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SENSED AND ACTUAL POSTURE OF GRADE 5 LEARNERS WHILE CARRYING A SCHOOLBAG

Submitted by:

Nteboheleng Phatela

In accordance with requirements for the degree

Masters in Occupational Therapy in the faculty of Health Sciences

Department of Occupational Therapy at the University of Free State

Study leader: Ms PA Hough

Biostatistician: Ms M Nel

October 2019

Declaration of own work

I hereby declare that the dissertation that I am submitting to the University of the Free State for the degree Masters in Occupational Therapy is my own independent work and has not been submitted by me or anyone to any other University for achievement of a degree.

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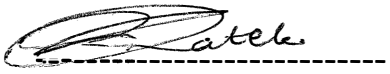

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List of acronyms

COG	**-**	**Centre of Gravity**
BIS	**-**	**Bilateral Integration and Sequencing**
PD	**-**	**Postural Dysfunction**
BW	**-**	**Body Weight**
SOT	**-**	**Sensory Organizational Tests**
LBD	**-**	**Lower Back Dysfunction**
P-MPA	**-**	**Photographic Method of Posture Assessment**
HSREC	**-**	**Health Science Research Ethics Committee**
SAHP	**-**	**School of Allied Health Professions**
UFS	**-**	**University of the Free State**
CI	**-**	**Confidence intervals**

List of pictures & Figures

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Clarification of terms

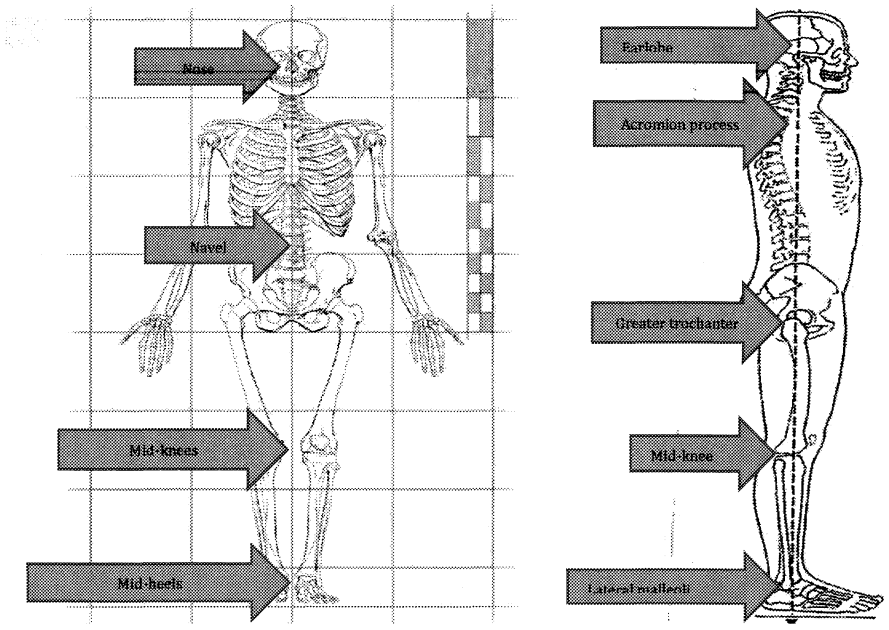
Backpack - Schoolbag- A bag that children use to carry their school books and other belongings in. It is carried on one's back and consists of two straps which go over the shoulders; the two terms (backpack and schoolbag) will be used interchangeably in the text.

Participants - Learners that will form part of the study population.

Actual and Sensed posture – For the purpose of the current study, actual posture is considered as the posture that is visible to others. Sensed posture is invisible and is dependent on the person who senses it (Murray, 2002, pp. 185).

Anatomical landmarks – Biologically meaningful points on a human body. In this study it refers to the following; nose, navel, mid heels, mid knees, lateral malleoli, greater trochanter, acromion, earlobe as outlined on picture 1 below (Kendall, 1993, p. 343).

Picture 1 – Anatomical landmarks



Anterior view Lateral view

ABSTRACT

Background

The main aim for the current study was to stablish the difference between sensed and actual posture while a Grade 5 learner is standing and carrying a schoolbag. Sensed posture is invisible and is dependent on the person who senses it; while actual posture is considered as the postural alignment that is visible to others. Due to the difference between sensed posture and actual posture, understanding how the two differ and how the body senses its posture as opposed the actual posture, will influence correct postural control on a child's body and their joint positioning in standing, walking and activity engagement and therefore promote physical wellbeing of the children. Despite a few single-joint studies done on the concept of sensed and actual posture, no study investigated sensed and actual posture in children with respect to whole body postural alignment, especially when they carry a backpack.

Methods

A descriptive cross-sectional study design was used in the current study. The study population consisted of 198 primary school learners in Grade 5. Participants had similar socio-economic status and were between the ages of 9.6 and 13.5, both boys and girls were included. The researcher used the Photographic Method of Postural Assessment (P-MPA) for assessment of postural alignment. The P-MPA was proved to accurately measure deviations between anatomical landmarks and the line of gravity, and also proved to be reliable in terms of reproducibility. In the set-up for the P-MPA, the participant assumed a position at 1 meter behind the plumb line, with the plumb line aligned with the lateral malleoli for the lateral standing position, and with the mid heels for the anterior standing position. The participant was asked to assume his/her most natural standing position. Photographs were taken by the researcher from 2m distance with a smartphone that was fixed on a tripod at a height of 950mm. Photographs were later printed and actual posture on the photographs was measured and results were captured on an excel spread sheet. The actual (real) distance on photos was established by calculating the ratio of measured (real) distance x distance from plumb line for each photo. A clinical significant difference from the reference point as measured on the photo was

set at 10mm. The coding was done by the researcher, followed by data analysis. Descriptive statistics, namely frequencies and percentages for categorical data, medians and percentiles for numerical data, were calculated. The sensed and actual deviation at each landmark, was compared by means of 95% confidence intervals (CI) for median differences for paired data.

Results

Results indicate that there was no significant difference observed on all the anterior views with reference to the difference between sensed and actual posture for the respective anatomical landmarks. Evidence from this study further indicate that sensed and actual posture differ when observed from lateral view, especially when weight is involved, in this instance; when a learner is carrying a backpack. Besides the remarkable clinical and statistical difference on the affected landmarks, the earlobe demonstrated significant difference more regularly than other anatomical landmarks; mid knees, greater trochanter and acromion process on the lateral views. Noticeably, the values of deviations increased per anatomical landmark moving from lower anatomical landmark; lateral malleoli to higher anatomical landmark; earlobe. Lastly, in most instances the anatomical landmarks that displayed significant difference on the left side also displayed a difference on the right side. Biographical questionnaire results indicate that 53% of participants compensate by bending when carrying a backpack, of whom 88.3% stated that they bend involuntarily.

Conclusion

Results from this study indicate the difference between sensed and actual posture while a Grade 5 learner is carrying a backpack, for all the respective landmarks noticeable from lateral views. These differences contribute to the knowledge base of factors that may have an impact on the learner's developing spine and wellbeing. It is recommended that these results be aligned with the Intergraded School Health Programme (ISHP) and to complement intervention strategies in order to enhance the wellbeing of individuals in school setting and the community at large.

OUTLINE OF CHAPTERS

Chapter 1 –Introduction and orientation

This chapter provides a general introduction to the outline of the current research study. It features a background to the research topic and problem statement. It further presents the aim of the study, the methodology and ethical considerations of the study.

Chapter 2 – Literature review

The literature review chapter gives an account of documented scholarship pertaining to background evidence on postural research, the difference between sensed posture and actual posture, sensory aspects that underlie sensed posture, and the values of good posture. It will further reflect on posture related assessment instruments. Furthermore, information on different backpacks, children's perspective in relation to their backpacks, posture and school health policy are also highlighted.

Chapter 3 – Research methodology

The study approach used in this research is explained in chapter 3. A quantitative cross-sectional, descriptive study design was used and the methodology discussed with reference to the population and sampling, measurement instrument, pilot study, data collection procedure, data analysis, reliability, measurement errors and ethical consideration.

Chapter 4 – Research results

In this chapter results obtained from analysis of the findings from the study is presented in the form of tables.

Chapter 5 – Discussion of the results

Results presented in chapter 4 are interpreted and discussed in this chapter. Also, associations between relevant research results are noted. Relevant findings, unique experiences and measurement errors have been elaborated on.

Chapter 6 – Conclusion and recommendations

Summary of the results and conclusions of the findings have been stipulated in this chapter. The researcher has given final recommendations and suggestions for future research.

CHAPTER 1 – INTRODUCTION AND ORIENTATION

1.1 Introduction

Often human instincts or guard feelings in life are lifesaving. When an individual feel that a certain action, behavior or thought is inappropriate; most of the time they are right. The same feeling applies to many parents and teachers. For instance, when they see bad postures that children assume when carrying their backpacks. That feeling of "just" knowing that the child's posture is wrong and may be harmful, it is actually their guard feeling or instinct. The current study attempts to understand the difference between the two aspects alleged to influence general posture in children; thus, sensed and actual posture of Grade 5 learners while they carry a schoolbag in a standing position. Grade 5 learners were purposely chosen because they carry heavy backpacks on their developing musculoskeletal structure and according to Kendall (2005, 340-343) in some individuals muscular skeletal structure stops developing at the age of twelve.

In the school setting most children make use of trollies or backpacks to carry their books and other school supplies. According to Orantes-Gonzalez, Heredia-Jimenez & Beneck (2017, p. 189-193) the backpack safe load range is between 10% and 20% of the child's body weight (BW) and as a safety measure, the trolley has been proposed as an alternative to the traditional backpack as it places less pressure on children's back (Orantes-Gonzalez, Heredia-Jimenez & Beneck, 2017, p. 189-193).

Although backpacks are becoming more common among school-children for the purpose of carrying school essentials (Sharan, Rajkumar, Mohandoss & Ranganathan, 2014, p. 929-930). Use of these backpacks may lead to the development of musculoskeletal discomfort among the schoolchildren. This is cause for concern to ergonomists and health care professionals (Sharan, Rajkumar, Mohandoss & Ranganathan, 2014, p. 929-930).

According to Kintner (2011, p. 99-100), there is research evidenced knowledge that schoolchildren across the world suffer from musculoskeletal pain or discomfort, impacting on their developing spine. For instance, a study by Kintner (2011, p. 99-100) points to a clear association between backpack load and measurable kinematic responses, as well as physiological responses such as cardiovascular, pulmonary, metabolic plus nerve function changes and lung volume response (Kintner, 2011, p. 99-100).

There are multiple postural adaptations that take place while a child is carrying a backpack. According to Radomski & Latham (2014, p. 818), postural adaptation is the ability of the body to automatically maintain balance and remain upright during alterations in position and challenges to stability. This process of postural adaptation is involuntary and is a basic response of the body to internal and external stimuli. For instance, in a case of a child carrying a backpack, an external stimulus would be the heavy backpack while internal stimuli could be what they sense or feel. To compensate for this destruction of a heavy backpack and ensure that stability is sustained, the central nervous system organizes postural adjustments preceding and accompanying the voluntary movement in a feed forward manner using knowledge of the dynamics of the body (Leonard, 2012, p. 11727-11732).

From the researcher's clinical experience, as the body performs its duty of compensation and postural adaptation, children seem to be unaware of their body position in space especially when they carry their backpack and this deprives their ability to re-position their bodies accordingly. As a result, more often than not, slouched postures are assumed by children. These postures may have a negative impact on the child's performance of daily activities such as listening, learning and participating in play. They may further have negative short-term and long-term effects on children's immature body structures.

Postural compensations due to carrying a heavy backpack include an anteriorly protruded head, disturbances in trunk position and changes in the pelvic position and gait patterns. (Kintner, 2011, p. 99-100). This change in posture leads to children being reprimanded by parents and teachers to walk

up straight. However, it is unclear whether or not children know to what extent it is meant by upright as they are probably comfortable with their incorrect slouched posture and perceive this as upright. If substantial relevant information based on the sense of posture is available and accessible to parents, teachers and learners, it may help everyone involved give children correct instructions on how to improve their posture while carrying backpacks.

The literature study to follow in chapter 2 will give account of theory and evidence that relates to the sense of posture and actual posture. Within the field of occupational therapy, this study attempts to understand and note the differences between actual posture and sensed posture of a Grade 5 learners while carrying a schoolbag. The literature review will firstly outline the key considerations with regards to occupational meaning as it relates to posture. As Pierce (2003, p. 5) states, "occupation is central to the way in which we create out identities, express who we are to others, and conform to expectations for our actions or choose not to conform."

Furthermore, studies that have been conducted on the relation between sensed and actual position of single joints in the body will be discussed. These studies focused mainly on each joint individually with regard to the importance of selecting the correct sensory information in order to maintain postural control; no evidence exists that relates to the difference or relation between actual posture and sensed posture of a Grade 5 learner while carrying a schoolbag. Additionally, the literature review aims to further investigate and understand background evidence on postural research, the difference between sensed posture and actual posture, the sensory aspects that underlie sensed posture, and the values of good posture. It will further reflect on posture tests that were used in the past and those that are currently being used by occupational therapists in South Africa.

Types of backpacks and how children and parents feel about them have also been investigated in the literature review. Understanding the comparative of pulling a school trolley versus carrying a backpack on posture should provide insight regarding recommendations for their use (Orantes, Jose & Beneck, 2017, p. 189-193). The aims and objectives of the integrated school health policy is

included in the literature review to give the reader a clear picture of the government's perspective regarding school health.

In brief, apart from studies reporting on posture relative to single joints, no research evidence was found confirming that the individual's sense of postural alignment is accurate enough when a child carries a backpack, therefore the current study proposes to answer the following question: Is there a difference between actual posture and sense of posture when a Grade 5 learner is carrying a schoolbag? Thus, the study aims to describe the difference between actual and sensed postural alignment during standing positions anterior, left and right lateral view, with and without a schoolbag pertaining to the specific anatomical landmarks.

The knowledge gained from this study will promote good posture and highlight the values of good posture in relation to muscular-skeletal development. In support of good posture Burn (2016, p.1-5) noted that according to Pownall, Moran & Stewart (2008, p. 44), other values of good posture are improved breathing, improved mood, reduced back and neck pain, improved memory and learning while the outcome of bad posture maybe associated with weaknesses and deficits of neurologic function.

1.2 Problem statement and scope

Literature indicates that posture is well defined as a necessity for an individual to have in order to obtain effective performance of daily activities. Good postural alignment is regarded as essential for safe and mechanically effective performance of activities (Umphred, 2013, p. 623-625). Occupational therapy intervention focuses on amongst others, the education of posture as a background to safe and effective occupational performance.

However, in the education setting, the researcher observed that learners understand and value the advantages of good postural alignment; but fail to apply this knowledge when performing daily activities. Some participants argue that it is not due to disobedience, but the impression that they do meet the expectations of good postural alignment.

From this speculation, the researcher suspects that a difference exists between one's sense of posture and the actual or real posture that a person adopts. Apart from studies done on individual joints pertaining to possible postural differences and posture related deformities, seemingly, no study had been reported on posture that investigated the difference of sensed and actual postural alignment of a child carrying a backpack. This gap in knowledge may influence an occupational therapist's treatment with reference to safety and efficiency of movement and to meaningful occupational performance. It also leaves the teachers, parents and significant others who deal with schoolchildren with no appropriate idea on how to assist children to correct their postural alignment while carrying a backpack.

Postural sense when a child carries a backpack is important as the child needs to have the skill to become aware of the movement and location of the body parts in order to effectively participate in occupation. The constructs of sense of postural alignment, and the actual posture in a child standing and carrying a backpack were chosen as theoretical basis to perform this study. For the current study, one standard backpack with the weight that was considered ideal by three different Grade 5 teachers was used during the assessment of all participants.

1.3 Research Question

What is the difference between the sensed and actual posture in a Grade 5 learner carrying a schoolbag?

1.4 Research Aim

In line with the study's main research question, the aim of the study was therefore to establish the difference between sensed and actual posture while a Grade 5 learner is standing and carrying a schoolbag.

1.5 Methodology

A detailed description of the research methodology will be discussed in chapter 3. For the purpose of this section, only an ephemeral overview of the methodology was provided.

A quantitative descriptive cross-sectional research design was used. One hundred and ninety-eight (198) participants were chosen from 19 schools proportionally sampled from a Sesotho-speaking area, of comparable socio-economic status in the Botshabelo district of the Free State Province in South Africa.

Prior to the start of the study the researcher obtained ethical clearance from the Health Science Research Ethics Committee (HSREC). Approval to conduct the study in respective schools was granted by the Department of Basic Education which also informed school principals about the study. Relevant documents such as HSREC approval letter, Basic Education approval letter, informed consent forms and information letters to the parents were subsequently delivered to schools.

Acceptance by school principals to participate in the study was followed by the researcher's request for both data collection appointments with individual school principals and lists of all Grade 5 learners for purposes of random sampling. The lists were later submitted to the Biostatistician in a blinded format. In return the Biostatistician provided the researcher with the numbers of participants which constituted the sample selection for the study. Prior to data collection, the researcher emailed the list of names of the learners who were chosen to take part to the relevant principals and requested that the principals distribute the information letters and informed consent forms to the selected participants' parents via learners.

On the day of data collection, signed consent forms were returned to the researcher by the participants when each learner was called to the researcher's data collection room. Information about the study was verbally provided to each learner, after which each learner was given an assent form to fill in with the assistance of the researcher.

In addition, a questionnaire in the learner's most preferred language between Sesotho and English was administered to the leaner. A valid and reliable postural assessment instrument, namely the Photographic Method of Postural Assessment (P-MPA) was used to obtain data for sensed and actual postural alignment. The data obtained was then captured on a data form, which was later transferred on an excel sheet twice to ensure accuracy and afterwards send to the Department of Biostatistics for analysis.

1.6 Ethical Considerations

The protocol was submitted to the study supervisor and then sent to the Research Evaluation Committee of the School of Allied Health Professions for evaluation and approval. After it had been approved by the Evaluation Committee, the protocol was submitted to the Health Sciences Research Ethics Committee (HSREC) for further approval which was granted per the UFS-HSD2018/1305/2901. The application procedure to conduct the study in the Department of Basic Education sector followed and approval was granted on the 25th of September 2018. Subsequently, information letters and informed consent forms written in Sesotho and English languages were distributed to the parents of selected participants. Signed informed consent forms were returned to the researcher on the day of data collection.

At the start of data collection, information was given to the participants and assent forms were filled in by the participants with the assistance of the researcher. The participants were informed about the aim of the study, the method of data collection and that their participation in the study would sustain no risk. It was further explained to the participants that participation was voluntary and that if they wanted to withdraw from the study, they could do so without being penalised (c.f. appendix N/O).

Confidentiality was ensured by use of numbers instead of names of participants. Participants were further assured that the information they provided would be treated with confidentiality, and that there would be no violation of their rights or privacy. Participants were de-identified on all photographs, participants were further not placed in any harmful situation. Participants were further made aware that they may not expect any monetary payment for participating before participation.

The language that was used in structured interviews depended on learner's preference between English and Sesotho (appendix K/L) as Botshabelo is a Sesotho-speaking neighbourhood.

1.7 Summary

Chapter 1 serves as an introduction to the study to familiarise the reader with the context and outline of the dissertation. It is evident that, apart from studies done on individual joints pertaining to postural alignment differences, seemingly there still is dearth of knowledge on and or about research-appraised reports on whole-body postural alignment and the difference of sensed and actual postural alignment of a child carrying a backpack. This gap in knowledge may influence an occupational therapist's treatment with reference to safety and efficiency of movement and to meaningful occupational performance. The information acquired from this study will contribute to the existing knowledge and will benefit the planning of appropriate intervention by occupational therapists in future.

CHAPTER 2-LITERATURE REVIEW

2.1 Introduction

In chapter 1 the reader was introduced to the scope of the study. A direction was specified to the study background, problem statement, research aim, methodology, ethical considerations and the value of the study. The current chapter stipulates detailed theory and evidence that relate to the scope of the study. It further aligns the study with relevant studies. This chapter critically reviews scholarship on posture; sensed and actual posture, children and their perspective relating to backpacks, types of backpacks and school health policy. The occupational meaning of posture and role of occupational therapy is also discussed in this chapter.

2.2 Posture

According to Crouch & Alers (2014, p. 374-376), posture is the outward manifestation of vestibular and proprioceptive processing. Although a postural deficit, on its own is not a practice disorder, it reflects the basis for deficits in bilateral integration and sequencing (BIS) and sometimes for somatodyspraxia; this means having difficulty with both feedback and feedforward-dependent motor actions.

Assessments and observation of posture are characterised by inclusion of relevant indicators. These indicators are ability to move neck into flexion against gravity, equilibrium, post-rotary nystagmus reactions, extensor muscle tone (observed in a standing position), prone extension and proximal stability (Crouch & Alers, 2014, p. 374-376). Umphred (2013, p. 927) emphasized that many levels of

neuromuscular control must be functioning to produce normal postural movements. At the most basic level, reflexes and righting reactions support postural orientation.

The vestibulocochlear reflex and the vestibule-spinal reflex contribute to orientation of the eyes, head, and body to self and environment (Umphred, 2013, p. 926-927). Recently Burns (2016, p. 1-5) added to the information that poor posture leads to a decline in proprioceptive function. It is further stated that forward head posture is a very common postural distortion. The effect of forward posture is not ideal for proprioceptive function and body position awareness (Burns, 2016, p. 1-5).

The literature reviewed for this study focused on children. Crouch & Alers (2014, p. 374-376) stated that children with postural deficits will have problems with postural control and stability as well as maintenance of good posture. The authors also state that postural abnormalities, whatever they may be, can be more easily corrected in children, or prevented from developing to a more marked degree, than at a later stage in life. Kintner (2011, p. 99-100) also points to a clear association between backpack load and measurable kinematic responses, as well as physiological responses such as cardiovascular, pulmonary, metabolic plus nerve function changes and lung volume response (Kintner, 2011, p. 99-100).

Posture is the structural framework of one's body. Burns (2016, p.1-5) avers that proper posture improves human function. Slouched posture is associated with weakness and deficits of neurologic function. Burns (2016, p.1-5) further argues that 2016 was a great year for postural research, as the importance of posture relating to function, and accurate proprioception was demonstrated in research findings.

One of the studies done by Orantes-Gonzalez (2017, p. 189-193) investigated if children require less gait kinematic adaptation to pull a trolley than to carry a backpack. The postural analysis indicated that both, carrying a backpack and pulling a trolley, significantly increased thorax flexion compared with the control group. However, thorax flexion was significantly greater when carrying a backpack compared to pulling a trolley. The higher thorax flexion, the more adaptation was needed to compensate for the additional load placed on the back to maintain the centre of mass over the pelvis

in order to maintain the body equilibrium (Orantes-Gonzalez, Heredia-Jimenez, Beneck, 2017, p. 189-193). It emerged from the Orantes-Gonzalez, et al's (2017) study that an important advantage of pulling a trolley in contrast to carrying a backpack was that due to lack of load on the back, less adaptation of the thorax was necessary, thus more closely resembling the thorax posture in the unloaded walking condition.

Sharan (2014, p. 929-930) asserted that backpacks are becoming more and more common among school children for carrying school books, laptops, water bottles, lunch boxes and many other items. However, the use of heavy backpack may lead to development of different musculoskeletal discomfort among the school children and it becomes a concern area for ergonomists (Sharan, 2014, p. 929-930). Sharan (2014, p. 929-930) further reported that school children across the world suffer from musculoskeletal pain or discomfort in the shoulder and back.

2.2.1 Good and Bad Posture

Good posture relates to concepts of balance which is referred to as postural stability by Shumway Cook & Woollacott (2012, p. 162). Another important indicator of good posture is the alignment of specified anatomical landmarks that need to be achieved in order for good postural alignment (Shumway-Cook & Woollacott, 2012, p. 167). The testing of the alignment of these specific landmarks is through the use of a plumb line.

Kendall (2005, p. 340) regards postural alignment as ideal when specified anatomical landmarks align with a plumb line, representing a vertical line of gravity through the centre of gravity. This line of gravity functions as the single point around which the mass of the body is equally distributed (Brunnstrom, 1996, p. 197).

In line with literature, the method of postural assessment in the current study will follow alignment between the plumb line and anatomical landmarks. From the lateral view, the plumb line will be slightly anterior to the lateral malleolus, and from the anterior view the plumb line will be aligned with the mid-heels. The other landmarks that will be taken into consideration from the anterior view will be mid-knees, navel and nose; and from the lateral view, the mid knees, greater trochanter,

acromion process and the earlobe. Bad posture comes as a result of deviations from the anatomical landmarks in relation to the plumb line (Shumwy-Cook & Woollacott, 2012, p. 168).

Karl (2008, p. 16) pointed out that anatomical landmark detection through surface palpation is a universal technique used in posture and gait studies. Palpated landmarks are often considered as a principle for quantitative evaluation of deformation. In the current study, the anatomical landmarks as mentioned above will be used as indicators during assessment.

Most bad postures are caused by automatic postural responses. According to Umphred (2013, p. 623-625) automatic postural responses operate to keep the center of gravity over the base of support. They are a set of functionally organized, long-loop responses that act to keep the body in a state of equilibrium. Functionally organized means that the responses, although stereotypical, are matched to the stimulus in direction and amplitude. If the stimulus is a push to the right, the response is a shift to the left, toward midline, the larger the stimulus, the greater the response (Umphred, 2013, p. 623-625).

Automatic postural responses therefore occur in response to a stimulus (Umphred, 2013, p. 623-625). In the case of a child carrying a backpack, depending on the load of the backpack, the body reacts in opposite direction of the stimuli which is the heavy backpack, resulting in a compensating forward bend posture.

In some instances, poor postures are pathological. Abnormal muscular responses in the extremities are noted when there is an acute vestibular disorder. This can result in postural instability. Vestibular dysfunction can result in an unconscious lateral weight shift, most often to the side of the lesion (Umphred, 2013, p. 623-625).

Prolonged poor posture places excessive strain on pain provoking structures of the lumber spine. Poor posture can occur while sitting, standing or lying. Adopting a slouched position while sitting is extremely common (Brukner & Khan, 2009, p. 216-217). Standing with a hyper lordotic posture will also place excessive strain on the structures of the lumber spine, hence the current study focuses on

investigating sensed and actual posture which are the core reasons of postural adaptations that we see with natural eyes as poor posture.

2.2.2 Postural Adaptations

Postural adaptation is the ability of the body to maintain balance automatically and remain upright during alterations in position and challenges to stability (Trombly, 2002, p. 160-162). Umphred (2013, p. 622) emphasises that righting and equilibrium reactions are dynamic reactions essential for the development of upright posture and smooth transitional movements. Righting reactions help maintain our head in an upright alignment and are the background for movement between positions. Equilibrium reactions occur in response to a change in body position or surface support to maintain body alignment. In simpler terms, righting reactions get us into a position and equilibrium reactions keep us in that position (Umphred, 2013, p. 623-625). Postural compensations are required for the maintenance of balance and functional movement when carrying a loaded backpack. Postural compensations due to backpack carriage include an increased forward head position and an increased forward lean of the trunk. Contrary to that, Radomski (2014, p. 123-137) describes postural adaptation as the ability of the body to maintain balance automatically and remain upright during alterations in position and challenges to stability.

2.2.3 Sensed Posture and Actual posture

Actual posture is considered as the posture that is visible to others. Sensed posture is invisible and is dependent on the person who senses it (Murray, 2002, p. 137). Due to the difference between sensed posture and actual posture, understanding how the two differ and how the body senses its posture as opposed the actual posture, will influence correct postural control on a child's body and their joint positioning in standing, walking and engagement in activity. It is important to understand this concept as this research study focuses on distinguishing between the sensed posture and actual posture, and the importance for a child to achieve the best posture by making relevant postural adjustments while carrying a backpack.

There is ample research done on the concept of sensed posture and external influences on the accuracy of the joint position. However, little evidence is noted regarding the sense of posture as a whole while a child carries a backpack. Hartsell (2000, p. 279-289) describes the effect of external bracing of the ankle on the sensed posture of ankle joint. It was proven that greater error in joint position exist in chronically unstable ankles in comparison to healthy ankles (Hartsell, 2000, p. 279-289).

A study by Lin (2016, p. 248) points to the influence of the height of one's shoes on the sensed posture or position at the knee joint. Specifically, the study findings revealed that while an elevated heel on one's shoe lead to an increased walking speed, the sensed posture of the knee is significantly decreased. Lin (2016, p. 248-257) conducted a study where the hypothesis was that the elbow and shoulder joint would have similar errors in sensed posture, and also that there will be no significant differences between left and right upper extremity joints. Their final research-supported hypothesis was that the sensed posture error will decrease nearing end of range of motion. This hypothesis was proven to be true in that there are no significant differences in sensed posture between the left and the right upper extremity joints (Lin, 2016, p. 248-257).

2.2.4 Postural Education and Children 's perspective of posture

Many studies related to posture have been done on children. These include studies featured by Burns (2016, p. 1-5) such as one by; Ghazala's (2014, p. 1-9) "Effects of heavy bags, plus desks, and postural variations", Kistner's (2012, p. 99-100) "Effects of backpack load carriage on cervical posture in primary schoolchildren" Vidal & Borras's (2012, p. 1-8), "The effects of postural education program on school backpack habits related to low back pain in children" and "Backpack carriage on head posture and ground reaction forces in schoolchildren". Of these investigations, Vidal's (2012, p. 782-787) study seemed most directly and immediately beneficial to the current study." Results from this study confirmed that children are able to learn healthy backpack habits and it might prevent future low back pain in children. Vidal & Borras (2012, p. 782-787) further emphasised that results from the Vidal's study were promising and suggested incorporating back care education in the training of

future primary school teachers. The results, also encouraged researchers to carry out intervention studies to determine the best way to reduce the prevalence of back pain, especially among children.

According to the Integrated School Health Policy Department of Basic Education (2018, p. 6), school health services are currently delivered by designated school health nurses who form part of the primary health care staff component. A review undertaken on implementation of the school health policy revealed that nurses identified a number of issues that impact on the provision of quality services, which includes partnership between the Department of Health with the Department of Basic Education. These issues have been raised and are in the pipe-line to be addressed by the government (Department of Education, 2018, p.6).

Once these issues are resolved an ideal platform for occupational therapists as part of the Department of Health multi-disciplinary team to engage in posture education will be created. However, investigations need to continue to build substantial and informative background. The integrated school health policy further states that most children spend up to thirteen years, from early childhood to young adulthood in school environment. This provides an ideal opportunity for postural training and intervention.

From the researcher's observation of multiple school communities, many different designs of backpacks exist, ranging from trolley with wheels, multicolour style fashion bags, sports bag to mere common backpack with two straps that go over the shoulders. The common backpacks seem to be the most commonly used due to their range in monetary value, durability and child preference. Prices of backpacks may vary from affordable to very expensive. These is what the parents focus on when deciding on the type of backpack their children need to use. Equally, this shows lack of education regarding the safety of the type and the weight of the backpack.

2.2.5 Sensory aspects in Sensed Posture

Two broad categories of sensations can be defined as primary sensations and cortical sensations. Primary sensations include exteroception and proprioception. The sensory component of sensorimotor control, namely proprioception, directly mediates feedforward and feedback

neuromuscular control of the body (Keir, 2002, p. 49-50). Proprioception is the most important sense addressed in this study, as it links directly to the individual's sense of position. Due to its importance in motor learning and postural response to new or changing environments, proprioception has significant connections to the cortical and cerebellar neural networks (Umphred, 2013, p. 620-625)

2.2.5.1 Proprioception

Lonn (2000, p. 592-597) describes position sense or sense of posture as the awareness of the actual position of the limb. Proprioception is a complex entity encompassing several different components, such as the sense of position, velocity, movement detection, and force, and that the afferent signals that give rise to them may well have origin in different types of receptors (Burns, 2016, p. 1-5). Proprioceptive input is an important aspect of our understanding of sensed and actual posture. It can potentially influence multiple levels of central nervous system function, and all of those levels can potentially modulate the intensity or importance of that information through many different mechanisms. Traditional evaluations of proprioception include the ability to distinguish motion, and motion direction at each joint. Proprioception may be tested by having the client close his eyes and then placing one of his limbs in a specific position and asking the client to copy the position and movement with the other limb (Umphred, 2013, p. 625). Various sensations can be impaired; problems in the sensory system are often reflected in the motor system, creating distorted movement through faulty information in the feed forward or feedback processes (Umphred, 2013, p. 620-625).

According to Murray (2002, p. 137), postural dysfunction is the outward manifestation of vestibular proprioceptive processing deficits. It is characterized by difficulty with proximal stability, low extensor muscle tone, poor prone extension, poor neck flexion against gravity and impaired equilibrium reactions. Substantiating this was a study by Georgy (2011, p. 201-207). The study was conducted with the purpose to compare the difference in repositioning accuracy, as a measure of lumbar proprioception, between patients with back dysfunction and healthy subjects. Georgy (2011, p. 201-207) concluded that differences in proprioception do exist between subjects with back dysfunction and normal subjects. The proprioceptive deficits do exist regardless of the cause of the back dysfunction and may represent an important aspect of the patho-physiology of such a condition.

2.2.5.2 Basal Ganglia

Basal ganglia refer to a group of subcortical nuclei responsible primarily for motor control, as well as other roles such as motor learning, executive functions and behaviours and emotions Lanciego. Et. al (2012, p. 1). The involvement of the basal ganglia in the initiation of movement may include a role in directing the postural adjustments necessary before distal movement can take place. In fact, in addition to the assumption of flexed, fixed postures, other postural abnormalities have been observed following lesions of the basal ganglia (Umphred, 2013, p. 662-669). According to Umphred (2013, p. 662-669), the exact role of the basal ganglia in postural stability is not known.

Studies of human disease processes support the hypothesis that the basal ganglia have a role in the postural mechanisms prior to active movement. Davies (2014, p. 24-25) in his extensive studies of patients with postural dysfunction, found that these patients, in addition to their akinesia, demonstrated severe disturbances in posture. Davies (2014, p. 24-25) and Umphred (2013, p. 662-669) noted that especially when vision was occluded these persons were unable to make the normal postural shifts involved in equilibrium reactions.

2.2.6 Postural abnormalities

Brukner & Khan (2009, p. 324) states that the most common postural abnormality of the spine in the younger athlete is excessive kyphosis of the spine due to osteochondrosis. This condition occurs typically in the thoracic spine but is also seen at the thoracolumbar junction and in later years may present an excessive thoracic kyphosis in association with a compensatory excessive lumbar lordosis (Brukner & Khan, 2009, p. 324).

In the case of vestibular loss, the sense of body position in space can be lost. Umphred (2013, p 624) explains that postural reflexes triggered by a perturbation may not be appropriate for the actual circumstance and therefore may cause destabilization. Clients with vestibular deficits often hold the center of gravity in a posterior position during quite stance. When perturbed, they reach their posterior limits of stability before appropriate postural adjustments can be made. This can result in a fall backward (Umphred, 2013, p 624).

Postural abnormalities, minor strains or excessive repetitive movements of the neck, can cause certain abnormalities of the neck muscles and fascia, which are common and readily recognized. One such abnormality is shortening of the trapezius muscle that occurs secondary to persistent shoulder elevation. Similarly, the levator scapulae muscle is a common site of pain (Brukner & Khan, 2009, p. 657).

A number of syndromes may be the result of poor posture assumed when a child is carrying a backpack. These syndromes are characterized by a typical posture of protracted chin and increased upper cervical lordosis (Brukner & Khan, 2009, p. 657). The patient typically has a stiff thoracic kyphosis associated with rounded shoulders, tight pectoral muscles, restricted shoulder movements and forward carriage of the head. It is classically seen in older women suffering osteoporotic thoracic kyphosis but may also be seen in any athlete who adopts prolonged postures. These include cyclists, baseball catchers and hockey players. Similar problems occur in the workplace among visual display unit operators, printers and production line workers (Brukner & Khan, 2009, p. 657-658).

2.3 Assessment of Posture

Postural inspection is normally performed by assessment of body alignment in relation to lateral, posterior and anterior views as displayed on page xii (Kendall, 2005, p. 343). In the current study, the focus during assessment will be on biologically meaningful points on a human body of which in this study refers to the following; nose, navel, mid heels, mid knees, lateral malleoli, greater trochanter, acromion, earlobe as outlined on picture 1 on page xii (Kendall, 2005, p. 343). Assessment will only focus on the anterior and lateral views in the current study.

2.3.1 The purpose of assessing posture

The purpose of assessing posture is to establish the state of postural alignment, and to identify possible deviations between anatomical landmarks and the plumb line. Postural assessment in

school-going children aims at improving the well-being of current and future school-going children. It has been seen successful in improving some aspects of posture over the years. Philippa (2008, p. 1-7) for instance, suggests that the clinical examination of the musculoskeletal system routinely commences with postural assessment and observation.

There is research evidence on the value of assessment of posture. To this end Vidal & Borras (2012, p. 782-787) report on a study conducted by Goodgold & Nielsen (2011, p, 43-47), who conducted a backpack health promotion program on 252 children aged 10-12 years (AOTA, 2018, p. 98-99). The program consisted of one session evaluating the backpack use (type, and how it is carried), locker usage, use of strategies to reduce backpack weight, self-perceptions (heaviness and comfort), history of back pain and recurrence, and belief that improper backpack use can cause injury. The postural programme resulted in positive changes, as 42% of the participants changed the way they used their backpack and 63% reported that the backpack program was worthwhile.

2.3.2 Methods and tests used in assessment of Posture

According to Vegar (2014, p. 1-7), numerous methods can be used to assess postural alignment defects. These methods include among others, visual observation, goniometry, photographic, radiographs, photogrammetry, flexiruler, electromagnetic tracking, as well as the plumb line method. Vegar further states that visual observation is the most generally used method to assess posture in clinical practice despite its inability to detect minor postural changes. On the other hand, Badhe & Kulkarni (2018, p. 08-15) also view visual observation method as widely working and still well-known due to its low cost, however it still has limitation that include deviation detection and giving detailed information.

The sensory organization Test (SOT) is an example of other tests used for assessment of posture. The test uses sophisticated computerized movable visual surroundings to systematically alter the surface and visual environments (Umphred, 2013, p. 629-630). These tests were developed to measure the use of sensory inputs to produce a balance performance outcome as literature suggests that sensory inputs play a critical role in postural control.

X-rays are noted with emphasis as effective methods for routine use to measure curvatures of the vertebral column and to analyse vertebral conditions (Badhe & Kulkarni 2018, p. 08-15). Although X-rays are considered to be the excellent standard regarding the observation of posture deviations, they expose individuals to radiation and this has a negative accumulative effect and is a health risk (Badhe & Kulkarni, 2018, p. 8-15).

Another method that is easy to use and provides a low-cost quantitative evaluation of spinal curvatures in the sagittal plane is the flexible ruler. Studies show exceptional levels of inter and intra-evaluator reproducibility and strong correlation between the method of flexible ruler and X-rays. In flexible ruler, 60 cm long coated lead made of plastic is moulded to an individual's spine, the mould is thereafter transferred to a sheet of paper where the values in millimetres of the spine curvatures are calculated (Badhe & Kulkarni, 2018, p. 8-15).

There are other interesting but expensive methods such as laser acquisition system used in scanners that consists of 3D optical measuring system that produces a digital copy of the surface of a human body (Badhe & Kulkarni, 2018, p. 8-15). In contrast, Badhe & Kulkarni (2018, p. 8-15) suggest that photography or filming are low cost methods which are easy and quick to use. Photography or filming methods enable clinicians to notice postural changes with time, and inter-relate various body parts through measurements with specific software. These methods need several methodological steps such as choice of environment, camera position, resolution of the image captured and the use of anatomical markers to standardise the photos or films and reduce measurement errors. Badhe & Kulkani (2018, p. 8-15) however believe these steps make this method more complex, add costs, require calibration and is not usually available for analysis in surgeries and clinics.

Results from a study by Petersen, Zimmermann, Cope, Bulow & Ewers-Panveno (2008, p. 7) proved that postural assessments using photographs produced satisfactory results when compared to other methods such as X-ray. Hough & Nel (2019, p. 42-47) developed the Photographic Method of Postural Assessment (P-MPA) that quantitatively measures postural alignment. The P-MPA proved to accurately measure deviations between anatomical landmarks and the line of gravity, and also proved to be reliable in terms of reproducibility. The researcher used the P-MPA in the current study.

In the set-up for the P-MPA, the participant assumes a position of 1 meter behind the plumb line, with the plumb line aligned with the anterior aspect of the lateral malleoli for the lateral standing position, and with the plumb line aligned with mid heels for the anterior standing position. The participant is asked to assume their most natural standing position. For the taking of measurement, the researcher assumes a position of 2-meter distance from the plumb line. Photographs are taken by the researcher with a smartphone that is fixed on a tripod at a height of 950mm.

Photographs are then printed in A4 size, after which measurements are taken with a ruler with increments in mm and transferred to data forms by the researcher. The actual (real) distance on photos is established by calculating the **ratio** of *measured distance/real distance x distance* from plumb line for each photo. A measuring tape of 1000mm is put up against the wall, to indicate reference for real distance, when the ratio is calculated. A clinical significant difference from the reference point as measured on the photo is set at 10mm (Grosso, Negrini, Boniolo & Negrini, 2002, p. 123-125).

2.4 Conclusion

From this literature review, the researcher concludes that posture is the outward manifestation of vestibular and proprioceptive processing (Crouch & Alers, 2014, p. 374-375) which will help prevent unnecessary postural deformities and injuries resulting from poor posture. Further investigation on sensed and actual posture of a schoolchild who carries a backpack is highly necessary, since seemingly hardly any evidence exists in literature regarding the influence of the two on each other while a child carries a backpack.

In occupational therapy intervention, occupational therapists use educational approaches and education-based methods to inform clients about the correct postural alignment, implications thereof to activity participation and with regard to any secondary effects caused by bad posture; for instance, back pain or external stimuli like a backpack. In order for occupational therapists to provide a school going child with knowledge of the correct postural alignment, it is imperative to know

whether the child can effectively and accurately determine the position of their body parts and maintain the correct position.

During education-based intervention, it is assumed that a child's sensed posture and actual posture are in line with one another as they carry their backpacks, however no research has been done on the correlation between sensed posture and actual posture while a child is standing and carrying a backpack. To be precise, knowledge lacks to confirm if the client's sense of posture is accurate enough for them to accurately respond to intervention strategies.

The existing Integrated School Health Policy states its goal as to contribute to the improvement of the general health of school-going children as well as the environmental conditions in schools. The Policy also addresses health barriers in relation to learning in order to improve education outcomes. occupational therapists are regarded as key role players in achieving this goal (Department of Education, 2018, p. 6). Through the current study, knowledge of what is fundamental comparative to sensed posture relative to actual posture may add value to the South African government goals. If this happens many families would financially and medically benefit as more strategies will be followed by the government to support postural awareness campaigns in schools.

CHAPTER 3 – RESEARCH METHODOLOGY

3.1 Introduction

The literature review in the previous chapter brought evidence relating to the complexity of posture in young children. It highlighted the dynamics of automatic postural responses in relation to stimuli of direction and amplitude. The differences between bad and good postures were described and one could conclude that children do certainly not receive postural education regularly. Despite available research evidence on single joint studies, a gap still exists in evidence pertaining to the difference in sensed and actual posture while a child is carrying a schoolbag.

This chapter discusses the study design and research methodology that were followed during the data collection process of this research study. The study design was a quantitative cross-sectional, descriptive study and the methodology relating to the study is discussed with reference to the population, sampling, measurement instrument, pilot study, data collection procedure, data analysis, reliability, measurement errors and ethical consideration.

3.2 Research Aim

The aim of the current study is to establish the difference between sensed and actual posture while a Grade 5 learner is standing and carrying a schoolbag.

The objectives of the study were to measure the sensed and actual posture with and without a backpack in lateral and anterior views (appendix M), and to describe the difference between sensed and actual posture for the respective levels of anatomical landmarks.

1. Anterior view: with and without backpack with relation to the anatomical landmarks mid feet, navel, sternum and nose.

2. In lateral view:

2.1 Right side: with and without backpack with relation to the anatomical landmarks lateral malleoli, mid-knee, greater trochanter, acromion process and earlobe.

2.2 Left side: with and without backpack with relation to the anatomical landmarks lateral malleoli, mid-knee, greater trochanter, acromion process and earlobe.

3.3 Research Design

The researcher used a quantitative descriptive cross-sectional research study design. The study was descriptive in that it described the difference between sensed and actual posture while a Grade 5 learner was standing with and without a backpack (De Vos 2011, p. 251). A number of anatomical landmarks, at different levels were compared for sensed and actual data and described in terms of anterior and lateral views.

3.4 Research Population

The study population included participants in Grade 5 registered with the Free State Department of Basic Education from the Botshabelo district. This population was chosen because the researcher had observed that at Grade 5, learners carry heavy backpacks, and the learners of Botshabelo district share similar socio-economic status.

3.5 Research Sample

Proportional random sampling was used to select 198 Grade 5 participants from blinded lists of 19 schools. Only participants whose parents had given consent participated in the study. Primary schools, registered with the Free State Department of Basic Education, and currently functioning public primary schools were chosen. Table 1 shows the distribution in numbers of participants who participated per school. The consent forms and information letters were provided to all sampled participants prior to data collection.

Table 1: Population and sampling

Name of schools	Total number of Grade 5s per school	Proportional sample per Grade per school
1. Batja Primary school	117	12
2. Bothobapelo Primary school	34	4
3. Dibeng Sa Tsebo Primary school	167	17
4. Ditholwana Primary school	42	4
5. Fadimehang Primary school	69	7
6. Hohle Primary school	139	14
7. Lerole Primary school	67	7
8. Mabela Primary school	106	11
9. Mpolokeng Primary school	115	12
10. Nkgothatseng Primary school	80	8
11. Nthabeleng Primary school	12	1
12. Pontsheng Primary school	140	15
13. Reentseng Primary school	85	9
14. Retsamaile Primary school	70	7
15. Sebabatso Primary school	146	15
16. Seroki Primary school	76	8
17. Setjhaba-se-maketse Primary school	135	14
18. Thabo Primary school	193	20
19. Tlholo Primary school	129	13
Totals	**1934**	**198**

3.5.1 Inclusion criteria

Inclusion criteria dictates compliance of participants in order to form part of the study and is therefore essential to specify. In the current study all participants met the following criteria.

- Learners registered with the Free State Department of Basic Education;
- Both male and female learners;
- Learners who were able to assume a standing position for at least 5 minutes;
- Learners who gave assent and whose parent gave consent;
- Learners with the cognitive capacity to understand and follow verbal instructions and complete a questionnaire in either Sesotho or English with the assistance of the researcher.

3.5.2 Exclusion criteria

To ensure that only the targeted population participated, exclusion criteria was followed and the following learners were excluded from participation:

- Learners with intellectual and physical temporary or permanent disabilities;
- Learners diagnosed with motor perception disorders;
- Learners below the age of 10 and above the age of 13. Learners 9.5 years and above were considered 10 and learners below 13.5 were considered 13.

3.6 Data Collection

Data as information gathered in research and collected according to a methodological procedure and measuring evidence on variables of interest to serve the research purpose (Graziano & Raulin, 2014, p. 392).

Data was collected by means of a biographical questionnaire (appendix K/L) and Photographic method of Posture Assessment (P-MPA) (Hough & Nel 2019, p. 42-47). Photos of the actual posture of participants were taken and deviations recorded on a data form in millimetres(mm) (appendix M). This will be discussed further in the next section.

3.6.1 Measurement Instrument

Good measures are reliable and therefore give consistent results regardless of who does the measuring (Graziano & Raulin, 2014, p. 392-394). In this study, biographical questionnaire and the Photographic method of posture assessment are the two measurement instruments that were adopted for collection of data.

3.6.1.1 A Biographical questionnaire (appendix K/L) consisting of 23 questions was used to gather information focusing on the following aspects:

a. Personal information
b. Schoolbag use
c. General health
d. Posture knowledge
e. Sport activities

For the majority of questions, the participants were expected to answer "yes or no". Some questions needed more elaboration as the options were descriptive.

3.6.1.2 The Photographic method of Posture Assessment (P-MPA) (Hough & Nel, 2019, p. 42-47); was used to obtain quantitative data for sensed and actual postural alignment.

Figure 1 illustrates the set-up for the P-MPA.

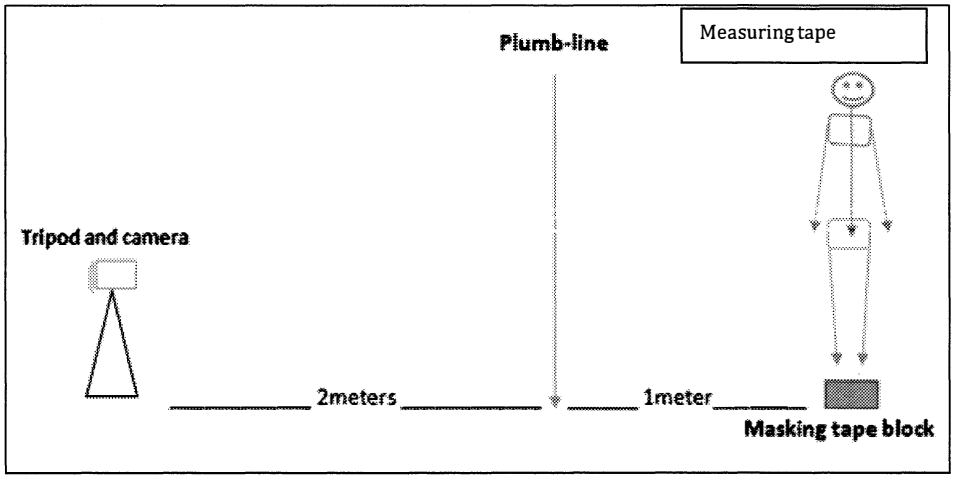


Figure 1

In the set-up for the P-MPA as illustrated in figure 1 above, the participant assumes a position 1 meter behind the plumb line, with the plumb line aligned with the anterior aspect of the lateral malleoli for the lateral standing position, and with the plumb line aligned with mid heels for the anterior standing position. The participant is asked to assume their most natural standing position. For the taking of measurement, the researcher assumes a position of 2-meter distance from the plumb line.

Photographs are taken by the researcher with a smartphone that is fixed on a tripod at a height of 950mm.

Photographs are then printed in A4 size, after which measurements are taken with a ruler with increments in mm and transferred to data forms by the researcher. The actual (real) distance on photos is established by calculating the **ratio** of *measured distance/real distance x distance* from plumb line for each photo. A measuring tape of 1000mm is put up against the wall, to indicate reference for real distance, when the ratio is calculated. A clinical significant difference from the reference point as measured on the photo is set at 10mm (Grosso, Negrini, Boniolo & Negrini, 2002, p. 123-125).

The P-MPA was proved valid and reliable for the measurement of postural alignment (Hough & Nel, 2019, 42-47). Differences between measured and actual values were proved clinically insignificant and the P-MPA was therefore used as measurement tool for the assessment of posture in the current study.

During data collection bright coloured stickers were used to mark the targeted anatomical landmarks, followed by six photographs taken for anterior and lateral views, with and without a backpack.

The researcher asked the participants questions relating to sense of posture and immediately recorded the responses on the data form (appendix M). Measurements of actual postural deviations were done at a later stage after all photographs had been printed.

A typical backpack (appendix P), with typical weight was used. The size and the contents of the backpack were according to what a Grade 5 learner is expected to carry to school and represented, books, lunch box and pencil case. The bag and contents were verified as typical by three Grade 5 teachers randomly selected from one of the involved schools, namely Lerole Primary School.

3.6.2 Data Collection Steps

Data collection was divided into ten steps for easy explanation of the procedure by the researcher:

First step

- Permission to conduct the study was firstly obtained from the Health Sciences Research Ethics Committee and the Department of Basic Education and then permission letters were prepared for handing to the respective school principles

- The researcher contacted the principals through e-mail outlining the purpose of the study and explained how data would be collected and when the consent forms and information letters would be delivered to the school.

Third step

- The researcher obtained agreement with the principals to collect data and obtained lists of participants in Grade 5 per school. The lists were sent to the biostatistician in a blinded format for sampling. The Biostatistician provided the researcher with samples per schools.

Fourth step

- Following this, the researcher visited the schools to finalise and confirm the sample with the principals and obtained an agreement with the relevant teachers for data collection date.

Fifth step

- Information, consent and assent forms were given to the principals to send home with the participants (appendix G/H, I/J)

Sixth step

- The researcher followed up telephonically to confirm if the consent forms were returned.

Seventh Step

- On the day of data collection agreed upon, information about the study was given to the participants whose parents had given consent. Subsequently, an assent form (appendix N/O) was filled by the participant who was further given the final opportunity to ask questions for clarification.

Eighth Step

- Data was gathered in phases as explained under 3.6.3

Ninth Step

Data was checked and captured on an excel spread sheet twice to ensure accuracy.

Tenth Step

Data was sent to the Department of Biostatistics for verification and analysis.

The above steps took place in all of the 19 schools illustrated in Table 1. The same procedure was followed for the pilot study as detailed in 3.9 below.

3.6.3 Data Collection Procedure

The participants were in their classrooms on the day of their participation; the researcher confirmed data collection procedure with their teachers a day prior to participation. Data collection took place from 21st January 2019 to 8th March 2019.

Handling of information, consent and assent documents prior data collection

i. The information documents, ethics approval, copies of questionnaire, assent and consent forms were distributed to the school principals.

ii. Dates and times were arranged with school principals for data collection. Some school principals informed Grade 5 class teachers of dates and times for data collection and the class teachers took over the responsibility of working hand in hand with the researcher. In some schools, the principals took the responsibility upon themselves.

The procedure for data collection that took place in phases is described below.

Phase 1: Set up for data collection

Phase 2: Collection of participants

Phase 3: Information session

Phase 4: Administration of the questionnaire

Phase 5: Gathering actual posture data

Phase 6: Gathering sense of posture data

Phase 7: Coding of questionnaire

Phase 8: Measurement of actual data

Phase 9: Data sent to Biostatistician

Phase 1. Set up for data collection:

Set up for data collection (Figure 2) was done on the day of data collection in a room provided for data collection, as identified and pre-arranged with school principal.

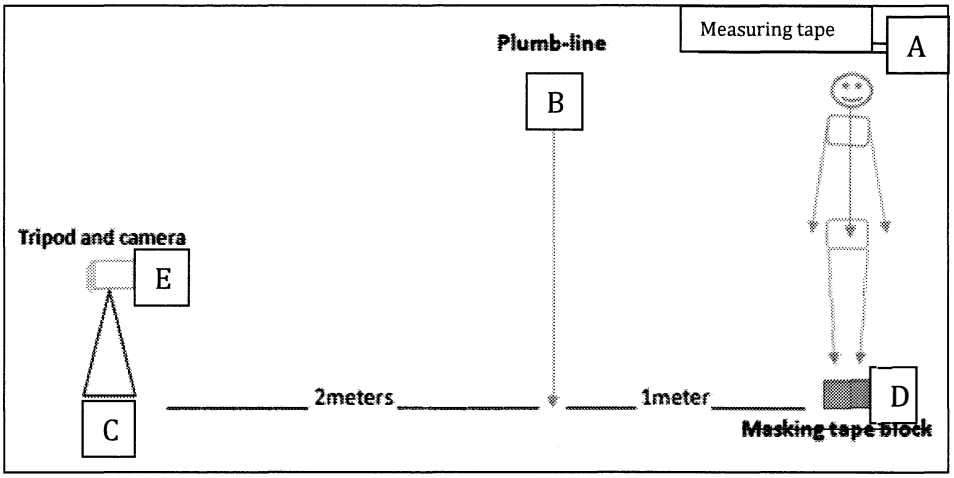


Figure 2

i) A 1-meter measuring tape (A) was placed horizontally at a height of 2 meters on the wall.

ii) The plumb line (B) was secured from the ceiling with the lead point of the plumb line touching perpendicular to the floor.

iii) A tripod (C) with camera (E) was set up at 2 meters from the plumb line (B) for the purpose of taking photos.

iv) A laminated footprint chart (D) was fixed on the floor at 1-meter distance from the plumb line to indicate the participant's standing position.

v) A table was set up behind the tripod with questionnaires and equipment that the researcher needed during data collection.

vi) The researcher took six photographs: Once the participant had been collected from their classroom and a structured interview session had been completed, photographs were taken: three with a backpack (lateral left and right, and anterior), followed by three without a backpack (lateral left and right, and anterior).

Phase 2. Collection of participants

i) The researcher collected the participants from their classroom as pre-arranged with their class teacher. In some schools, the class teachers brought the participants to the room allocated for data collection.

Phase 3. Information Session

i) A summary of information regarding the research was given to participants as they come in for data collection, as a detailed information pamphlet had already been sent home with the consent forms. The information sessions were presented by the researcher and all questions were addressed prior to data collection. Data collection only commenced after the participant had given assent by signing the assent form (appendix N/O).

Phase 4. Administration of the questionnaire

i) After the information session, the structured interview was carried out and the researcher assisted by clarifying some questions to the participants when it became necessary.

Phase 5. Gathering <u>actual posture</u> data

On each day of data collection:

(i) The researcher marked anatomical landmarks by applying brightly coloured stickers on each anatomical landmark of the participant i.e. lateral view: lateral malleoli, mid-knee, greater trochanter, acromion process and earlobe and anterior view: mid feet, mid knees, navel and nose.

(ii) The participants were asked to assume lateral left and right, and anterior positions standing behind the plumb line. When assuming these positions, the participant firstly carried a backpack, and secondly, without a backpack.

(iii) The researcher took photographs in;

a. Standing position **with** a backpack:
    i. Lateral view (left and right): The plumb line point of reference was aligned with the anterior aspect of the lateral malleolus.
b. Standing position **without** a backpack:
    i. Lateral view (left and right): The plumb line point of reference was aligned with the anterior aspect of the lateral malleolus.
c. Standing position **with** a backpack:
    i. Anterior view: The plumb line point of reference was aligned with the mid-heels of the participant.
d. Standing position **without** a backpack:
    i. Anterior view: The plumb line point of reference was aligned with the mid-heels of the participant.

Phase 6. Gathering sense of posture data

For the three respective views namely lateral (left and right), and anterior view, the participants were requested to verbally indicate their sense of deviation of each anatomical landmark in relation to the plumb line by indicating front/behind/left or right of the plumb line, or typical if no deviation was sensed. Sensed deviations were indicated using increments of mm, on lateral views the participants were allowed to turn their heads to check the distance of the plumb line and then position themselves in their most comfortable position again. The researcher documented the results of the participants' sense of posture on the data form (appendix M).

Phase 7. Coding of questionnaire

The researcher coded the questionnaires and captured the findings on an excel spread sheet twice to ensure accuracy.

Phase 8. Measurement of data

The researcher printed the photographs and measured actual posture on the photographs and captured the results on an excel spread sheet twice to ensure accuracy.

Phase 9. Data sent to Biostatistician

Data was sent to the Department of Biostatistics for analysis and interpretation.

3.7 Data Measurement Procedure

Measurement: Participants stayed in their school uniform during data collection. They were requested to remove heavy, unnecessary and loosely fitted clothing. The following landmarks as illustrated on picture 1, page xii under clarification of terms, were marked with a 5 mm colour sticker by the researcher:

- Lateral view (left and right): Anterior aspect of lateral malleolus, mid knee, greater trochanter, acromion and earlobe.
- Anterior view: mid-heels, mid-knees, navel, and nose.

Measurement of actual posture: Measurement of data entailed the following:

- Photos of lateral (left and right) and anterior view, with and without backpack were printed in A4 size (Appendix Q).
- The distance between the plumb line and each anatomical landmark was measured on the printed photograph (in mm) with a clear ruler.
- The length of the measuring tape on each photo was measured and recorded on the data form in mm.
- Finally, the measurements of actual posture and sense of posture were transferred to an excel spread sheet by the researcher, and then re-transferred to a different spread sheet to ensure accuracy.

10mm difference between sensed and actual posture was regarded as a clinical significant difference to allow for breathing and repositioning (Grosso, Negrini, Boniolo & Negrini, 2002, p. 123-125).

3.8 Measurement and Methodological Errors

According to Grove et al. (2014), measurement and methodological errors are certainly part of the research process, common factors that contribute to these errors are discussed in this section, the researcher explores these aspects and how there were addressed during the study.

Every project includes one or more variables that the researcher manipulates and measures (Graziano & Raulin 2014, p. 78). The authors describe a variable as any characteristic that can take more than one form of value and any event can be a research variable. Measurement error misrepresents the scores so that the observation does not accurately reflect reality (Graziano & Raulin, 2014, p. 83).

Validity of data management: To avoid measurement errors, steps were taken to ensure validity of the results of posture assessment of the participants. During the information session, the researcher verbally requested participants who finished the process to not communicate it with those participants that will still be assessed, this assisted participants to respond honestly and thoroughly during data collection. In addition to that, a visible note was always attached on the exterior side of the door where data collection took place.

Validity and Reliability of the instruments

The Photographic Method of Postural Assessment (P-MPA) that was used for the assessment of posture in the current study (Hough and Nel, 2019, p. 42-47), has been proved valid and reliable.

The following were taken into account to enhance reliability and validity:

i. A questionnaire was compiled using literature and assessment tools specifically aimed at assessment of posture.
ii. The 1 metre measuring tape was measured in each photograph to ensure correct measurement.
iii. Data integrity was enhanced by typing measurements from the data form into an excel spread sheet twice by the researcher.
iv. Measurements were verified by the biostatistician before analysis.
v. A pilot study was done in one of the 19 schools prior to data collection.

Table 2: Methodological and measurement errors

Possible methodological and measurement errors	Plan to limit the errors
The participants may have been overwhelmed by the participation experience and this might influence their willingness to participate.	The researcher ensured that participants understood the purpose of the study and communicated in the participant's preferred language.
The participants may be worried that participation would compromise their lesson attendance time	Data collection was done during lunch time or at a time confirmed feasible by the principal. The questionnaire was short (10 minutes), and the researcher assisted by conducting a structured interview.
Participants may be concerned about their personal information not being kept confidential.	The researcher clarified that confidentiality was a crucial issue of the study and that there were measures in place such as HSREC to guarantee confidentiality. The researcher further ensured that doors were closed during participation with an informative note at the door. The researcher covered the participants face with a child friendly face musk to de-identify the participants on the photographs.
Participants may share their experience of the research with the participants who have not taken part yet.	The researcher requested the participants not to share information related to data collection with the participants who were waiting to take part.
The validity and reliability of the questionnaire can be questioned.	The researcher used the literature and existing assessment tools specially meant to assess posture. The P-MPA validity and reliability was tested and proven (Hough & Nel, 2019, p.42-47).

	The questionnaire was tested during the pilot study.
Knowledge and skill of researcher in performing assessment of posture	The researcher's experience in assessing posture while assisting the Department of Occupational Therapy and Biostatistics of the University of Free State (UFS) in 2017 posture related research was taken into consideration.
Measurement errors	The participants were asked to stand 1 metre from the plumb line, to exclude possibility of touching the line during measurement. The tripod and camera were in a predetermined and fixed position, as well as masking tape block indicating the standing position of the participant (figure 1).
Coding errors	The researcher double checked the questionnaire and entered the coding twice on the excel spread sheet to eliminate coding errors.
Photo measurements error	The researcher measured the distance between the respective anatomical landmarks and plumb line on each photograph.
Data recording errors	Data was recorded on an excel spread sheet twice to ensure accuracy. The biostatistician further verified data before data analysis was done.
Backpack weight, height and contents may differ	A standard backpack of the same weight as per agreement with at least three teachers of what is expected in a backpack, with the same contents as demonstrated in (appendix P) was used.

3.9 Pilot Study

In a quantitative study method, the completion of the piloting process should leave the researcher feeling confident that all the preparatory work has paid off and that the tools that will carry out the real study are all available (Davies & Hughes, 2014, p. 25).

The pilot study was undertaken on 07th November 2018 prior to school examinations. Davis and Hughes (2014, p. 24-25) suggests that the research instrument should be tried out on subjects as similar as possible to those whom the researcher targets. The pilot study was carried out in order to test the research procedures, and whether the components of the study were organized. Two learners of one of the schools were chosen to be part of the pilot study.

During this process, the researcher was able to identify practical problems related to posture, data collection and the coding of questionnaires. Challenges discovered during the pilot study were amended before data collection. This process also provided an opportunity to reduce the margin for errors in the main study.

Challenges discovered during data collection included time management, the researcher learned how much time she spent with each participant and therefore planned the actual data collection accordingly. The discovery also guaranteed the knowledge of the researcher on how to administer instructions clearly and correctly to participants in order to avoid misunderstandings. Lastly it assisted in elimination of possible errors.

All questionnaire answers and data forms completed in the pilot study were coded and entered into an excel spread sheet twice to ensure accuracy. The process ensured that there were no errors on coding, and it further re-assured the researcher that the excel sheets were relevant for the study. The results of the pilot study did not form part of the main study data analysis.

3.10 Data Analysis

The research results were processed and analysed by the Department of Biostatistics at the University of the Free State.

Descriptive statistics in the form of frequencies and percentages for categorical and means and standard deviations or medians and percentiles for numerical data were calculated. The participants were compared by means of 95% confidence intervals. The analysis was carried out by the Department of Biostatistics.

3.11 Implementation of findings

After completion of the study, the findings will firstly be shared at occupational therapy academic and clinical platforms. The findings will secondly be presented to the Free State Department of Basic Education. Above it all, the findings will serve as a guideline for the teachers and parents on how to guide and assist learners in their postural alignment. Furthermore, it is imperative that parents be informed on how the sensing of posture and actual posture differs, and the significance of this difference in their children's activities of daily living. This study's results will further be of benefit to book-carrier manufacturing factories. After completion of this study, the findings will be developed into an article suitable to be submitted for publication by an accredited peer-reviewed journal.

3.12 Ethical Considerations

Davies & Hughes (2014, p. 24-25) emphasised that the researcher must take full account of ethical issues associated with their study. These issues can relate to the topic one is engaged in, the way in which participants were approached and how data was handled once it had been gathered. In the current study the following key ethical issues were addressed:

1. The research ethical requirements of the UFS were complied with as follows:

The research protocol was evaluated by the following UFS personnel and committees for approval:

i The study leader at the Department of Occupational Therapy,

ii The Department of Biostatistics (appendix A),

iii The research evaluation committee of the School of Allied Health Sciences (appendix B).

2. The HSREC of the UFS (appendix C) and approval was granted (UFS-HSD2018/1305/2901).

In addition to the above-mentioned procedures, an application for approval to perform the study in the Department of Basic Education was submitted to the Department of Basic Education and approval was granted on the 25th September 2018 (appendix E).

3.12.1 Informed consent, confidentiality and assurance of privacy

Learners were only allowed to participate in the study if their parents or guardians had given informed consent by signing the consent form (appendix I/J). Participants were further requested to read and sign assent form (appendix N/O) prior participation.

Information about the study and that participation is voluntary was provided in an information letter (appendix G/H). Information was available in English and Sesotho. The information letter further included the details on the method of data collection, purpose of the study and contact details of the researcher.

Participants were assured that data collected would be kept confidential and none of their rights or privacy would be violated. Numbers instead of names of participants were furthermore used to enhance confidentiality and only the researcher had access to the lists of names of the participants. Confidentiality will further be maintained during publication and research presentation. Participant's faces were de-identified through provision of a child friendly face mask to wear when all photographs were captured.

Participants were assured that they would not be placed in any harmful situation, that they will be treated with respect and the researcher ensured professionalism at all times. They were further given allowance to quit participation at any stage when they felt like it without expecting any punishment or being un-favoured.

The information letter explained that there were no financial implications relating to the study for the participants. Participants could choose their preferred participation language between English and Sesotho.

Full disclosure regarding the study aim, implications of the results, possibility of publishing the results was included in the information letter (appendix G/H) and were provided to the participants and the parents. It was further summarised on the day of data collection.

3.13 Summary

The current chapter focused on describing the methodology in detail. Descriptive cross-sectional study design was used in order to achieve the study aim. The population included Grade 5 learners from a common socio-economic environment. In this chapter all data collection phases and steps were emphasised. Data collection instruments were described and how they would be used in the current study. Measurement errors were established and strategies that were used to prevent the errors were outlined. Lastly, handling of ethical issues was explained in this chapter.

The next chapter will portray the results of descriptive statistics. This will be done through use of tables, figures and descriptions.

CHAPTER 4 – RESEARCH RESULTS

4.1 Introduction

The aim of the current study was to establish the difference between sensed and actual posture while a Grade 5 learner is standing and carrying a backpack.

The objectives of the study were to measure the sensed and actual posture with and without a backpack in lateral and anterior views (appendix M), and to describe the difference between sensed and actual posture for the respective levels of anatomical landmarks.

1. Anterior view: with and without backpack with relation to the anatomical landmarks mid heels, mid knees, navel and nose.
2. In lateral view:

2.1 Right side: with and without backpack with relation to the anatomical landmarks lateral malleoli, mid-knee, greater trochanter, acromion process and earlobe.

2.2 Left side: with and without backpack with relation to the anatomical landmarks lateral malleoli, mid-knee, greater trochanter, acromion process and earlobe.

In this chapter, results are presented to address the aim and the objectives listed above. The results will be presented in table format and in some instances in text form. The results will further be presented in frequencies and percentages and all percentages will be converted to the nearest decimal. Deviations from the plumb line were reported in millimetres(mm).

Firstly, participants were described, and secondly results from the biographical questionnaire (Appendix K/L) were presented with reference to the following;

f. Personal information
g. Schoolbag use
h. General health
i. Posture knowledge

Lastly, results pertaining to sensed and actual posture for each anatomical landmark in lateral and anterior view will be presented and summarized.

4.2 Description of Participants

Data was collected from 198 participants (as stipulated on table 4.1 below) who are currently registered with the Department of Basic Education and are in the same socio-economic area Botshabelo. Two hundred participants were initially scheduled for the current study, of whom 2 participants were excluded from participation as they did not comply with age inclusion criteria. This implies that the response rate was good since 96.0% of the expected population participated. Fifty four percent of the study population was boys and the median age amongst all participants was 10.6 with the youngest participant being 9.6 years old and the oldest being 13.4 years old.

Table 4.1 PARTICIPANTS PER SCHOOL: n=198

Name of schools	Total number of Grade 5s per school	Proportional sample per Grade per school
Batja Primary school	117	12
Bothobapelo Primary school	34	4
Dibeng Sa Tsebo Primary school	167	17
Ditholwana Primary school	42	4
Fadimehang Primary school	69	7
Hohle Primary school	139	14
Lerole Primary school	67	7
Mabela Primary school	106	11
Mpolokeng Primary school	115	12
Nkgothatseng Primary school	80	8
Nthabeleng Primary school	12	1
Pontsheng Primary school	140	15
Reentseng Primary school	85	9
Retsamaile Primary school	70	7
Sebabatso Primary school	146	15
Seroki Primary school	76	8
Setjhaba-se-maketse Primary school	135	14
Thabo Primary school	193	20
Tlholo Primary school	129	13
Totals	1934	198

All participants indicated that they had a schoolbag. Of these participants, 96.0 % indicated their type of a schoolbag as a backpack. Furthermore, 95.0% reported to be carrying their backpacks daily; while 80.8% indicated that they liked their backpack. The table below presents in descending frequencies, the different reasons the participants gave for liking their backpack.

Table 4.2 REASONS FOR LIKING THEIR BACKPACK: n=160

REASON	FREQUENCY	PERCENTAGE
Helps me carry books	67	41.9%
It is beautiful	35	21.9%
It is comfortable	21	13.1%
Helps carry books well	14	8.7%
It keeps my books safe	6	3.8%
It is new	6	3.8%
It is important to me	5	3.1%
It is strong	3	1.9%

It is mine	1	0.6%
For no reason	1	0.6%
It is not comfortable	1	0,6%

One hundred and eighty-eight (188), being 94.5% of the participants indicated that they experienced pain in their body. Most (34.3%) of them pointed to pain at the shoulders; while 3 participants (1.5%) indicated pain on the stomach. Detailed areas of experienced pain are illustrated in table 4.3 below.

TABLE 4.3 AREAS OF PAIN: n=188

AREA/ BODY PART	FREQUENCY	PERCENTAGE
Shoulders	68	34.3%
Back	64	32.3%
Neck	62	31.3%
Waist	35	17.7%
None	31	15.7%
Head	21	10.6%
Arms	20	10.1%
Hands	19	9.6%
Feet	15	7.6%
Stomach	3	1.5%

Barely more than half (51.5%) of participants indicated that they experienced the pain on daily basis while 46.1% experienced the pain occasionally. Only a few participants (2.4%) indicated that they experience the pain constantly.

The participant's general health status and history were investigated and 57.6% of the participants reported to have never been ill in the past six months. The rest of the participants (42.4%) reported to have been ill with different kinds of ailments with flu being the most (17.9%) commonly reported.

When knowledge relating to posture and postural background was investigated, 72.7% of the participants reported that they have never been taught about posture before. The other 54 participants who had been taught about posture before, mentioned different people (as stipulated on Table 4.4 below) who taught them about posture.

TABLE 4.4 POSTURAL EDUCATION: PARTICIPANTS WHO INDICATED THAT THEY HAVE BEEN TAUGHT ABOUT POSTURE: (n=54)

WHO TAUGHT PARTICIPANT ABOUT POSTURE	FREQUENCY	PERCENTAGE
Teachers	40	75.5%
Mother	5	9.4%
Brothers	4	7.6%
Friends	4	3.8%
Doctors	1	1.9%

Regarding the knowledge relating to the difference between good and bad posture, 57.1% of the participants indicated that they knew the difference between good and bad posture. They further indicated different postures that they assume when carrying a backpack. Some indicated that they bend backwards (16.2 %), some sideways (1.5%), some walk up straight (27.3%), and some were not sure, while the majority (53.0%) indicated that they bend forward when carrying a backpack.

One hundred and five (53.0%) participants indicated that they compensate by bending when carrying a backpack, of whom 88.3% stated that they bend involuntarily. The participants who indicated that they bend voluntarily said they bent due to too much weight on their back.

More than half (63.3%) of the participants stated that the backpack affects the way they stand. Of these, eighty-seven (43.9%) agreed that they think their backpack affects the way they stand and walk. Most participants (70.2%) specified that no one ever advised them to sit or walk up straight in the community. The remaining 29.9% agreed that different members of the community as outline on table 4.5 below usually advised them to sit and walk up straight.

TABLE 4.5 PREVIOUS POSTURAL EDUCATION: n=59

COMMUNITY MEMBER	FREQUENCY	PERCENTAGE
Parents	26	44.1%
Other children	22	37.3%
Grandparents	6	10.1%
Teachers	3	5.0%
Street passers	2	3.4%

When participants were asked, at the end of the structured interview whether they learned anything about posture, 56.1% reported that they did not learn anything about posture; while 43.9% declared that they gained knowledge relating to postural differences (good and bad posture) during the interview.

4.3 Measurement Description of sensed and actual posture results

The Photographic Method of Postural Assessment (P-MPA) (Hough & Nel, 2019, p. 42-47) that quantitatively measures postural alignment (appendix Q) was used to measure deviations between anatomical landmarks and the line of gravity (plumb line). The following section (tables 4.6, 4.7, 4.8, 4.9 and 4.10) reports on results that pertain to the sensed and actual posture with and without a backpack in lateral and anterior views (appendix M). Descriptive statistics namely, frequencies and percentages for categorical data, and medians and percentile for numerical data were calculated per group. The groups were compared by means of 95% confidence interval for the median difference for paired data (Grosso, Negrini, Boniolo & Negrini, 2002, p. 123-125).

The emphasis in this section is on the medians even though ranges are also presented. In the following tables, the deviations to the left of the plumb line are indicated through use of the "minus" sign **–**; while deviations to the right of the plumb line are indicated by the "plus" sign **+.** Posterior deviations are indicated as "minus" **–** sign, while anterior deviations are indicated as "plus" **+**. All

measurements are reported in millimetres (mm). The tables further report on the upper and lower Inter Quartile Ranges which describes the distribution around the median. The median range will also be stipulated.

From table 4.6 below, the observation is that when sense of posture was measured without a backpack, the median was 0 for all anatomical landmarks and the maximum of the upper quartile was 100mm.

TABLE 4.6 DEVIATION IN SENSED POSTURE <u>WITHOUT</u> A BACKPACK: n=198

			Inter Quartile Range		Median range	
Anatomical landmark	**View**	**Median**	**Lower Quartile**	**Upper Quartile**	**Minimum**	**Maximum**
Mid heels	Anterior	0	0	0	-200	+300
Mid knees	Anterior	0	0	0	-300	+300
Navel	Anterior	0	0	0	-100	+200
Nose	Anterior	0	0	0	-300	+300
Lateral Malleoli	Lateral left	0	0	0	-300	+300
Mid knee	Lateral left	0	0	0	-300	+300
Greater Trochanter	Lateral left	0	0	0	-300	+300
Acromion process	Lateral left	0	0	+100	-300	+300
Earlobe	Lateral left	0	0	+100	-300	+300
Lateral malleoli	Lateral right	0	0	0	-300	+300
Mid knee	Lateral right	0	0	0	-300	+300
Greater Trochanter	Lateral right	0	0	0	-300	+300
Acromion process	Lateral right	0	0	+100	-300	+300
Earlobe	Lateral right	0	0	+100	-200	+300

For the following table 4.7, it is observed that the median values increase as the anatomical landmark go up higher (greater trochanter to the earlobe) in comparison to the previous table 4.6 where there was no change in the median value of anatomical landmarks. This may imply that the participants

could sense better with a backpack than without a backpack. It is further observed that the increment on left and right side have common values.

TABLE 4.7 DEVIATION IN SENSED POSTURE <u>WITH</u> A BACKPACK: n=198

			Inter Quartile Range		Median range	
Anatomical landmark	**View**	**Median**	**Lower Quartile**	**Upper Quartile**	**Minimum**	**Maximum**
Mid heels	Anterior	0	0	0	-300	+300
Mid knees	Anterior	0	0	0	-300	+1000
Navel	Anterior	0	0	0	-200	+200
Nose	Anterior	0	0	0	-200	+200
Lateral Malleoli	Lateral left	0	-100	0	-300	+300
Mid knee	Lateral left	0	0	0	-300	+300
Greater Trochanter	Lateral left	+100	0	+200	-300	+400
Acromion process	Lateral left	+200	+100	+200	-300	+500
Earlobe	Lateral left	+200	+100	+200	-200	+400
Lateral malleoli	Lateral right	0	0	0	-300	+400
Mid knee	Lateral right	0	0	0	-300	+300
Greater Trochanter	Lateral right	+100	0	+200	-200	+400
Acromion process	Lateral right	+200	+100	+200	-300	+500
Earlobe	Lateral right	+200	+100	+200	-200	+400

The results of the measurements that will be presented in the following section (table 4.8) were measured directly from the photographs in millimetres and are a reflection of actual posture deviation without a backpack.

TABLE 4.8 DEVIATION IN ACTUAL POSTURE <u>WITHOUT</u> A BACKPACK: n=198

			Inter Quartile Range		Median range	
Anatomical landmark	**View**	**Median**	**Lower Quartile**	**Upper Quartile**	**Minimum**	**Maximum**
Mid heels	**Anterior**	**0**	**0**	**0**	**-53.6**	**+66.6**
Mid knees	**Anterior**	**0**	**0**	**0**	**-55.6**	**+30.7**
Navel	**Anterior**	**0**	**-14.1**	**0**	**-102.6**	**+45.5**
Nose	**Anterior**	**0**	**-14.3**	**16.4**	**-83.3**	**+85.7**
Lateral Malleoli	**Lateral left**	**0**	**0**	**0**	**-76.9**	**+30.3**
Mid knee	**Lateral left**	**17.9**	**0**	**40.0**	**-58.8**	**+166.7**
Greater Trochanter	**Lateral left**	**35.7**	**0**	**58.8**	**-83.3**	**+216.2**
Acromion process	**Lateral left**	**17.9**	**0**	**52.6**	**-83.3**	**+314.3**
Earlobe	**Lateral left**	**39.7**	**0**	**76.9**	**-74.6**	**+378.4**
Lateral malleoli	**Lateral right**	**0**	**0**	**0**	**-35.7**	**+32.3**
Mid knee	**Lateral right**	**16.9**	**0**	**50.6**	**-94.3**	**+171.4**
Greater Trochanter	**Lateral right**	**42.7**	**14.3**	**66.7**	**-113.2**	**+171.4**
Acromion process	**Lateral right**	**18.0**	**0**	**54.1**	**-83.3**	**+371.4**
Earlobe	**Lateral right**	**37.7**	**0**	**64.1**	**-97.6**	**+400.0**

Although there were extreme deviations observed from the plumb line (indicated in millimetres) in the following table 4.9, the left and the right lateral views share the same pattern in increment of millimetres of the median values; as landmarks go up higher from the lateral malleoli to the earlobe, the median value increases. The median value of the anterior view remained the same (0).

TABLE 4.9 DEVIATION IN ACTUAL POSTURE <u>WITH</u> A BACKPACK: n=198

			Inter Quartile Range		Median range	
Anatomical landmark	**View**	**Median**	**Lower Quartile**	**Upper Quartile**	**Minimum**	**Maximum**
Mid heels	Anterior	0	0	0	-31.3	67.6
Mid knees	Anterior	0	0	0	-57.1	55.6
Navel	Anterior	0	0	16.1	-81.1	88.2
Nose	Anterior	0	-9.9	27.0	-150.0	117.6
Lateral Malleoli	Lateral left	0	0	0	-29.4	54.1
Mid knee	Lateral left	33.3	0	57.1	-68.9	205.9
Greater Trochanter	Lateral left	62.5	35.7	100.0	-58.8	290.3
Acromion process	Lateral left	164.1	119.4	213.1	-14.1	416.7
Earlobe	Lateral left	219.4	179.1	292.7	-28.2	513.5
Lateral malleoli	Lateral right	0	0	0	-28.6	29.4
Mid knee	Lateral right	22.6	0	50.6	-57.1	166.7
Greater Trochanter	Lateral right	55.6	17.9	85.7	-105.3	277.8
Acromion process	Lateral right	157.5	118.4	203.4	-150.0	317.4
Earlobe	Lateral right	217.4	175.7	277.8	-183.3	472.2

Comments on the summary table 4.10 below indicate that there was not statistically significant deviation noted on the anterior view landmarks during the assessment. There was no further deviation at the landmark (lateral malleoli) for both left and right sides regardless whether the participant carried a backpack or not. It may further be noted that the lateral malleoli were the starting point of reference when photographs were captured. More participants displayed no

deviation on all the anatomic landmarks for the sensed posture without carrying a backpack. There is further a large difference in the median values of the sensed posture and the actual posture noted.

TABLE 4.10 SUMMARY TABLE FOR THE MEDIAN VALUES FOR DEVIATIONS IN SENSED AND ACTUAL POSTURE WITH AND WITHOUT A BACKPACK: n=198

Anatomical landmark	View	DEVIATION IN SENSED POSTURE WITHOUT A BACKPACK	DEVIATION IN SENSED POSTURE WITH A BACKPACK	DEVIATION IN ACTUAL POSTURE WITHOUT A BACKPACK	DEVIATION IN ACTUAL POSTURE WITH A BACKPACK	COMMENTS DEVIATION OR NO DEVIATION
Mid heels	Anterior	0	0	0	0	NONE
Mid knees	Anterior	0	0	0	0	NONE
Navel	Anterior	0	0	0	0	NONE
Nose	Anterior	0	0	0	0	NONE
Lateral Malleoli	Lateral left	0	0	0	0	NONE
Mid knee	Lateral left	0	0	17.9	33.3	DEVIATION
Greater Trochanter	Lateral left	0	+100	35.7	62.5	DEVIATION
Acromion process	Lateral left	0	+200	17.9	164.1	DEVIATION
Earlobe	Lateral left	0	+200	39.7	219.4	DEVIATION
Lateral malleoli	Lateral right	0	0	0	0	NONE
Mid knee	Lateral right	0	0	16.9	22.6	DEVIATION
Greater Trochanter	Lateral right	0	+100	42.7	55.6	DEVIATION
Acromion process	Lateral right	0	+200	18.0	157.5	DEVIATION
Earlobe	Lateral right	0	+200	37.7	217.4	DEVIATION

In Table 4.11 below statistical and clinical significant differences are evident for both lateral left and right views on the following anatomical landmarks; greater trochanter, acromion process and the right earlobe. Significant differences are observed on both the left and the right side except on the earlobe. The 95% confidence interval (CI) for the median difference for paired data is displayed. **Please note:** Statistically significant differences are indicated with a *, and clinically significant differences are indicated with a #.

TABLE 4.11 THE DIFFERENCE IN DEVIATIONS BETWEEN ACTUAL POSTURE WITH A BACKPACK AND ACTUAL POSTURE WITHOUT A BACKPACK: n=198

			Inter Quartile Range		Median range		
Anatomical landmark	**View**	**Median**	**Lower Quartile**	**Upper Quartile**	**Minimum**	**Maximum**	**95% CI for the median difference**
Mid heels	Anterior	0	0	0	-67.6	40.0	0:0
Mid knees	Anterior	0	-13.9	0	-83.3	57.1	0:0
Navel	Anterior	0	-18.8	12.7	-111.1	74.4	0:0
Nose	Anterior	0	-25.0	14.5	-166.7	100.0	0:0
Lateral Malleoli	Lateral left	0	-13.2	0	-76.9	58.0	[-5.0:0]
Mid knee	Lateral left	-15.9	-39.2	0	-120.2	84.1	0:0
Greater Trochanter	Lateral left	-27.8	-58.8	0	-162.2	111.1	[-18.7: -2.6] *
Acromion process	Lateral left	-142.7	-194.3	-102.2	-411.8	314.3	[-33.1: -19.2] *#
Earlobe	Lateral left	-183.1	-235.3	-142.9	-478.6	365.5	[-153.6:133:1]
Lateral malleoli	Lateral right	0	-0.4	0	-55.6	53.0	[-200:169.1]
Mid knee	Lateral right	0	-20.4	15.2	-169.8	95.2	0:0
Greater Trochanter	Lateral right	-13.8	-39.2	18.5	-226.4	110.4	[-20.20: -0.45] *
Acromion process	Lateral right	-142.0	-185.7	-85.6	-324.3	312.6	[-152.8: -126.8]*#
Earlobe	Lateral right	-185.5	-236.3	-141.0	-472.2	282.4	[-196.4: -175.2]*#

* Statistical significant difference

Clinical significant difference

In Table 4.12 below, the differences between actual and sensed posture for the respective levels of anatomical landmarks are displayed, with respect to with a backpack. The observation is that sensed posture and actual posture differ when the participant is with a backpack (Table 4.12). The statistical and clinical significant differences are evident for both lateral left and right views on the mid knees and the earlobe.

TABLE 4.12 THE DIFFERENCE IN DEVIATIONS BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK (ACTUAL VS SENSED): n=198

			Inter Quartile Range		Median range		
Anatomical landmark	**View**	**Median**	**Lower Quartile**	**Upper Quartile**	**Minimum**	**Maximum**	**95% CI for the median difference**
Mid heels	**Anterior**	**0**	**-18.9**	**14.5**	**-300.0**	**300.0**	**0:0**
Mid knees	**Anterior**	**0**	**-28.6**	**14.3**	**-1000**	**314.9**	**0:0**
Navel	**Anterior**	**0**	**-28.6**	**16.4**	**-275.0**	**227.8**	**0:0**
Nose	**Anterior**	**0**	**-26.7**	**27.0**	**-350.0**	**259.7**	**0:0**
Lateral Malleoli	**Lateral left**	**0**	**-15.4**	**100.0**	**-314.9**	**300.0**	**0:0**
Mid knee	**Lateral left**	**39.6**	**-20.8**	**100.0**	**-300.0**	**355.6**	**[27.8:47.6]*#**
Greater Trochanter	**Lateral left**	**-55.6**	**-149.2**	**84.7**	**-386.1**	**414.3**	**[-93.3:0]**
Acromion process	**Lateral left**	**-7.4**	**-90.6**	**111.1**	**-442.0**	**442.9**	**[-28.6:17.4]**
Earlobe	**Lateral left**	**44.4**	**-30.8**	**161.1**	**-300.0**	**550.0**	**[22.2:72.7]*#**
Lateral malleoli	**Lateral right**	**0**	**-14.9**	**14.1**	**-400.0**	**300.0**	**0:0**
Mid knee	**Lateral right**	**28.6**	**-14.3**	**90.9**	**-330.3**	**300.0**	**[16.7: 42.3]*#**
Greater Trochanter	**Lateral right**	**-2.4**	**-125.9**	**81.1**	**-328.6**	**300.0**	**[-42.0: 14.7]**
Acromion process	**Lateral right**	**-4.6**	**-72.6**	**105.6**	**-500.0**	**428.6**	**[-29.8:22.2]**
Earlobe	**Lateral right**	**66.3**	**-16.3**	**159.4**	**-483.3**	**514.3**	**[45.3:85.1]*#**

* Statistical significant difference

Clinical significant difference

Table 4.13 displays the differences between actual and sensed posture for the respective levels of anatomical landmarks with respect to without a backpack.

Table 4.13 further indicates the statistical and clinical significant differences as evident for both lateral left and right views on the following anatomical landmarks; mid knees and greater trochanter. These findings are similar to those in Table 4.12 as the pattern for statistical and clinical significant differences on the lateral left is similar to that on the lateral right view with respect to the mid knee. The results without a backpack however show statistical and clinical differences for the greater trochanter, both left and right views.

TABLE 4.13 THE DIFFERENCE IN DEVIATIONS BETWEEN ACTUAL AND SENSED POSTURE WITHOUT A BACKPACK (ACTUAL VS SENSED): n=198

			Inter Quartile Range		Median range		
Anatomical landmark	**View**	**Median**	**Lower Quartile**	**Upper Quartile**	**Minimum**	**Maximum**	**95% CI for the median difference**
Mid heels	Anterior	0	0	0	-314.5	213.3	0:0
Mid knees	Anterior	0	0	0	-300.0	300.0	0:0
Navel	Anterior	0	-18.9	0	-214.5	117.5	0:0
Nose	Anterior	0	-15.9	16.7	-314.5	317.9	0:0
Lateral Malleoli	Lateral left	0	-14.3	15.6	-300.0	300.0	0:0
Mid knee	Lateral left	19.3	0	57.1	-255.6	325.0	[11.1: 28.6] *#
Greater Trochanter	Lateral left	34.2	-13.9	76.9	-273.3	405.9	[20: 48.4] *#
Acromion process	Lateral left	0	-57.1	58.8	-300.0	355.6	0:0
Earlobe	Lateral left	28.0	-42.0	100.0	-353.6	500.0	[0:36.4)
Lateral malleoli	Lateral right	0	-15.2	0	-315.4	274.4	0:0
Mid knee	Lateral right	15.9	0	58.8	-264.5	300.0	[12.5: 24.1] *#
Greater Trochanter	Lateral right	37.0	0	81.1	-284.8	300.0	[27.4:50.8] *#
Acromion process	Lateral right	0	-54.8	54.1	-300.0	342.9	[0:6.4]
Earlobe	Lateral right	18.2	-30.3	61.2	-343.5	371.4	[0:34.5]

* Statistical significant difference

Clinical significant difference

In the following table the statistical and clinical significant difference is evident for both lateral left and right views on the acromion process and earlobe. Another discovery is that for Tables 4.12, 4.13 and 4.14, the pattern of anatomical landmarks with significant difference is the same for both lateral left and lateral right views.

TABLE 4.14 THE DIFFERENCE IN DEVIATIONS BETWEEN SENSED POSTURE WITH A BACKPACK AND SENSED POSTURE WITHOUT A BACKPACK: n=198

			Inter Quartile Range		Median range		
Anatomical landmark	**View**	**Median**	**Lower Quartile**	**Upper Quartile**	**Minimum**	**Maximum**	**95% CI for the median difference**
Mid heels	**Anterior**	**0**	**0**	**0**	**-400.0**	**300.0**	**0:0**
Mid knees	**Anterior**	**0**	**0**	**0**	**-500.0**	**900.0**	**0:0**
Navel	**Anterior**	**0**	**0**	**0**	**-400.0**	**200.0**	**0:0**
Nose	**Anterior**	**0**	**0**	**0**	**-400.0**	**300.0**	**0:0**
Lateral Malleoli	**Lateral left**	**0**	**-100.0**	**100.0**	**-300.0**	**500.0**	**0:0**
Mid knee	**Lateral left**	**0**	**-100.0**	**100.0**	**-300.0**	**500.0**	**0:0**
Greater Trochanter	**Lateral left**	**100.0**	**0**	**200.0**	**-400.0**	**500.0**	**[0:100]**
Acromion process	**Lateral left**	**200.0**	**0**	**200.0**	**-400.0**	**600.0**	**[100:200]*#**
Earlobe	**Lateral left**	**200.0**	**100.0**	**200.0**	**-400.0**	**600.0**	**[200:200]*#**
Lateral malleoli	**Lateral right**	**0**	**0**	**0**	**-300.0**	**400.0**	**0:0**
Mid knee	**Lateral right**	**0**	**-100.0**	**0**	**-400.0**	**300.0**	**0:0**
Greater Trochanter	**Lateral right**	**0**	**0**	**200.0**	**-400.0**	**400.0**	**[0:100]**
Acromion process	**Lateral right**	**100.0**	**0**	**200.0**	**-600.0**	**500.0**	**[100:200] *#**
Earlobe	**Lateral right**	**100.0**	**0**	**200.0**	**-300.0**	**500.0**	**[100:200] *#**

* Statistical significant difference

Clinical significant difference

Table 4.15 below summarises the 95% confidence interval (CI) for the median difference for sensed and actual posture with and without a backpack. For all anterior view landmarks; mid heels, mid knees, navel and nose no significant difference is observed. For the lateral view landmarks significant

differences are observed. At the earlobe significant difference is observed for most postures contrary to all the other landmarks, the significant difference is both clinical and statistically significant.

TABLE 4.15 SUMMARY TABLE: 95% CONFIDENCE INTERVAL (CI) FOR THE MEDIAN DIFFERENCE FOR SENSED AND ACTUAL POSTURE WITH AND WITHOUT A BACKPACK: n=198

Anatomical landmark	View	ACTUAL POSTURE WITH A BACKPACK AND ACTUAL POSTURE WITHOUT	ACTUAL POSTURE WITH A BACKPACK AND SENSED POSTURE WITH	ACTUAL POSTURE WITHOUT A BACKPACK AND SENSED POSTURE WITHOUT	SENSED POSTURE WITH A BAG AND SENSED POSTURE WITHOUT	COMMENTS (SIGNIFICANT DIFFERENCE/ NOT SIGNIFICANT DIFFERENCE)
Mid heels	Anterior	0:0	0:0	0:0	0:0	NONE
Mid knees	Anterior	0:0	0:0	0:0	0:0	NONE
Navel	Anterior	0:0	0:0	0:0	0:0	NONE
Nose	Anterior	0:0	0:0	0:0	0:0	NONE
Lateral Malleoli	Lateral left	[-5.0:0]	0:0	0:0	0:0	NONE
Mid knee	Lateral left	0:0	[27.8:47.6]*#	[11.1: 28.6] *#	0:0	DIFFERENCE
Greater Trochanter	Lateral left	[-18.7: -2.6] *	[-93.3:0]	[20: 48.4] *#	[0:100]	DIFFERENCE
Acromion process	Lateral left	[-33.1: -19.2] *#	[-28.6:17.4]	0:0	[100:200]*#	DIFFERENCE
Earlobe	Lateral left	[-153.6:133:1]	[22.2:72.7]*#	[0:36.4)	[200:200]*#	DIFFERENCE
Lateral malleoli	Lateral right	[-200:169.1]	0:0	0:0	0:0	NONE
Mid knee	Lateral right	0:0	[16.7: 42.3]*#	[12.5: 24.1] *#	0:0	DIFFERENCE
Greater Trochanter	Lateral right	[-20.20: -0.45] *	[-42.0: 14.7]	[27.4:50.8] *#	[0:100]	DIFFERENCE
Acromion process	Lateral right	[-152.8: -126.8]*#	[-29.8:22.2]	[0:6.4]	[100:200]*#	DIFFERENCE
Earlobe	Lateral right	[-196.4: -175.2]*#	[45.3:85.1] *#	[0:34.5]	[100:200]*#	DIFFERENCE

* Statistical significant difference

Clinical significant difference

*SUMMARY OF TABLES (4.11, 4.12, 4.13, 4.14 and 4.15)

In the tables 4.11, 4.12, 4.13, 4.14 and 4.15 above, the differences between sensed and actual posture for the respective levels of anatomical landmarks are displayed, with respect to with and without a backpack. The tables compare two occasions; in some instances, the participants are with a backpack and in some instances without a backpack. The 95% confidence interval (CI) for the median difference for paired data is displayed on these tables.

The observation is that on most of the landmarks, sensed posture and actual posture do differ when the participant is with and is without a backpack. The is no significant difference on the actual and sensed posture observed on all anterior views and lateral malleoli regardless whether left or right viewed.

It is worth noting that a statistical significant difference is identified when 0 is excluded from the confidence intervals per anatomical landmark. A clinical significant difference is identified where the confidence interval is greater than 10mm. The median difference per anatomical landmark was calculated by subtracting the value obtained of actual posture from sense of posture. A negative value resulting from the calculations indicates that the actual deviation is greater than the sensed deviation. The clinical significant difference is only considered where there is statistical significance Fethney (2010, p. 93-97).

The following section will display comparisons between biographical results and the differences found in sensed and actual posture while a child is carrying a backpack, and while not carrying a backpack. Differences are indicated per view, and anatomical landmark.

One hundred and ninety participants indicated that they carry a backpack. The differences between actual and sensed posture (with and without a backpack) are indicated Table 4.16. The statistical and clinical significant difference is evident for both lateral left and right views at the mid knees and earlobe while the participant is carrying a backpack. Contrary to that, while the participant is without

a backpack the pattern on left and the right side is not the same but more anatomical landmarks display a difference. This may mean that the accuracy of sense of posture is better while the participant carries a backpack than while they do not carry a backpack. There is no significant difference on all the anterior view landmarks and lateral malleoli.

TABLE 4.16 DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH AND WITHOUT A BACKPACK FOR PARTIPANTS WHO CARRY A BACKPACK: n=190

		With a backpack			Without a backpack		
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	**Anterior**	**0**	**0:0**	**None**	**0**	**0:0**	**None**
Mid knees	**Anterior**	**0**	**0:0**	**None**	**0**	**0:0**	**None**
Navel	**Anterior**	**0**	**0:0**	**None**	**0**	**0:0**	**None**
Nose	**Anterior**	**0**	**0:0**	**None**	**0**	**0:0**	**None**
Lateral Malleoli	**Lateral left**	**0**	**0:0**	**None**	**0**	**0:0**	**None**
Mid knee	**Lateral left**	**36.6**	**27.8:50.0**	***#**	**19.0**	**0:28.6**	**None**
Greater Trochanter	**Lateral left**	**-49.1**	**-83.8:0**	**None**	**34.5**	**21.3:49.2**	***#**
Acromion process	**Lateral left**	**-6.3**	**-31.0:19.4**	**None**	**5.5**	**0:25.0**	**None**
Earlobe	**Lateral left**	**44.1**	**22.2:72.7**	***#**	**29.5**	**13.7:40.0**	***#**
Lateral malleoli	**Lateral right**	**0**	**0:0**	**None**	**0**	**0:0**	**None**
Mid knee	**Lateral right**	**28.6**	**16.9:42.9**	***#**	**16.8**	**13.5:25.6**	***#**
Greater Trochanter	**Lateral right**	**-2.4**	**-41.2:14.7**	**None**	**41.4**	**27.8:51.3**	***#**
Acromion process	**Lateral right**	**-11.3**	**-32.4:21.6**	**None**	**0**	**0:14.1**	**None**

Earlobe	**Lateral right**	**64.2**	**42.9:80.0**	***#**	**24.5**	**0:39.2**	**None**

* Statistical significant difference

Clinical significant difference

It has been evident on all the previous tables that there are differences between sensed and actual posture while participants were with and without a backpack. The following section focuses on only when the participant is carrying a backpack. The aim is to compare actual and sensed posture significant differences with a backpack.

Table 4.17 presents the difference between actual and sensed posture with a backpack for the 188 participants who indicated that they carried their backpack daily. There is significant difference at the mid knees and the earlobe for both the left and right side respectively.

TABLE 4.17 DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO CARRY THEIR BACKPACK DAILY: n=188

		With a backpack		
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	**Anterior**	**0**	**0:0**	**None**
Mid knees	**Anterior**	**0**	**0:0**	**None**
Navel	**Anterior**	**0**	**0:0**	**None**
Nose	**Anterior**	**0**	**0:0**	**None**
Lateral Malleoli	**Lateral left**	**0**	**0:0**	**None**
Mid knee	**Lateral left**	**37.7**	**27.8:46.9**	***#**
Greater Trochanter	**Lateral left**	**-51.9**	**-98.3:0**	**None**

Acromion process	**Lateral left**	**-8.6**	**-33.3:17.4**	**None**
Earlobe	**Lateral left**	**42.4**	**22.2:70.8**	***#**
Lateral malleoli	**Lateral right**	**0**	**0:0**	**None**
Mid knee	**Lateral right**	**28.6**	**16.7:42.9**	***#**
Greater Trochanter	**Lateral right**	**-6.3**	**-42.0:14.5**	**None**
Acromion process	**Lateral right**	**-11.3**	**-32.4:22.2**	**None**
Earlobe	**Lateral right**	**64.7**	**42.3:85.7**	***#**

* Statistical significant difference

Clinical significant difference

In the following section, Tables 4.18 and 4.19 were drawn to compare the significant differences of the participants who were previously taught about posture and participants who have never been taught about posture before, the significant difference will only be determined when the participant is carrying a backpack. Differences identified are explained prior the display of each table and discussed further at the end of both tables.

In Table 4.18 below, the mid heels (left and right) and the right ear lobe anatomical landmarks of the 54 participants who declared that they had been taught about posture before display statistical and clinical significant difference in sensed and actual posture.

TABLE 4.18: DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO WERE TAUGHT ABOUT POSTURE BEFORE: n=54

With a backpack				
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	Anterior	0	0:0	None
Mid knees	Anterior	0	0:0	None
Navel	Anterior	0	-14.7:0	None
Nose	Anterior	0	-19.2:0	None
Lateral Malleoli	Lateral left	0	0:0	None
Mid knee	Lateral left	36.6	14.9:55.6	*#
Greater Trochanter	Lateral left	-64.5	-117.8:32.8	None
Acromion process	Lateral left	-34.5	-61.1:34.3	None
Earlobe	Lateral left	41.0	-5.9:92.3	None
Lateral malleoli	Lateral right	0	0:0	None
Mid knee	Lateral right	54.2	28.6:71.4	*#
Greater Trochanter	Lateral right	-2.4	-95.8:41.7	None
Acromion process	Lateral right	-23.2	-70.6:26.4	None
Earlobe	Lateral right	39.1	8.3:83.3	*

* Statistical significant difference

Clinical significant difference

Table 4.19 below, presents on the 144 participants who stated that they had never been taught about posture before. No significant difference is visible on all anterior views and the lateral malleoli. The significant difference is observed on left and right earlobe and left lateral mid knee.

TABLE 4.19: DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO HAD NEVER BEEN TAUGHT ABOUT POSTURE BEFORE: n=144

		With a backpack		
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	**Anterior**	**0**	**0:0**	**None**
Mid knees	**Anterior**	**0**	**0:0**	**None**
Navel	**Anterior**	**0**	**0:0**	**None**
Nose	**Anterior**	**0**	**0:0**	**None**
Lateral Malleoli	**Lateral left**	**0**	**0:13.9**	**None**
Mid knee	**Lateral left**	**40.4**	**27.8:52.6**	***#**
Greater Trochanter	**Lateral left**	**-51.9**	**-85.7:0**	**None**
Acromion process	**Lateral left**	**0**	**-20.9:30.8**	**None**
Earlobe	**Lateral left**	**48.1**	**22.2:87.5**	***#**
Lateral malleoli	**Lateral right**	**0**	**0:0**	**None**
Mid knee	**Lateral right**	**23.4**	**0:40.5**	**None**
Greater Trochanter	**Lateral right**	**-3.9**	**-61.1:29.1**	**None**

Acromion process	**Lateral right**	**14.3**	**-29.8:40.7**	**None**
Earlobe	**Lateral right**	**74.8**	**59.3:97.9**	***#**

* Statistical significant difference

Clinical significant difference

When comparing the results displayed on table 4.18 where the significant difference in sensed and actual posture of participants who had been taught about posture before and 4.19 where the significant difference in sensed and actual posture of participants who had never been taught about posture before are compared, the statistical and clinical significant difference values are observed to follow the same pattern on left and right sides. Displaying at least a difference on one anatomical landmark, mid knee, for both left and right lateral view. Except for the earlobe, the table further show no significant difference observed on most of the anatomical landmarks.

In the following section, two separate tables 4.20 and 4.21 will be drawn to compare the significant differences of the participants who were previously told to walk up straight and participants who have never been told to walk up straight before. The significant difference will only be determined when the participant is carrying a backpack. Differences identified will be explained prior the display of each table and discussed further at the end of both tables.

Only 59 participants indicated that people have reprimanded them in relation to posture. The people advised them to either walk up straight or sit up straight. According to able 4.20, this group that had been advised before displays no significant difference between sensed and actual posture when they carry a backpack on most anatomical landmarks. An outstanding observation is that there is further no pattern on the left and the right differences as in this table the significant differences are observed on the left views; lateral left greater trochanter and statistical difference on the lateral left earlobe.

TABLE 4.20: DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO HAVE BEEN TOLD TO SIT OR WALK UP STRAIGHT: n=59

With a backpack				
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	Anterior	0	0:0	None
Mid knees	Anterior	0	0:0	None
Navel	Anterior	0	-31.3:0	None
Nose	Anterior	0	-25.0:0	None
Lateral Malleoli	Lateral left	0	0:0	None
Mid knee	Lateral left	25.3	-18.5:52.6	None
Greater Trochanter	Lateral left	-106.7	-137.5: -37.8	*#
Acromion process	Lateral left	7.7	-31.0:50:0	None
Earlobe	Lateral left	50.0	5.9:103.0	*
Lateral malleoli	Lateral right	0	0:0	None
Mid knee	Lateral right	28.6	0:71.4	None
Greater Trochanter	Lateral right	0	-81.4:25.0	None
Acromion process	Lateral right	-28.6	-59.4:24.3	None
Earlobe	Lateral right	37.3	-8.3:85.7	None

* Statistical significant difference

Clinical significant difference

One hundred and thirty-nine participants indicated that they had never been reprimanded by people to either walk up straight or sit up straight before. According to Table 4.21 below, a significant difference between sensed and actual posture when they carry a backpack is evident at the mid knees and earlobe both for left and right lateral views.

TABLE 4.21: DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO HAVE NOT BEEN TOLD TO SIT OR WALK UP STRAIGHT: n=139

		With a backpack		
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	Anterior	0	0:0	None
Mid knees	Anterior	0	0:0	None
Navel	Anterior	0	0:0	None
Nose	Anterior	0	0:0	None
Lateral Malleoli	Lateral left	0	0:0	None
Mid knee	Lateral left	37.7	27.8:46.9	*#
Greater Trochanter	Lateral left	-51.9	-98.3:0	None
Acromion process	Lateral left	-8.6	-33.3:17.4	None
Earlobe	Lateral left	42.4	22.2:70.8	*#
Lateral malleoli	Lateral right	0	0:0	None
Mid knee	Lateral right	28.6	16.7:42.9	*#
Greater Trochanter	Lateral right	-6.3	-42.0:14.5	None
Acromion process	Lateral right	-11.3	-32.4:22.2	None
Earlobe	Lateral right	64.7	42.3:85.7	*#

*Statistical significant difference

Clinical significant difference

When comparing the results displayed in Tables 4.20 and 4.21 statistically and clinically significant differences are similar on the left and right lateral views for participants who had never been told to walk or sit up straight before. There is also no pattern on the left and the right significant differences for participants who have been reprimanded before.

In the following section, three separate tables 4.22, 4.23 and 4.24 will indicate the significant differences for bending of the participants when they are carrying a backpack. Differences identified will be explained prior the display of each table and discussed further at the end of all the three tables.

Of the 105 participants who declared that they bend forward when carrying a backpack, there is no significant difference on all the landmarks except at the left and right earlobe and the lateral left mid knees. At the earlobe, for lateral left and lateral right views, both statistical and clinical significant differences are observed. Table 4.22 below displays the results thereof.

TABLE 4.22: DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO BEND FORWARD WHEN CARRYING A BACKPACK: n=105

		With a backpack		
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	**Anterior**	**0**	**0:0**	**None**
Mid knees	**Anterior**	**0**	**0:0**	**None**
Navel	**Anterior**	**0**	**0:0**	**None**
Nose	**Anterior**	**0**	**0:0**	**None**

Lateral Malleoli	**Lateral left**	**0**	**0:27.0**	**None**
Mid knee	**Lateral left**	**40.0**	**20.0:55.5**	***#**
Greater Trochanter	**Lateral left**	**-44.4**	**-114.3:27.8**	**None**
Acromion process	**Lateral left**	**0**	**-35.6:35.6**	**None**
Earlobe	**Lateral left**	**52.9**	**22.2:94.0**	***#**
Lateral malleoli	**Lateral right**	**0**	**0:0**	**None**
Mid knee	**Lateral right**	**16.9**	**0:37.7**	**None**
Greater Trochanter	**Lateral right**	**-39.4**	**-85.7:14.7**	**None**
Acromion process	**Lateral right**	**-11.3**	**-36.7:47.1**	**None**
Earlobe	**Lateral right**	**73.1**	**38.9:100.0**	***#**

* Statistical significant difference

Clinical significant difference

Sixteen participants indicated that they voluntary decide to bend because of the heavy load of the backpack. The observation in Table 4.23 below is that there is no significant difference on all anatomical landmarks for participants who indicated that they decided to bend while they carry a backpack. Except for the lateral right mid knees, both clinical and statistical significant differences is observed.

TABLE 4.23: DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO DECIDE TO BEND WHEN CARRYING A BACKPACK: n=16

With a backpack				
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	Anterior	0	-21.3:100	None
Mid knees	Anterior	0	-100:0	None
Navel	Anterior	7.4	-20.8:24.4	None
Nose	Anterior	-3.3	-55.6:29.4	None
Lateral Malleoli	Lateral left	13.5	0:125.0	None
Mid knee	Lateral left	82.2	0:175.0	None
Greater Trochanter	Lateral left	32.0	-118.9:138.9	None
Acromion process	Lateral left	35.7	-69.6:214.3	None
Earlobe	Lateral left	101.0	-4.3:223.5	None
Lateral malleoli	Lateral right	0	0:100.0	None
Mid knee	Lateral right	50.7	28.6:100.0	*#
Greater Trochanter	Lateral right	50.6	-131.5:97.6	None
Acromion process	Lateral right	21.9	-42.1:161.1	None
Earlobe	Lateral right	70.5	-14.3:222.0	None

*Statistical significant difference

Clinical significant difference

Table 4.24 below displays the significant differences between actual and sensed posture for 121 participants who indicated that they automatically bend their back when carrying a backpack. There is no significant difference observed on most anatomical landmarks. Both statistical and clinical significant differences are observed at the left and right earlobe and left lateral mid knee.

TABLE 4.24: DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO INDICATED THAT BENDING IS INVOLUNTARY WHEN CARRYING A BACKPACK: n=121

		With a backpack		
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	**Anterior**	**0**	**0**	**None**
Mid knees	**Anterior**	**0**	**0**	**None**
Navel	**Anterior**	**0**	**0**	**None**
Nose	**Anterior**	**0**	**0**	**None**
Lateral Malleoli	**Lateral left**	**0**	**0:14.9**	**None**
Mid knee	**Lateral left**	**33.9**	**20:45.5**	***#**
Greater Trochanter	**Lateral left**	**-70.1**	**-114.3:0**	**None**
Acromion process	**Lateral left**	**-9.5**	**-33.3:14.3**	**None**
Earlobe	**Lateral left**	**41.2**	**12.8:70.1**	***#**
Lateral malleoli	**Lateral right**	**0**	**0:0**	**None**
Mid knee	**Lateral right**	**20.4**	**0:42.9**	**None**
Greater Trochanter	**Lateral right**	**-18.5**	**-71.4:13.7**	**None**

Acromion process	**Lateral right**	**-11.8**	**-36.7:27.0**	**None**
Earlobe	**Lateral right**	**73.9**	**45.3:94.4**	***#**

* Statistical significant difference
# Clinical significant difference

When comparing the results displayed on the above tables 4.22, 4.23 and 4.24, it is clear that the lateral left and lateral right side significant differences between sensed and actual posture for a few (16) participants on table 4.23 who consciously decide to bend while they carry a heavy backpack are not on the same anatomical landmarks. On the other hand, the other two tables 4.22 and 4.24 display significant differences for lateral left and lateral right earlobe and the right mid knees.

In the following section, two separate tables 4.25 and 4.26 will indicate the differences of the participants who believe backpack affects their posture and participants who do not believe that the backpack affects their posture. The tables refer only to with a backpack. Differences identified will be explained prior the display of each table and discussed further at the end of both tables.

Again, from table 4.25 below, there is no significant difference observed on all the anatomical landmarks except for both lateral left and lateral right mid knees and both lateral left and lateral right earlobes, the significant differences on the lateral left and lateral right are on the same landmarks.

TABLE 4.25: DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO BELIEVE BACKPACK AFFECTS THEIR POSTURE: n=129

		With a backpack		
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	Anterior	0	0:0	None
Mid knees	Anterior	0	0:0	None
Navel	Anterior	0	0:0	None
Nose	Anterior	0	0:0	None
Lateral Malleoli	Lateral left	0	0:14.5	None
Mid knee	Lateral left	33.9	21.7:51.7	*#
Greater Trochanter	Lateral left	-70.1	-102.4:0	None
Acromion process	Lateral left	-5.6	-33.3:30.8	None
Earlobe	Lateral left	50.0	14.3:87.5	*#
Lateral malleoli	Lateral right	0	0:0	None
Mid knee	Lateral right	34.5	16.7:52.6	*#
Greater Trochanter	Lateral right	0	-33.3:51.3	None
Acromion process	Lateral right	-1.4	-29.8:27.0	None
Earlobe	Lateral right	73.1	59.3:97.3	*#

* Statistical significant difference

Clinical significant difference

From table 4.26 below, no significant differences are observed, except for the left lateral mid knees and earlobe. The significant difference for the lateral right and lateral left sides are on different anatomical landmarks.

TABLE 4.26: DIFFERENCES BETWEEN ACTUAL AND SENSED POSTURE WITH A BACKPACK FOR PARTIPANTS WHO BELIEVE A BACKPACK DOES NOT AFFECT THEIR POSTURE: n=73

		With a backpack		
Anatomical landmark	**View**	**Median**	**95% CI for the median difference**	**Statistical and clinical differences (*/#/None)**
Mid heels	**Anterior**	**0**	**0:0**	**None**
Mid knees	**Anterior**	**0**	**0:0**	**None**
Navel	**Anterior**	**0**	**0:0**	**None**
Nose	**Anterior**	**0**	**0:0**	**None**
Lateral Malleoli	**Lateral left**	**0**	**0:0**	**None**
Mid knee	**Lateral left**	**41.7**	**25.0:57.1**	***#**
Greater Trochanter	**Lateral left**	**-47.4**	**-106.7:23.1**	**None**
Acromion process	**Lateral left**	**-9.5**	**-35.6:39.1**	**None**
Earlobe	**Lateral left**	**42.9**	**16.2:94.1**	***#**
Lateral malleoli	**Lateral right**	**0**	**0:0**	**None**
Mid knee	**Lateral right**	**27.0**	**0:50.6**	**None**

Greater Trochanter	**Lateral right**	**-36.7**	**-86.1: 13.6**	**None**
Acromion process	**Lateral right**	**-11.3**	**-44.4:47.1**	**None**
Earlobe	**Lateral right**	**38.9**	**-12.5:97.2**	**None**

* Statistical significant difference

Clinical significant difference

Tables 4.25 and 4.26 above displayed similarities, the clinical and statistical significant differences are observed at the mid knees on the lateral left view and the earlobe on the lateral left view.

4.4 Results summary

Chapter 4 presented results pertaining to the current study. The results were presented in two categories; namely, results from the biographical questionnaire (appendix K/L) relating to personal information, backpack use, general health and posture knowledge, and results pertaining sensed and actual posture for each anatomical landmark in lateral left and right, and anterior views. Descriptive statistics by frequencies and percentages for categorical data and medians with their indications of sensed and actual posture data were calculated per anatomical landmark with and without a backpack and summarized in tables throughout the chapter. Sensed posture and actual posture results were compared and differences were noted and described by means of 95% confidence intervals for the percentage or median difference.

The response rate was good with 99.0% of the research sample who participated in the study. Fifty four percent (50%) of the study population were boys and the median age of participants was 10.6, with the youngest participant being 9.6 years old and the oldest being 13.4 years old. All the 198 participants were participating in the study relating to posture for the first time.

More than half (63.3%) of the participants stated that the backpack affects the way they stand while carrying a backpack. Eighty-seven (43.9%) participants think their backpack affects the way they stand and walk, and further indicated that no one in the community ever reprimanded them to sit or walk up straight. More participants demonstrated increasing median values for the difference between sensed and actual posture at the following anatomical landmarks in comparison to other anatomical landmarks; greater trochanter, acromion process and earlobe while they carried a backpack and while they did not carry the backpack.

The median values of sensed posture without a backpack were 0 so were the median values of all anterior views. While the participants carried a backpack, the sensed median values deviations seemed to increase in an ascending pattern from lower anatomic landmark (greater trochanter) to higher anatomical landmark (earlobe). In actual posture, the median values deviations seemed to increase in an ascending pattern from lower anatomical landmark (mid knees) to higher anatomical landmark (earlobe).

Zero deviation at the landmark (lateral malleoli) for both left and right sides was noted regardless whether the participants carried a backpack or not. It may further be noted that the lateral malleoli were the starting point of reference when photographs were captured from lateral views. More participants displayed no deviation on all the anatomical landmarks for the sensed posture without carrying a backpack. There is further, a large difference in the median values of the sensed posture and the actual posture noted when the participants carried a backpack.

Generally, when 95% confidence intervals (CI) for the median difference for sensed and actual posture with and without a backpack is assessed, all anterior view landmarks; mid heels, mid knees, navel and nose demonstrates no significant differences. For all other landmarks significant differences are observed. At the earlobe significant difference is observed on most views (multiple times) more than the other landmarks.

Participants' responses to biographical questions were also compared. Differences that pertain to sensed and actual posture while the participant was standing and carrying a backpack and without a backpack were established. Such findings were analyzed and placed in the following categories; participants who carried backpacks (190), of which others indicated that they carry their backpack daily were (188), participants who indicated to have pain were (68), who indicated to experience pain daily (86), others who indicated that they were taught about posture previously were (54).

Postural education was also established and (144) participants indicated that they were taught about posture before. Some (105) indicated that they bend forward when they carry their backpacks, of these participants, (16) indicated that they decide to bend when they carry their backpacks while (121) indicated that they bend spontaneously when carrying a backpack. It was furthermore established if the participants have insight related to posture; (125) participants indicated that a backpack does affect their posture, on the other hand (73) did not believe that backpack affects their posture. Lastly, community knowledge relating to posture was established and only (59) participants indicated that they had been reprimanded to walk or stand up straight by someone before and (87) indicated that they learnt something in relation to posture during participation.

Sensed posture and actual posture results for these groups were compared. The differences were noted and described by means of 95% confidence intervals for the percentage of median difference Fethney (2010, p. 93-97). In most tables when the biographical questionnaire results of sensed and actual difference were compared in terms of 95% confidence intervals, clinical and statistical significant differences were observed at the ear lobe and the mid knees, even though on a few instances the greater trochanter also displayed a significant difference.

From the data reported in the chapter 4, evidence emerged that sensed and actual posture do differ, and that a pattern is noticed with respect to views and anatomical landmarks for the differences. Differences between sensed and actual posture were further reported on in multiple tables where weight (backpack) is carried. A significant statistical and clinical difference between sensed and actual posture at the ear lobe was more evident than on all the other anatomical landmarks and the pattern (affected anatomical landmarks) observed on the lateral left side were similar to the pattern on lateral right side. Furthermore, the significant difference was evident at the left and right mid knees and seldom presented at the greater trochanter.

Two findings emerged as major throughout interrogation of data in this chapter. One was that there is no significant difference observed on all the anterior views and lateral malleoli. Another main finding was that there is a significant difference between sensed and actual posture on the other anatomical landmarks especially the earlobe, mid knees and greater trochanter. In the following chapter results are discussed and interpreted in relation to claims derived from existing relevant literature as reviewed in chapter 2 of this study.

CHAPTER 5 – DISCUSSION

5.1 Introduction

The current study was engaged in to establish the difference between sensed and actual posture while a Grade 5 learner is standing and carrying a backpack. The findings of this study will inform health promotion and intervention programmes relating to postural alignment among Grade 5 learners. Good posture will promote good participation in school activities and other social and recreational engagements. The ability to engage in meaningful occupation is an integral part of occupational therapy, it adds experience to a fulfilling and worthy life and is positively related to health and well-being (Umphred, 2013, p. 135-157).

The previous chapter presented the data pertaining to the research question. The results highlighted the difference between sensed and actual posture while a Grade 5 learner is standing and carrying a schoolbag. The study population responded positively towards participation in the study. This therefore, reflects the insight and willingness of the Department of Basic Education and its learners, to assist in finding solutions to problems relating to postural alignment among this school going population of Botshabelo at large.

Two objectives premised the study. One was to measure the sensed and actual posture with and without a backpack in lateral and anterior views (appendix M). Another was to describe the difference between sensed and actual posture for the respective levels of anatomical landmarks. Below are the respective levels of anatomical landmarks and the particular views.

Anterior view: with and without backpack with relation to the anatomical landmarks mid heels, mid knees, navel and nose.

1. In lateral view:

1.1 Right side: with and without backpack with relation to the anatomical landmarks lateral malleoli, mid-knee, greater trochanter, acromion process and earlobe.

1.2 Left side: with and without backpack with relation to the anatomical landmarks lateral malleoli, mid-knee, greater trochanter, acromion process and earlobe.

In this chapter, the results presented in the previous chapter are discussed in detail. The pattern for discussion followed that of the previous chapter. Demographic information of participants will be discussed first. This covers personal information, backpack use, general health and knowledge relating to posture. Lastly, results pertaining to sensed and actual posture for each anatomical landmark in lateral and anterior views are discussed.

To address the aim and the objectives of the study, the discussion chapter followed the heading listed below in sequence:

1. DESCRIPTION OF PARTICIPANTS

Demographic description of participants (cf. appendix K/L)

2. MEASUREMENTS DISCUSSION OF SENSED AND ACTUAL POSTURE RESULTS

   a) Deviation in sensed posture without a backpack.

   b) Deviation in sensed posture with a backpack.

The measurements discussed in the following section were measured directly from the photographs in millimetres. They focused on:

a) Deviation in actual posture without a backpack.

b) Deviation in actual posture with a backpack

Median and 95% confidence intervals values for the deviations in sensed and actual posture with and without a backpack are summarized as follows:

c) The difference in deviation between actual posture with a backpack and actual posture without a backpack
d) The difference in deviation between actual posture with a backpack and sensed posture with a backpack (actual vs sensed).
e) The difference in deviation between actual posture without a backpack and sensed posture without a backpack (actual vs sensed).
f) The difference in deviation between sensed posture with a backpack and sensed posture without a backpack
g) The summary; 95% confidence interval (CI) for the median difference for sensed and actual posture with and without a backpack.
h) Comparison of participants' responses of the biographical questionnaire with the difference noted in sensed and actual posture while the participant is carrying a backpack and while not carrying a backpack.

Recommendations constitute at the end of this chapter, while discussion of these recommendations makes the next chapter. Three voices were used throughout the chapter, namely-the research voice based on the results stipulated in chapter 4, the theoretical voice based on available literature and research findings reported in literature, and lastly the clinical voice based on the researcher's own experiences. Each specific voice was presented to support the context of the discussion. No specific order that was followed in adoption of these voices.

The first-person approach was used when emphasising the researcher's own clinical experiences, in which context the researcher referred to 'learners or patients' and not participants since it relates to school and clinical setting. This implies that when the term 'learners or patients' is used; the statement is likely to be based on clinical experiences and not research results. Contrary to that, when discussing the results of the current study, reference was made to 'participants' in the third person. The researcher furthers refer to herself as 'my' - thus referring to self as the current researcher.

5.2 Demographic description of participants

Demographic data presented in this study is not directly linked to the research aim and objectives but is crucial to identify and inform potential challenges that relate to effective education and successive goal achievement. Literature shows that an educational intervention approach is aimed towards changing behaviour, which includes motor behaviour (Integrated School Health Policy (ISHP), 2017, p. 15). Therefore, the essence of using an educational approach within occupational therapy, when treating individuals who suffer from postural alignment challenges relies on the ability of an individual to apply the learned knowledge independently post intervention. Discussion of participants' demographic information will dictate the participant's ability to learn and therefore determine the success of future intervention. Furthermore, clinical information will be informative to the reader on the health status of the participants.

The current study was aimed at children, of whom 54% were boys with the median age amongst all participants 10.6. The youngest participant was 9.6 years old; while the oldest was 13.4 years old. Two hundred participants were initially scheduled for the current study, of which 2 participants were excluded from participation as they did not comply with age inclusion criteria. This implies a good response rate since 96.0% of the expected population participated.

A back-pack and a trolley are noted as alternative ways of carrying books and other supplies to school. (Orantes, Heredia & Beneck, 2017, p. 189-193). For instance, it is indicated that children habitually use either a backpack or trolley to carry books and other supplies when travelling to and from school. According to Orantes et al, 2017 (p. 189-193) backpack loads range from 10% to 20% of body weight (BW). The school trolley has been proposed as an alternative to the traditional backpack because it eliminates the need to support the load on the back. Parents as well think trolleys seem to solve the problem of the increasingly heavy loads being carried on a young child's back (Orantes, Heredia & Beneck, 2017, p. 189-193).

In the current study, all participants indicated that they had a schoolbag. Of these 96.0 % specified their type of a schoolbag as a backpack. Furthermore, 95.0% indicated that they carry their backpacks daily; while 80.8% further indicated that they liked their backpack. This occurrence confirms that

schoolchildren still use backpacks more than trolleys even though school trolley has been proposed as an alternative to the traditional backpack. My findings show that the children use their back to support their backpack. Carrying a backpack is not a point of concern in their lives as 80.8% of the participants confirmed that they liked their backpacks. Orantes, Heredia & Beneck (2017, p. 189-193) however reported that the school trolley had been proposed as an alternative to the traditional backpack and argues that it eliminates the need to support the load on the back. Orantes et al (2017, p. 189-193) further state that parents think trolleys solve the problem of the increasingly heavy loads being carried on a young child's back but disregard the weight of trolleys. Evidence from the researcher's findings indicates that majority of learners in the low socio-economic communities do not use trolleys to carry their items to and from school. Furthermore, the researcher has observed that learners who use trolleys occasionally bend to one side as the body adaptation takes place in order to accommodate the weight. From the results of the current study one may already conclude that exposure to heavy backpacks is faced by the majority of learners in the school setting; and therefore, a trolley is not regarded as a solution to the problem.

Sharan (2012, p. 929-930) asserted that backpacks are becoming more and more common among school children for carrying school books, laptops, water bottles, lunch boxes and many other items. However, the use of heavy backpack may lead to development of different musculoskeletal discomfort among the school children and it becomes a concern area for ergonomists (Sharan, 2012, p. 929-930). Sharan (2012, p. 929-930) further reported that school children across the world suffer from musculoskeletal pain or discomfort in the shoulder and back. Sharan's assertion in this study is confirmed by the revelation that one hundred and eighty-eight (94.5%) participants who carried a backpack experienced pain in their body. About thirty four percent (34.3%) of them reported pain at the shoulders. About thirty-two percent (32.3 %) experienced back pain; while the rest reported pain on various body parts including neck, waist, head, arms, hands, feet and stomach.

The common element in these findings is that carrying backpacks negatively impacts on the learner's postural alignment, with pain reported at different parts of the body. Furthermore, the study reveals that backpacks cause some musculoskeletal discomforts. The impact is evident as more than half (51.5%) of the participants specified that they encountered the pain on daily basis; while 46.1% felt the pain occasionally. Besides the pain experienced on the body parts, the participants were

generally healthy as participant's general health status and history were investigated and 57.6% of the participants reported to have never been ill in the past six months. The rest of the participants (42.4%) reported to have been ill with different kinds of ailments with common flu being the most (17.9%) common ailment reported.

Children often get reprimanded by parents and teachers to walk up straight. The question is whether or not these children know to what extent they should walk upright. Children probably feel comfortable in their wrongly perceived half upright position. When knowledge relating to posture and postural background was investigated in the current study, 72.7% of the participants reported that they have never been taught about posture before. This may imply that postural education is neglected. If this is the situation, then Burn's (2016, p. 2) postulation that upright posture and mobility enhances cognitive functioning in healthy individuals, is sadly violated.

Most participants (70.2%) specified that no one ever advised them to sit or walk up straight in the community, therefore they stay with an assumption that their posture is appropriate. My observation of these learners when they walk on the streets carrying these heavy backpacks is that they are so used to bending that they do not realise that it is incorrect posture. Sadly, this unacceptable habit on the learners' part violates Burn's (2016, p.2) advisory postulation that postural rehabilitation is dependent upon postural balance, with the focus on strengthening of the weak muscular structure and improvement of dynamic balance. Equally unheeded is Burn's proposal that, in addition to the above, educational intervention is necessary to enable postural balance.

It emerged from the current study that on the other hand, other participants reported to have been taught about posture before by different people. Forty (75.5%) of these participants were taught about posture by their teachers. Five (9.4%) of them indicated that their mothers had taught them about correct posture. About 7.6% reported having acquired such knowledge from friends; while 1.9% indicated that they were beneficiaries of such knowledge from doctors. From these findings, it seems reasonable to note that teachers are influential in educating children about posture. The conclusion is consistent with Dowd's (2018, p. 1) description of the value of a teacher in a learner's

life. The essence of the finding is the teacher's role in provision of endless opportunity and resource for learners to understand and achieve their full potential premised on principles of occupational therapy.

Emerging from the analysis of data in the study is that participants are not totally uninformed about the difference between good and bad posture. Substantiating this was an indication by 57.1% of the participants that they knew the difference between good and bad posture. Some participants were aware that a backpack may negatively affect their posture but were uninformed on what the solution could be. More than half (63.3%) of the participants stated that the schoolbag affects the way they stand. Of these 63.3% participants, eighty-seven (43.9%) participants agreed that they think their backpack affects the way they stand and walk. They also indicated that no one ever reprimanded them to sit or walk up straight. However, 29.9% agreed that different members of the community including parents, other children, street passers, teachers and grandparents do reprimand them to correct their postures. If only 29.9 % have been reprimanded about posture before, low community involvement in education on posture is cause for concern.

The assumption exists that individuals are able to accurately perceive their own postural alignment and adjust their bodies accordingly. From my clinical experience, as the body performs its duty of compensation and postural adaptation, children seem to be unaware of their body position in space in order to re-position their bodies accordingly. Participants indicated that they bend differently when carrying a backpack. It surfaced that as individuals they tend to bend differently with some inclined to bend forward; while others as individuals assume backwards, sideways and upright walk positions.

Postural adaptation is the ability of the body to maintain balance automatically and remain upright during alterations in position and challenges to stability (Radomski 2014, p. 123-137). This process of postural adaptation is involuntary, and a basic response of the body to stimuli. Some participants (16.2%) indicated that they bend backwards when carrying their backpacks, some (1.5%) bend sideways, some (27.3%) walk up straight, and some were not sure, while the majority (53.0%)

indicated that they bend forward when carrying a backpack, 88.3% of them stated that they bend involuntarily. The fact that 88.3% stated that they bend involuntarily confirms that postural adaptation is taking place in order to maintain balance automatically and assist an individual remain upright during alterations in position and challenges to stability. This relates to the current study since before postural adaptation, there should be a sense of deviation with respect to the various anatomical landmarks.

Participants may bend for different reasons while carrying their backpacks. For instance, participants who bend spontaneously said they do so due to too much weight on their back. Reasonably arguable from this finding is that even though individuals are able to perceive their postural alignments and adjust their bodies, they do not necessarily adjust their postural alignment correctly. Further postulation could be that that the individual's sense of posture is different from the actual posture that we are able to visualise as significant differences were highlighted on majority of the landmarks in the previous chapter. My insight from these findings is that sense appears to be unique to an individual. Substantiating this issue, it was observed that some (88.3%) participants' bodies were reportedly sensitive to weight and therefore reflexively adjusted to accommodate the weight. However, for a few individuals (11.7%), it was a matter of thinking about the weight of the backpack and adjusting their bodies according to the need cognisant of the fact, note that the adjustments were incorrect and could harm their back.

Burn (2016, p. 1-7) suggests that slouched posture is associated with weaknesses in the skeletomuscular wellbeing and deficits of neurologic function. The current study brings an insight that besides weaknesses in the skeletomuscular wellbeing, slouched posture is associated with sense of self and it is in most (88.3%) cases involuntary. Contrary to actual posture, sensed posture is invisible but controlled by sensation. Enhanced sensation facilitates the attainment of a number of different postural and sensorimotor benefits (Murray, 2002, p. 24). If this is the case, one may conclude that sensation is the primary facilitator or contributor to sensed posture. In other words, sensed posture is the controller of actual posture. Furthermore, that 88.3% of the participants bend spontaneously even though they are generally healthy could mean their bending is a counter effect to the heavy backpacks

The key findings from the study in question point to its uniqueness in comparison with similar studies on sense and actual postural alignment. One of such unique features is the addition of weight; which in this case is a backpack and use of children as study population. I observed the participants who carried their heavy backpacks on daily basis and drew a number of conclusions based on principles of occupational therapy. One conclusion was the fact that, in situations where participants carry heavy backpacks, deformities are not prevented; thus, compromising promotion of healthy lifestyle. Another conclusion was that if this area is not further investigated and resolved, then the intention of the Integrated School Health Programme (2017, p. 6), which aims to provide a more comprehensive package of services, which address not only barriers to learning, but also other conditions which contribute to morbidity and mortality amongst children during both childhood and adult hood (Integrated School Health Policy, 2017, p. 6) is violated. No studies had been performed that investigated the difference between the sensed and actual posture on a child, either when the child carried a backpack or did not.

The current study suggests that learners still lack repetitive educational measures for postural education in order to be the influential in their communities. According to the Integrated School Health Policy (2017, p. 6), once learners are educated, they can potentially become influential sources of health information and models of healthy behaviour for their families and broader community. It was evident when 56.1 % participants indicated that they did not learn anything about posture post administration of the questionnaire in which posture was described that one educational session is not enough for learners. Forty-three percent (43.9%) participants confirmed that they gained knowledge relating to postural differences (good and bad posture) during the interview. This the fact that 56.1 % did not learn anything related to posture immediately after postural education implies the need for repetitive education and simplified educational strategies when using education as form of intervention. Montessori (2017, p.3) describes repetition as an enhancer of the neural processors for learning, and therefore further provides an opportunity for the skill and successful learning.

5.3 Measurements discussion of sensed and actual posture results

Confidence intervals (CI) were assessed in the study. When 95% confidence intervals for the median difference for sensed and actual posture with and without a backpack was assessed, all anterior view landmarks (mid heels, mid knees, navel and nose) demonstrated no significant differences. When comparing the study by Hough & Nel (2019, in press) similar findings are noted where there are no clinical and statistical significant differences on the anterior views. This finding is supported by explanation (Shumway & Woollacott, 2012, p. 180) who describes the importance of vision, providing individuals with information regarding the position and motion of the head with regards to verticality and surrounding objects. This visual test is done through visual input from one's peripheral visual information as well as central visual information. In the anterior view, the plumb line is placed directly in front of the participant and is visible and this explains the reason for deviations on the anterior views.

On the other hand, clinical and statistical significant differences are observed on all other landmarks for lateral views especially when the participant carried a backpack. At the earlobe significant difference was observed multiple times contrary to all other landmarks and deviations were greater when the child carried a backpack than when they did not carry a backpack. The presence of weight causes the body to respond, with consequent greater distance between the anatomical landmark and plumb line. The reason for this is that according to literature, weight stimulates sensory and proprioceptor inputs and therefore stimulates the human body for postural adaptation, hence increased distance between anatomical landmark and line of gravity, as represented by the plumb line (Murray, 2002, p. 137). This distance in relation to the plumb line was reflected in the results of the current study by the clinical and statistical significant differences on sensed and actual posture as reported on and discussed below.

5.3.1 Sensed Posture

As indicated in chapter 3, Photographic Method of Postural Assessment was adopted. Results from the P-MPA indicated zero median values for all anatomical landmarks when sense of posture was measured without a backpack. Zero median values in this category suggest that participants do not sense any deviation of their anatomical landmarks when they are not carrying a backpack. Contrarily when the participants are carrying a backpack the median values increased as the anatomical landmarks go higher from greater trochanter to the earlobe.

The anatomical landmark deviation is more evident when the participant carried a backpack than when they are not carrying a backpack. This suggests that the participants could sense better with a backpack than without a backpack. Further reasonable is a conclusion that backpack weight increases or stimulates sense of posture. Yet another conclusion is that the larger the deviations the greater sense of posture even though there is not much evidence in literature relating to association between external weight and sensation. Similar finding is noticeable in the study by Hough & Nel (2019, in press) where less differences between sensed and actual posture were found at larger and weight bearing joints i.e. knee and hip joints; whereas the shoulder (acromion landmark) and head (ear lobe) were less exposed to mechanoreceptor proprioceptive input.

The common value of increment of the left and right lateral sides was looked into. The study showed that sense of posture is similar for both the left and the right sight of the body. This finding consistent with what was observed in the related study by Hough & Nel (2019, in press) even though the former study's population was adults. Literature does not report on proprioceptive evidence relating to differences between left and right sides of the body.

5.3.2 Actual Posture

The current study findings were reached through use of Photographic Method of Postural assessment (P-MPA) (Hough & Nel, 2019, p. 42-47). Then analysis of the results was bases on 95 % confidence intervals for the median difference. Note: A statistical significant difference is identified when 0 is excluded from the confidence intervals per anatomical landmark. A clinical significant

difference is identified where the confidence interval is greater than 10mm. The median difference per anatomical landmark was calculated by subtracting the value obtained of actual posture from sense of posture. A negative value resulting from the calculations indicates that the actual deviation is greater than the sensed deviation. The clinical significant difference is only considered where there is statistical significance (Fethney, 2010, p. 94).

When the P-MPA was used to investigate the actual deviations of the anatomical landmarks from the line of gravity placed anterior to the participant, the median values of the lateral anatomical landmarks differed, however the left and the right side frequently displayed deviations from the plumb line on similar anatomical landmarks concurrently. The median value for the anterior mid heels was zero and this displayed the accuracy of photo capturing as mid heels was the starting point of reference anteriorly for capturing photographs. The groups were compared by means of 95% intervals for the median difference for paired data and significant difference in median values of sensed and actual posture was observed.

A statistically more significant number of participants demonstrated increasing median values at the different areas and this will be elaborated next. Other participants displayed both statistical and clinical differences on numerous anatomical landmarks. Sensed and actual posture for the respective levels of anatomical landmarks were displayed, with respect to with and without a backpack in different tables in the previous chapter. The tables compared two occasions; in some instances, the participants are with a backpack and in some instances without a backpack. The observation is that on most of the landmarks and on several occasions, sensed posture and actual posture differed regardless of whether the participants were with or without backpacks, 95% confidence interval (CI) for the median difference for paired data was compared with significant differences. It was furthermore found that there were more differences when the participant carried a backpack than when they did not carry a backpack.

Evidence was noted verifying that sensed and actual posture differ especially when weight is involved in this instance, when a learner is carrying a backpack. Besides the remarkable clinical and statistical difference on all other affected landmarks, the earlobe demonstrated significant difference at all

times, whereas other anatomical landmarks; mid knees, greater trochanter and acromion process on the lateral views displayed significant differences occasionally. It was fascinating to see the dominant clinical and statistical differences at the earlobe because the previous literature supports the finding in that, the habit of forwarding head position does not favour the proprioception within the top landmarks like the ear (Yong, Lee & Lee, 2016, p. 857-860). As a result, the participant's sense of posture is greatly affected and the more affected the sense of posture, the greater the postural adaptation. This therefore that the larger deviations will be visible on the actual posture.

Biographical results and the differences noted in sensed and actual posture while participants carried a backpack and while they did not were interrogated for association. Significant clinical differences were noted on the lateral views. In multiple occurrences when the biographical questionnaire results of sensed and actual difference were compared by means of 95% confidence intervals, clinical and statistical significant differences were observed at the ear lobe and the mid knees, even though in a few instances the greater trochanter also displayed a significant difference.

Due to an observation that there were more significant differences while the participants carried a backpack than when they did not, the researcher decided to investigate the differences of only when the participants carried a backpack. The aim was to compare actual and sensed posture significant differences with a backpack. Sensed posture and actual posture results for these groups were compared and differences were noted and described by means of 95% confidence intervals for the percentage of median difference. From the data reported in the previous chapter, there is evidence that sensed and actual posture do differ. The significant difference was further reported on in multiple tables where weight (backpack) is carried. The significant difference between sensed and actual posture at the ear lobe was more evident than on all the other anatomical landmarks and the pattern observed on the lateral left side was similar to the pattern on lateral right side. Furthermore, the significant difference was evident on the lateral left and right mid knees and seldom present on the greater trochanter.

Sense of posture and actual posture was proven different in 2019 by Hough & Nel (2019, in press) who investigated the difference on adults from the community of Thaba-Nchu and Botshabelo. An unpublished study by Tredoux et al. (2019) applied a similar investigation amongst Allied Health

Professionals and found both clinical and statistical significant differences for actual and sensed postural alignment. With regards to my investigation where I focused on young children, I also encountered both statistical and clinical differences for various anatomical landmarks. This finding makes reasonable a conclusion that regardless of whether it is an adult or child, sensed and actual posture differ. A significant discovery is that actual and sensed posture differ more when weight is involved. Furthermore, the study brought to surface knowledge that weight being represented by a backpack makes a difference in the value of deviations as the deviations recorded at the earlobe were greater and experienced more regularly in the current study than it was in the findings by (Hough & Nel, 2019, in press).

The study in question focused on children of ages 9.6 to 13.4. The reason for targeting this age group was that their spinal structure has not reached maturity yet, despite them having started carrying massive weight of books as proven by the three-random Grade 5 teachers consulted prior to data collection. I aim to emphasise that if their spine is always bent due to postural adaptation as a response to load of the backpack, short and long-term consequences may have to be considered. It is therefore urgent for the Department of Basic Education to involve relevant professionals such as occupational therapists and ensure effective intervention.

The Integrated School Health Policy (ISHP) (2018, p. 15) decrees that a package of on-site services should be provided at schools. According to this policy, these services include immunizations and environmental assessment. It is anticipated by the ISHP that the on-site services will be expanded over time. The rehabilitation services are not mentioned amongst the services that the ISHP intends to provide on-site. I believe rehabilitation services are a priority in this regard as they will support in decreasing the effects of future disability. According to World Health Organisation (2014, p. 100), therapy is concerned with restoring and compensating for loss of function and preventing or slowing deterioration in functioning in every area of a person's life. It is further stated in the Document that therapy measures include training, exercises, compensatory strategies, education, support and counselling therefore is vital. The current study investigates the sense of posture and actual posture with a goal to fulfil both the statements by WHO and ISHP which commonly have the interest of the wellbeing of learners. With the findings of this study I conclude that it creates a step ahead to goal attainment.

The findings and conclusions on actual posture as deliberated on in the foregoing paragraphs imply some intervention measures. One could be that the manufacturing companies should consider designing trolleys that children may push. However, this resolution would need to be coupled with intensive and regular educational strategies. Furthermore, different geographical areas in which schools are located would need to be taken into consideration. It is worth noting that the study in question was conducted in Botshabelo, which is a semi-rural area with low socio-economic status in Free State province. The terrain in this area is uneven and a trolley may not be an effective consideration particularly in view of the finding that 95.0% of participants carry their backpacks daily. The findings point to a need for regular educational intervention by relevant qualifies professionals as the most possible way forward at this stage.

There were three most vital elements displayed throughout the current chapter. Firstly, it is revealed that there is no significant difference observed on all the anterior views as per indication by the results of the previous chapter. Secondly, the earlobe when viewed laterally demonstrated more regular significant differences when compared with the other landmarks, especially when the participants carried a backpack and lastly, in most instances the anatomical landmarks that displayed significant difference on the left side also displayed a difference on the right side. In the following chapter the conclusion will be reached and discussed and further recommendations for future studies will be delineated.

5.4 Summary of discussion

This chapter presented and elaborated on the results from an analysis of data. The findings were expounded on in relation to claims in reviewed scholarship and the researcher's experience as an occupational therapist. The pattern for discussion was similar to that of the reporting of results which started with discussion of the biographical information, covering personal information, schoolbag use, general health and knowledge relating to posture. Secondly, results relating to sensed and actual posture for each anatomical landmark in lateral and anterior view were discussed. The next chapter will draw conclusions based on the aim, objectives and results of the current study. The conclusion section will highlight the therapeutic value of the results obtained in chapter 4, and how

these results will contribute to the existing body of knowledge within occupational therapy. Limitations of the study and possible future research will also be discussed.

CHAPTER 6 – CONCLUSION

6.1 Introduction

The aim of the study was to quantitatively establish the difference between sensed and actual posture of a Grade 5 learner while they stand and carry a backpack. In the previous chapter, the results of the current study were discussed in line with research methodology. The difference between sensed and actual posture of a Grade 5 learner while carrying a backpack was discussed. Chapter 5 also highlighted literature findings and the researcher's clinical experiences and associated them with the current research results. The current chapter is a summary of the information pertaining to sensed and actual posture, the difference between the two and their relation to a Grade 5 learner while they stand and carry a backpack and while they do not. Improvement of assessment methods, treatment protocols and recommendations for future studies will be examined and determined in this chapter.

6.2 Summary of results

Difference between sensed and actual posture

Findings of the study indicate that irrespective of the nature of the community where the research took place, regardless of the age of the participants and irrespective of whether the participants carried a backpack or did not, clinically and statistically significant differences between sensed and actual posture were found. The difference between the sensed and actual posture further demonstrates deviation from the plumb line which may have negative effects on development of an immature musculoskeletal structure eventuating in possible postural mal-alignment.

Research study by Hough & Nel (2019, in press) have recently embarked on scrutinising the issue of differences in sensed and actual posture. As mentioned in the previous chapter, another related

investigation was undertaken on allied health professionals while the other was done on community members, but none of these studies focused on children. Documented studies on the difference between sensed and actual posture revealed similar results when compared to results found in the current study, confirming the difference between sensed and actual posture. The extend of the significant differences however varies; and as observed in the current study, is influenced by external factors such as addition of weight in the form of a backpack. The carrying of a backpack increased the value of the differences between sensed and actual posture.

At the anatomical landmark of the earlobe, regular significant difference between sensed and actual posture was observed when viewed from the lateral side, and more especially so when the participants carried a backpack. Additionally, literature advocates that being exposed to this forward shifted earlobe on daily basis has been proven to disrupt the ability to function optimally. furthermore, good posture improves function and breathing ability. Another problem which influences continuation of this inappropriate posture is lack of knowledge. Alternative solution would be introducing regular educational intervention to create awareness and I believe this will ultimately decrease the effects of heavy backpacks that in due course over stimulate the proprioceptive input and result in unnecessary postural adaptation.

Another noteworthy finding from the present study is that all the lateral view landmarks, except for mid heels, show both statistical and clinical significant differences between sensed and actual deviation for standing position. The significant difference is more evident while the participant is with a backpack than without a backpack. This adds to the fact that addition of weight increases sense of posture and in this case causes larger deviations subsequently more recognisable significant differences.

Results from this study indicated that early-onset of poor posture caused by constant overuse of proprioception sense impacts on the actual posture and causes differences between what we see (actual posture) and what the young learners feel (sensed posture) as they carry their backpacks daily. The researcher concluded that this increased proprioceptor input indicated increased counter-effects like increased postural adaptation that contribute to mechanical stresses on the developing musculoskeletal system. Such findings are consistent with literature indicating the dangers that excessive loads pose to the maturing spine.

An interesting observation from the study is that participants are not totally uninformed with respect to the difference between good and bad posture, since 57.1% of the participants indicated that they knew the difference between good and bad posture. Some participants are aware that a backpack may negatively affect their posture but are uninformed on what the solution could be. More than half (63.3%) of the participants stated that the backpack affects the way they stand. Of these 63.3% of participants, eighty-seven (43.9%) participants agreed that they think their backpack affected the way they stand and walk. About seventy percent (70.2%) % of the participants further indicated that no one has ever reprimanded them to sit or walk up straight. Of the 198 participants, 29.9% however agreed that different members of the community including parents, other children, street passers, teachers and grandparents have reprimanded them to correct their postures. If only 29.9 % have been reprimanded about posture before, it can be concluded from this study that community involvement in postural education is of concern.

Sensed and actual posture

The literature has focused on several areas of posture, one of these being the potential effects of bad posture and what controls posture. As mentioned previously, there was a gap in literature on whether the sensed and actual posture really differ, specifically on children and more specifically when they carry weight of a backpack.

From the discussion of results in the previous chapter and as mentioned above, there is clear evidence that sensed and actual posture do differ. The significant difference between sensed and actual posture was demonstrated by the clinical and statistical significant difference found at the respective anatomical landmarks, and in anterior and lateral views. Furthermore, the significant difference noted on the lateral left side anatomical landmarks resided on similar anatomical landmarks on lateral right side. This hypothesis is based on other research finding indicating a difference in sensed and actual posture regardless whether participants were adults or children, whether professionals or not professionals. Drawing upon this significant difference between sensed and actual posture, it is a positive attempt that in the current study, the researcher diverted investigation to other critical areas such as on children carrying backpacks.

Though past researchers have speculated about the directionality of the relationship between sensed and actual posture, studies have consistently indicated the role of proprioceptive function in assisting the body to identify position in space, and therefore also controls posture, but not associating the issue or taking into consideration the extend of this control in association with a backpack on a developing spine of a Grade 5 learner. The risks associated with the difference found between sensed and actual posture of a Grade 5 learner while they stand and carry a backpack is the next concern implicated by in the current research study.

Conversely, it is possible that limitation of backpack use may eliminate over use of proprioceptors that results in significant differences in actual and sensed posture. Either way, backpack manufacturers and Integrated School Health Programme (ISHP) may benefit by noting the evidence on postural compromises due to carrying backpacks and assume collective responsibility for the promotion of health and wellbeing of learners at this stage of development. Occupational therapists would need to influence policies and standard operational procedures that will guide manufactures to promote wellbeing of their clients and prevent future disabilities.

It is evident from this research findings that people are not adequately informed about posture, since only 29.9 % of the population used in the current study were reprimanded about posture before. In addition to this, we would see posture educational posters framed and posted on school notice boards and public places, which is something that I rarely witness. The government promises good health system as stated in the ISHP, but professionals remain with the responsibility to advice the execution of such speculation and adherence thereof through control of deterioration and maintenance of relevant programmes.

6.3 Limitations of the study

The study population comprised of only participants from low socio-economic status in the Botshabelo district, Free State Province. The significant difference found between the sensed and actual posture in the current study might differ in educational contexts with differently designed backpacks, as compared to the backpacks that were used by participants in the current study. The study population further comprised of the age groups 9.6 to 10.5 and did not include all age groups of participants who carry backpacks. This therefore may result in findings that differ and therefore the results of the current study are subject to the included age group only.

During the collection of biographical information, numerous questions relating to sensed posture had to be clarified. This may indicate possible misunderstanding of complicated concepts, with responses compromised with reference to the fact that at the end of the questionnaire when participants were asked if they had learned anything about posture during the interview, the majority (56.1%) indicated that they did not learn anything. It would benefit the data collection procedure to have a few but clear questions and explanations with examples.

Data collection comprised of one person, namely the researcher. The data collection process could benefit by more than one researcher in order to handle issues such as unexpected intruders while data capturing process was in progress.

There were no arrows to indicate left/right side to easily and effectively direct the participant and avoid confusion during photo capturing. But the researcher could counteract this by physically pointing for the participants where they needed to face.

6.4 Value of the study

Research studies investigating the difference between sensed posture and actual posture are limited to one study in South Africa, which is currently in press. Except for sense and actual alignment done on single joints, no studies on a global level had been performed that investigated the difference between sensed and actual posture for whole body postural alignment. Results from the current study will be beneficial in establishing a body of knowledge that can inform educational programmes regarding postural intervention in the education system. The ISHP aims to build on, and strengthen existing school health services, with some important changes that amongst others includes provision of more comprehensive package of services which does not only focus on only barriers to learning, but also other conditions which contribute to morbidity and mortality. The current study results will support the initiative of the ISHP.

The relevant allied health professionals will benefit from the quantitative data pertaining to the clinical and statistical significant difference found between actual and sensed posture as it will guide them during academic and clinical intervention. Community members will be sensitised by the allied health professionals through educational intervention, health promotion activities with supported background from the study in question. Therefore, from the current research study, the community members will benefit directly and as a result insight on good postural behaviour will be gained.

The ISHP has been very clear about its intention to build on and strengthen existing school health services. The common idea between the ISHP and occupational therapy is to provide health services that will promote wellbeing of individuals both in childhood and adult hood. This study will provide proof of why posture should be considered in the planning to provide health services in school and therefore motivate for funding and budget allocation by the government to support the Department of Basic Education in this regard.

Determination of priorities regarding early childhood development needs will be simplified when substantial evidence is readily available from this study to support and guide the decision makers

regarding the priority health hazards that need to immediately be attended to by the government. Therefore, parents, teachers, student governing bodies and learners will benefit from the findings of the current study as they will be able to access information at any given time.

Another interesting factor is that regular research and feedback sensitises and draws people's attention. The results from the current study will stimulate an interest amongst the allied health professionals in identification of other posture related challenges in school setting and subsequently improving the approach of postural education and awareness in South Africa.

The foregoing conclusions from the findings, form the basis on which the following recommendations for intervention and further research are made.

6.5 Recommendations

In order to optimise the aim of the study, which was to establish the difference between sensed and actual posture of a Grade 5 learner while they stand and carry a backpack and make benefit from the results thereof, recommendations and conclusions will be stated in this section. The most natural recommendation is that findings from the current study that indicate the difference between sense and actual posture in children when they carry a backpack, must further be investigated.

Further studies could focus on investigating if the occupational therapists currently in the field of practice take initiative in getting involved in postural education at schools and public places.

A natural progression of this study would be to analyse the difference between sense of posture in movement and actual posture in movement, with specific focus on a comparison between sensed and actual posture in learners carrying different types of backpack. Research studies could further investigate the influence of height and weight of a learner with regard to the difference between sense and actual posture.

It is recommended that results of this study be communicated to the Department of Basic Education, as well as to the respective stakeholders, including community and family members, informing them

on the value of knowing and understanding the difference between sense and actual posture, and the consequent implications on postural adjustment while a learner is performing an activity.

Lastly it is recommended that occupational therapists design educational intervention programmes relating to sense and actual posture, in order to improve the learner's knowledge which will simultaneously improve wellbeing of learners in school settings. Allied health professionals may also assist the local Departments of Basic Education on evaluating policies and standard operational procedures related to postural education.

6.6 Conclusion

The aim of the study was to determine the differences between sensed and actual posture of a Grade 5 learner while they carry a backpack and while they do not carry a backpack. The study proved the difference between sensed and actual postural alignment, which was evidently more profound on the lateral views, as they relate to anatomical landmarks and the plumb line. Data was collected from 198 participants and the researcher could achieve the research aim. The results of the current study presented statistical and clinical significant differences for sense and actual postural deviations from the plumb line, for certain anatomical landmarks in lateral standing and profound differences at the earlobe when participants carried a backpack.

Four main conclusions can be drawn from the study. Firstly, a difference is found between sensed and actual posture when a Grade 5 learner is standing and carrying a backpack. Secondly, similarities were identified on the left and the right sides of the body, with respect to the anatomical landmarks in the areas where the difference is observed. Thirdly, the most affected anatomic landmark when a child is carrying a backpack is the anatomical landmark of the earlobe, portraying regular and larger values of significant differences. Lastly this study proved that when a learner is carrying a backpack, the deviation value increases per anatomical landmark, moving from the lower anatomical landmark to the higher i.e. from the lateral malleoli to the earlobe. This can be associated with the forward bending of the head during postural adaptation as the child carries a heavy backpack. Also, the fact that anatomical landmark deviation is more evident when the participant carried a backpack than

when they are not carrying a backpack suggests that the participants could sense better with a backpack than without a backpack.

There are more discoveries that are not necessarily major but play a vital role in a learners' wellbeing. For instance, the current study revealed that there is lack of knowledge and understanding of posture by learners, this speculation arose since at the end of structured interview that included postural education, the majority of the participants still indicated that they did not learn anything about posture. Furthermore, intervention strategies to improve posture in school settings are still limited. On the note of intervention strategies, the current study revealed that trolleys may not be the solution to replace backpacks in school setting as literature suggested. Trolleys are rather relevant in places where the terrain is accommodative and at places of medium to higher socio-economic status where parents would afford to purchase them.

It was astonishing to realise that more than half of the participants (70.2%) specified that no one ever reprimands to correct their posture, this discovery teaches me that, not only the learners lack postural education but even the community members. It adds to the fact that intervention strategies to improve posture are limited in school setting but also in the community at large.

Another important finding from the current study was the use of heavy backpack may lead to development of different musculoskeletal discomfort among the schoolchildren, in the current (94.5%) participants who carried a backpack experienced pain in their body, this adds to already existing literature that where a child carries a backpack daily, more frequent than not, body pain may be associated with a heavy backpack and may also lead to development of musculoskeletal discomfort.

In essence, when a Grade 5 learner is standing and carrying or not carrying a backpack, there is a difference between their sensed and actual posture. This difference is actually more evident when they carry a backpack. The difference established between sensed and actual posture in children mostly when they carry a backpack may indicate unhealthy posture and therefore needs to be prevented through intervention strategies by occupational therapists.

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APPENDICES

Appendix A – Biostatistician letter

UFS·UV

[redacted]

07 August 2018

For attention: Health Sciences Research Ethics Committee
Faculty of Health Sciences

Title of project:

SENSED AND ACTUAL POSTURE OF A GRADE 5 LEARNER WHILE CARRYING A SCHOOLBAG

Researcher:

N Phatela

I have given input regarding the above mentioned project's protocol on the following aspects of the protocol, namely the study design, sample, measurement, measuring instrument and statistical analysis.

The input will be implemented under supervision of the study leader Mrs PA Hough.

Yours faithfully

M. Nel

Departement Biostatistiek
Department of Biostatistics
T: +27(0)51 401 3044/5/6/7, F: +27(0)51 401 3441
205 Nelson Mandela Drive/Rylaan, Park West/Parkweg, Bloemfontein 9301, South Africa/Suid-Afrika
P.O. Box/Posbus 339 (G31), Bloemfontein 9300, South Africa/Suid-Afrika, www.ufs.ac.za

Appendix B- Evaluation Committee report

UFS·UV

APPENDIX 2

MASTER'S / PHD DEGREES

SCHOOL FOR ALLIED HEALTH PROFESSIONS
SUMMARY OF EVALUATION COMMITTEE REPORT FOR THE PURPOSE OF ETHICAL CLEARANCE SUBMISSION TO THE HSREC

Initials and surname (student):	N Phatela
Student number:	2017444726
Degree:	Master's in Occupational Therapy
Style of Study (Article/Mini-Dissertation/Dissertation):	Dissertation

Members of the Evaluation Committee:	Present	Absent
Chair: Prof Louise van den Berg	X	
Dr Marianne Reid	X	
Me Riette Nel	X	
Me Monique Strauss	X	
Me Ronette Hough	X	

Date of meeting:	7 August 2018
Proposed title:	SENSED AND ACTUAL POSTURE WHILE CARRYING A SCHOOLBAG
Amended title:	SENSED AND ACTUAL POSTURE OF GRADE 5 LEARNERS WHILE CARRYING A SCHOOLBAG

Outcome of meeting (Mark with an X) – To be completed by Chair of Evaluation Committee:

Acceptance of protocol without chang e	Yes	No
Acceptance of protocol with changes under the supervision of the study-leader	Yes X	No
Protocol not accepted and student should resubmit protocol to evaluation committee	Yes	No

Signature: Chair of Evaluation Committee:

VvdBerg

Name: Louise van den Berg Date: 10/9/2018

Appendix C – Health Science Research Ethics Committee Approval

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

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

[redacted]

Health Sciences Research Ethics Committee

14-Jan-2019

Dear **Ms Ntebohaleng Phatela**

Ethics Clearance: **SENSED AND ACTUAL POSTURE OF GRADE FIVE LEARNERS WHILE CARRYING A SCHOOLBAG**

Principal Investigator: **Ms Ntebohaleng Phatela**

Department: **Occupational Therapy Department (Bloemfontein Campus)**

APPLICATION APPROVED

Please ensure that you read the whole document

With reference to your application for ethical clearance with the Faculty of Health Sciences, I am pleased to inform you on behalf of the Health Sciences Research Ethics Committee that you have been granted ethical clearance for your project.

Your ethical clearance number, to be used in all correspondence is:**UFS-HSD2018/1305/2901**

The ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the HSREC for approval to ensure we are kept up to date with your progress and any ethical implications that may arise. This includes any serious adverse events and/or termination of the study.

A progress report should be submitted within one year of approval, and annually for long term studies. A final report should be submitted at the completion of the study.

The HSREC functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act. No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2006); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 (for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; The International Conference on Harmonization and Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH Tripartite), Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines, Constitution of the HSREC of the Faculty of Health Sciences.

For any questions or concerns, please feel free to contact HSREC Administration: 051-4017794/5 or email EthicsFHS@ufs.ac.za.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours Sincerely

Dr. SM Le Grange
Chair : Health Sciences Research Ethics Committee

Health Sciences Research Ethics Committee
Office of the Dean: Health Sciences
T: +27 (0)51 401 7795/7794 | E: ethicsfhs@ufs.ac.za
IRB 0000624O; REC 230408-011; IORG0005187; FWA00012784
Block D, Dean's Division, Room D104 | P.O. Box/Posbus 339 (Internal Post Box G40) | Bloemfontein 9300 | South Africa

Appendix D – Letter for the school principals

Department of Occupational Therapy
CR De Wet Building
University of Free State
Bloemfontein

29th November 2018

The Principal
Department of Basic Education
Botshabelo

Dear Principal,

Research study title: SENSED AND ACTUAL POSTURE OF GRADE FIVE LEARNERS WHILE CARRYING A SCHOOLBAG

I am a Master's degree student at the department of Occupational Therapy, University of Free State, I intend to execute the above mentioned study to escalate information for Occupational Therapists so that they may be able to place relevant educational material for teachers, parents and relevant people regarding the importance of sense of posture as a basic reference for actual posture in human occupation, specifically in the case of a school going child who is carrying a schoolbag.

The results of this study will contribute to attainment and maintenance of optimal postural alignment and stability to the advantage of efficient and safe performance of activities. I intend to collect data at your school between 21st January 2019-20th March 2019, I have received permission (attached) to execute the study from the Department of Basic Education and ethical issues have been considered.

Please advise if the estimated days of data collection would suite your school, detailed plan will be communicated closer to data collection the necessary documents such as consent forms, assent forms and information letters will be handed with this letter. Learners will take approximately 30 minutes each for data collection. For more information my contact details are attached below.

Yours faithfully

Nteboheleng Phatela

***Contact details of the researcher – Cell phone number: 0798861551 Email: nphatela85@gmail.com Contact details of the study leader: Email: houghpo@ufs.ac.za, 051 401 2829 Contact details of the Health Sciences Research Ethics Committee (HSREC), University of the Free State** – for reporting of complaints/problems. Telephone number (051) 4052812*

1

Appendix E - Approval from Department of Basic Education

Enquiries: KK Motshumi
Ref: Research Permission: AN Phatela
Tel. 051 404 9283 / 9221 / 079 503 4943
Email: K.Motshumi@fseducation.gov.za

education
Department of Education
FREE STATE PROVINCE

AN PHATELA
27352
Vista Park
BLOEMFONTEIN, 9323

079 8861 551

Dear Ms Phatela

APPROVAL TO CONDUCT RESEARCH IN THE FREE STATE DEPARTMENT OF EDUCATION

1. This letter serves as an acknowledgement of receipt of your request to conduct research in the Free State Department of Education as follows;

   Topic: Sensed and actual posture of Grade 5 learners while carrying a schoolbag.

   Schools involved: Batja, Bothobapelo, Dibeng Sa Tsebo, Ditholwana, Fadimehang, Hohle, Lerole, Mabela, Mpolokeng, Nkgothatseng, Nthabeleng, Pontsheng, Ramoshoane, Reentseng, Retsamaile, Sebabatso, Seroki, Serope, Setjhaba Se Maketse, Thabo, Tlholo Primary School.

   Target Population: Grade 5 learners.

2. **Period**: From the third week of January 2019 until 30 September 2019. Please note the department does not allow any research to be conducted during the fourth term (quarter) of the academic year nor during normal school hours.

3. Should you fall behind your schedule by three months to complete your research project in the approved period, you will need to apply for an extension.

4. The approval is subject to the following conditions:

   4.1 The collection of data should not interfere with the normal tuition time or teaching process.
   4.2 A bound copy of the research document or a CD, should be submitted to the Free State Department of Education, Room 319, 3rd Floor, Old CNA Building, Charlotte Maxeke Street, Bloemfontein.
   4.3 You will be expected, on completion of your research study to make a presentation to the relevant stakeholders in the Department.
   4.4 The ethics documents must be adhered to in the discourse of your study in our department.

5. Please note that costs relating to all the conditions mentioned above are your own responsibility.

Yours sincerely

DR JEM SEKOLANYANE
CHIEF FINANCIAL OFFICER

DATE: 25/09/2018

Enquiries: KK Motshumi
Ref: Notification of research: AN Phatela
Tel. 051 404 9221 / 079 503 4943
Email: K. Motshumi@fseducation.gov.za

education
Department of Education
FREE STATE PROVINCE

The District Director:
Motheo District

Dear Mr Moloi

NOTIFICATION TO CONDUCT RESEARCH PROJECT IN YOUR DISTRICT BY AN PHATELA

1. The above mentioned candidate was granted permission to conduct research in your district as follows:

   Topic: Sensed and actual posture of grade five learners while carrying a schoolbag

   Schools involved: Batja, Bothobapelo, Dibeng Sa Tsebo, Ditholwana, Fadimehang, Hohle, Lerole, Mabela, Mpolokeng, Nkgothatseng, Nthabeleng, Pontsheng, Ramoshoane, Reentseng, Retsamaile, Sebabatso, Seroki, Serope, Setjhaba Se Maketse, Thabo, Tlholo Primary Schools.

   Target Population: Grade 5 learners.

2. **Period**: From the third week of January 2019 until 30 September 2019. Please note the department does not allow any research to be conducted during the fourth term (quarter) of the academic year nor during normal school hours.

3. **Research benefits:** Relevant educational material for teachers, parents and relevant people regarding the importance of sense of posture as a basic reference for actual posture in human occupation, specifically in the case of a school going child who is carrying a schoolbag.

4. Logistical procedures were met, in particular ethical considerations for conducting research in the Free State Department of Education.

5. The Strategic Planning, Policy and Research Directorate will make the necessary arrangements for the researcher to present the findings and recommendations to the relevant officials in your district.

Yours sincerely

DR JEM SEKOLANYANE
CHIEF FINANCIAL OFFICER

DATE 25/09/2018

SENSED AND ACTUAL POSTURE OF GRADE 5 LEARNERS WHILE CARRYING A SCHOOLBAG

ORIGINALITY REPORT

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Appendix G - Parents/guardians Information letter (English)

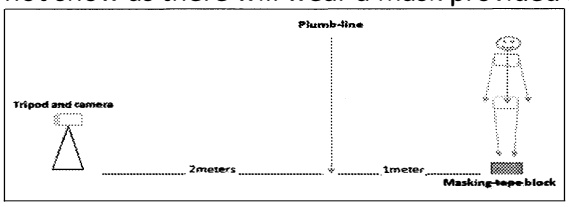
Study title: SENSED POSTURE AND ACTUAL POSTURE WHILE A GRADE 5 LEARNER IS CARRYING A SCHOOLBAG

Dear Parents/guardian/foster parents,

I am Ms Nteboheleng Phatela, a Masters student in occupational therapy at the University of the Free State. I am doing a research study to learn more about the difference between posture that your child feels and posture that your child shows while he/she stands and carry a schoolbag. Your child is kindly invited to participate in gathering necessary information for this investigation.

At the end of the research, people may learn better about what controls and affects the way children stand while carrying a schoolbag. This information will make it easier for everyone to teach children the good way of standing.

During this study the following will be done: (a) your child will be asked to stand with and without a schoolbag, as shown on the picture below. The researcher will take six photos. Your child's face will not show as there will wear a mask provided by the researcher.



(b) Your child will be asked to say how they feel their body in relation to the plumb line (c) A questionnaire will be completed by the researcher with your child in either English or Sesotho. All of this is expected to take about 30 minutes.

By taking part, your child will contribute to improvement of medical knowledge in schools and the country at large. Children's personal identity information will not be revealed and there will be no individual link of the information with your child No physical and emotional harm are expected due to participation in the study. Participation in the study will not take your child's learning time as the above processes will happen during break time.

Your child will not be paid for participation and she/he will also not be requested to pay to participate. Participation is totally voluntary, and your child may choose not to participate in the research or may stop participating at any time. If you allow your child to take part in the above explained study, please fill in the consent form attached and kindly return it with your child to the class teacher.

Contact details of the researcher – Cell phone number: 0798861551 Email: nphatela@gmail.com Contact details of the study leader: Email: houghpa@ufs.ac.za, 051 401 2829 Contact details of the Health Sciences Research Ethics Committee (HSREC), University of the Free State – *for reporting of complaints/problems: Telephone number (051) 4052812*

Appendix H - Parents/guardians Information letter (Sesotho)

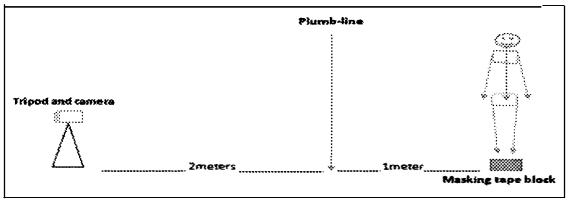
Study title: SENSED POSTURE AND ACTUAL POSTURE WHILE A GRADE 5 LEARNER IS CARRYING A SCHOOLBAG

Batswadi ba kgabane,

Ke Mme Nteboheleng Phatela, ke moithutwana wa mangolo a phahameng Yuniversiting ya Fraisetata lekaleng la occupational therapy, ke tlo etsa dipatlisiso ka phapang ka tsa seemo sa ngwana ha a eme a jere mokotlana wa hae o tshelang dibuka. Ka boikokobetso mora/moradi wa hao o memelwa ho nka karolo dipatlisisong tsena.

Tebello ke hore batho ba tla una molemo ka hore tsebo ya bona e mabapi le seemo sa ngwana e eketsehe, le hore ba tsebe hore ke dife dintho tse nkang karolo ha ngwana a eme a jere mokotlana wa hae o tshelang dibuka. Ditaba tsena di tla nolofaletsa setjaba ho ruta bana mekgwa e nepahetse ya seemo kappa ho tsamaya.

Ka nako ya dipatlisiso, hotla etsahala tse latelang, (a) ngwana wa hao o tla ema a jere le ho ema a sa jara mokotlana wa dibuka, a eme ka pele ho line ya letshwaho ele ho monka dinepe tse tsheletseng jwalo ka setshwantshong se tla latela, a rwetse musk o kwahelang sefahleho (b) o tla hlalosa seemo sa hae mabapi le line ya letshwaho e tla beng e behilwe, jwalo ka setshwantshong se tla latela. (c) ngwana wa hao o tla tlatsa le ho araba dipotso ka English kapa Sesotho ka thuso ya mobatlisisi. Tsena tsohle di lebelletswe ho nka metsotso e 30.



Bohlokwa ba hore ngwana wa hao a nke karolo ke hore o tlabe a kentse letsoho ntlafatsong ya tsa maphelo a matle dikolong le setjhabeng. Tsa boitsebiso ba ngwana ya nkang karolo di tla bolokwa ele sephiri hape ha hona moo dipatlisiso tsena di tlang ho bua ka ngwana ale mong, sephetho se tlo bua ka sehlopha sa bana. Dipatlisiso tsena di ke ke tsa kena kenana le tsa bophelo ba ngwana bo botle ha a nka karolo. Ha hona tebelello ya tshitiso ya dithuto tsa ngwana kaha dipatlisiso di tla etswa ka nako ya kgefutso ya dithuto sekolong.

Ha hona na dipatala kapa dimpho mabapi le dipatlisiso tsena, ba nkang karolo le bona ha ba lebellwa ho patala, tsohle ke ka ho ithaopa. Ngwana a keke a qobellwa ho nka karolo tlasa boemo bofe kapa bofe. Ha o dumella mora/moradi wa hao ho nka karolo dipatlisisong tsena, ka kopo tlasa lengolo la ditumellano le latelang o le romele sekolong ka ngwang wa hao.

Dinomoro tsa mmatlisisi: 0798861551 Email: nphatela@gmail.com, Mookamedi wa mmatlisisi: houghpa@ufs.ac.za, 051 401 2829
Health Sciences Research Ethics Committee (HSREC), University of the Free State – *Sebakeng sa ditletlebo/mathata: Dinomoro tsa mohala (051) 4052812*

Appendix I - Informed consent document (English)

CONSENT FORM

Title of Project: **SENSED POSTURE AND ACTUAL POSTURE WHILE A GRADE 5 LEARNER IS CARRYING A SCHOOLBAG**

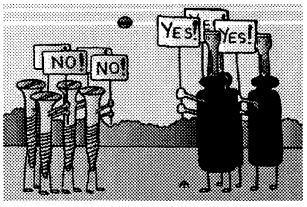
Name of Researcher: Miss Nteboheleng Phatela

Participant Number:

If you agree that your child may take part, please initial all boxes below

1. I confirm that I have read and understand the information sheet attached for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.  ☐

2. I understand that my child's participation is voluntary and that he/she is free to withdraw at any time without giving any reason, and his/her legal rights will not be affected. ☐



3. I agree that my child may take part in the above study. ☐

Name of Participant (Child)	Surname	Place
Name of Parent	Date	Signature

Appendix J - Informed consent document (SESOTHO)

LENGOLO LA DITUMELLANO

Sehlooho sa dipatlisiso: **SENSED POSTURE AND ACTUAL POSTURE WHILE A GRADE 5 LEARNER IS CARRYING A SCHOOLBAG**

Lebitso la mmatlisisi: Miss Nteboheleng Phatela

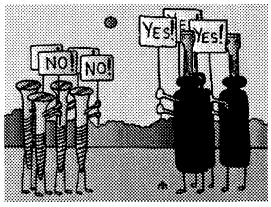
Nomoro ya monka karolo:

Ha o dumella ngwana wa hao ho nka karolo, ngola di initiale mabokoseng a ka tlase

1. Ke tshepisa hore ke badile le ho utlwisisa ditaba tse ka hodimo tse mabapi le lipatlisiso tsa sehloho se ka hodimo. Ke iphile nako ya ho imamela ka ditaba tseo le ho botsa dipotso mme eke kgotsofetse ke ka moo di arabilweng ka teng. ☐

2. Ke utlwisisa hore ngwana waka o tlo nka karolo ka ho ithaopa ebile ona le tokelo ya ho tlohela ho nka karolo nako yohle ha a batla ho tlohela, le ha a sena mabaka a ho tlohela a keke a qoswa hoba o tla be a sa tlola molao. ☐

3. Ke dumella ngwana waka ho nka karolo dipatlisisong tse ka hodimo. ☐



_____ _____ _____

Lebitso la ngwana (Mo nki karolo) fane sebaka

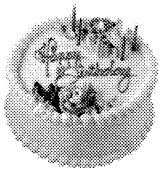
_____ _____ _____

Lebitso la motswadi letsatsi Tekena

Appendix K - Questionnaire (English)

Participant Number ☐

1. Date questionnaire is completed (dd/mm/yyyy) ☐☐☐☐☐☐☐☐



2. What is your birth date (dd/mm/yyyy) ☐☐☐☐☐☐☐☐

3. Are you a boy or a girl?

Girl		Boy	

4. Do you have a schoolbag?

	Yes		No

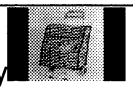
5. Do you like a schoolbag?

	Yes		No

6. If you answered yes above, why?

.....

7. What type of a schoolbag do you have?

	Back pack 
	Briefcase 
	Plastic bag 
	Trolley 

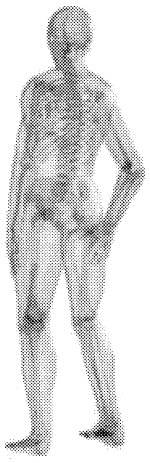
Other types.....

8. How much do you carry the above bag?

	Daily		Sometimes		Never

Other.....

9. Do you sometimes feel the pain in the following areas?



	Head
	Neck
	Back
	Waist
	Hands
	Arms
	Feet
	None

Other.....

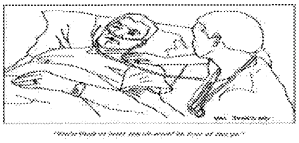
10. If yes on the above question, how regularly do you feel the pain?

	Daily		Sometimes		All the time

General Health

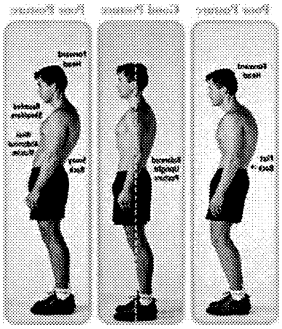
11. Have you ever been ill in the past six months?

	Yes		No



12. If yes, from what? .....

I am now going to ask you questions about your posture *(Assessor explains what posture means using the attached picture)*



13. Were you taught about posture before today?

	Yes		No

14. If yes, who taught you about posture? .....

15. Do you know the differences between good posture and bad posture?

	Yes		No

16. When you carry a schoolbag, do you…

	Walk up straight 
	Bend your back forward 
	Bend your back backwards 
	Bend your back sideways 
	I do not know

17. If you answered bend, do you decide to bend as above or it just happens?

	I decide		It just happens

18. If you decide, why?.....

19. Do you think your schoolbag affects the way you stand/walk?

	Yes		No

20. Does anyone ever ask you to sit or walk up straight?

	Yes		No

21. If you answered yes above who is that?

	My teachers 
	Parent/s 
	Other children 
	Other.....

Sport/Activities

22. Have you ever participated in any of the following sports in the past six months?

	Sports/activities
	Athletics
	Netball
	Volley ball
	Soccer
	Rugby
	Golf

Others.....

23. Have you learnt anything about posture today?

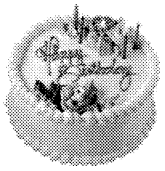
	Yes		No

Explain.....

Appendix L - Questionnaire (Sesotho)

Participant Number ☐

1. Letsatsi leo foromo e tlatsitsweng ka lona (dd/mm/yyyy) ☐☐☐☐☐☐☐☐



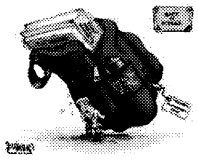
2. hlahile neng? (dd/mm/yyyy) ☐☐☐☐☐☐☐☐

3. Bong ba hao ke bofe?

Ngwanana		Moshanyana	

4. Na o na le mokotlana wa ho tshela dibuka?

	Ee		Tjhee



5. Na o rata mokotlana wa ho tshela dibuka?

	Ee		Tjhee

6. Ha eba o arabile eek a hodimo, hobaneng?

.....

7. Mokotlana wa hao ke wa mofuta ofe?

	O jarwang ka morao 
	O nkwang ka letsoho 
	Wa polasetiki 
	O hulwang 

Tse ding.....

8. O jara mokotlana o ka hodimo hangata hakae?

	Letsatsi le letsatsi		E seng hangata		Ha ke o jare

Tse ding.....

9. Na o ke o utlwe bohloko dibakeng tse latelang?

	Hloohong
	Molaleng
	Mokokotlong
	Lethekeng
	Matsohong
	Diphakeng
	Maotong
	Ha ke bo utlwe

Tse ding.....

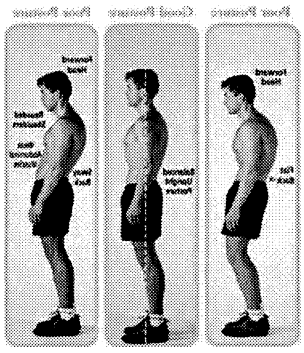
10. Haeba o itse ee, bohloko o bo utlwa hangata hakae?

	Letsatsi le letsatsi		E seng hangata		Nako yohle

Tse ding.....

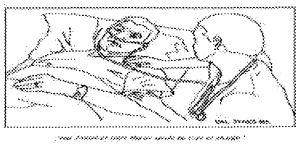
Tsa bophelo bo botle

11. Na o kile wa etela setsing sa tsa bophelo bo botle? Dikgweding the tsheletseng tse fetileng?



12. Ha o arabile ee kahodimo, bothata ene ele eng?

	Yes		No



Hlalosa.....

Ke tlo o bots aka seemo *(mobatlisisi a hlalose na seemo se bolelang) a sebedisa setshwantsho se ka hodimo*

13. Na o kile wa rutwa ka seemo sa mmele?

	Ee		Tjhee

14. Ha eba o itse ee ka hodimo, Ke mang? .....

15. Na o tseba phapang pakeng tsa seemo se setle le se sebe? 

	Ee		Tjhee

16. Ha o jere mokotlana wa hao wa dibuka, na o...

	Tsamaya o eme hantle 
	O kobela mokokotlo wa hao pele 
	O kobela mokokotlo wa hao morao 
	O kobela mokokotlo wa hao lehlakoreng 
	Ha ke tsebe

17. Na o wa ikemisetsa ho koba?

	Ee		Tjhee

18. Ha eba o wa ikemisetsa hobaneng?.....

19. Na o nahana mokotlana wa hao wa dibuka o na le seabo seemong sa hao kapa motsamaong wa hao?

	Ee		Tjhee

20. Na ho kobe le batho ba o kgotsang ka seemo sa hao?

	Ee		Tjhee

21. Ha eba o arabile eek a hodimo, Bomang?

	Matichere 
	Batswadi 

	Bana ba bang 
	Ba bang.....

Dipapadi

22. Na o ke o nke karolo dipapading tse latelang dikgweding tse tsheletseng tse fetileng?

Dipapadi	
	Mabelo
	Netball
	Volley ball
	Bolo ya Maoto
	Rugby
	Golofo

Tse ding.....

23. Na hona le seo o ithutileng sona ka seemo kajeno?

	Ee		Tjhee

Hlalosa.....

Appendix M - Photographic Method of Posture Assessment (P-MPA)-data forms for sensed posture

Participant number: ☐

SENSE WITHOUT A SCHOOLBAG

All participants must be standing without a schoolbag during this assessment

Anterior view: Participant is asked if the marked anatomical landmark is ***left or right*** to the line plumb line

Lateral views (left and right): Participant is asked if anatomical landmark is ***anterior or posterior*** to the line plumb line

Participant is asked to indicate how much the deviation is in millimetres.

Findings be entered in the form below

VIEW	STANDING WITHOUT A SCHOOLBAG						
	Sense of deviation				Actual deviation		
ANTERIOR	Deviation in mm	Sensed deviation to LEFT or RIGHT		None	Actual deviation in mm	Deviation to LEFT or RIGHT	
	In mm	L	R		In mm	L	R
Mid heels							
Mid knees							
Navel							
Nose							

	STANDING WITHOUT A SCHOOLBAG						
	Sense of deviation				Actual deviation		
LATERAL LEFT	Deviation in mm	Sensed deviation to ANT. or POST.		None	Actual deviation in mm	Deviation to ANT. or POST.	
	In mm	A	P		In mm	A	P
Lat malleo							
Mid knee							
Gr troche							
Acromion							
Ear lobe							

	STANDING WITHOUT A SCHOOLBAG						
	Sense of deviation				Actual deviation		
LATERAL RIGHT	Deviation in mm	Sensed deviation to ANT. or POST		None	Actual deviation in mm	Deviation to ANT. or POST.	
	In mm	A	P		In mm	A	P
Lat malleo							
Mid knee							
Gr troche							
Acromion							
Ear lobe							

SENSE WITH A SCHOOLBAG **participant number** ☐

All participants must be standing and carrying a schoolbag throughout the assessment
Anterior view: Participant is asked if the marked anatomical landmark is ***left or right*** to the line plumb line
Lateral views (left and right):
Participant is asked if anatomical landmark is ***anterior or posterior*** to the line plumb line
Participant is asked to indicate how much the deviation in millimetres.
Findings be entered in the form below

VIEW	STANDING WITH A SCHOOLBAG						
	Sense of deviation				Actual deviation		
ANTERIOR	Deviation in mm	Sensed deviation to LEFT or RIGHT		None	Actual deviation in mm	Deviation to LEFT or RIGHT	
	In mm	L	R		In mm	L	R
Mid heels							
Mid knees							
Navel							
Nose							

	STANDING WITH A SCHOOLBAG					
	Sense of deviation				Actual deviation	
LATERAL LEFT	Deviation in mm	Sensed deviation to ANT. or POST.		None	Actual deviation in mm	Deviation to ANT. or POST.
	In mm	A	P		In mm	A	P
Lat malleo							
Mid knee							
Gr troche							
Acromion							
Ear lobe							

	STANDING WITH A SCHOOLBAG						
	Sense of deviation				Actual deviation		
LATERAL RIGHT	Deviation in mm	Sensed deviation to ANT. or POST		None	Actual deviation in mm	Deviation to ANT. or POST.	
	In mm	A	P		In mm	A	P
Lat malleo							
Mid knee							
Gr troche							
Acromion							
Ear lobe							

ACTUAL POSTURE

Six photographs will be taken, anterior with and anterior without a schoolbag, lateral right with and without a schoolbag, lateral left with and without a schoolbag.

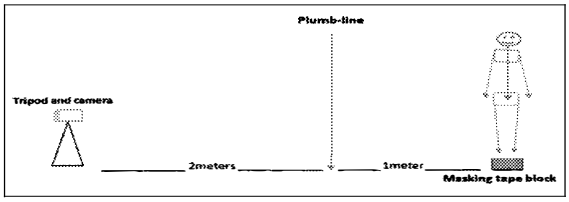
Photographs were printed, actual deviation was measured on each photograph, and result were documented in the shaded columns.

Appendix N - Child Assent form (English)

LEARNER ASSENT FORM

I am Ms Nteboheleng Phatela, a Masters student in occupational therapy at the University of the Free State. I will do a research study to learn more about the difference between posture that you feel and posture that you show while you stand and carry a schoolbag. You are kindly invited to participate in gathering information for this investigation.

At the end of the research, people may learn more about what controls and affects the way children stand while carrying a schoolbag. This information will make it easier for everyone to teach children the good way of standing. During this study the following will be done: (a) you will stand with and without a schoolbag. You will stand in front of a line as shown on the picture below and the researcher will take photos of you. Your face will not show as you will wear a mask provided by the researcher.



(b) You will be asked to say how you feel your body in relation to a vertical line, as shown on the photo. (c) A questionnaire will be completed by the researcher and you in English or Sesotho, all this is expected to take about 30 minutes.

By taking part, your will contribute to improvement of medical knowledge in schools and the country at large. Your personal identity information will not be seen by other people and there will be no individual link of the information with you. No physical and emotional harm are expected due to participation in the study. Taking part in the study will not take your learning time as information will be collected during break time.

You will not be paid for participation and you will also not be requested to pay to participate. Participation is totally from your heart, and you may choose not to participate in the research, or may stop participating at any time. I have already asked your parents but you can still say if you want to take part or not. If you would like to take part, please fill in this form at the bottom and kindly return it to your class teacher.

Please sign this form only if you:

(i)You have understood what you will be doing for this study,
(ii) Have had all your questions answered,
(iv) Have talked to your parent(s)/legal guardian about this project, and
(v) Agree to take part in this research

Your Signature Child Printed Name Date

Name of Parent(s) or Legal Guardian(s)

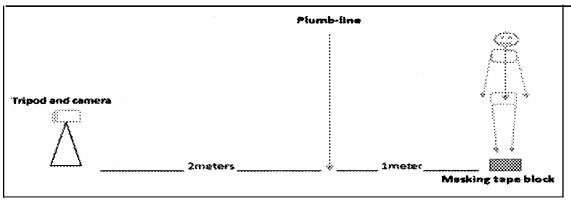
Researcher explaining study (sign) Name Date

Appendix O - Child Assent form (Sesotho)

LENGOLO LA MOITHUTWANA LA DITUMELLANO

Ke Mme Nteboheleng Phatela ke moithutwana hotswa yuniversiting ya Freisetata. Ke tlo etsa dipatlisiso ka seemo sa ngwana ha a eme a jere mokotlana wa dibuka. O kupuwa hore o nke karolo dipatlisisong tsena.

Ka nako ya dipatlisiso, mo batlisisi o tla o kopa ho, (a) ho hlalosa seemo sa hao mabapi le line ya letshwaho e tla beng e behilwe jwalo ka setshwantshong se latelang. (b) ho ema o jere le ho ema o sa jara mokotlana wa dibuka oo mobatlisisi a tlang ho fana ka ona, ho ema ka pele ho line ya letshwaho ele ho nkwa dinepe jwalo ka setshwantshong se ka tlase(c)Ho tlatsa le ho araba dipotso ka English kapa Sesotho ka thuso ya mobatlisisi. Tsena tsohle di lebelletswe ho nka metsotso e 30. Mo batlisisi o tla boloka dikarobo ele lekunutu.



Ha hona dikotsi tse ka o hlahelang mabapi le dipatlisiso tsena, ha o nka karolo o tla be o kentse letsoho ntlafatsong ya tsa bophelo bo botle dikolong. Tseba hore ha wa qobellwa ho nka karolo dipatlisisong tsena, o keke wa kena bothateng le molao kapa matichere kapa sekolo ha o tlohela ho nka karolo ka nako tsohle. Ha hona le dipotso tseo o sa rateng ho di araba o dumelletswe ho se di arabe. Batswadi ba hao ba se ba kopilwe hore o nke karolo mme ba dumetse empa qeto e ntse ele ya hao. O ka botsa dipotso hajwale kapa ha morao. Ha o dumela honka karolo, tlatsa foromo e ka tlase ka kopo.

Tekena foromo ena ha:

(i) O utlwisisitse na o tlo nka karolo jwang dipatlisisong tsena,
(ii) Dipotso tsa hao di arabilwe,
(iv) O buile le batswadi ba hao ka dipatlisiso tsena,
(iv) O dumellane le batswadi ba hao ho nka karolo.

_____

Tekena Mabitso a ngwana Letsatsi

_____

Mabitso a batswadi/ba ikarabellang

_____

Mabitso a mobatlisisi a hlalosang

Tekena Letsatsi

Appendix P - Standard schoolbag used: with contents

Appendix Q – Actual Photograph samples - Lateral view

Anterior view