 9.7 | 7.8 | 0 | 34 |
| Curl-up | 47 | 6 | 14 | 20 | 17.1 | 15 | 0 | 75 |
| Trunk lift | 48 | 27.9 | 30.5 | 30.5 | 27.9 | 5.2 | 0 | 30 |
| Sit and reach - left | 47 | 0.8 | 7.6 | 20.3 | 11.1 | 10.5 | 0 | 30.5 |
| Sit and reach - right | 48 | 0.1 | 9.8 | 20.3 | 11.5 | 10.7 | 0 | 30.5 |

**Abbreviations: n = Girls, % = 25$^{th}$ and 75$^{th}$ percentile, Min = Minimum, Max = Maximum**

Length was measured in cm; the mean was 155,4 cm with a standard deviation of 9,2cm. The shortest girl in the active group was 121,9 cm and the tallest girl was 170,2 cm.

Weight was measured in kg; the mean was 51,6 kg with a standard deviation of 11,1 kg. The lightest girl weighed in at 31,8 kg and the heaviest girl at 88,5 kg.

The one mile run was measured in minutes and seconds, the mean for this variable was 11 min with a standard deviation of 3,1. During the run the fastest time was 6,3 min and the slowest time was 15,6 min.

The 25$^{th}$ percentile regarding the push-up test was 4 with a median of 7 and the 75$^{th}$ percentile was 15 push-ups. The minimum push-ups performed in the active group were 0 and the maximum was 34 push-ups.

Curl-ups had a 25$^{th}$ percentile of 4 a median of 7 and the 75$^{th}$ percentile was 15 curl-ups. The minimum curl-ups performed in the active group were 0 and the maximum was 75.

The trunk lift was also measured in cm and the 25th percentile was 27.9 cm the median was 30,5 cm and the 75th percentile was 30,5 cm. The minimum measurement was 0 cm with a maximum of 30 cm.

The final variable was the back saver sit and reach test for the left and right leg. The results for the left leg were 0,8 cm for the 25th percentile, the median 7,6cm and the 75th percentile 20,3 cm. The minimum measurement was 0cm and the maximum was 30.5cm. The right leg was 0.1cm for the 25th percentile, the median 9,8 cm and the 75th percentile 20,3 cm. The minimum measurement was 0 cm and the maximum was 30,5 cm.

In conclusion the difference between the mean values in the groups shows no significant difference with regard to length (p = 0,7874) as well as weight (p = 0,5842).

According to the median values, the research proves a significant difference with regard to the one mile run (p-value is 0,0011*), trunk-lift test (p = 0,0344*) as well as the push-up test (p = 0,0001*) where the active group outperformed the inactive group. No significant difference (p = 0,5575) were found between the groups with regard to the curl-ups , back saver sit and reach left leg (p = 0,9590) as well as for the right leg (p = 0,9654).

According to fat percentage, a significant difference (p = 0,0156*) is noticeable between the active and inactive group with regard to the median values. The fat percentage is indicated in Figure 4.6.

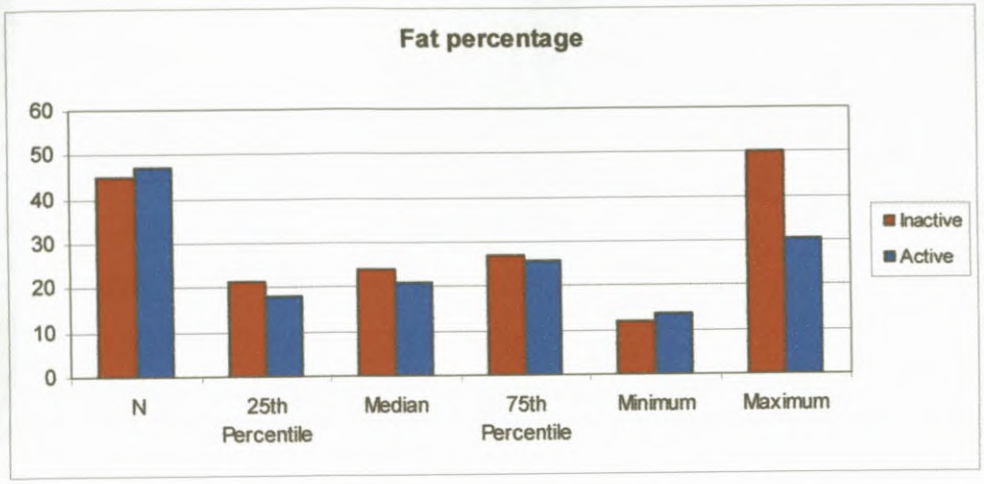


**Figure 4.6: A comparison of fat percentage per group**

The Fitnessgram (Cooper Institute, 2005:59) classifies children into two groups according to performance. The first category refers to children who fall into the healthy fitness zone (HFZ), meaning that the child is healthy for a specific variable according to age. The second category refers to children who fall into the needs to improvement zone (NTIZ). Children who fall into this category need to improve their fitness according to the specific variable.

To classify girls in the HFZ a specific criteria for girls between 12 and 13 years of age are used. The one mile run should be completed between 9min and 11.5 min. The push-up test should have a minimum of 7 repetitions and the curl-up test 18 repetitions. The minimum criteria for the trunk lift is 22,86 cm and for the back saver sit and reach test (left and right leg) are 25,4 cm. The final variable refers to body fat percentage and the criteria range between 13% and 32%.

In order to determine if a significant difference occurred in fitness performance with regard to the HFZ and NTIZ between the groups, each variable according to the Fitnessgram was used and compared with the active and inactive girls.

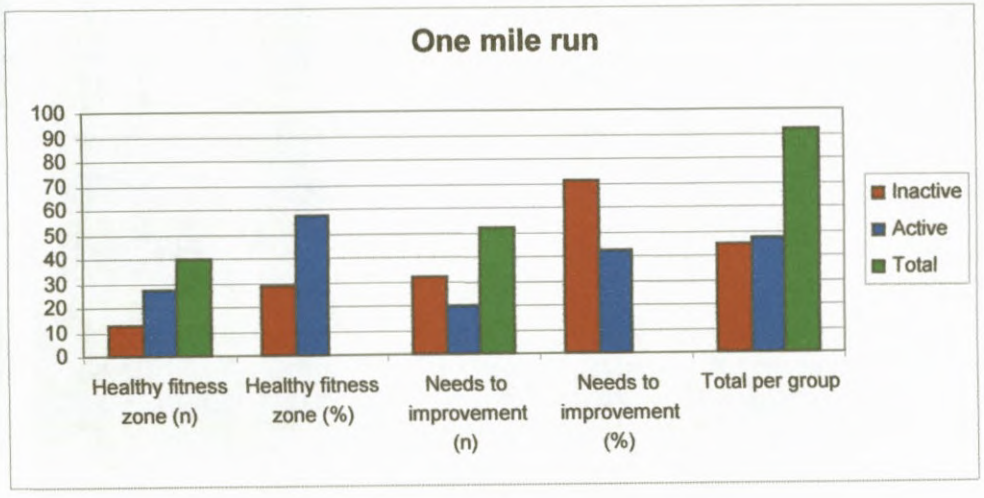


**Figure 4.7: One mile run per group**

In order to determine a significant difference between the mean values of the two groups each variable according to the Fitnessgram was used. The one mile run shows a significant difference of p = 0,0057* between the two groups. The inactive group had 28% of girls which fell into the HFZ and 71,1% into the NTIZ. The active group had 57,5% in the HFZ and 42,6% need to improve their aerobic capacity. The one mile run per group is indicated in Figure 4.7.

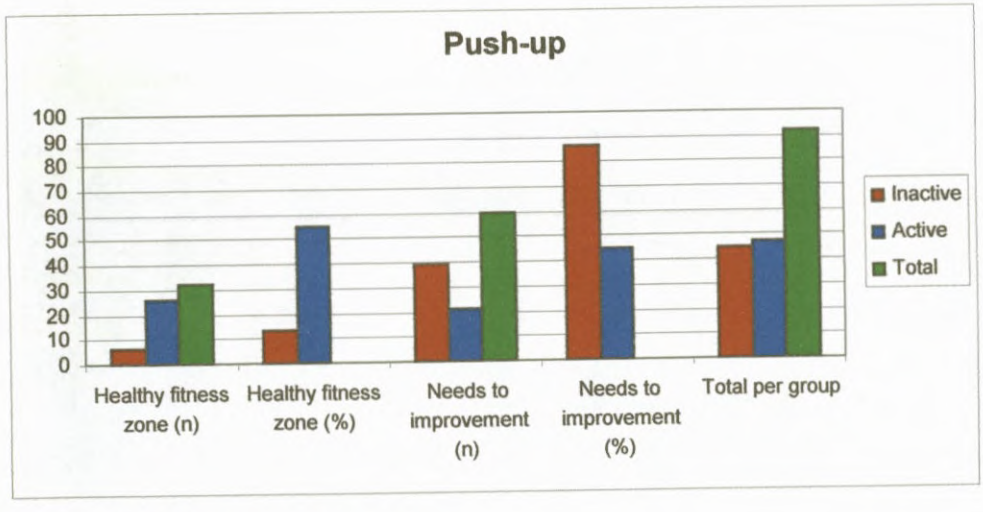


**Figure 4.8: Push-ups per group**

The following variable refers to the push-up test. The inactive group only had 13,3% of girls in the HFZ and 86,7% need to improve their strength. The active group had 55,3% in the HFZ and 44,7% need to improve their strength. A significant difference of p = 0,0001* occur between the two groups (figure 5.7). The curl-up test per group is indicated in Figure 4.8.

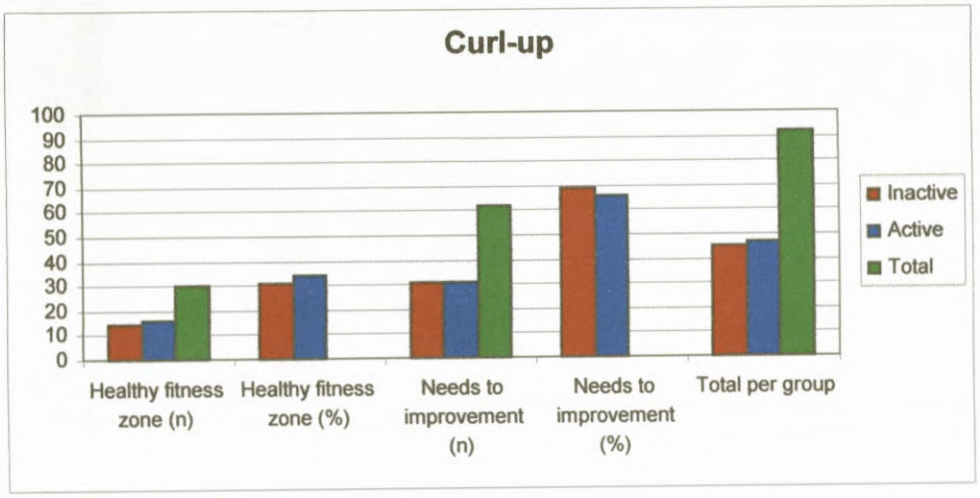


**Figure 4.9: Curl-ups per group**

According to the curl-up test there was no significant difference (p = 0,7643) between the two groups. The inactive group had 31,1% in the healthy fitness zone in relation to 34% of girls in the active group. The research shows that 68,9% of girls in the inactive group and 66% in the active group need to improve on their strength. The curl-up test per group is indicated in Figure 4.9.

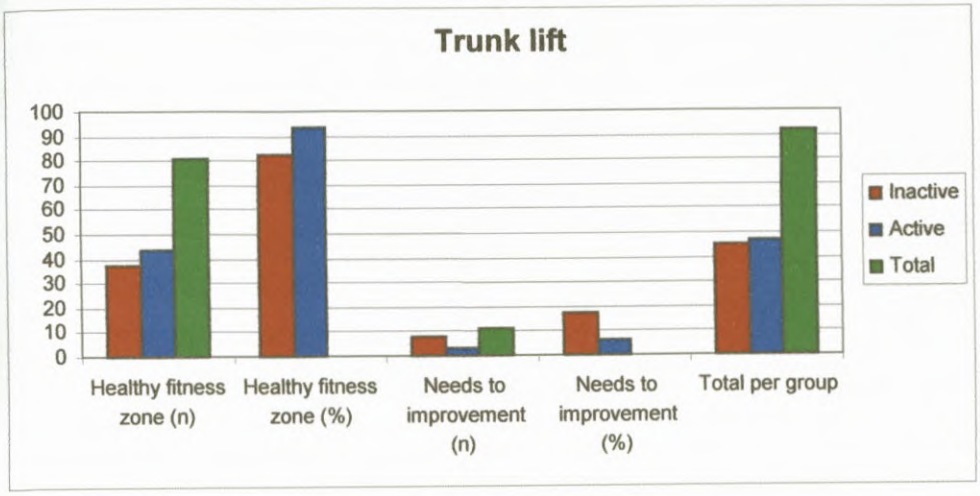


**Figure 4.10: Trunk lift per group**

According to the trunk lift test there was no significant difference (p = 0,0922) between the two groups. The inactive group had 82,2% in the HFZ in relation to 93,6% of girls in the active group. The research shows that 17,8% of girls in the inactive group and 6,4% in the active group need to improve their flexibility. The trunk lift test per group is indicated in Figure 4.10.

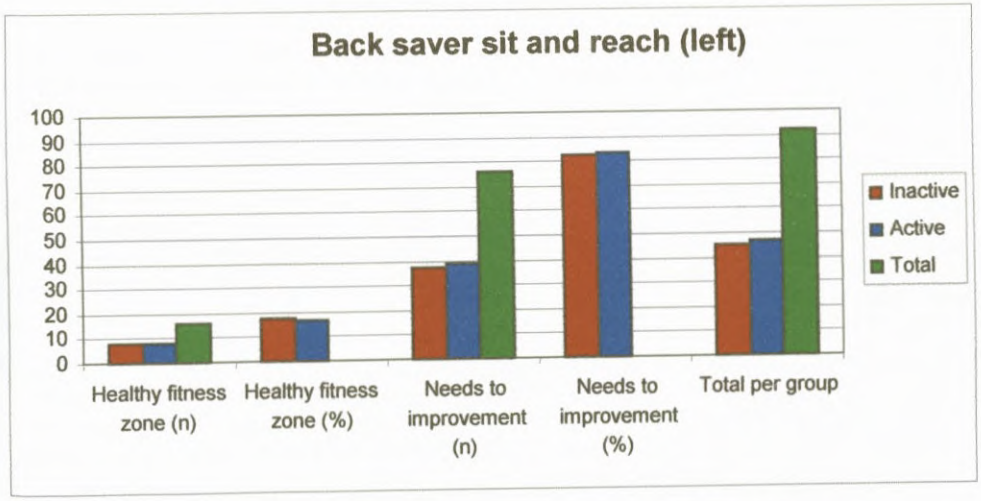


**Figure 4.11: Back saver sit and reach (left leg) per group**

The back saver sit and reach test is divided into the left leg, right leg and both legs. In the inactive group 17,8% of the girls fell into the HFZ and 82,2% need to improve their

hamstring flexibility of the left leg. The active group shows 17% of the girls fall into the HFZ and 83% need to improve. No significant difference were found between the two groups (p = 0,9238). The sit and reach test (left leg) test per group is indicated in Figure 4.11.

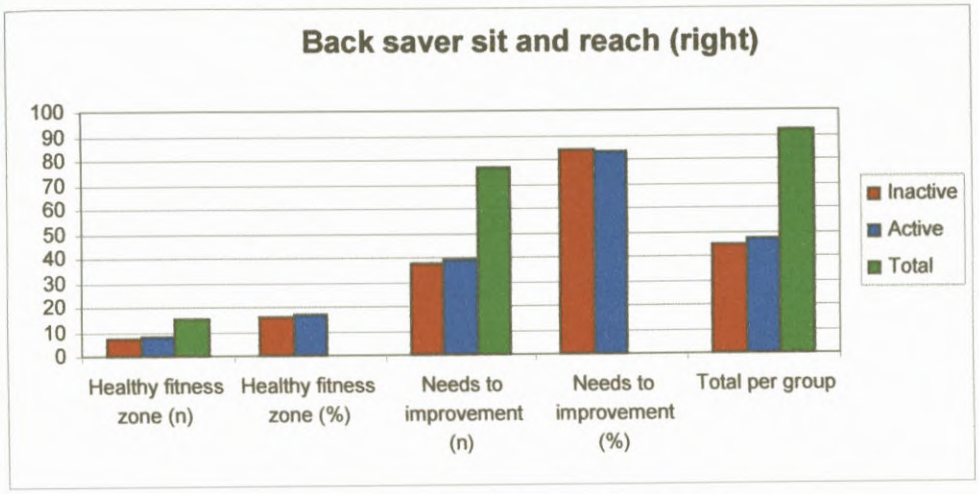


**Figure 4.12: Back saver sit and reach (right leg) per group**

Flexibility of the right leg in the inactive group indicates 15,6% of the girls fell into the HFZ and 84,4% need to improve their hamstring flexibility of the right leg. The active group indicates 17% of the girls fell into the HFZ and 83% need to improve. No significant difference were found between the two groups (p = 0,8491). The sit and reach test (right leg test) per group is indicated in Figure 4.12.

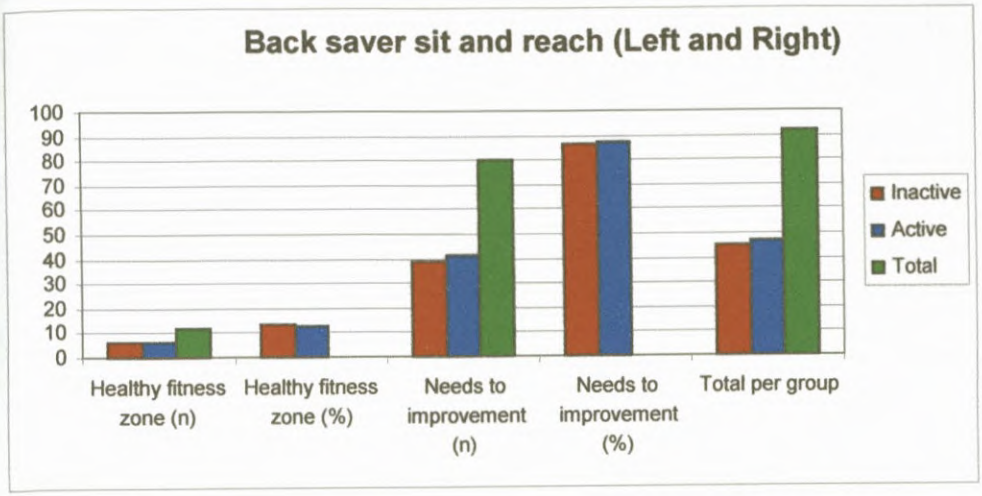


**Figure 4.13: Back saver sit and reach (both legs) per group**

In addition, a combination of the left leg and right leg was taken into consideration. The inactive group had 13,3% for both legs in the HFZ in relation to 12,8% of girls in the active group. The research shows that 86,7% of girls in the inactive group and 87,2% in the active group need to improve flexibility in both legs in order to fall in the HFZ. There is no significant difference between the two groups (p = 0,2365). The back saver sit and reach test for both legs per group is indicated in Figure 4.13.

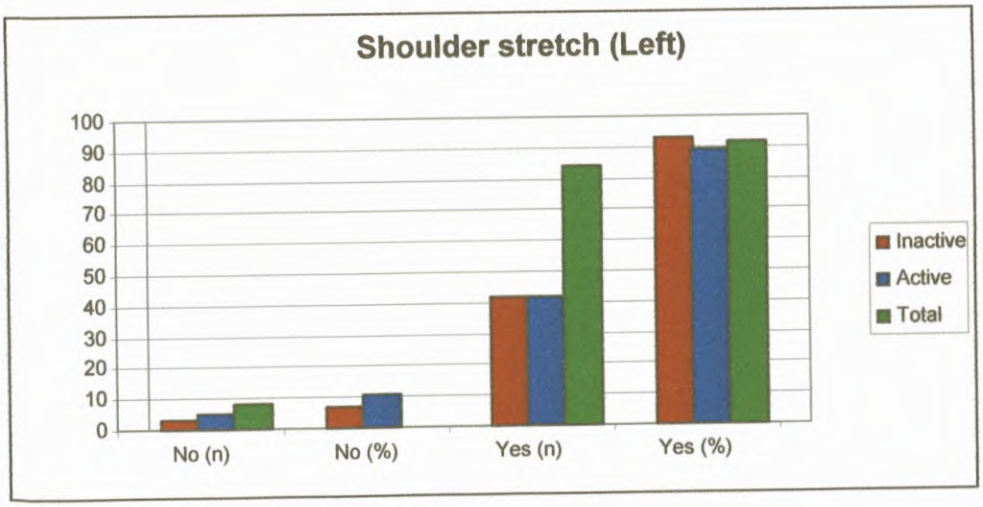


**Figure 4.14: Shoulder stretch (left arm) per group**

Flexibility of the left arm was measured by means of the shoulder stretch; the inactive group indicates 6,7% could not perform the shoulder stretch and 93,3% could stretch the left arm. The active group indicates 10,6% of the girls could not perform the shoulder stretch and 89,4% could stretch the left arm. No significant difference were found between the two groups (p = 0,7145). The shoulder stretch test (left arm), per group is indicated in Figure 4.14.

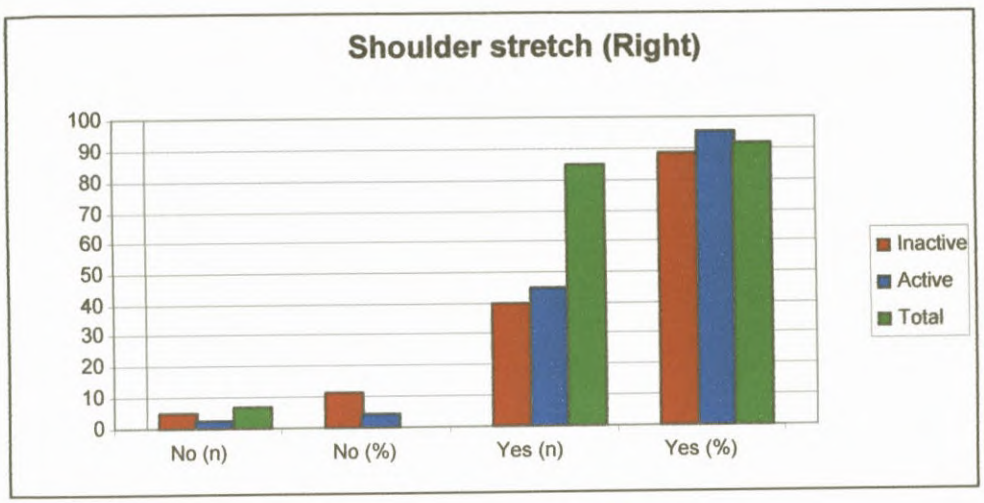


**Figure 4.15: Shoulder stretch (right arm) per group**

Flexibility of the right arm was measured with the same procedure; the inactive group indicates that 11,1% could not perform the shoulder stretch and 88,9% could stretch the right arm. The active group indicates 4,3% of the girls could not perform the shoulder stretch and 95,7% could stretch the right arm. No significant difference between the groups (p = 0,2620) was observed. The shoulder stretch for both the left and right leg is the second test where the majority of girls in this sample fell into the HFZ. The shoulder stretch test (right arm), per group is indicated in Figure 4.15.

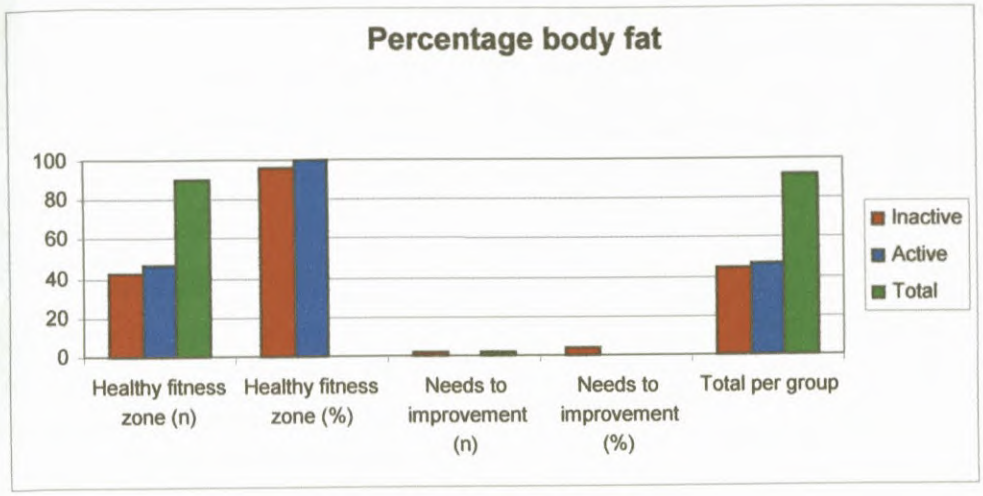


**Figure 4.16: Percentage body fat per group**

The final variable refers to percentage body fat and shows no significant difference (p = 0,2365) between the two groups. The inactive group had 95,6% in HFZ in relation to 100% of girls in the active group. The research shows that 4,4% of girls in the inactive group and 0% in the active group need to improve their body fat percentage. The percentage body fat per group is indicated in Figure 4.16.

In summary, the research indicates that only two of the variables of health-related fitness show a significant difference between the inactive and active groups with regard to the HFZ and NTIZ, namely the one mile run and the push-up test. No significant difference was indicated between the groups regarding the curl-up, trunk-lift, back saver sit and reach (individual legs and both legs), shoulder stretch (left and right arm) as well as percentage body fat.

If the total group (n values) is taken into consideration, it is clear that both groups have a majority of girls who need to improve their fitness. The variables that need to be improved is the one mile run (n=52 of 92), push-up (n=60 of 92), curl-up (n=62 of 92), the back saver sit and reach test (left leg) (n=76 of 92), back saver sit and reach test (right leg) (n=77 of 92) and both legs (n=80 of 92). Tests in which a majority of girls fall into the HFZ include the trunk lift test (n=81 of 92), shoulder stretch (left arm) (n=84 of 92) and shoulder stretch (right arm) (n=85 of 92) and percentage body fat (n=90 of 92).

The following information was gathered to determine if there is a significant difference between active and inactive girls with regard to physical fitness (HFZ versus NTIZ) at different motor proficiency categories. Table 4.3 to Table 4.10 are present as a matter of interest as no significant differences were revealed between active and inactive girls on any of the variables tested.

**Table 4.3: Motor proficiency and physical fitness per group – one mile run**

| | Inactive | | Active | | Inactive | | Active | | Total (n) |
|---|---|---|---|---|---|---|---|---|---|
| | HFZ (n) | HFZ (%) | HFZ (n) | HFZ (%) | NTIZ (n) | NTIZ (%) | NTIZ (n) | NTIZ (%) | |
| Low Average | 1 | 50 | 0 | 0 | 1 | 50 | 0 | 0 | 2 |
| Medium Average | 1 | 33 | 0 | 0 | 3 | 66.67 | 0 | 0 | 4 |
| High Average | 4 | 44.5 | 0 | 0 | 5 | 55.6 | 3 | 100 | 12 |
| Low High | 3 | 18.8 | 5 | 83.3 | 13 | 81.3 | 1 | 16.7 | 23 |
| Medium High | 0 | 0 | 6 | 42.9 | 6 | 100 | 8 | 57.1 | 20 |
| Very High | 4 | 44.4 | 16 | 66.7 | 5 | 55.6 | 8 | 33.3 | 33 |
| Total (n) | 13 | | 27 | | 32 | | 20 | | 92 |

Abbreviations: HFZ = Healthy fitness zone, NTIZ = Needs to improvement zone, n = Girls, % = Percentage

No significant difference was noted between the inactive group and active group with regard to the HFZ ($p = 0,2502$) nor between the two groups ($p = 0,0516$) with regard to the NTIZ at different motor proficiency categories. The motor proficiency and physical fitness results for both groups regarding the one mile run are indicated in Table 4.3.

**Table 4.4: Motor proficiency and physical fitness per group – push-up**

| | Inactive | | Active | | Inactive | | Active | | Total (n) |
|---|---|---|---|---|---|---|---|---|---|
| | HFZ (n) | HFZ (%) | HFZ (n) | HFZ (%) | NTIZ (n) | NTIZ (%)) | NTIZ (n) | NTIZ (%) | |
| Low Average | 0 | 0 | 0 | 0 | 2 | 100 | 0 | 0 | 2 |
| Medium Average | 0 | 0 | 0 | 0 | 3 | 100 | 0 | 0 | 3 |
| High Average | 1 | 11.1 | 3 | 100 | 8 | 88.9 | 0 | 0 | 12 |
| Low High | 4 | 25 | 1 | 16.7 | 12 | 75 | 5 | 83.3 | 22 |
| Medium High | 0 | 0 | 7 | 50 | 6 | 100 | 7 | 50 | 20 |
| Very High | 1 | 11.1 | 15 | 63 | 8 | 88.9 | 9 | 38 | 33 |
| Total (n) | 6 | | 26 | | 39 | | 21 | | 92 |

Abbreviations: HFZ = Healthy fitness zone, NTIZ = Needs to improvement zone, n = Girls, % = Percentage

The difference between the active group and the inactive group regarding the push-up test at different motor proficiency categories was compared. No significant difference was revealed between motor proficiency and the push-up test in the two groups with regard to the HFZ (p=0,8242) or the NTIZ (p = 0,0853) in the active and inactive groups. The motor proficiency and physical fitness results for both groups regarding the push-up tests are indicated in Table 4.4.

**Table 4.5: Motor proficiency and physical fitness per group – curl-up**

| | Inactive | | Active | | Inactive | | Active | | Total (n) |
|---|---|---|---|---|---|---|---|---|---|
| | HFZ (n) | HFZ (%) | HFZ (n) | HFZ (%) | NTIZ (n) | NTIZ (%) | NTIZ (n) | NTIZ (%) | |
| Low Average | 1 | 50 | 0 | 0 | 1 | 50 | 0 | 0 | 2 |
| Medium Average | 0 | 0 | 0 | 0 | 3 | 100 | 0 | 0 | 3 |
| High Average | 1 | 11.1 | 0 | 0 | 8 | 88.9 | 3 | 100 | 12 |
| Low High | 7 | 43.8 | 1 | 16.7 | 9 | 56.3 | 5 | 83.3 | 22 |
| Medium High | 0 | 0 | 3 | 21.4 | 6 | 100 | 11 | 78.6 | 20 |
| Very High | 5 | | 12 | | 4 | | 12 | | 33 |
| Total (n) | 14 | | 16 | | 31 | | 31 | | 92 |

Abbreviations: HFZ = Healthy fitness zone, NTIZ = Needs to improvement zone, n = Girls, % = Percentage

The following difference is between the two groups with regard to motor proficiency and the curl-up test. No difference between motor proficiency and the curl-up test in the inactive group or active group with regard to the HFZ (p = 0,0707) or the NTIZ (p = 0,1399) could be revealed. The motor proficiency and physical fitness results for both groups regarding the curl-up test are indicated in Table 4.5.

**Table 4.6: Motor proficiency and physical fitness per group – trunk lift**

| | Inactive | | Active | | Inactive | | Active | | Total (n) |
|---|---|---|---|---|---|---|---|---|---|
| | HFZ (n) | HFZ (%) | HFZ (n) | HFZ (%) | NTIZ (n) | NTIZ (%) | NTIZ (n) | NTIZ (%) | |
| Low Average | 1 | 50 | 0 | 0 | 1 | 50 | 0 | 0 | 2 |
| Medium Average | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| High Average | 5 | 55.6 | 3 | 100 | 1 | 50 | 0 | 0 | 9 |
| Low High | 14 | 87.5 | 6 | 100 | 2 | 12.5 | 0 | 0 | 22 |
| Medium High | 5 | 83.3 | 13 | 92.9 | 1 | 16.7 | 1 | 7.1 | 20 |
| Very High | 9 | 100 | 22 | 91.7 | 0 | 0 | 2 | 8.3 | 33 |
| Total (n) | 37 | | 44 | | 8 | | 3 | | 92 |

Abbreviations: HFZ = Healthy fitness zone, NTIZ = Needs to improvement zone, n= Girls, % = Percentage

The difference between the groups regarding motor proficiency and the trunk lift test was measured. No difference was established between the groups with regard to the HFZ (p = 0,1048) or the NTIZ (p = 1,0000). Both groups have a large number of girls who falls into the HFZ. The motor proficiency and physical fitness results for both groups regarding the trunk lift test are indicated in Table 4.6.

**Table 4.7: Motor proficiency and physical fitness per group – Sit and reach left**

| | Inactive | | Active | | Inactive | | Active | | Total (n) |
|---|---|---|---|---|---|---|---|---|---|
| | HFZ (n) | HFZ (%) | HFZ (n) | HFZ (%) | NTIZ (n) | NTIZ (%) | NTIZ (n) | NTIZ (%) | |
| Low Average | 0 | 0 | 0 | 0 | 2 | 100 | 0 | 0 | 2 |
| Medium Average | 0 | 0 | 0 | 0 | 3 | 100 | 0 | 0 | 3 |
| High Average | 2 | 22.2 | 1 | 33.3 | 7 | 77.8 | 2 | 66.7 | 12 |
| Low High | 2 | 12.5 | 1 | 16.7 | 14 | 87.5 | 5 | 83.3 | 22 |
| Medium High | 1 | 16.7 | 2 | 14.3 | 5 | 83.3 | 12 | 85.7 | 20 |
| Very High | 3 | 33.3 | 4 | 16.7 | 6 | 66.7 | 20 | 83.3 | 33 |
| Total (n) | 8 | | 8 | | 37 | | 39 | | 92 |

Abbreviations: HFZ = Healthy fitness zone, NTIZ = Needs to improvement zone, n = Girls, % = Percentage

The difference between the two groups with regard to motor proficiency and the back saver sit and reach test, determine the flexibility in the left leg, right leg and in addition both legs. No difference was shown between motor proficiency and the back saver sit and reach test (left leg) in both groups with regard to the HFZ (p = 0,8105) or the NTIZ (p = 0,8524). The motor proficiency and physical fitness results for both groups regarding the sit and reach (left leg) are indicated in Table 4.7.

**Table 4.8: Motor proficiency and physical fitness per group – Sit and reach right**

| | Inactive | | Active | | Inactive | | Active | | Total (n) |
|---|---|---|---|---|---|---|---|---|---|
| | HFZ (n) | HFZ (%) | HFZ (n) | HFZ (%) | NTIZ (n) | NTIZ (%) | NTIZ (n) | NTIZ (%) | |
| Low Average | 1 | 50 | 0 | 0 | 1 | 50 | 0 | 0 | 2 |
| Medium Average | 0 | 0 | 0 | 0 | 3 | 100 | 0 | 0 | 13 |
| High Average | 1 | 11.1 | 1 | 33.1 | 8 | 88.9 | 2 | 66.7 | 12 |
| Low High | 1 | 6.3 | 1 | 16.7 | 15 | 93.8 | 5 | 83.3 | 22 |
| Medium High | 1 | 16.7 | 3 | 21.4 | 5 | 83.3 | 11 | 78.6 | 20 |
| Very High | 3 | 33.3 | 3 | 13 | 6 | 66.7 | 21 | 88 | 33 |
| Total (n) | 7 | | 8 | | 38 | | 39 | | 92 |

Abbreviations: HFZ = Healthy fitness zone, NTIZ = Needs to improvement zone, n = Girls, % = Percentage

No difference was revealed between the two groups regarding motor proficiency and the back saver sit and reach test (right leg) in both groups regarding the HFZ (p = 0,2739) or the NTIZ (p = 0,7017). The motor proficiency and physical fitness results for both groups regarding the sit and reach (right leg) are indicated in Table 4.8.

**Table 4.9: Motor proficiency and physical fitness per group – Sit and reach both legs**

| | Inactive | | Active | | Inactive | | Active | | Total (n) |
|---|---|---|---|---|---|---|---|---|---|
| | HFZ (n) | HFZ (%) | HFZ (n) | HFZ (%) | NTIZ (n) | NTIZ (%) | NTIZ (n) | NTIZ (%) | |
| Low Average | 0 | 0 | 0 | 0 | 2 | 100 | 0 | 0 | 2 |
| Medium Average | 0 | 0 | 0 | 0 | 3 | 100 | 0 | 0 | 3 |
| High Average | 1 | 11.1 | 1 | 33.3 | 8 | 88.9 | 2 | 66.7 | 12 |
| Low High | 1 | 6.3 | 1 | 16.7 | 15 | 93.8 | 5 | 83.3 | 22 |
| Medium High | 1 | 16.7 | 2 | 14.3 | 5 | 83.3 | 12 | 85.7 | 20 |
| Very High | 3 | 33.3 | 2 | 8.3 | 6 | 66.7 | 22 | 91.7 | 33 |
| Total (n) | 6 | | 6 | | 39 | | 41 | | 92 |

Abbreviations: HFZ = Healthy fitness zone, NTIZ = Needs to improvement zone, n = Girls, % = Percentage

No difference was established between the two groups with regard to motor proficiency and the back saver sit and reach test (both legs) regarding the HFZ (p = 0,5050) or the NTIZ (p = 0,4448). The motor proficiency and physical fitness results for both groups regarding the sit and reach (both legs) are indicated in Table 4.9.

**Table 4.10: Motor proficiency and physical fitness per group – percentage body fat**

| | Inactive | | Active | | Inactive | | Active | | Total (n) |
|---|---|---|---|---|---|---|---|---|---|
| | HFZ (n) | HFZ (%) | HFZ (n) | HFZ (%) | NTIZ (n) | NTIZ (%) | NTIZ (n) | NTIZ (%) | |
| Low Average | 1 | 50 | 0 | 0 | 1 | 50 | 0 | 0 | 2 |
| Medium Average | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| High Average | 9 | 100 | 3 | 100 | 0 | 0 | 0 | 0 | 12 |
| Low High | 15 | 93.8 | 6 | 100 | 1 | 6.3 | 0 | 0 | 22 |
| Medium High | 6 | 100 | 14 | 100 | 0 | 0 | 0 | 0 | 20 |
| Very High | 9 | 100 | 24 | 100 | 0 | 0 | 0 | 0 | 33 |
| Total (n) | 43 | | 47 | | 2 | | 0 | | 92 |

Abbreviations: HFZ = Healthy fitness zone, NTIZ = Needs to improvement zone, n = Girls, % = Percentage

The final difference between the two groups was motor proficiency and percentage body fat. No difference was found between the active and inactive group (p = 0,1788). The motor proficiency and physical fitness results for both groups regarding percentage body fat is indicated in Table 4.10.

#### 4.2.3.3 The Activitygram

The Activitygram provides detailed information of girls physical activity levels (The Cooper Institute, 2005:1). The Fitnessgram and Activitygram are linked to a powerful database system that allows data on each girl to be tracked and compiled over time. Components of the Fitnessgram are designed to assist teachers and kinderkineticists in accomplishing the primary objective of youth fitness programs which help girl's establish physical activity as part of their daily lives.

##### 4.2.3.3.1 Analyzes of Activitygram logging chart

An activity logging chart was completed by the girls in order to determine activity levels of active and inactive groups.

Sport participation among the active group varies from swimming, track and field, cross country, netball, hockey, tennis and squash. Their participation levels ranged between 2 to 3 times a week and Saturdays for competition. The training programs consist of all the health-related components (cardio-vascular endurance, muscular strength, muscular endurance and flexibility) as well as skill-related components (speed, balance, coordination, agility, reaction time and power) in order to improve overall abilities.

The inactive group participated in activities such as singing in a choir, playing musical instruments, horse riding, drama, chess, taking part in debates (public speaking) and dancing. A majority of these activities did not provide ample opportunities to improve health-related components, where as horse riding and dancing might influence fitness components such as cardio-vascular endurance, muscular strength, muscular

endurance and flexibility. Cultural activities such as playing instruments and drama can have a positive effect on skill-related components, specifically balance and coordination.

The active and inactive girls took part in physical education classes presented by the school. The girls participated once a week for 30min in swimming activities during summer (the season in which the research took place). The physical education classes provided additional opportunities for the active group to enhance their fitness levels. For some of the inactive girls, this was the only form of physical activity they participated in. In conclusion, it is clearly noticeable that the inactive group had fewer opportunities to improve their motor proficiency and health-related fitness components than the active group.

## 4.3 Discussion of results

### 4.3.1 Motor proficiency

It is interesting to note that both groups fell into the high category regarding motor proficiency competency indicating sufficient motor proficiency competency for both groups according to Bruininks (1978:137). An explanation for this occurrence might be due to certain cultural activities (horse riding and dancing) having a positive effect on motor proficiency competence. Research conducted by Bouffard et al., (1996:148) as well as Wrotniak et al., (2006:e1762) states that motor proficiency was positively associated with higher activity levels, conversely this study indicates sufficient motor proficiency competency in active and inactive girls.

The results indicate sufficient motor proficiency competency for both groups, although the smaller segments indicate that the inactive girls have a low high ability compared to the active girls' very high ability. The results indicate a significant difference ($p < 0,05$) between the groups with regard to the various segments. This statement correlates well with Wrotniak et al., (2006:e1758) indicating that children in the greatest quartile (segment) of motor proficiency were the most physically active.

### 4.3.2 Physical fitness

A significant difference between active and inactive girls with regard to the one mile run, push-up test, fat percentage and the trunk lift test was observed in the present study. On the other hand, the results revealed no significant difference with regard to the curl-up test and the back saver sit and reach test between active and inactive girls. A discussion will follow with regard to each variable.

The one mile run refers to a test to determine cardio-respiratory endurance. The results of the study reveal a significant difference ($p < 0.05$) between active and inactive girls. This confirms with research performed by Tan (2002:187) and Dollman and Ridley, (2006:191) who observed that inactivity results in inferior cardio-respiratory endurance in comparison with active girls. Although fat percentage will be discussed separately, the results are needed to make the following comparison with regard to cardio-respiratory endurance. The results indicate a significant difference in fat percentage between active and inactive girls and, according to research by Chen et al., (2006:1367), overweight/obese girls tend to have poorer cardio-vascular endurance.

In order to determine muscular endurance and muscular strength the push-up test and curl-up test were applied. A considerable difference ($p< 0,05$) between the active and inactive girls occurred regarding the push-up test. The results are similar to Gallahue and Ozmun (2002:248), where the authors state that a significant increase in muscular endurance and muscular strength only occur if girls take part in special training programs. For this reason it can be concluded that the sport participation of the active group improved muscular endurance and muscular strength, specifically for push-ups.

No significant difference was observed with regard to the curl-up test indicating that the training program did not improve muscular endurance and muscular strength as posed by Gallahue and Ozmun (2002:248), specifically for the curl-ups test among active girls. As mentioned earlier, fat percentage will be discussed separately, but the results are needed to make the following comparison with regard to muscular endurance and

muscular strength. The results indicate a significant difference in fat percentage between active and inactive girls. According to research by Chen et al., (2006:1367), overweight/obese girls tend to have poorer muscular endurance and muscular strength, which compares well to the push-up test which contrasts with the curl-up test.

A skinfold calliper was used to determine fat percentage in active and inactive girls. A significant difference ($p < 0,05$) was observed and compares with research by Dollman and Ridley, (2006:191) who found that inactive girls had higher fat percentages. Higher fat percentage levels are negatively associated with other health-related fitness components such as the one mile run (cardio-respiratory endurance) and push-ups (muscular endurance and muscular strength) but not with regard to the curl-up test as mentioned under the various variables.

The trunk lift test and back saver sit and reach test was conducted to determine the girls' flexibility. A significant difference ($p < 0,05$) occurred between active and inactive girls, specifically with regard to the trunk lift test. This reveals results comparable to Garcia, (2002:248) who stated that flexibility decreases with sedentary lifestyles. On the other hand, no significant difference regarding the back saver sit and reach test was observed indicating that hamstring flexibility among girls decreases every year (Baquet et al., 2006:51).

Then a majority of girls in both groups need to improve their fitness levels, indicating insufficient fitness levels on various aspects as mentioned in the above paragraphs with regard to fitness (The Cooper Institute, 2005).

### 4.3.3 Activity logging chart

The recommended physical activity requirements refer to 60min of moderate to vigorous intensity activities every day (Spinks et al., 2007:161; The Cooper Institute, 2005:79). The activity logging chart for both groups revealed that the active girls met the recommended physical activity requirements (accumulated by means of sport

participation, physical education classes and recess time) in comparison with the inactive girls whom did not meet the requirements.

This brings us back to various studies such as Bouffard et al., (1996:148), Engelbrecht et al., (2004:52) and Wrotniak et al., (2006:e1759) where the researchers observed that low activity levels and sedentary lifestyles among girls are rapidly increasing. For this reason, inactivity is becoming an international epidemic. Therefore, an effort should be made to improve activity levels as far as possible to aid inactive girls to becoming active and staying active throughout life.

In Chapter 4, the testing procedures regarding health-related fitness (fitness) as well as skill-related fitness (motor proficiency) were explained and followed by discussions of the results of motor proficiency, fitness levels as well as the activity levels for the active group (sport) and the inactive group (cultural). Chapter 5 will address the conclusion and recommendations.

## 4.4 References

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# CHAPTER 5

# Conclusions and recommendations



## 5.1 Conclusions

The conclusions that are drawn from this research are presented in accordance with the hypotheses set in Chapter 1, (p. 13).

**Hypothesis 1 states that there will be a significant difference between active and inactive girls aged 12 to 13 regarding motor proficiency.**

The results indicate sufficient motor proficiency competency for both groups, although the smaller segments indicate that the inactive girls have a low high ability compared to the active girls' very high ability. According to the results of this study there was a significant difference in motor proficiency between active and inactive girls aged 12 to 13. Hypothesis 1 is accepted.

**Hypothesis 2 states that here will be a significant difference between active and inactive girls aged 12 to 13 regarding physical fitness.**

From the results of this study, it appears that hypothesis 2 could only be partially accepted regarding a significant difference in physical fitness between active and inactive girls aged 12 to 13. This is mainly due to the fact that the active girls outperformed the inactive girls in a few aspects such as the one mile run, push-up test and the trunk lift test of physical fitness.

**Hypothesis 3 states that here will be a significant difference between physical fitness performance (HFZ versus NTIZ) of active and inactive girls at different motor proficiency categories.**

This comparative study rejected hypothesis 3 and revealed that there was no significant difference between physical fitness performance (HFZ versus NTIZ) of active and inactive girls at different motor proficiency categories.

Answers regarding the questions posed in Chapter 1, (p. 9) will be discussed.

1. **Is it more important for children to be physically active or to be physically fit?**

   Findings of the present study indicate that the active girls outperformed the inactive girls in various health-related fitness components such as the 1 mile run the push-up test, trunk lift and percentage body fat. Therefore physical activity is important and can be seen as a prerequisite for physical fitness.

2. **Should more emphasis be placed on children's activity habits or should attempts be made to improve their physical fitness?**

   The research indicates that higher physical activity levels contribute to better physical fitness results in various aspects. Regardless of higher activity levels, a majority of girls falls into the needs to improvement category. Therefore, attempts should be made to improve the quality (intensity, frequency, duration and specificity) of the activity programs in which the girls participate.

3. **Physical activities and physical fitness are probably both important depending on the desired health benefit, but how can motor proficiency influence the child's decision to take part in certain physical activities?**

   Proper physical activity programs can lead to appropriate physical fitness levels improving health over all. As stated in Chapter 2, (p. 44) girls need fundamental movement abilities in order to take part in specialized movement skills. If the fundamental movement skills are not acquired they will not be able to take part in complex physical activities such as sport, minimizing the variety of activities girls could take part in.

4. **A major reason for not taking part in sport is because girls are not interested, and for this reason we need to determine why girls are not interested in sport?**

   A variety of reasons regarding girls not being interested in sport are stated in Chapter 1, (11). Therefore fundamental skills should be learned in order to take part in sport. Research according to Davies (1996:47) stated that girls experiencing low achieving performance are more negative towards traditional school sport such as hockey and tennis. For this reason a variety of new sports should be introduced in the school and community environment, to attract girls to participate in physical activities and enjoy sporting activities.

## 5.2 Recommendations

In an attempt to improve activity levels, motor proficiency and fitness levels among girls, the followings strategies may be applied:

To improve the activity levels of girls, the physical education programs in the school environment should be revised. According to Naughton et al., (2006:40) and Chiodera et al., (2007:1), physical education declines in schools; then again, the school involved in the present study provided physical education classes. Pate et al., (2004:1258) concluded their study with the observation that boys participated in significantly more moderate-to-vigorous physical activity and vigorous physical activity than did girls. Although the girls who participated in the present study have access to physical education classes it is clearly observable that the classes are not appropriate for the inactive girls with regard to the time (duration) spent on physical education, as well as the intensity and frequency. The present study revealed that inactive girls did not meet the minimum daily recommended physical activity requirements as posed by Spinks et al., (2007:161).

The results indicate sufficient motor proficiency competency for both groups, although the smaller segments indicate that the inactive girls have a low high ability compared to the active girls' very high ability. Skill-related components such as balance, coordination, agility, reaction time, speed and power can be improved by means of motor development programs. Establishing these programs in the school environment will provide sufficient opportunities to improve fundamental skills (motor proficiency), to facilitate physical activity, and sport participation as posed by Haubenstricker and Seefeldt (1986:45). A lack of motor proficiency can be improved by means of intervention programs conducted by a kinderkineticist or physical therapist. The success of intervention programs are evident in work done by Chiodera et al., (2007:1) and Van Niekerk et al., (2007:159).

The present study clearly indicates insufficient fitness performance on various aspects and correlates with the study of Rowland and Freedson, (1994:670) which describes children's low fitness scores as a "fitness crisis". According to Hands, (2008:155) the fitness components are being compromised by a lack of reduced activity; conversely, the present study revealed that the active girls also exhibit poor fitness levels.

The first step to improving fitness levels and health would be to minimize inactivity by means of a decrease in time spend with technology such as television and computers. To improve overall fitness levels, girls in the active as well as in the inactive group will benefit from taking part in sports, recreational activities or any other form of physical activity.

The physical activity pyramid as mentioned in Chapter 1, (p. 6) according to Powers and Howley, (2007:333) will guide girls in the process of improving their fitness levels. It would be advisable for the inactive girls to start off slowly in order to become active and stay active throughout their lives. Walking is a great activity to start with and it is recommended that girls should walk almost every day for at least 30min. As the inactive girls improve their fitness levels, such as cardio-vascular endurance, muscular strength, muscular endurance and body fat percentage, they can include aerobic activities (jogging and cycling).

The next step would be to take part in active sports, for example tennis, swimming and netball. The active girls would start with this phase and both groups should take part in sporting activities for at least 3 days a week. Various sporting activities should include a sport specific training program regarding flexibility, strength and muscular endurance. In order to improve flexibility, stretching before and after training session would be advisable. Stretching all the muscles of the body and holding each stretch for at least 10 - 15 seconds.

Strength would automatically improve by means of running, throwing, kicking, jumping and catching activities. Additional exercises to improve strength would be isometric

exercises, body weight exercises, using equipment such as elastic bands as well as medicine balls. Strengthening exercises should be done at least 3 - 4 times a week and the exercises should be age related to prevent injuries.

To improve muscular endurance, exercises such as push-ups and curl-ups will be appropriate. Exercises used in strength could be applied to muscular endurance. An example would be to take an elastic band with less resistance, increasing the repetitions and decrease resting time in between sets. Following a basic program will improve the fitness levels of girls.

## 5.3 Further research

The study demonstrated several limitations on various areas, which could be overcome in future research. The limitations include the following:

- The study's population sample consisted of 97 girls who were all recruited from the same institution and province, therefore the results cannot be generalized to the larger population of 12 and 13 year old girls in the country, as certain discrepancies may occur.
- The representation of different ethnic groups in this sample was not recorded. This may cause misinterpretation of results and consequently result in invalid conclusions.
- Although the study had only a small sample (n=97), the end result remains important. Research on the motor development of children is well acknowledged but research on skill-related fitness (motor proficiency) is still limited. Conversely an abundance of research on health-related fitness is available.
- Further research is planned regarding this topic, by means of Pearson product-moment correlations between active and inactive girls.

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# APPENDIX A

## Informed Consent Form

UNIVERSITEIT VAN DIE VRYSTAAT
UNIVERSITY OF THE FREE STATE
YUNIVESITHI YA FREISTATA

Department of Human Movement Science
Departement Menslike Bewegingskunde

**22 September 2008**

Dear Parent

The University of the Free State would like to invite your daughter to participate in a research project which tests the motor abilities and physical abilities of active scholar's to that of an inactive scholar.

The study will need 100 participants, of which 50 should be involved in sport participation and 50 involved in cultural activities. Testing procedures will take place at the school.

8 Honor students from the Department of Human Movement Science will be testing the 100 scholar's motor abilities and fitness.

The tests will be taking place on Tuesdays between 2 pm and 4 pm, for a period of 4 weeks. The dates of the study will take place from the 6th of October 2008 until the 7th of November 2008.

The results are of a personal nature and will be given to Principle.

We would kindly appreciate the participation of your daughter.

_____

**ME. M. DE MILANDER**
**JUNIOR LECTURER / KINDERKINETICIST**
**DEPT. HUMAN MOVEMENT SCIENCE**

Hereby I the parent/guardian of _____ give permission to take part in the research project, starting on the 6th of October 2008 until the 7th of November 2008. Please return this to the school on the 26 of September 2008.

_____
Parent/Guardian

_____
Date

DEPARTMENT OF HUMAN MOVEMENT SCIENCE

339, Bloemfontein 9300 (051) 9342/3431 (051) 444 5133 demilanderm.hum@ufs.ac.za

# APPENDIX B

# Bruininks-Oseretsky Test Of Motor Proficiency: Individual Record Form

# 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

### Complete Battery:

| SUBTEST | POINT SCORE Maximum | POINT SCORE Subject's | STANDARD SCORE Test (Table 23) | STANDARD SCORE Composite (Table 24) | PERCENTILE RANK (Table 25) | STANINE (Table 25) | OTHER |
|---|---|---|---|---|---|---|---|
| GROSS MOTOR SUBTESTS: | | | | | | | |
| 1. Running Speed and Agility | 15 | | | | | | |
| 2. Balance | 32 | | | | | | |
| 3. Bilateral Coordination | 20 | | | | | | |
| 4. Strength | 42 | | | | | | |
| **GROSS MOTOR COMPOSITE** | | | * SUM | | | | |
| 5. Upper-Limb Coordination | 21 | | * | | | | |
| FINE MOTOR SUBTESTS | | | | | | | |
| 6. Response Speed | 17 | | | | | | |
| 7. Visual-Motor Control | 24 | | | | | | |
| 8. Upper-Limb Speed and Dexterity | 72 | | | | | | |
| **FINE MOTOR COMPOSITE** | | | * SUM | | | | |
| **BATTERY COMPOSITE** | | | * 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.

### Short Form:

| | POINT SCORE Maximum | POINT SCORE Subject's | STANDARD SCORE (Table 27) | PERCENTILE RANK (Table 27) | STANINE (Table 27) |
|---|---|---|---|---|---|
| **SHORT FORM** | 98 | | | | |

## 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**[SF*]

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**[SF] *(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**[SF] *(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)

RECORD POINT SCORES FOR SHORT FORM

*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**[SF] *(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**[SF]

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**[SF] *(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 |

RECORD POINT SCORES FOR COMPLETE BATTERY

RECORD POINT SCORES FOR SHORT FORM

POINT SCORE SUBTEST 3 (Max: 20)

POINT SCORE SUBTEST 4 (Max: 42)

*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**[SF] *(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**[SF] *(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 |
|---|---|---|
| Point Score | (0) | (1) |

8. **Touching Thumb to Fingertips—Eyes Closed** *(90 seconds maximum)*

| * Raw Score | Fail | Pass |
|---|---|---|
| Point Score | (0) | (1) |

9. **Pivoting Thumb and Index Finger** *(90 seconds maximum)*

| * Raw Score | Fail | Pass |
|---|---|---|
| Point Score | (0) | (1) |

## SUBTEST 6: Response Speed

1. **Response Speed**[SF]

| TRIAL | | SECONDS TO WAIT | | SCORE[1] | RANKED TRIAL SCORES[2] |
|---|---|---|---|---|---|
| Practice | 1 | 1 | | XXXX | |
| Practice | 2 | 3 | | XXXX | |
| | 1 | 2 | | _____ | HIGHEST ☐ |
| | 2 | 3 | | _____ | ☐ |
| | 3 | 1 | | _____ | ☐ |
| | 4 | 3 | | _____ | MEDIAN ☐ → |
| | 5 | 2 | | _____ | ☐ |
| | 6 | 1 | | _____ | ☐ |
| | 7 | 1 | | _____ | LOWEST ☐ |

[1] Record number from response speed stick in this column.

[2] 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.

RECORD POINT SCORES FOR COMPLETE BATTERY

RECORD POINT SCORES FOR SHORT FORM

POINT SCORE SUBTEST 5 (Max: 21)

POINT SCORE SUBTEST 6 (Max: 17)

*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 6 | 6 | 2-5 | 1 | 0 |
|---|---|---|---|---|---|
| Point Score | (0) | (1) | (2) | (3) | (4) |

**3. Drawing a Line Through a Straight Path with Preferred Hand**[SF]

NUMBER OF ERRORS: _____

| Raw Score | Above 6 | 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**[SF]

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**[SF]

SCORE: _____

| * Raw Score | 0 | 1 | 2 |
|---|---|---|---|
| Point Score | (0) | (1) | (2) |

RECORD POINT SCORES FOR COMPLETE BATTERY

RECORD POINT SCORES FOR SHORT FORM

POINT SCORE SUBTEST 7 (Max. 24)

*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 | 26-30 | 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**[SF] *(15 seconds)*

NUMBER OF CARDS: _____

| Raw Score | 0 | 1-8 | 9-12 | 13-16 | 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**[SF] *(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 |

RECORD POINT SCORES FOR COMPLETE BATTERY

RECORD POINT SCORES FOR SHORT FORM

POINT SCORE SUBTEST 8 (Max: 72)

## NOTES/OBSERVATIONS

For additional forms, call AGS toll-free (800)328-2560, visit our Web site www.agsnet.com, or write and ask for item 1584 (25 per package).

Product Number: 1584 B 0 9 8 7 6 5 4 3 2

# APPENDIX C

# Bruininks-Oseretsky Test Of Motor Proficiency: Student Booklet

**Bruininks-Oseretsky Test**
**of Motor Proficiency**

Robert H. Bruininks, Ph. D.

STUDENT BOOKLET

Name _____

Examiner _____ Date _____

AGS® American Guidance Service
Circle Pines, Minnesota 55014-1796

**SUBTEST 3: Bilateral Coordination**

Item 8 / Drawing Lines and Crosses Simultaneously

PRACTICE

TEST

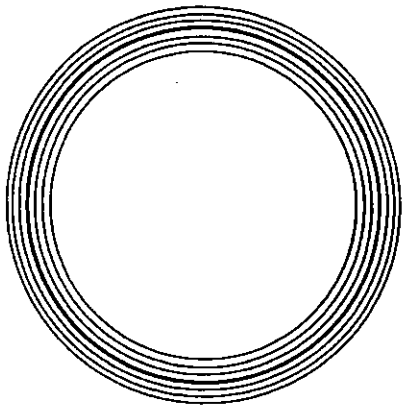


3 0 9 8 7

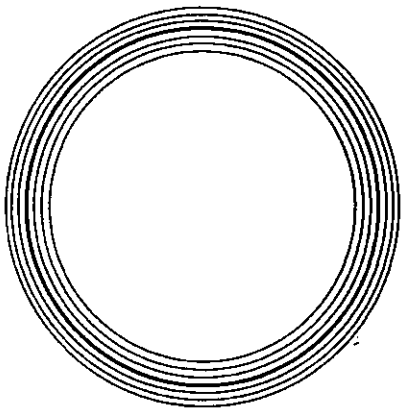
Number of pairs ☐

## SUBTEST 7: Visual-Motor Control

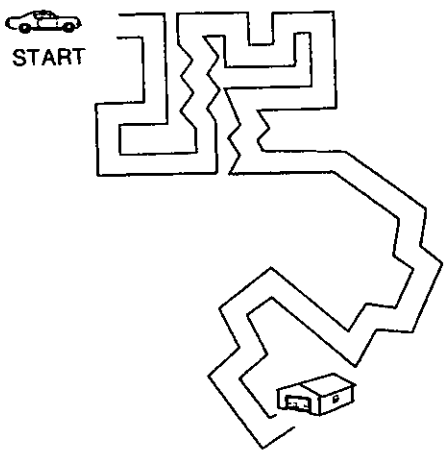
Item 1 / Cutting Out a Circle with Preferred Hand



Number of Errors ☐



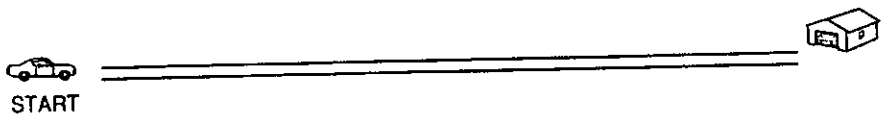
Item 2 / Drawing a Line Through a Crooked Path with Preferred Hand




Number of Errors ☐

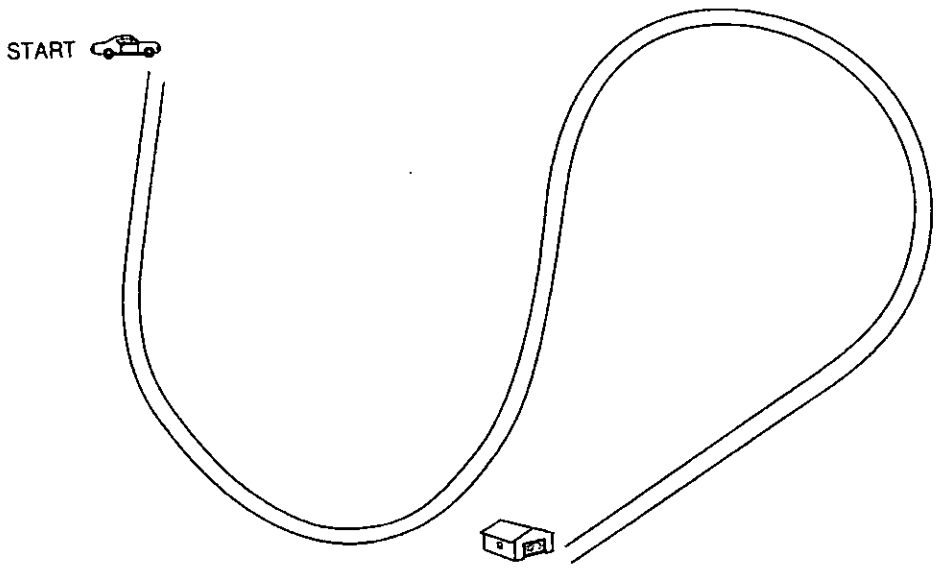
## SUBTEST 7: Visual-Motor Control

Item 3SF / 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

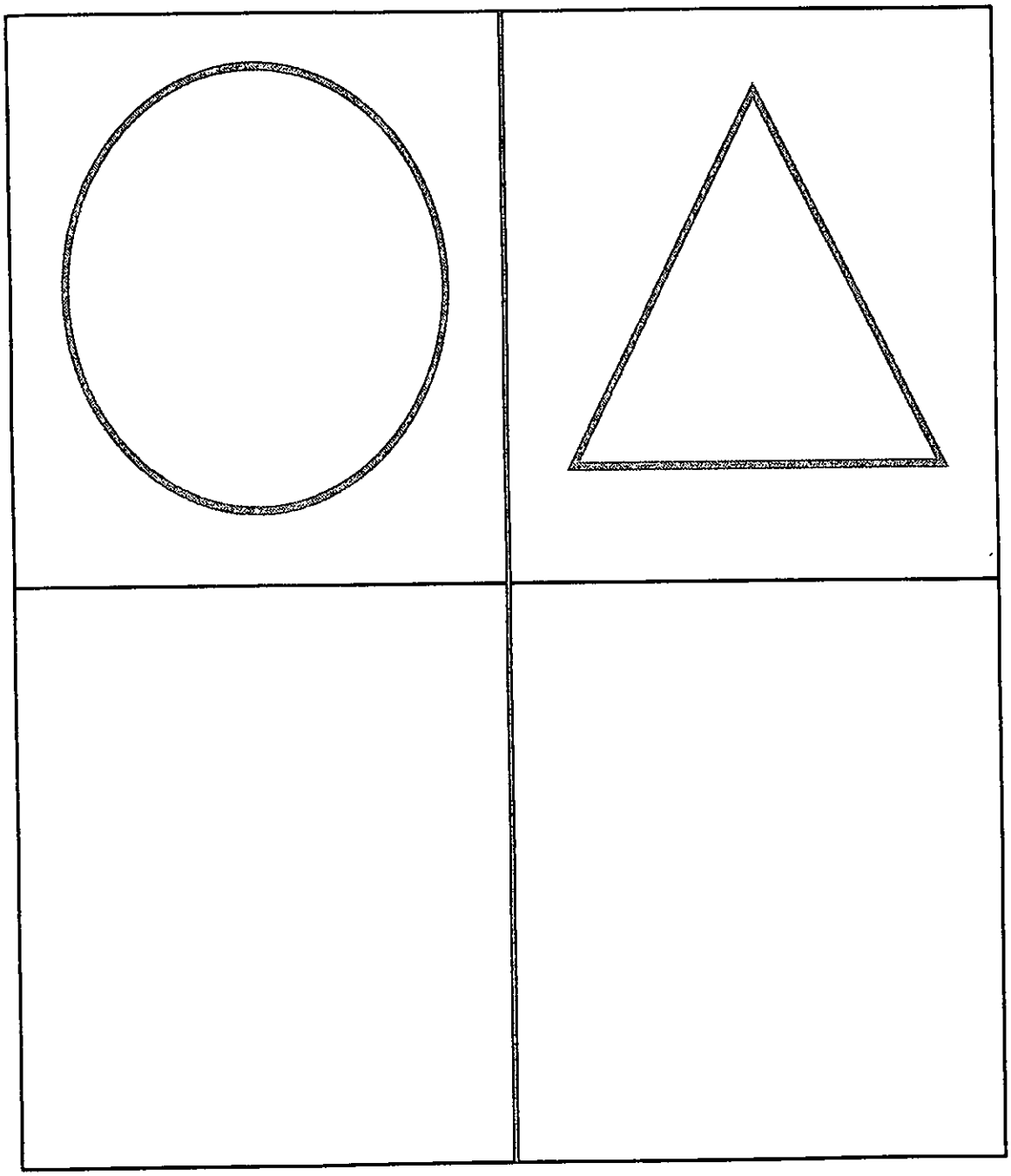



Number of Errors ☐

## SUBTEST 7: Visual-Motor Control

Item 5SF / Copying a Circle
with Preferred Hand

Item 6 / Copying a Triangle
with Preferred Hand

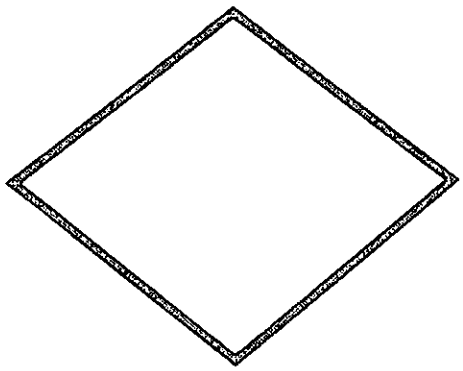


Score ☐

Score ☐

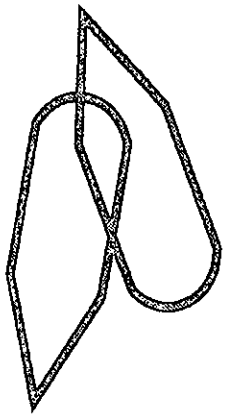
## SUBTEST 7: Visual-Motor Control

Item 7 / Copying a Horizontal Diamond with Preferred Hand



Score ____

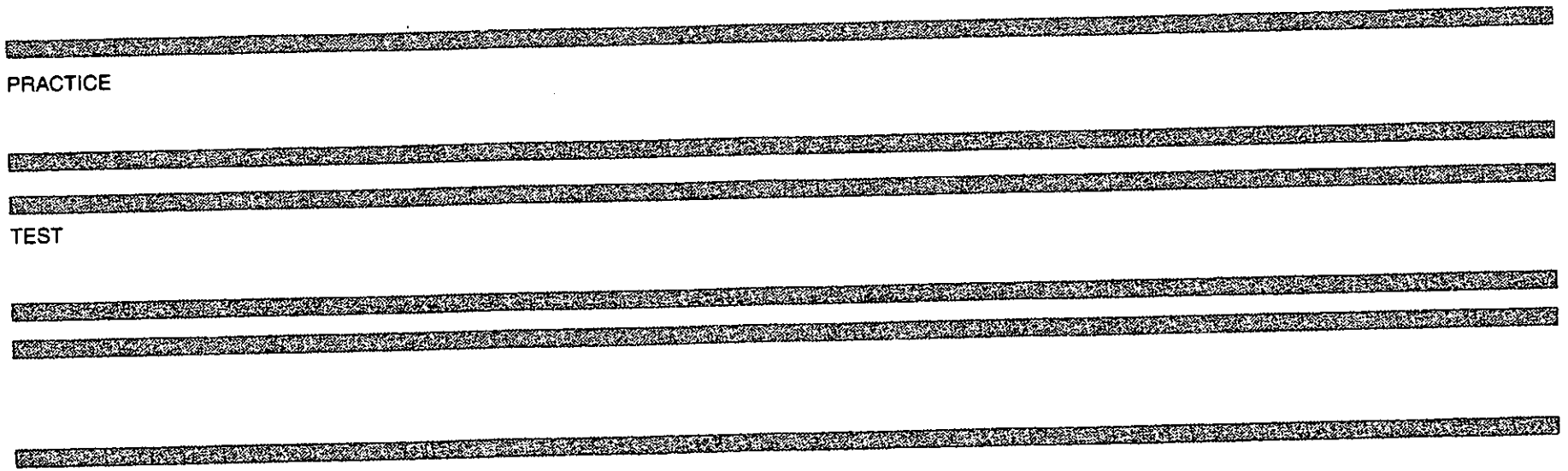
Item 8SF / Copying Overlapping Pencils with Preferred Hand



Score ____

## SUBTEST 8: Upper-Limb Speed and Dexterity

Item 6 / Drawing Vertical Lines with Preferred Hand



PRACTICE

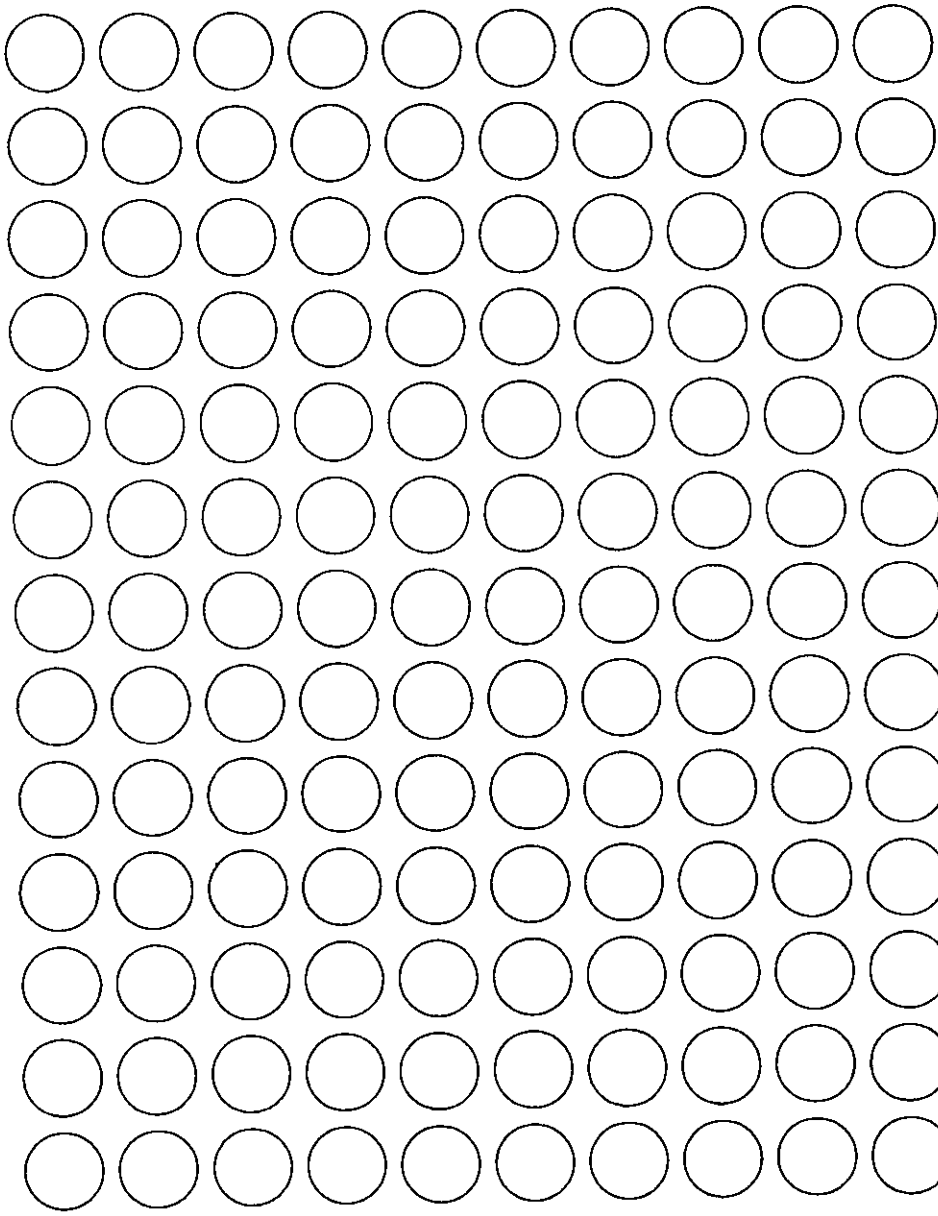
TEST

Number Correct

**SUBTEST 8: Upper-Limb Speed and Dexterity**

Item 7[SF] / Making Dots in Circles with Preferred Hand

Practice:



Number Correct

**SUBTEST 8: Upper-Limb Speed and Dexterity**

Item 8 / Making Dots with Preferred Hand

PRACTICE

Number Correct

# APPENDIX D

## Fitnessgram Class Score Sheet


## Class Score Sheet

Teacher_____ Page number_____ Grade_____

Class_____ Test date_____

| ID# | Name | Birth date | Sex | Height | Weight | Aerobic capacity | Curl-up | Upper body | Trunk lift | Flexibility L/R | Skinfolds | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Triceps | Calf |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |

FIGURE B.11
From *FITNESSGRAMIACTIVITYGRAM Test Administration Manual, Updated Third Edition* by The Cooper Institute, 2005, Champaign, IL: Human Kinetics

# APPENDIX E

## Activitygram Logging Chart

FITNESSGRAM

## ACTIVITYGRAM Logging Chart

Name_____ Age____ Teacher_____ Grade_____

Record the *primary* activity you did during each 30-minute interval during the day using the list at the bottom of the page. Then select an intensity level that best describes how it felt (Light: "Easy"; Moderate: "Not too tiring"; Vigorous: "Very tiring"). *Note:* All time periods of rest should have "Rest" checked for intensity level.

| Time | Activity | Rest | Light | Mod. | Vig. | Time | Activity | Rest | Light | Mod. | Vig. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7:00 | | | | | | 3:00 | | | | | |
| 7:30 | | | | | | 3:30 | | | | | |
| 8:00 | | | | | | 4:00 | | | | | |
| 8:30 | | | | | | 4:30 | | | | | |
| 9:00 | | | | | | 5:00 | | | | | |
| 9:30 | | | | | | 5:30 | | | | | |
| 10:00 | | | | | | 6:00 | | | | | |
| 10:30 | | | | | | 6:30 | | | | | |
| 11:00 | | | | | | 7:00 | | | | | |
| 11:30 | | | | | | 7:30 | | | | | |
| 12:00 | | | | | | 8:00 | | | | | |
| 12:30 | | | | | | 8:30 | | | | | |
| 1:00 | | | | | | 9:00 | | | | | |
| 1:30 | | | | | | 9:30 | | | | | |
| 2:00 | | | | | | 10:00 | | | | | |

## Categories of Physical Activities

| Lifestyle activity | Active aerobics | Active sports | Muscle fitness activities | Flexibility exercises | Rest and inactivity |
|---|---|---|---|---|---|
| "Activities that I do as part of my normal day" | "Activities that I do for aerobic fitness" | "Activities that I do for sports and recreation" | "Activities that I do for muscular fitness" | "Activities that I do for flexibility and fun" | "Things I do I when I am not active" |
| 1. Walking, bicycling, or skateboarding | 11. Aerobic dance activity | 21. Field sports (baseball, softball, football, soccer, etc.) | 31. Gymnastics or cheer, dance or drill teams | 41. Martial arts (tai chi) | 51. Schoolwork, homework, or reading |
| 2. Housework or yard work | 12. Aerobic gym equipment (stairclimber, treadmill, etc.) | 22. Court sports (basketball, volleyball, hockey, etc.) | 32. Track and field sports (Jumping, throwing, etc.) | 42. Stretching | 52. Computer games or TV/ videos |
| 3. Playing active games or dancing | 13. Aerobic activity (bicycling, running, skating, etc.) | 23. Racket sports (tennis, racquetball, etc.) | 33. Weightlifting or calisthenics (push-ups, sit-ups, etc.) | 43. Yoga | 53. Eating or resting |
| 4. Work-active job | 14. Aerobic activity in physical education | 24. Sports during physical education | 34. Wrestling or martial arts (karate, aikido) | 44. Ballet dancing | 54. Sleeping |
| 5. Other | 15. Other | 25. Other | 35. Other | 45. Other | 55. Other |

**FIGURE B.14**

From *FITNESSGRAM/ACTIVITYGRAM Test Administration Manual, Updated Third Edition* by The Cooper Institute, 2005, Champaign, IL: Human Kinetics