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APPENDIX A

LECTURE AT SCHOOLS

Back problems are seen increasingly in young children. There are a variety of causes. Some can be hereditary, while others may be due to injuries. Many problems may be due poor posture.

There are two problems that I would like to explain:

- Scoliosis or an S-formed back:

  The development of an S-formed back is usually permanent. If this deformity is noticed early it can be treated successfully; if not, the deformity can worsen and cause severe complications. Movement can be affected and respiratory complications can develop.

  Scolioses are seen in at least three per cent of all adolescents. It is present more frequently in girls, especially in those girls who grow fast. If one's parents have spinal deformities one would be more vulnerable to develop a deformity. This deformity can be verified by X-rays, but certain recognisable postural features can also identify this problem:

  * one shoulder will be higher
  * one shoulder blade will stand away from the body
  * one arm will hang further from the body or a skin fold will be present on the one side
  * a prominent rib hump will be present

The second back problem that I would like to explain is the kyphosis or hunched back. This can develop in one specific area of the back or in the back as a whole, and is seen in eight per cent of adolescents. A kyphosis is present more frequently in boys than in girls, and hereditary factors can also cause this deformity.

These conditions can be treated by means of exercises and a brace. In severe cases the back will be operated on, resulting in a stiff back.

A few important factors that you can look at are:

* Do not do your homework on the floor or the bed
* Sit on a good supporting chair at a table
* It is ideal for the table to be inclined
* Sit with your chair close to the table
* Prevent poking of the chin when doing homework
* Never carry your bookcase over only one shoulder
* Ideally, carry your bookcase over both shoulders, but do not lean forwards
* Sit up straight in front of the television and in the classroom
* Stand up straight with your weight evenly distributed between both feet
* When you do sport activities, warm up well with emphasis on the stretching of hamstring muscles
* Do not sleep on your stomach
* Support your neck in a neutral position by means of a pillow
* Do not pick up heavy objects
* Always bend your knees and keep your back straight when you pick up an object

Information forms will be handed out. Please give them to your parents. A volunteer form for a research study I am conducting, has also been attached.

Thank you

****

APPENDIX B

INFORMATION LETTER

SPINAL DEFORMITIES IN ADOLESCENTS

Scoliosis (S - formed back) and kyphosis (round back) are very common disorders that start during adolescence. The reasons for the development of these disorders are not all known. A research study is currently being done in Middelburg to identify certain causative factors of back deformities. The research is aimed at children between twelve and seventeen years who attend any of the schools in Middelburg. There are no costs involved in participating in this research study. During the research your child's back will be examined for any deformities. Afterwards the mother of the child will be interviewed with regard to the child's development for approximately twenty minutes.

It is in the interest of your child and other children to participate in this study, irrespective of whether your child has a deformity or not. Early diagnosis and treatment of a deformity provide a better prognosis for the child. The results of this study could enable physiotherapists to help prevent and treat deformities in a more effective way. An exercise programme, to either treat or limit a deformity, will be given to your child after the examination of his / her back.

The researcher is a Master's student at the Department of Physiotherapy of the University of Pretoria and the research will be done in Middelburg, Mpumalanga.
Please complete the attached form and return it to the school before 23 / 09 / 98 or contact me at any of the following telephone numbers : (w) 013 - 2824440 (h) 2824280 cell. 0828952403.

Thank you

Ms René Alberts

VOLUNTEER

I hereby give permission that you may contact me and my child for an appointment.

PARENT:.....

CHILD:.....AGE:.....

SCHOOL:.....

TEL NO : (W)..... (H)..... .

SPINALE DEFORMITEITE BY ADOLESSENTE

'n Skoliose (S - vormige rug) en 'n kifose (boggelrug) is algemene deformiteite wat by adolessente voorkom. Die redes vir die ontwikkeling van hierdie deformiteite is nie almal bekend nie. Daar word tans 'n navorsingstudie gedoen in Middelburg om sekere oorsaaklike faktore van spinale deformiteite te identifiseer. Die studie word gedoen op kinders tussen twaalf en sewentien jaar wat skoolgaan in Middelburg. Daar is geen kostes verbonde aan deelname in hierdie studie nie.

Tydens die navorsingprosedure sal u kind se rug geevalueer word vir enige deformiteite. Daarna sal die moeder van die kind ondervra word met betrekking tot die ontwikkeling van die kind.
Dit is in belang van u kind sowel as ander kinders om deel te neem aan hierdie navorsingstudie, hetsy u kind 'n afwyking het of nie, en of u 'n afwyking vermoed. Vroeë diagnose en behandeling van 'n deformiteit sal lei tot 'n beter prognose. Die resultate van hierdie studie kan moontlik fisioterapeute help om in die toekoms deformiteite beter te behandel of moontlik te voorkom. 'n Oefenprogram sal na afloop van die evaluasie aan u kind gegee word om sy / haar spiere te versterk en /of om die deformiteit te behandel.

Die navorser van hierdie studie is 'n Magister student van die Departement Fisioterapie aan die Universiteit van Pretoria en die navorsing word gedoen in Middelburg, Mpumalanga.
Voltooi asseblief die volgende vorm en stuur dit terug aan die skool voor 23 / 09 / 98 of kontak my by enige van die volgende telefoonnommers: (w) 013 - 2824440 (h) 013 - 2824280
sel. 0828952403.

Baie dankie

Mev. René Alberts

VRYWILLIGER

Hiermee stem ek as ouer toe dat u my kan kontak vir 'n afspraak met my en my kind.

OUER:.....

KIND:.....OUDERDOM:.....

SKOOL:.....

TEL: (W)..... (H)..... .....

APPENDIX C

INFORMED CONSENT

Protocol : 94/98

TITLE:

AN INVESTIGATION INTO THE ASSOCIATION BETWEEN DEVELOPMENTAL MILESTONES OF BABIES AND THE PREVALENCE OF SPINAL DEFORMITIES IN ADOLESCENTS.

RESEARCH STUDY

I,....., willingly agree to participate in this research study which has been explained to me by Ms René Alberts. This research study is being conducted by the Departement of Physiotherapy at the University of Pretoria where Ms Alberts is a post-graduate student.

PURPOSE OF STUDY

The purpose of this study is to determine if there is an association between the milestones of babies and the prevalence of spinal deformities in adolescents.

DESCRIPTION OF PROCEDURES

This is a research study where certain criteria are necessary for eligibility to either the case or control groups.

This study includes a physical evaluation of the adolescent's spine. The adolescent will be examined for any abnormality in the curve of the spine. He/She will be dressed in a pair of shorts and the girls will also wear a halter-neck top. After the physical examination the mother will be interviewed with regard to certain aspects of the development of the adolescent during his/her early years. The physical examination will take approximately twenty minutes.

RISKS OR DISCOMFORTS

There is no danger of any exposure of intrusive procedures. No discomfort will be experienced during any of the examination techniques.

CONTACT PERSONS

The researcher is a Master's student at the Physiotherapy Department of the University of Pretoria and the research will be done in Middelburg, Mpumalanga.

BENEFITS

It is in your interest to participate in this study because early diagnosis and treatment of a deformity provides a better prognosis for adolescents. The result of this study could enable us as physiotherapists to help prevent and treat deformities in a more effective way.

ALTERNATIVES

The control and experimental groups will both undergo the same evaluation procedures.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. No compensation for participation will be given. Each participant will receive an exercise programme to prevent/treat the appropriate deformity. You are free to withdraw your consent to participate in this research study at any time. If you refuse to participate or withdraw, you will still receive an exercise programme.

CONFIDENTIALITY

A record of the participant's evaluation will be kept in a confidential file at the private physiotherapy practice of Ms René Alberts and also in a computer file of the Window ' 95 program at 13 Letaba Street, Middelburg, Mpumalanga. No information by which you can be identified will be released or published.

I have read all the above, had time to ask questions, received answers concerning the areas I did not understand and I willingly give my consent to participate in this research study. Upon signing this form, I will receive a copy.

_____ _____

(PATIENT SIGNATURE) DATE

WITNESSES SIGNATURE:

1. _____ 2. _____

_____ _____

DATE DATE

_____ _____

(SIGNATURE OF PARENT) DATE

WITNESSES SIGNATURES:

1. _____ 2. _____

_____ _____

DATE DATE

_____ _____

PHYSIOTHERAPIST SIGNATURE DATE

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APPENDIX D

EXCLUSION CRITERIA

(i)	Any congenital deformities of lower limbs, chest or back?	YES NO
(ii)	Previous fractures to vertebrae?	YES NO
(iii)	Any spinal deformity of neurological origin?	YES NO
(iv)	Previous thoracic surgery?	YES NO
(v)	Any disease such as cystic fibrosis, TB?	YES NO
(vi)	Permanent use of crutches/wheelchair?	YES NO

PHYSICAL EVALUATION

1. **Respondent No:** V1 [ ][ ][ ] (1 2 3)

2. **Card No:** V2 [1] (4)

3. **Case** [1] **Control** [2] V3 [ ] (5)

4. **Age:** **Years** [|] **Months** [|] V4 [ ][ ][ ] (6 7 8)

5. **Gender:** **Male** [1] **Female** [2] V5 [ ] (10)

6. **Age of menarche in females** [|] **years** V6 [ ][ ] (11 12)

7. **Height** [| | |] **mm** V7 [ ][ ][ ] (13 14 15)

8. **Leg length discrepancy:** (L) _____ (R) _____

   Difference: [| |] **mm** V8 [ ][ ][ ] (17 18 19)

8.1 **Longest Leg:** [Left (1)] [Right (2)] [Equal (3)] V9 [ ] (20)

9. **Straight leg raise: (Inclinometer)**

   Degrees (L) [ ][ ][,] V10 [ ][ ][ ] (21 22 23)

   Degrees (R) [ ][ ][,] V11 [ ][ ][ ] (24 25 26)

10. **Thomas Test**

    Degrees of hipflexion (Inclinometer)

    L [ ][ ][,] V12 [ ][ ][ ] (27 28 29)

    R [ ][ ][,] V13 [ ][ ][ ] (30 31 32)

11. **Scoliosis**

Hump Size: Tx ____ mm V14 (33 34 35)

Side: Left (1) | Right (2) | Not applicable (3) V15 (36)

Hump Size: Lx ____ mm V16 (37 38 39)

Side: Left (1) | Right (2) | Not applicable (3) V17 (40)

Hump Size: Tx–Lx ____ mm V18 (41 42 43)

Side: Left (1) | Right (2) | Not applicable (3) V19 (44)

Angle of trunck rotation:

Forward Bending ____ degrees V20 (45 46)

12. **Plumbline:**

Distance from gluteal cleft ____ mm V21 (47 48 49)

Left (1) | Right (2) | Not applicable (3) V22 (50)

Maximum distance from spine ____ mm V23 (51 52 53)

Tx(L) (1)	Tx(R) (2)	Lx(L) (3)
Lx(R) (4)	Tx–Lx(L) (5)	Tx–Lx(R) (6)
	Not applicable (7)	

V24 (54)

13. **Tx Kyphosis: (Inclinometer)**

Degrees ____ V25 (55 56 57)

14. **Lx Lordosis:**

Degrees ____ V26 (58 59 60)

15. **Cx–Tx junction:**

Forward head posture Yes (1) | No (2) V27 (61)

16. **Postural Observations:**

Asymmetric winging of Scapula

Yes (1)	No (2)

V28 [ ] 62

Left (1)	Right (2)	Not applicable (3)

V29 [ ] 63

Asymmetric elevated shoulder

Yes (1)	No (2)

V30 [ ] 64

Left (1)	Right (2)	Not applicable (3)

V31 [ ] 65

One arm further from trunk

Yes (1)	No (2)

V32 [ ] 66

Left (1)	Right (2)	Not applicable (3)

V33 [ ] 67

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APPENDIX E

QUESTIONNAIRE

Respondent: V1 [ ][ ][ ] (1 2 3)

Card No: V2 [2] (4)

1. **Does your child have defective hearing**

YES (1)	NO (2)	Do not know (3)

V34 [ ] (5)

1.1 **If YES, is it:**

Left Sided (1)	Right Sided (2)	Both (3)
Do not know (4)	Not applicable (5)	

V35 [ ] (6)

1.2 **If YES, when did it develop:**

< 1 year (1)	1 – 5 years (2)	5 – 10 years (3)
> 10 years (4)	Do not remember (5)	Not applicable (6)

V36 [ ] (7)

2. **Does your child have defective eyesight?**

YES (1)	NO (2)	Do not know (3)

V37 [ ] (8)

2.1 **If YES, is it:**

Left sided (1)	Right sided (2)	Both (3)
Do not know (4)	Not applicable (5)	

V38 [ ] (9)

2.2 **If YES, at what age did it develop?**

< 1 year (1)	1 – 5 years (2)	5 – 10 years (3)
> 10 years (4)	Do not remember (5)	Not applicable (6)

V39 [ ] (10)

2.3 **If Yes, is He/She**

Far sighted (1)	Short sighted (2)	Do not know (3)
Not applicable (4)	Other (5)	Both (6)

V40 [ ] (11)

3. **Did you know that your child had a deformity?**

Yes (1)	No (2)	Not Applicable (3)

V41 [ ] (12)

4. **When was the deformity first noticed?**

< 5 years (1)	5 – 10 years (2)	10 – 15 years (3)
> 15 years (4)	Do not know (5)	Not applicable (6)

V42 [ ] (13)

5. **Does any family member, according to your knowledge, have a deformity?**

Yes (1)	No (2)	Do not know (3)

V43 ☐ 14

5.1 **If YES what is their relationship**

Mother

Yes (1)	No (2)	Not Applicable (3)

V44 ☐ 15

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not applicable (4)	Do not know (5)

V45 ☐ 16

Father

Yes (1)	No (2)	Not Applicable (3)

V46 ☐ 17

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do Not know (5)

V47 ☐ 18

Sister

Yes (1)	No (2)	Not Applicable (3)

V48 ☐ 19

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V49 ☐ 20

Brother

Yes (1)	No (2)	Not Applicable (3)

V50 ☐ 21

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V51 ☐ 22

Maternal side:

Grandmother

Yes (1)	No (2)	Not Applicable (3)

V52 ☐ 23

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V53 ☐ 24

Aunt

Yes (1)	No (2)	Not Applicable (3)

V54 ☐ 25

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V55 ☐ 26

Grandfather

Yes (1)	No (2)	Not Applicable (3)

V56 ☐ 27

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V57 ☐ 28

Uncle

Yes (1)	No (2)	Not Applicable (3)

V58 ☐ 29

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V59 ☐ 30

Paternal side:

Grandfather

Yes (1)	No (2)	Not Applicable (3)

V60 ☐ 31

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V61 ☐ 32

Uncle

Yes (1)	No (2)	Not Applicable (3)

V62 ☐ 33

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V63 ☐ 34

Grandmother

Yes (1)	No (2)	Not Applicable (3)

V64 ☐ 35

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V65 ☐ 36

Aunt

Yes (1)	No (2)	Not Applicable (3)

V66 ☐ 37

Kyphosis (1)	Scoliosis (2)	Kypho–scoliosis (3)
	Not Applicable (4)	Do not know (5)

V67 ☐ 38

6. Can you remember during which week of pregnancy your child was born?

YES (1)	NO (2)

V68 ☐ 39

6.1 If YES, how many weeks?

☐|

V69 ☐☐ 40 41

7. Was the birth:

Caeserian (1)	Normal (2)
Normal with Instruments (3)	

V70 ☐ 42

8. Did your child prefer:

Back lying (1)	Stomach lying (2)	Side Lying (3)
Not one specifically (4)	Do not remember (5)	

V71 ☐ 43

9. At what age did your child sit independently?

–6 months (1)	6–9 months (2)	
9–12 months (3)	+12 months (4)	Do not remember (5)

V72 ☐ 44

10. Did your child crawl on his hands and knees?

YES (1)	NO (2)	Do not remember (3)

V73 ☐ 45

10.1 At what age did your child crawl on his hands and knees?

–6 months (1)	6–9 months (2)	
9–12 months (3)	12–15 months (4)	
+15 months (5)	Do not remember (6)	Did not crawl (7)

V74 ☐ 46

10.2 How long did your child crawl before walking?

–1 month (1)	1–2 months (2)	
2–3 months (3)	+3 months (4)	Not applicable (5)

V75 ☐ 47

10.3 Did your child move forward in any other way?

YES (1)	NO (2)	Do not remember (3)

V76 ☐ 48

10.3.1 If YES, in what way did your child move forward?

CREEPING ON STOMACH (1)		SHUFFLING ON BUTTOCKS (2)
ROLLING (3)	OTHER WAY (4)	CRAWLING ON HANDS AND FEET (5)
DO NOT REMEMBER (6)		NOT APPLICABLE (7)

V77 ☐☐☐ 49 50 51

☐☐☐ 52 53 54

☐ 55

11. At what age did your child walk independently?

–6 months (1)	6–9 months (2)	9–12 months (3)
12–15 months (4)	+15 months (5)	Do not remember (6)

V78 ☐ 56

12. Did you make use of a sit chair for your child between birth and one year?

YES (1)	NO (2)	Do not remember (3)

V79 ☐ 57

12.1 If YES, for what length of time per day?

–1 hour (1)	1–2 hours (2)	2–3 hours (3)
+3 hours (4)	Do not remember (5)	Not applicable (6)

V80 ☐ 58

13. Did you make use of a walking ring for your child between birth and one year?

YES (1)	NO (2)	Do not remember (3)

V81 ☐ 59

13.1 If YES, for what length of time per day?

–1 hour (1)	1–2 hours (2)	2–3 hours (3)
+3 hours (4)	Do not remember (5)	Not Applicable (6)

V82 ☐ 60

14. Did you make use of a "Jolly jumper" for your child from birth to one year?

YES (1)	NO (2)	Do not remember (3)

V83 ☐ 61

14.1 If YES, for what length of time per day?

–1 hour (1)	1–2 hours (2)	2–3 hours (3)
+3 hours (4)	Do not remember (5)	Not Applicable (6)

V84 ☐ 62

15. Did your child have a sudden growth spurt?

Yes (1)	No (2)	Do not remember (3)

V85 ☐ 63

15.1 At what age did your child have a sudden growth spurt?

5 – 10 years (1)	10 – 15 years (2)	> 15 years (3)
	Do not remember (4)	Not applicable (5)

V86 ☐ 64

* Thank you for your participation *

APPENDIX F

PROTOCOL

AN INVESTIGATION INTO THE ASSOCIATION BETWEEN DEVELOPMENTAL MILESTONES OF BABIES AND THE PREVALENCE OF SPINAL DEFORMITIES IN ADOLESCENTS

1. INTRODUCTION

There are numerous spinal deformities in the paediatric population. Idiopathic scoliosis, Scheuermann's kyphosis and the postural round back account for most of these conditions.[1]

Idiopathic scoliosis is a combination of lateral curvature in the coronal plane and vertebral rotation.[1] Idiopathic scoliosis should be regarded as a multifactorial disease. No single factor alone has been demonstrated to cause idiopathic scoliosis.[2] Eighty per cent of structural scoliosis has an unknown cause. The prevalence of idiopathic scolioses in the general population is less than 0,5 % and 1,8 per one thousand for children between eight and eighteen years.[3] Factors related to trunk asymmetry, posture, and growth, independent of one another, predict the development of scoliosis.[4] Idiopathic scoliosis may develop at any age during growth, but it tends to appear more frequently during a growth spurt in the adolescent period.[3,5] Growth considered in isolation is not a primary cause of idiopathic scoliosis.[5,6,7] Family studies have shown an increased risk of scoliosis in first degree relatives of patients with idiopathic scoliosis.[8] Functional impairment in the postural regulation system between the brainstem centre and the proprioceptive system could be an aetiological factor in idiopathic scoliosis.[9,10]

Kyphosis is by definition a curvature or angulation of the spine in which the concavity faces anteriorly. Scheuermann's kyphosis presents with a typical postural round back and has a prevalence of 0,5 - 8 % in the general population.[1] Postural deformities tend to develop in adolescence when an increase of height and sudden growth spurt occur, but the increase in postural muscle strength is inadequate.[5] The aetiology of Scheuermann's disease is unknown. The prevalence of kyphosis is higher in males and an autosomal dominant inheritance is associated with this condition.[1]

Modified perceptual analysis of sensory data describing erect vertebral alignment could cause disturbances in vertebral orientation of the vertebral spine and postural stability.[11,12]

The process of crawling provides a start of eye-hand co-ordination, vestibular processing, improvement of balance and equilibrium, spatial awareness, tactile inputs, kinaesthetic awareness and social maturation.[13] It is believed that the passage through specific obligatory phases of development (creeping and crawling) is a prerequisite for well-organised psychomotor development.[14] Boachie-Adjei and Lonner (1996)[1] hypothesise that abnormal developmental milestones in young children may suggest a neuromuscular cause of spinal deformities. No study has been done to prove this theory.

The literature review was conducted using databases Medline from 1981 to 1998 and CINAHL from 1982 to 1987. The reference lists of each article was screened for relevant articles. Only articles in Afrikaans and English were reviewed. No evidence of any study done to determine if there was any correlation between abnormal development of an infant and spinal deformities during adolescence, was found.

It was decided to do this study to determine the prevalence of spinal deformities in the absence of normal developmental milestones, in adolescents who attend schools in Middelburg, Mpumalanga.

If this study shows a correlation between defective motor development and the development of spinal deformities exists, physiotherapists could instruct young mothers in the stimulation of gross motor skills (such as sitting, crawling, and walking) and the strengthening of hypotonia. This intervention should minimise the risk factors in the development of spinal deformities.

Although only a small percentage of the population is affected by spinal deformities, it is important to prevent this condition due to complications like pulmonary impairment, and the unsuccessful treatment of spinal deformities. [1,2,8]

2. AIM OF STUDY

2.1. RESEARCH QUESTION

Do abnormal developmental milestones of neurologically intact babies have an influence on the prevalence of spinal deformities in adolescents in Middelburg, Mpumalanga?

2.1.1. MAIN AIM

To determine if certain developmental milestones, namely lying, sitting, crawling and walking, could influence the development of spinal deformities in adolescents aged between twelve and seventeen years, in Middelburg, Mpumalanga.

2.1.2. SUB AIMS

2.1.2.1. To determine if a literature review could show any correlation between the developmental milestones of a baby and the development of spinal deformities in adolescents.

2.2.2.2. To determine if the following factors may have any influence on the prevalence of spinal deformities:

Developmental factors:

- age at which babies sat independently
- whether babies crawled
- age at which babies crawled
- age at which age babies walked independently

Other factors:

- family history of deformities
- period of gestation

- preference of lying position
- other ways of locomotion before babies walked
- the use of aids such as walking rings, sit chairs or " jolly jumpers "
- any hearing deficiency
- problems with eyesight
- growth spurts
- height
- gender
- menarche in girls
- hip flexor tightness
- lack of flexibility of hamstring muscles

2.3. HYPOTHESIS

Deviations of certain normal developmental milestones namely sitting, crawling and walking, as well as certain other factors, in neurologically intact babies, may influence the development of spinal deformities.

3. RESEARCH DESIGN

A case-control study will be conducted in Middelburg, Mpumalanga. Adolescents with spinal deformities will be compared with adolescents without spinal deformities, with regard to their developmental milestones as babies and other factors.

3.1. STUDY POPULATION

All adolescents, male and female, between the ages of twelve and seventeen years, who attend any of the schools in Middelburg, Mpumalanga, will be considered part of the total population. The schools are:-

- Dennesig Primary School
- Kanonkop Primary School
- Middelburg Primary School
- CR Swart Primary School
- Kanonkop High School
- Steelcrest High School
- Middelburg High School
- Middelburg Technical High School

3.2. SAMPLING

The sampling frame will include pupils from the community who comply with the criteria and who volunteer to participate in the study. The sampling will be done in the following way:

School principals in the town of Middelburg, Mpumalanga, will be approached for permission to give a lecture on back deformities and back care at each relevant school. This lecture will be given to all pupils aged between twelve and seventeen years at the specific schools (appendix A)

Permission will also be obtained to hand out an information letter on common spinal deformities to this group of pupils (appendix B). The letter has to be given to their parents. They will also be informed about the research study, in which they can voluntarily participate. No costs will be

incurred. The fact that this research would not harm the children in any way, will also be explained. The parents will be asked to return the completed volunteer form to the school, or to telephone the researcher. A form granting consent to participate in the study, will also be included (appendix B).

All the volunteer forms will be collected at the schools. Appointments will be made, to meet with the volunteer and his / her mother. All volunteers who reply will be included in the study if they comply with the inclusion criteria.

3.3. SAMPLE CRITERIA

EXCLUSION CRITERIA

- Any congenital deformities of the lower limbs, chest or vertebrae
- Any abnormal locomotion such as the permanent use of crutches or a wheel chair
- Any leg length discrepancy of more than ten millimetres
- Previous fractures of vertebrae
- Any spinal deformity of neurological origin
- Any chronic lung disease such as cystic fibrosis or tuberculosis
- Previous thoracic surgery

INCLUSION CRITERIA FOR CASES:

All adolescents diagnosed with a spinal deformity after the physical evaluation of height, leg length, straight leg raise, hip flexion tightness, hump size, angle of rotation, deviation from midline, kyphosis/lordosis measurements, and postural observations.

INCLUSION CRITERIA FOR CONTROLS:

All adolescents who show no deformity after the physical evaluation of height, leg length, straight leg raise, hip flexion tightness, hump size, angle of rotation, deviation from midline, kyphosis/lordosis measurements, and postural observations.

3.4. RESEARCH PROCEDURE

When the subjects and their mothers arrive at the physiotherapy practice, they will be informed of procedures. The informed consent form will be handed to the mothers (appendix C). They will be given time to read the informed consent. The researcher will answer any questions. The subjects and their mothers will be asked to sign the informed consent form if they agreed to participate. Thereafter the subjects will be asked to dress in the specific shorts. The females will also wear halter-neck tops with thin straps to expose their backs.

3.4.1. PHYSICAL EXAMINATION (Appendix D)

The subjects and their mothers will be informed of specific procedures which will be followed during the evaluation. An informed consent form will be signed by the subject and his / her mother and they will be questioned to determine if there are any exclusion criteria.

All subjects will be dressed similarly:

MALES: Loose fitting running shorts without shirts and barefoot.

FEMALES: Loose fitting running shorts and halter neck tops with thin straps to expose the back.

SUBJECTIVE INFORMATION:

- **Age:** The age of the subject will be noted in years and months
- **Gender:** The gender of the subject will be noted
- **Age of menarche:** The age of menarche of female subjects will be noted in years

OBJECTIVE EVALUATION:

All measurements will be done three times and the mean will be determined.

- **Height:** The subject will be requested to stand with his / her back against a fixed measuring cane. His / her heels have to be against the wall (or as close as possible) and his / her feet have to be together (or as close as possible). A spirit level will be placed on the head of the subject to eliminate faulty parallax. The height of the subject will be noted in millimetres.
- **Leg length discrepancy:** The subject will be asked to lie supine on the examination bed. His / her pelvis will be levelled by placing the iliac crests on a straight line. The tips of the anterior superior iliac spines will be palpated and marked with a pen. The tips of the medial malleoli will be palpated and marked with a pen . A standard tape measure will be used to determine the distance between the anterior superior iliac spines and the medial malleolus. The same procedure will be followed with the other leg. Any difference between the two legs will be noted.
- **Straight leg raise:** The subject will be asked to lie supine on an examination bed. The greater trochanter of the femur will be palpated and marked with a pen. The lateral condyle of the distal end of the femur will also be marked with a pen and these two points will be joined by a line alongside the shaft of the femur. The zero of the inclinometer will be determined level to the examination bed. The heel of the relevant leg will be placed on the researcher's shoulder and the knee will be stabilised in extension with one hand. The leg of the subject will be raised by means of the researcher's shoulder while her other hand will maintain the inclinometer

alongside the shaft of the femur. The opposite knee of the subject will be stabilised by means of the researcher's other knee. The leg being measured will be lifted to a level where the onset of tension in the hamstring or calf muscles is felt by the subject. Care will be taken that no pelvic rotation takes place. A reading on the inclinometer indicating the degrees of hip flexion during straight leg raise will be noted. The same procedure will be followed with the opposite leg.

◊ **Degrees of hip flexion tightness:** With the subject still in supine, the inclinometer will be zeroed on the level of the examination bed. The subject will be requested to flex one hip and knee and to pull the knee onto his/her chest to the end range of movement. The level of the examination bed will be used as the zero level for the inclinometer. The inclinometer will be placed alongside the shaft of the opposite femur and a reading on the inclinometer will be noted. This will indicate the degrees of hip flexion contracture.

◊ **Hump size:** The subject will be asked to stand with his/her feet in line with the hips. The toes will be placed on a straight line. A mark will be made on the floor midway between the two big toes. The subject will be requested to place the palms of the hands together, to point them towards the mark on the floor and to place the chin on the sternum. In this way active trunk rotation will be prevented. The subject will be asked to flex the trunk up to ninety degrees while pointing the fingers towards the mark. The subject will be observed from posterior. The spirit level will be placed transversely across the spine in the thoracic area. The spirit level will be maintained while a measurement, using a metal ruler graduated in millimetres, is taken. The point where the spirit level is placed, and the point at which the measurement by means of the ruler is made, have to be exactly the same distance from the spine. The same measurement will be taken in the thoraco-lumbar region and the lumbar region. The difference in millimetres as well as the side of the hump will be noted.

◊ **Angle of trunk rotation:** The rotational prominence or angle of trunk rotation will be measured by means of the inclinometer. The subject will be requested to stand with

his/her feet in line with the hips. The palms of the hands will be placed together and pointed to a mark midway between the two big toes, and the chin will be flexed to the sternum. The subject will be requested to flex the trunk to ninety degrees. The most prominent part of the hump will be measured by means of the inclinometer. The inclinometer will be zeroed on horizontally placed a spirit level and will then be positioned across the spine from the hump to the same level on the opposite side of the spine. Any angle will be noted.

◊ **Plumbline:** The subject will be asked to flex forwards in the same way as described above. The tip of the spinous process of each vertebra or as close as possible to the tip (in cases where rotation is advanced) will be marked with a pen. The subject will be asked to stand erect after the markings are completed. A plumbline hanging from the ceiling will be used. The patient will be positioned so that the seventh vertebra is aligned with the plumbline. If there is a deviation of the spine from the plumbline, the distance from the gluteal cleft to the plumbline will be measured with a graduated ruler. The side to which the gluteal cleft is shifted in relation to the plumbline will also be noted. The rest of the spine will be observed to determine any deviation from the straight line. In the case of a deviation the area of maximum deviation of the spine from the plumbline will be noted.

◊ **Kyphosis / Lordosis :** The curve of the subject will be viewed laterally to determine the start of the normal / abnormal kyphotic curve. The subject will be asked to stand up straight, but no postural correction will be done. The subject will be asked to look at a specific point at eye-level on the opposite wall. The following levels will be marked on the subject's back to determine the normal / abnormal sagittal curve: lumbo-sacral junction, thoraco-lumbar junction or the superior end of the lordosis, the cervico-thoracic junction or the superior end of the kyphosis. The digital inclinometer will be used to determine the curve in the sagittal plane. All the readings will be taken three times and then the average reading will be used. The short base of the inclinometer will be placed on the lumbo-sacral junction and then zeroed at this point. The

inclinometer will then be moved to the thoraco-lumbar junction and a reading will be taken. This reading is the degree of the lordotic curve. The area of the lordosis will be noted. To determine the kyphotic curve the thoraco-lumbar junction or the superior end of the lordosis / inferior end of the kyphosis will be used for the zero reading. The inclinometer will then placed on the cervico-thoracic junction to determine the degree of kyphosis present. The area of the crest of the kyphosis will be noted.

◊ **Forward head posture:** The subject will be viewed from the side with the plumbline hanging on the lateral side in such a manner that the plumbline passes through the centre of the ear. The position of the line as it passes through / posterior or anterior to the shoulder will be determined. If the plumbline passes in front of the shoulder, the subject will be considered to have a forward head posture. This will be noted.

◊ **Postural observations:** The subject will be observed from posterior while standing. If an asymmetrical winging of a scapula and if so , the side of asymmetrical winging will be noted. Any shoulder girdle elevation will be noted, indicating the elevated side. The arms hanging next to the trunk will be observed to determine if one arm is hanging further away from the trunk than the other, and on which side it is further way.

3.4.2. **QUESTIONNAIRE** (Appendix E)

Once the evaluation is completed, the researcher will interview the mother of the subject and complete the questionnaire. The following data will be obtained during the structured interview:

- Hearing problems, and if so, the side of defective hearing and the age at which the subject developed a hearing problem, will be determined.
- Defective eyesight, the side affected, the age at which this problem manifested and if the subject is far sighted or short sighted.

- Whether the mother knows that her child has a spinal deformity, and when it was first noticed.
- Family history concerning kyphosis and scoliosis.
- Age of gestation and the process of birth (normal, Caesarean section, or normal with instrumentation).
- Position of lying that the subject preferred as a baby.
- Age at which the subject sat independently.
- Whether the subject crawled and at which age he / she started crawling and for what period he / she crawled before walking.
- Whether any other way was used to move forward.
- The age at which the subject walked independently.
- Whether the mother made use of a sit chair / transport chair and for what period of time per day.
- Whether the mother made use of a walking ring for the subject and for what period of time per day.
- Whether the mother made use of a "Jolly Jumper" and for what period of time per day
- Did the child have a sudden growth spurt and at what age did it occur?

Selection bias will be eliminated by using all the volunteers who reply. Selection for the control and case groups will be controlled by the specific inclusion criteria of each group. The numbering of the cases and controls will be done in a systematic manner. On completion of the evaluation the subjects will be allocated to either the case or a control group, according to the results. In each group, numbering will take place by using the next consecutive number.

3.4.3. BIAS

INTERVIEWER BIAS: Only one interviewer will be used.

INSTRUMENTAL BIAS: The same tape-measure, ruler, spirit level, plumbline and inclinometer will be used.

QUESTIONNAIRE BIAS: The questionnaire will be pre-tested and a pilot study will be done to ensure that all the evaluation techniques are possible. A structured interview will be used.

RECALL BIAS: Some mothers might have difficulty in remembering precise ages of certain developmental stages. Categorised answers, according to normal developmental stages, will be used to minimise the recall bias.

INTERVIEWER BIAS: Only one interviewer will be used.

MEASUREMENT BIAS: A second researcher will be trained to repeat the evaluation of the first ten subjects to determine the inter-observer reliability.

3.5. STATISTICAL ANALYSIS OF THE DATA

A confidence interval of 5 % will be used, and thus a significant value of 0,05 will be considered statistically significant in the analysis of the data. The paired t-test will be used to calculate the significant values for the comparison of the means, while the Chi squared test will be used to determine the relationship between frequencies.

The outcome of the variables will be illustrated on separate histograms to compare the outcome of the cases with those of the controls.

4. BUDGET

7.1 Linguist:	R1000-00
7.2 Typist:	R2000-00
7.3 Photo copies:	R3000-00
	R6000-00

5. REFERENCES

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APPENDIX G

ADDENDUM

LEG LENGTH DISCREPANCY

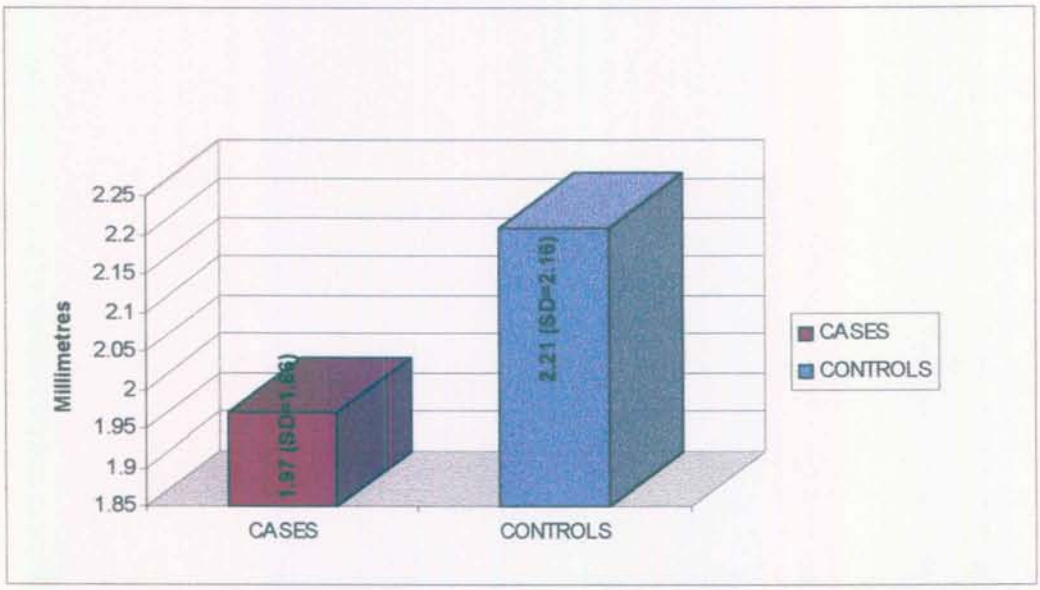

Figure 45: Mean leg length discrepancy for case and control subjects.

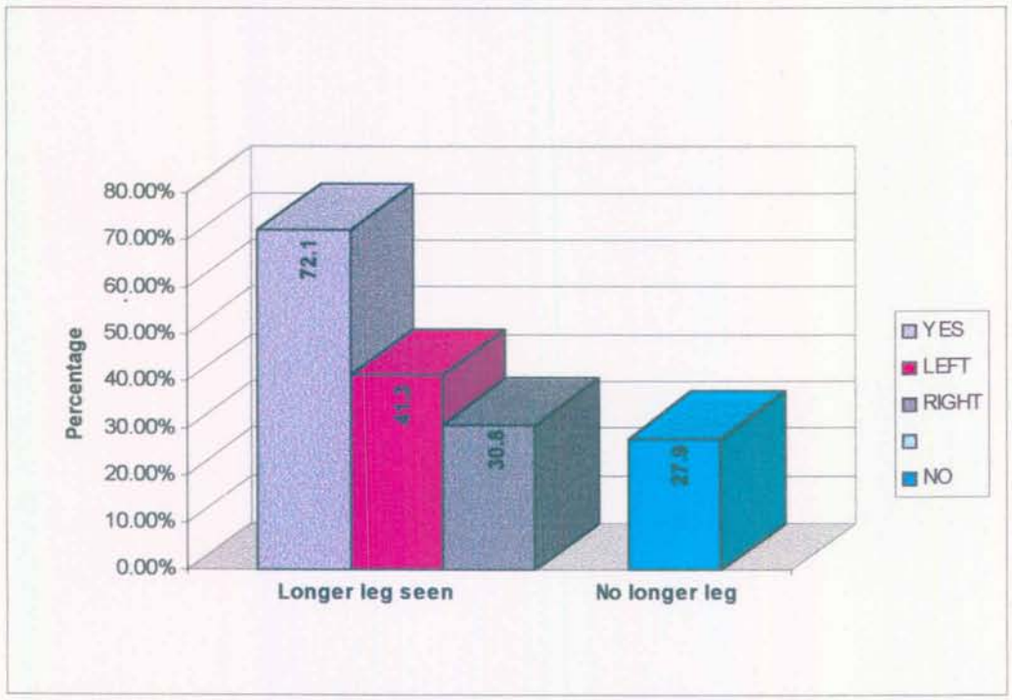

Figure 46: Presence of a longer leg indicating side of the longest leg.

STRAIGHT LEG RAISE

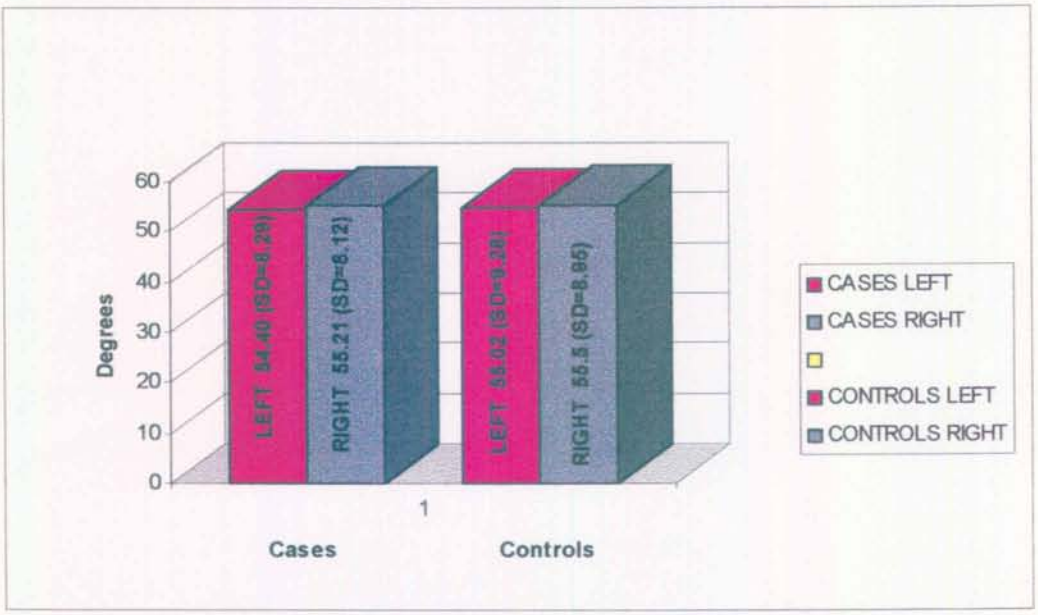

Figure 47: Mean straight leg raise for case and control subjects comparing the left and right side.

Table 8: Mean straight leg raise for the different planes of deformities.

Planes	Mean:left leg	SD	Mean:right leg	SD
Sagittal	54.75	8.41	55.49	8.31
Coronal	53.23	6.27	54.79	6.56
Combined sagittal & coronal	54.94	10.10	55.14	9.56

HIP FLEXOR TIGHTNESS

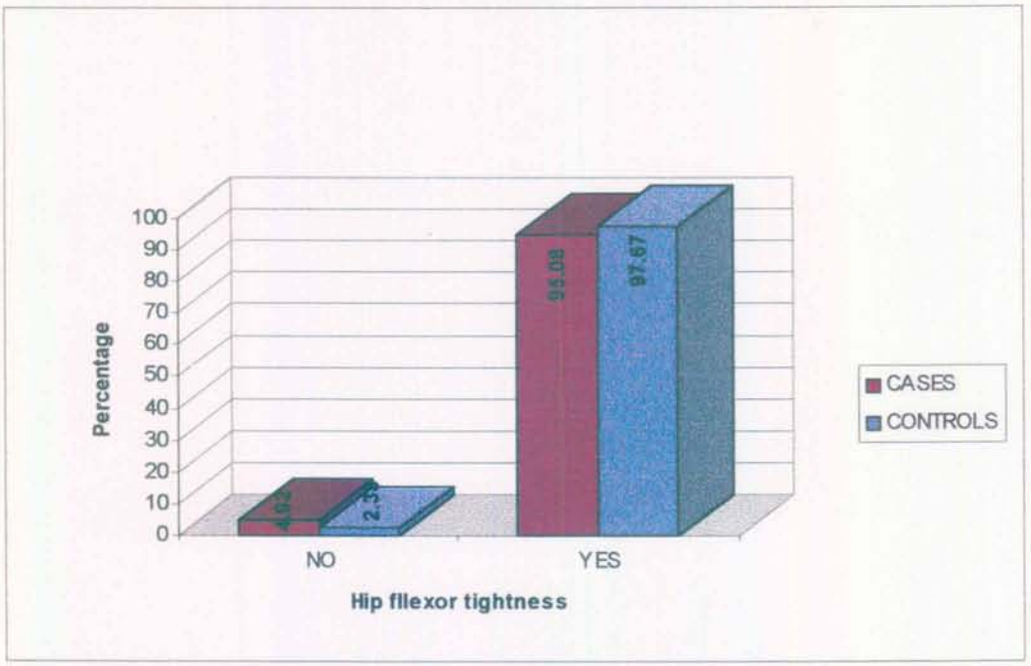

Figure 48: Comparison of the percentage of cases and controls with hip flexor tightness.

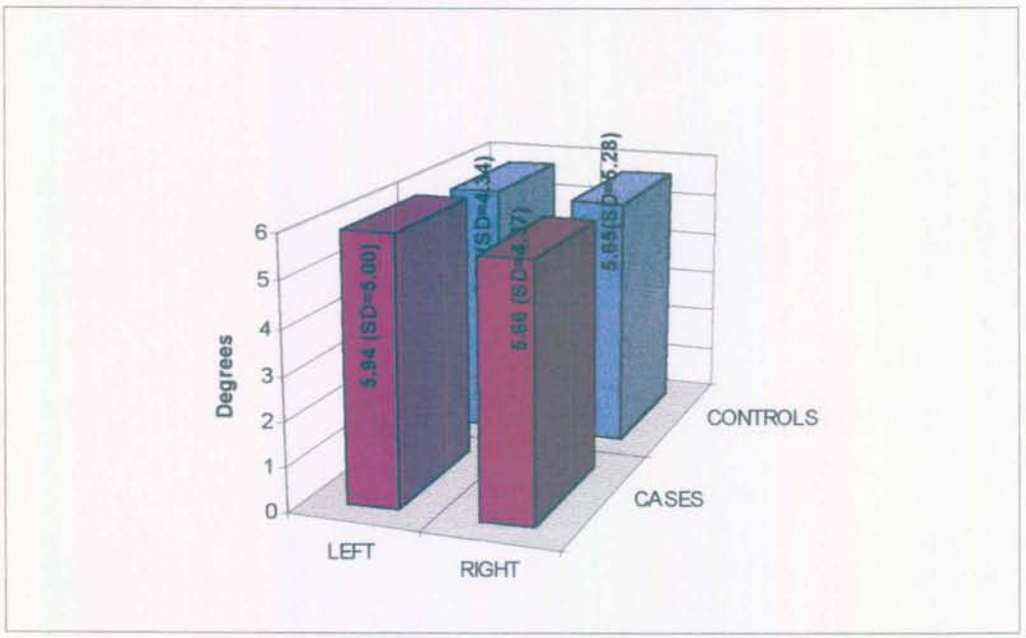

Figure 49: Mean hip flexor stiffness for case and control subjects.

FAMILY HISTORY OF DEFORMITIES

Table 9: Different deformities in direct family

	CASES			CONTROLS	
	Kyphosis	Scoliosis		Kyphosis	Scoliosis
Mother (n=7)	42,9%	57,1%	Mother (n=6)	17,7%	83,3%
Father (n=7)	71,4%	28,6%	Father (n=3)	100%	0%
Brother (n=1)	100%	0%	Brother (n=1)	100%	0%
Sister (n=3)	66,7%	33,3%	Sister (n=3)	33,3%	66,7%

Table 10: Different deformities on the maternal side

	CASES				CONTROLS			
Relationship	K	S	K-S	DNK	K	S	K-S	DNK
Grandmother	33,3%	33,3%	8,3%	25%	50%	25%	0%	25%
Grandfather	0%	25%	0%	75%	50%	50%	0%	0%
Uncle	0%	100%	0%	0%	0%	0%	0%	0%
Aunt	50%	25%	0%	25%	0%	0%	0%	100%

K = kyphosis; S = scoliosis: K-S = kypho-scoliosis; DNK = did not know

Table 11: Presence of different deformities on the paternal side of the cases

Relationship	Kyphosis	Scoliosis	Kypho-scoliosis	Did not know
Grandmother	100%	0%	0%	0%
Grandfather	75%	25%	0%	0%
Uncle	0%	0%	0%	100%
Aunt	0%	0%	0%	0%

DEFECTIVE HEARING

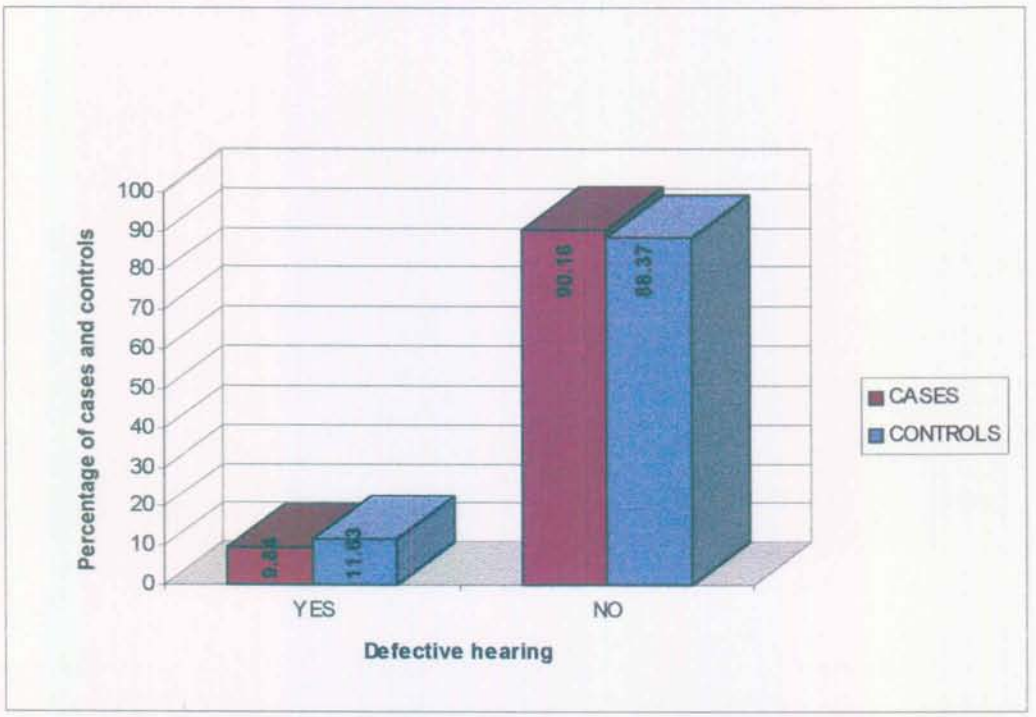

Figure 50: Percentage of case and control subjects who presented with defective hearing.

Table 12: Side of defective hearing in the cases and controls of those who presented with defective hearing.

Side affected	Left	Right	Both	Did not know
Cases n=6	0%	50%	16,7%	33,3%
Controls n=5	40%	20%	20%	20%

Table 13: Percentage of cases and controls who presented with defective hearing, indicating the age at which the defective hearing was noticed

Age	<1 year	1-5 years	5-10years	>10 years	Could not recall
Cases n=6	16,7%	16,7%	0 %	50%	16,7%
Control n=5	20%	0%	20%	40%	20%

DEFECTIVE VISION

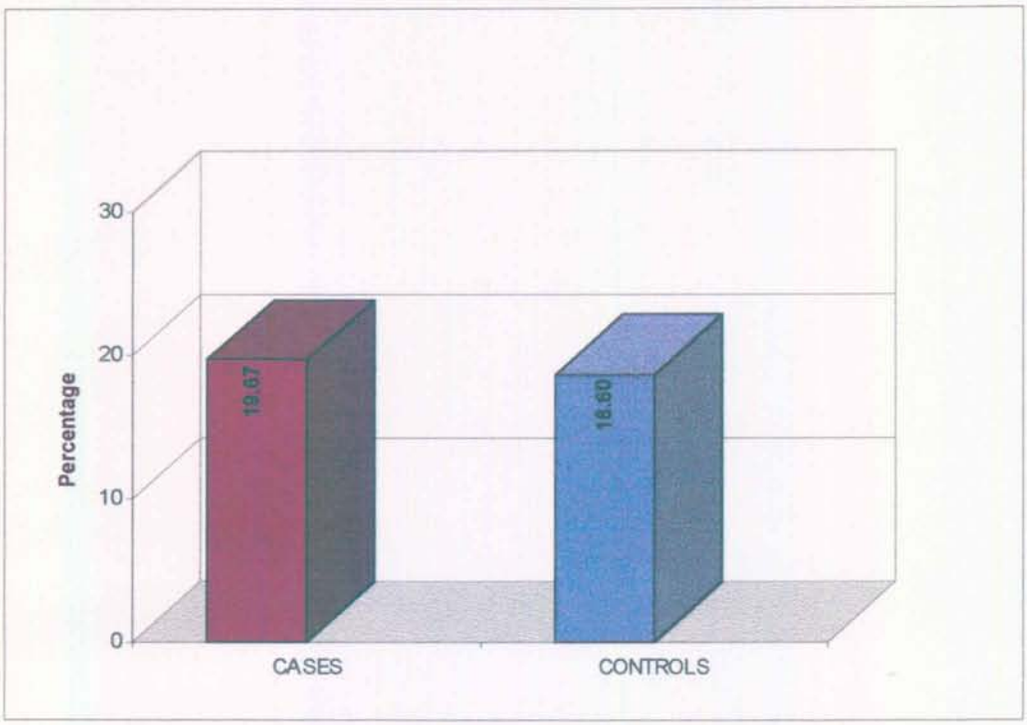

Figure 51: Percentage of case and control subjects who presented with defective vision.

Table 14: Side of defective vision in all affected subjects

Side	Left	Right	Both	Not sure
Cases	16,7%	8,3%	41,7%	33,3%
Controls	11,1%	0%	33,3%	55,6%

Table 15: Age at which defective vision was first noticed

Age	<1 year	1-5 years	5-10 years	> 10 years	Could not remember
Cases	0%	16.7%	16,7%	58,3%	8,3%
Controls	0%	11,1%	44,4%	44,4%	0%

Table 16: Type of visual problem in the affected subjects

Type	Far sighted	Short sighted	Both	Did not know	Other
Cases	41,7%	25%	8,3%	8,3%	16,7%
Controls	55,6%	33,3%	0%	0%	11,1%

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