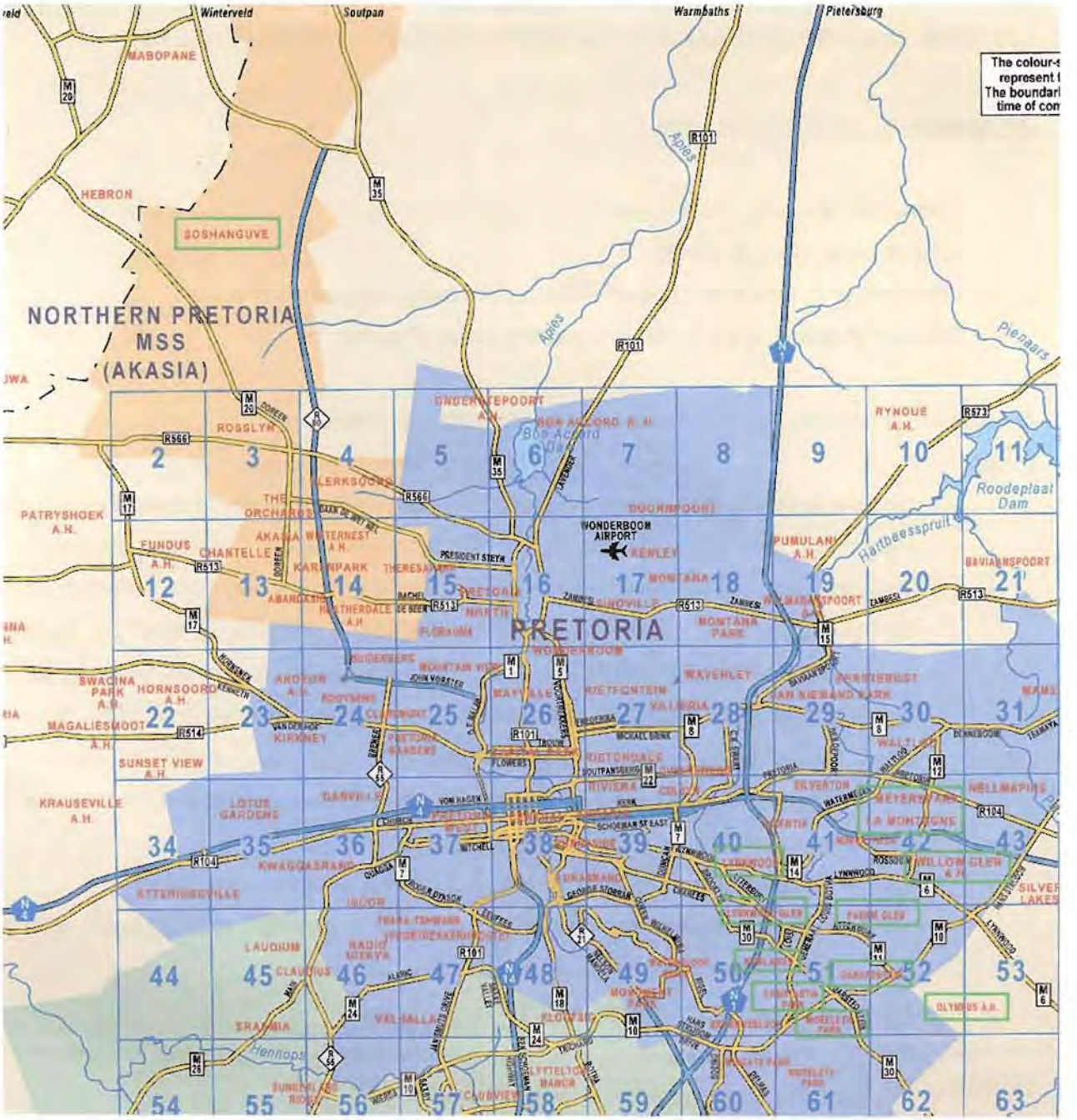
APPENDICES

APPENDIX A. NAMES OF THE PRE-SCHOOL FACILITIES PARTICIPATING IN THE STUDY

Pre-school name	Location	Contact person	No of children	Operating times
SOSHANGUVE	**Block**			
Vulamehlo	H	Elizabeth Masilela	~30	07:00-16:30
Masizane	H	Sophie Mazisa	42	07:00-16:00
Boitumelu	F	Onicah Ledwaba	35	07:00-16:00
Bella's creche	K	Gran Ndlovu	>20	07:00-16:30
Makgopa	K	Maggie Makgopa	28	07:00-16:30
Boitabison ELC	L	Mrs Mofomme	27	07:00-16:00
Dimakatsong	L	Asnath Masebe	20	07:00-16:00
Lesedi	L	Faith Pitjeng	60	07:30-18:00
Kgotsofatso	L	Eva Mashiane	21	08:30-16:00
Sandile Day Care	AA	Doris Malyebe	30	06:00-16:30
Thushanang	F	Josephina Choma	25	07:00-19:00
Arehlomphaneng	P	Emma Magagula	42	07:00-17:00
Imameleng	P	Maria Makoga	~35	07:30-16:00
Rekgepetse	P	Elizabeth Monare	96	07:00-16:30
Tebogo Day Care	Y	Margaret Kgabo	28	07:00-16:00
Ekukhanyeni	Y	Beauty Mthombeni	48	06:15-17:00
Katlego	P	Johanna Madimabe	~120	07:00-16:00
Thusong	P	Thaitha Mamaobolo	~34	06:00-16:00
Reatlegile Early Learning	P	Johanna Letsoalo	~70	05:00-17:00
Rethakgetse	P	TM Malakapatlo	~57	07:00-15:00
Thusanang Preschool	P	Lena Kekana	~35	07:00-17:00
Phumzile	SS	Sina Mahlango	18	07:00-16:00
Reitumetse	SS	Dora Konaite	70-80	06:30-16:00
Kutlwane	SS	Margaret Khoza	37	06:30-16:00
Mpepule	R	Elsie Mokonyana	54	06:00-16:30
Siyafunda	R	Gladys Nqoko	34	06:00-17:00
Tirisano	R	Queen Mabuso	47	07:00-17:00
Faith Day Care Centre	GG	Caroline Mjole	20	06:00-17:00
Tsweletsang	JJ	Johanna Masiteng	30	07:00-16:00
Botshabelo	JJ	Sina Msiza	41	07:00-16:00
PRETORIA EAST	**Area**			
Kiddies Academy Nursery School	Garsfontein	Charmaine/Zahn	**130**	06:45-17:30
Heavenly Tots	Garsfontein	Felicity Dederickse	**1**	6:45-17:30
Sungardens Nursery	Garsfontein	Peggy Agombar		07:00-17:50
Glen Play Centre And Pre-Primary School	Garsfontein	Mrs Stanley	**100**	07:00-17:00
Edutots	Garsfontein	Mrs Scimper	**70**	06:30-18:00
Moreleta Montessori Centre for Early Education	Moreleta Park	Leonie Breytenbach		06:30-17:30
Morsjorsies	Menlopark	Elsabe Bogenhofer		06:45-17:30
Babbelbekkie Nursery School	Faerie Glen	Mariette Scheepers	**100**	06:45-17:30
Faerieland Nursery School	Faerie Glen	Rene v Rensburg		06:45-17:30
Tomorrow's people Kleuterskool	Faerie Glen	Zelna Botes	120	07:00-17:30
Highland Kids	Faerie Glen	Magda Boonzaaier		06:45-17:00
Bambolini Kleuterskool	Faerie Glen	Elsabe Joubert	**320**	06:45-17:00
Laspossie Nursery School	Wapadrand	Corlia Snyman	**~ 20**	07:00-17:00
Snipper-Snip Preprimêreskool	Garsfontein	Henriette du Plessis	**146**	06:45-17:30
Happy Hours Nursery	Garsfontein	Veronica Kemsley	**25**	07:00-17:30
Noddyland Crèche-Cum-Nursery School	Garsfontein	Evelyn McPhaiel	**>20**	06:45-17:30
Wiegel Waggel	Willows	Shenique	100	07:00-17:30
Tjokkerland	Menlopark	Jean-Marie		
Heideland Hotelskool	Lynwood	Linda Bosch		
Tiggywinklers Nursery School	Maroelana	Jenni Brock	85	Full day
Babbel & Krabbel Nursery School	Meyerspark	Rika Arnold	~105	Full day
Meyerspark Nursery School	Meyerspark	Ronel vd Bil	~90	07:00-17:00
Moreletapark Creche-Cum Nursery School	Moreleta Park			07:00-17:30
Moreleta Duifies	Moreleta Park			07:00-17:30

APPENDIX B. SPATIAL DISTRIBUTION OF THE TWO STUDY AREAS IN RELATION TO EACH OTHER.



Indicates the areas included in the study

APPENDIX C. INSTRUCTIONS AND RECORDING SHEET FOR AIR MONITORING

CRITERIA AND PROCEDURES FOR AIR MEASUREMENTS: (GREEN SHEETS)

Air sampling - stationary monitors

1. Check the flow rate of the Gilian pump when switching on (should be 1.9 L/min) Check black mark on pump.
2. Remember to take filter caps off filters before switching pumps on!!
3. Use small screw driver to close protective cover of pump.

Guidelines on selecting suitable places to position stationary monitors

Inside:

- Sample in the location where the 5-year olds spend the majority of their time
- Put on teacher's table, if available, the filter face being about 1 m above the floor.
- Take into account the positions of windows and doors that may have an effect on air flow through the room – record these. Sample, if possible, at least 3m away from windows used for ventilation, ie that are open on the day of sampling, or air conditions or vents for heating/air conditioning. Sample at least 3 m away from doors used to going in and out of the building.
- If it is impossible to place >3 m away from one of these, record this on the data recording sheet.
- Do not place samplers adjacent to a wall or other flow-obstructing object
- Do not place samplers immediately adjacent to a potential source, such as a stove, heat vent etc. Note if there are such sources in the room.
- Make sure that filter is at right height – about 1 meter

Outside:

Sampler will be placed according to the following criteria:

- In an area where 5-year olds play most of the time, according to the teacher
- On the same play ground where traffic counts and surface sampling will be done
- in a location where the sampler will not get run over by children, as close as possible to the fence nearest to the street where traffic counts will be conducted – if 5-year olds are likely to play there.
- If no suitable object can be found to place samplers on, put on laboratory stool and attach to a retort stand, (inside as well outside) (use prestic to attach pumps to retort stand)

STATIONARY MONITORING RECORDING SHEET (for Gilian pumps)

Indicate positions of pumps on sketch

Name of facility: _____

Field worker: _____

Date of sampling: _____

Pump no	Filter no	Time on	Particle size	Flow rate @ start	Location	Time off	Value on display at end	Flow rate @ end	Comments
			RSP		Outdoors				
			TSP		Outdoors				
			TSP		Indoors				
			RSP (if enough pumps)		Indoors				

Comments:
Indicate if pump was replaced and if so, the volume of old pump, the time of replacement, the number of the new pump
Note any irregularities observed during the time of monitoring

APPENDIX D. INSTRUCTIONS AND RECORDING SHEET FOR SOIL AND SURFACE DUST MONITORING

PROCEDURE AND CRITERIA FOR SOIL AND SURFACE DUST SAMPLING (BLUE SHEETS)

Soil and surface dust sampling

WORK AS CLEAN AS POSSIBLE TO PREVENT CONTAMINATION OF TOOLS

Outdoors:

If possible, do soil sampling before the sampling area is cleaned on the day of sampling.

Indicate whether sample was taken before or after cleaning

Criteria for selecting area to sample from:

If the 5-year olds play in an area closest to the road where traffic counts will be taken (ie the busiest road) at any given time, sample from this playground.

Only sample from the area furthest from this road if it is impossible for 5-year olds to play in area closest to the busy road.

Procedure to collect soil outdoors:

Measure the surface area of the playground

Take one sample for every 10 m^2 (eg if surface area is 50 m^2, take 50/10 = 5 samples. Round off, if necessary)

Taking into account the number of samples to be taken, ensure that one sample is taken more or less in the middle of the playground, at least one sample close to the road (inside the playground)

If there are no big sandy area(s), take soil samples in small sandy areas where children are likely to spend time, eg a flower bed.

If surface dust samples are taken outside (no soil), use same criteria as for soil samples to determine no of surface dust samples. Use criteria mentioned in 2 to determine number of surface dust samples to take.

Clean spoon with water and then with alcohol, using clean toweling paper.

If there is a big area in which to take soil samples, take samples in as random way possible – indicate on sketch where samples were taken

Take 4 scoops of soil (within the first 2-5 cm) with the spoon and put it in the zipper bag.

Seal firmly and label clearly – both on sampler and recording sheet
Note soil colour
If there is a sand pit, take one sample from the sand pit.

Remember that it is not necessary to wear gloves when taking soil samples. Work as hygienically as possible with the toweling paper used for cleaning the spoon. If you do not wear gloves, ensure that your hands are clean prior to doing the sampling.

Indoors:
Ask principal and/teachers whether you can sample before cleaning is being done for the day
Do surface dust sampling before the sampling area is cleaned on the day of sampling.
Indicate whether sample was taken before or after cleaning

Procedure to collect surface dust indoors:
NB. Before sampling, find out when last the area under consideration was cleaned and indicate on questionnaire. (It is preferable to take the sample before cleaning has been done for the day).
Take at least two samples indoors in a room where the 5-year olds spend most of their time.
Take one sample from a window sill – indicate whether window was open or closed (if area is too small to use the template, just clean the window sill properly using the procedure described below – indicate the surface area of the window sill).
Take another sample from an object such as a bookshelf where things are stored (again, if area is too small to use the template, just clean the object properly using the procedure described below – indicate the surface area of the object).
Take a third sample on a non-carpeted floor where the 5-year olds play – towards the side of the room (if the floor is carpeted, do not take a sample on the floor and note the fact that it is carpeted overall).
Indicate on data recording sheet where samples were taken.
Record sample number, location, date and time on data recording sheet.
Indicate on separate sketch where samples where taken.

How to do the sampling:
Put on a new pair of gloves for the sampling
Take an ashless filter and moisten with 1-2 ml of deionised water
Apply no more water than necessary to moisten approximately the central 80% area of the filter (too much water may cause sample loss)

Take the washable template and place firmly on the surface (10 cm by 10 cm inner dimensions)

Wipe the area using 3-4 vertical S-strokes

Use an open flat hand with the fingers together and wipe the marked surface in an overlapping S pattern.

Fold in half with the sample side folded in.

The process should be repeated with one side of the folded wipe/filter.

Wipe/filter should be folded again with sample side folded in

Put filter (or wipe) in zipper bag, seal firmly and label clearly

Discard the gloves in plastic bag

Clean the template with deionised water and dry with towelling paper before doing the next wipe sample.

DATA RECORDING SHEET FOR SOIL MONITORING

Pre-school name[2]: _____
Date of sampling [2]: _____

Surface soil outdoors:
Field worker that took the sample: _____
Surface area of the playground where 5 year olds play the most: _____ x _____
No of samples taken at a specific playground _____ (surface area/10)

Sample No[2] (start @ 1)	Shape of playground	Surface area of playground	Location of sample Indicate on rough sketch the outlay of the playground and where samples were taken	Time when sample was taken[2]	Colour of soil	Comments

1 Round off, eg if I get 2.5, take 3 samples
2 Remember to put this info on label on the plastic bag

Surface dust indoors:
Field worker that took the samples: _____
Surface area of the room where 5 year olds play the most: _____ x _____
No of samples taken in the specific room _____

Sample No[2] (start @ 1)	Location of sample Indicate on rough sketch the outlay of the room and where samples were taken	Time when sample was taken[2]	Comments – **Indicate surface area if template was not used**

Remember to put info on the label on the bag.

APPENDIX E. TYPES OF ACTIVITIES INCLUDED IN DIFFERENT LEVELS OF ACTIVITIES SPECIFIED

Activity level	Type of activity
Low	Sitting Sitting and talking
	Sleeping
	Praying
	Standing
Medium	Walking
	Singing without actions (normally)
	Crawling
	Washing hands
	Eating
	Sitting and playing
	Pushing light objects
	Climbing on objects
	Laughing normally
	Bathing
High	Running
	Jumping
	Fighting/bullying others
	Singing actively – with actions
	Lifting heavy objects (eg children)
	Pushing heavy objects

APPENDIX F: TIME-ACTIVITY DIARY TEMPLATE

PROCEDURES AND CRITERIA FOR TIME-ACTIVITY DIARIES

Observations and Time-Activity Diaries

1. Sheets with the criteria were given to pre-schools beforehand, where possible and teachers asked to assist with selection of children if possible.
2. These teachers were asked to draw up the following:

- A list of children with birth dates between 1 August 1995 and 31 July 1996.
- Indicating duration of pre-school attendance

3. From this list, select **one class** containing 5-year olds (if appropriate) and mark names of children from this class on the list

- If there are more than two boys and two girls in this class, two boys and two girls will be selected from the class, using a list of random numbers that will be provided
- If there are less than 2 boys and two girls in this class to do this selection, select a second class.
- As one student will observe two children, either two or all four children should be from the same class.
- If there are only four children, select all four
- If there are only four 5-year olds, but one is sick, select him/her but indicate clearly that it is a sick child (indicate what the conditions is, if possible)
- If there are **less** than four 5-year olds, select a 6-year old (first choice) or a 4 year old but indicate clearly that you have done so.

Indicate in comments at end of TAD how you made the selection.

Inclusion/exclusion criteria for selecting children at the pre-school:
Included are:

- 5-year old children without any visible or physical disability that inhibits the child from normal movement (as judged by the teacher)

Excluded are:

- Children with an acute disease on the day during which sampling takes place, which would hamper their movement – as recommended by the teacher.
- Children who only attend the pre-school half day (ie less than 8 hours)

Questionnaire no
Number of child
Number of pre-school
Colour given to child

General information

1. Date of survey: _____

2. Area in which pre-school is: Garsfontein | Soshanguve | Faerie Glen

   Other area: _____

3. Name of pre-school: _____

4. Address of pre-school: _____

Personal details of child

5. What time did the child arrive at the pre-school? _____ (observe or ask teacher)

6. **Birth date:** Day: _____Month: _____ Year _____ (date should preferably not be before 1 July 1995)

7. Gender of child: Boy ☐ Girl ☐

8. Weight of child: _____ **kg (obtain from school records)**

Family history of child

9. How long has child been attending this center? ____ years ___ months

(If they don't know exact time, ask them to indicate one of the following):

1 y _____ 2 y _____ 3 y _____ > 3 y _____

TIME-ACTIVITY DIARIES FOR OBSERVATION (pink sheets) **Name: _____**

Note: only the start and the end is indicated here.

Time of day	Location (indicate actual time in minutes if possible)		Type of activity Indicate whether child did any of these during the period under consideration	Main activity level-low/med/high*	Comments
	Indoors	Outdoors			
07:00 – 07:15			Run ☐ Climbing on objects ☐ Jumping ☐ Put dirt/sand in mouth ☐ Put other objects in mouth (specify) ☐ Eat without washing hands ☐ Eat with hands ☐ Other significant activity (specify) ☐		
07:15 – 07:30 etc...			Run ☐ Climbing on objects ☐ Jumping ☐ Put dirt/sand in mouth ☐ Put other objects in mouth (specify) ☐ Eat without washing hands ☐ Eat with hands ☐ Other significant activity (specify) ☐		
16:30 – 16:45			Run ☐ Climbing on objects ☐ Jumping ☐ Put dirt/sand in mouth ☐ Put other objects in mouth (specify) ☐ Eat without washing hands ☐ Eat with hands ☐ Other significant activity (specify) ☐		

Time of day	Location (indicate actual time in minutes if possible)		Type of activity Indicate whether child did any of these during the period under consideration		Main activity level-low/med/high*	Comments
16:45 – 17:00			Run Climbing on objects Jumping Put dirt/sand in mouth Put other objects in mouth (specify) Eat without washing hands Eat with hands Other significant activity (specify)	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐		

* Activity level = Low – sleeping, sitting and playing quietly without walking around
Activity level = Medium – eating, painting, walking around
Activity level = High – running, climbing on objects, laughing a lot while playing

Add detail of specific activities in comments section of TAD (speak to teachers during pilot studies)

(If unable to collect some of the information below by asking child or teacher, ask the person who fetches the child at the end of the day.)

10. What time did the child go home? _____

11. Any general comments about the child? (e.g., if the child is much smaller than other children, seem to be restless and not participate well, is very naughty a lot of the time, very shy, etc)

_____

_____

_____

12. Any problems experienced while observing the child? (e.g., difficult to follow the child, difficulty to observe more than one child, children very distracted by observations)

_____

_____

_____

_____

13. Any general comments?

_____

_____

_____

APPENDIX G. QUESTIONNAIRE FOR ADMINISTRATION TO TEACHER IN CHARGE AND ONE OTHER MEMBER OF STAFF IF POSSIBLE

CRITERIA AND PROCEDURES FOR QUESTIONNAIRE ADMINISTRATION TO TEACHERS AND ONE OTHER MEMBER OF STAFF IF POSSIBLE

Two questionnaires will be provided. Observations only have to be made once

Questionnaires (Yellow sheets)

Questionnaires to be administered to the principal or teacher in charge (if available) and one other member of staff (first teacher should be teacher responsible for 5-year olds – if more than one, draw a name out of a hat if feasible) to determine additional information that will distinguish between different types of areas and pre-school facilities from one another and provide information on possible confounding factors.

Traffic counts)

One person will do both ways of traffic, using the two counters

Indicate the **total** number as counted by counters in no 43.

- If the traffic is very busy, just provide an indication of the total number of trucks over the counting period.
- If there is a fair amount of traffic, indicate after every 10 vehicles the number of trucks.
- If there is little traffic, indicate the types of vehicles, ie motor vehicle, taxi, bakkie, truck on the recording sheet

QUESTIONNAIRE FOR ADMINISTRATION TO TWO STAFF MEMBERS

We are conducting an investigation to determine the exposure of pre-school children to environmental pollutants at different pre-school facilities. In order to do this, we need to determine the factors involved in, as well as the sources contributing to different exposures. Your information will contribute to our understanding of the effect of different child-care facilities on exposure and will lead to improvement of early childhood education policy.

Your participation is entirely voluntary. All information in this study will be treated as confidential and no person will be identified by name.

Questionnaire no: ☐
(office use)

PERSONAL DETAILS

1. Name of pre-school: _____
2. Name and surname of teacher (optional) or teacher ID: _____
3. Date of questionnaire completion: _____
4. Time of completion: _____
5. Interviewer's name: _____

6. How much do the parents pay per month (per child)? R _____

LOCATION OF THE PRE-SCHOOL

12. Physical address of pre-school:

MAKE-UP OF CHILDREN AT THE CENTER

8. Total number of children:
8.1 Normally attending pre-school: ☐ 8.2 On the survey day: ☐

9. Number of 5 year olds (born between 1 Aug 1995 and 31 July 1996):
9.1 Normally attending pre-school ☐ 9.2 On the survey day: ☐

MAKE-UP OF TEACHERS AT THE CENTER

10. Total number of teachers:

10.1 Normally at the pre-school ☐ 10.2 On the survey day: ☐

10.3 Normally teaching 5-y olds ☐ 10.4 On the survey day: ☐

FUELS AND APPLICATIONS THEREOF AT THE CENTER

11. What fuels do you use for ***cooking*** at the center? Please encircle all applicable.

	Type of fuel (Tick applicable)		Time of day	Total duration of use (in hours please)
11.1	Wood		Morning/afternoon/whole day	
11.2	Paraffin		Morning/afternoon/whole day	
11.3	Gas		Morning/afternoon/whole day	
11.4	Electricity		Morning/afternoon/whole day	
11.5	Charcoal		Morning/afternoon/whole day	
11..6	Anthracite (smokeless coal)		Morning/afternoon/whole day	
11.7	Dung		Morning/afternoon/whole day	

11.8 Other (specify)_____

Any clarification on the question above?

_____

_____

12. What cooking apparatus do you use?

12.1 Stove ☐
12.2 Primus ☐
12.3 Open fire ☐
12.4 Other (specify) _____

13. Where do you do the cooking? (tick applicable box)

13.1 In the kitchen, inside the center ☐
13.2 In other areas inside center (specify) ☐ _____
13.3 Outside cooking place (specify where) ☐ _____
13.4 Other? _____

14. Is the kitchen a separate enclosed area? Yes ☐ No ☐

15. What fuels do you use for ***heating***? Please encircle all applicable.

	Type of fuel	Time of day	Total duration of use (in hours please)
15.1	None	----------	------
15.2	Wood	Morning/afternoon/whole day	
15.3	Paraffin	Morning/afternoon/whole day	
15.4	Gas	Morning/afternoon/whole day	
15.5	Electricity	Morning/afternoon/whole day	
15.6	Charcoal	Morning/afternoon/whole day	
15.7	Anthracite (smokeless coal)	Morning/afternoon/whole day	
15.8	Dung	Morning/afternoon/whole day	

15.9 Other (specify)

_____

_____

_____

16. If applicable, which rooms do you heat? (tick applicable box)

16.1 All the rooms ☐

16.2. Rooms where 5-year olds play most of the time? ☐

16.3 Other (specify) ☐ _____

BUILDING STRUCTURE

(Field worker: If not done already, draw a rough sketch, indicating the building in relation to the nearest road and the road where traffic counts were taken. Indicate where outside windows and doors are located – use white separate sheets provided

17. How many rooms does the child-care center have? _____
18. How many doors leading to the outside does the building have? _____

19. Which outside doors are normally open on a typical winters day?
All ☐ Some ☐ None ☐

20. In how many rooms do the 5-year olds play during the day? ☐
(Field worker: Mark these on the map)

21. What is the surface area of these various rooms (**To be measured by field workers – do not do during class time!)**

1 ___ m x ____m
2. ___ m x ___ m.
3. ___ m x ___ m.

22. How many outside windows are there:
22.1 In total _____
22.2 Per room where 5-year olds play most of the time?
Room 1 _____
Room 2 _____
Room 3 _____

23. Which windows are normally open during this time of year?

23.1 All windows ☐
23.2 No windows ☐
23.3 Certain windows ☐

24. If certain windows open, are they the ones?
24.1 Closest to the road? ☐
24.2 Furthest from the road? ☐
24.3 On various sides? ☐ Specify _____

25. What types of material are the building made of?

25.1 Bricks (painted) ☐
25.2 Facebrick ☐
25.3 Corrugated iron ☐ (mazinke)
25.4 Other? ☐ Specify: _____

SMOKING STATUS OF TEACHERS?

26.1 Do any of the teachers at the school smoke tobacco?
Yes ☐ No ☐

26.2 If yes, how many are smoking? _____

26.3 If yes, do any of the teachers ever smoke while indoors with the children?

Yes ☐ No ☐

GENERAL ISSUES AT PRE-SCHOOL RELATED TO LEAD EXPOSURE

Outside:

27 Describe the type(s) of surface outside:

Soil ☐
Grass ☐
Cement ☐
Carpet ☐
Other ☐ specify _____

28 What does the material of the playground where the 5-year olds play consist of? (If more than one area, mark priority with 1-3.)

Mostly sand? ☐
Mostly cement? ☐
Mostly lawn/grass ☐
Other ☐ Specify _____

29.1 Is the playground ever cleaned?
Yes ☐ ☐ No

29.2 If yes, how is it cleaned? (explain procedure)

_____
_____

29.3 How often is the playground sweeped?

Daily ☐
Weekly ☐ _____ times a week
Monthly ☐ _____ times a month
Less often ☐ specify _____

30. Has any sanding been done of any painted surface recently (ie during the last 3 months?)
Yes ☐ No ☐

Inside:

31. Describe the type(s) of surface(s) indoors:

Cement ☐
Carpet ☐
Tile ☐
Soil ☐
Other ☐ specify _____

32.1 Are the surfaces where the children play inside ever cleaned?
Yes ☐ No ☐

32.2 How often are the surfaces inside where the children play, cleaned?

Daily ☐
Weekly ☐ _____ times a week
Monthly ☐ _____ times a month
Less often ☐ specify: _____

32.3 What is used to clean these surfaces?

A broom ☐
A dry cloth ☐
Water and soap ☐
Other? ☐ Specify: _____

TIME-TABLE

33.1 Does the school have a time-table for the 5-year olds?
Yes ☐ No ☐

33.2 If yes, request a time-table for the 5-year olds - or alternatively, write it down at back of questionnaire

OTHER SOURCES OF POLLUTION AT AND AROUND THE FACILITIES OR FACTORS CONTRIBUTING TO POLLUTION, EG SMALL INDUSTRIES, DUSTY STREETS

34. Is there a sandpit (hole with sand) on the playground?

Yes ☐ No ☐

35. If yes, how often is the sand changed?

Every week ☐ _____
Every 2nd week ☐ _____
Every month ☐ _____
Less often ☐ _____

36. If yes, when last was the sand changed? _____

37. What is the surface area of the playground(s) where the 5-year olds play most of the time? (Indicate more or less what shape this area was, ie square, rectangular, triangular)

_____ m x _____ m shape of area: _____
_____ m x _____ m (if they play in more than one area) shape of area: _____

38.1 Is the colour of the playground soil the same all over?
Yes ☐ No ☐

38.2 If not, what are the different colours?

Black ☐
Red ☐
Brown ☐
Other ☐ specify: _____

39.1 Are there any small industries near the pre-school?
Yes ☐ No ☐

39.2 If yes, list them: _____
_____
_

40. Are there any other sources of pollution at or around the pre-school?
Yes ☐ No ☐

40.1 If yes, list them: _____

41. OBSERVATIONS AROUND THE CENTER – to be observed by students

41.1 Name of **closest** street to pre-school (if applicable):

_____

41.2 Distance of this street to the fence of school (as crow flies) : _____ metres
(measure distance)

41.3 What material does this road consist of?
Dust ☐
Tar ☐
Other (specify) ☐ _____

41.4 If different street from 41.2, what is distance of street where **traffic counts** are taken from the fence of the school (may have to estimate or ask teacher – measure if possible)

41.5 Location of pre-school:

Is it directly next to a quiet road ☐ Next to a busy road ☐

41.6 Closest **main** street/road to pre-school: _____
(very busy road)

41.7 Is there a stop street or robot near the pre-school (visible from school)?

Yes ☐ No ☐

41.8 What is the distance from the stop street or the robot to the fence of the pre-school?

0-10 m ☐ 11-20 m ☐ > 20 m ☐

42. Motor vehicle count at street closest to the center (if main street is within about 20 m from school and visible from the pre-school, do traffic count at this street, otherwise do it at street right next to the pre-school – indicate both roads on picture – App H):

42.1 Is the street at a slope? Yes ☐ No ☐

42.2 When facing the traffic, are vehicles going uphill on:
the side of the pre-school ☐ on other side of road? ☐

43. **Total motor vehicle counts** as measured by **counters** (see 44 -breakdown of vehicles)

		Traffic closest to pre-school*	**Traffic furthest***
43.1	Morning at around 07:30 for 15 minutes		
43.2	Afternoon at 13:00 for 15 minutes		
43.3	Afternoon at around 16:00 for 15 minutes		

** when facing traffic*

44. **Indicate types of motor vehicles:**

- If traffic is not busy and it is possible, record no of bakkies, taxis and normal vehicles comments section.
- If traffic fairly busy, indicate no of trucks for every 10 vehicles
- If traffic is very busy, just indicate total no of trucks over each 15-min period

No of trucks for every 10 vehicles							
Tot no of vehicles	**07:30**		**13:00**		**16:00**		**Comments**
	Traffic next to	**Traffic opposite**	**Traffic next to**	**Traffic opposite**	**Traffic next to**	**Traffic opposite**	
1-10 vehicles							
11-20 vehicles							
21-30 vehicles							
31-40 vehicles							
41-50 vehicles							
51-60 vehicles							
71-80 vehicles							

OTHER OBSERVATIONS AROUND THE PRE-SCHOOL

45. Was it a particularly windy day? Yes ☐ No ☐

46. Did the wind blow:
In the morning ☐
In the afternoon ☐
The whole day ☐
Other? (specify) _____

47. Was it exceptionally cold during the day? Yes ☐ No ☐

48. Were the children outdoors less often than normal because of the weather?

Yes ☐ No ☐

Any general comments/extensions on questions? Put the question number and the comment on this page.

_____

_____

_____

_____

_____

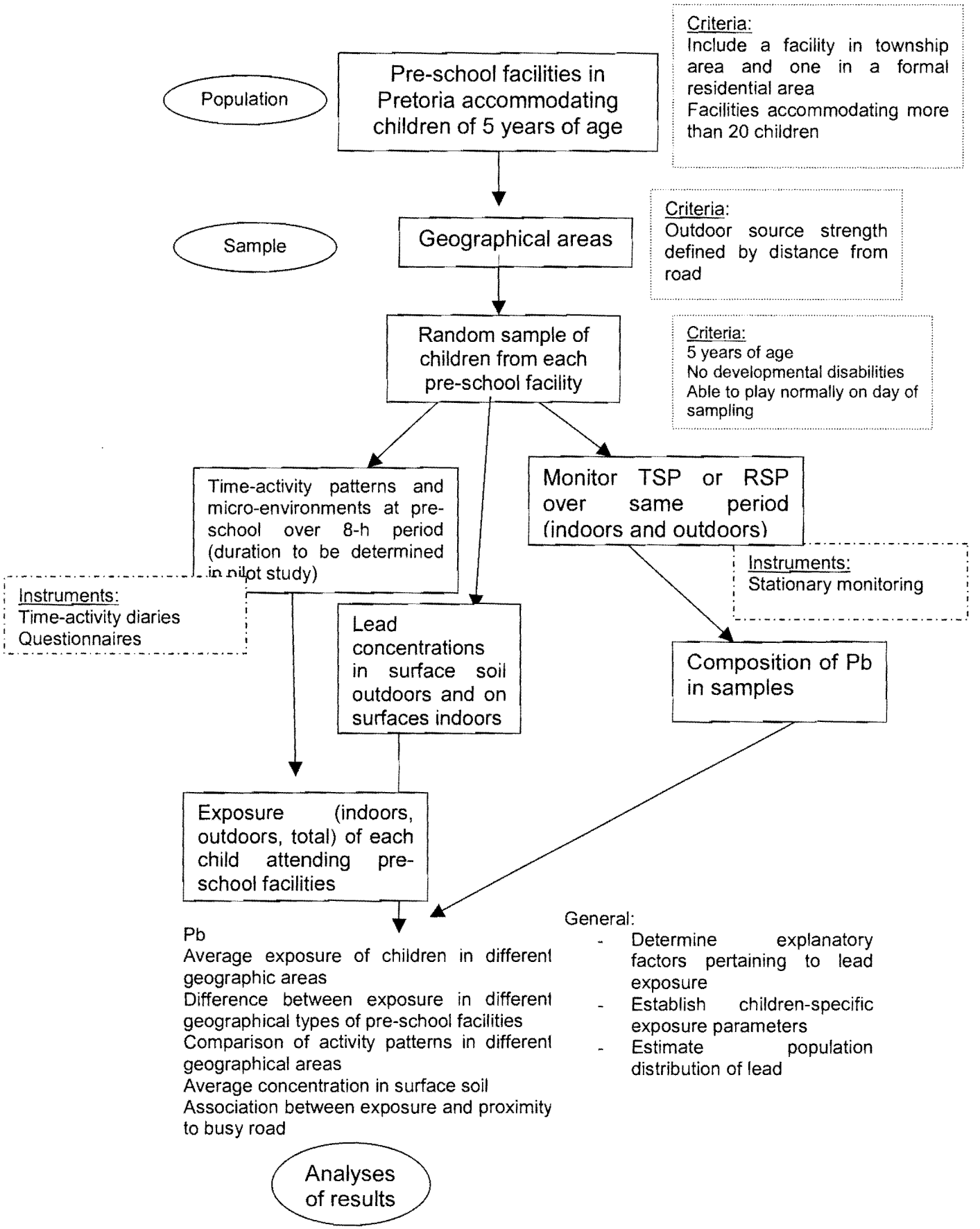
APPENDIX H. INSTRUMENTAL CONDITIONS FOR THE ICP-MS

- 50 ms Dwell time
- 10 Sweeps / Reading
- 3 Readings / Replicate
- 3 Replicates
- Dual detector mode
- Autolens on
- Internal standard 20 ppb In

APPENDIX I. LABORATORY CONDITIONS FOR GRAVIMETRIC ANALYSES

- The conditions in the laboratory are monitored continuously by means of a thermohygrometer.
    - The temperature is kept between 22 and 26°C
    - Humidity is kept between 50 and 70%.
- Gravimetric analyses are conducted according to the methods currently used by the Air Quality laboratory which are based on guidelines developed by the Department of Minerals and Energy [2].

APPENDIX J. FLOW DIAGRAM OUTLINING EXECUTION OF STUDY



APPENDIX K. LETTER OF CONSENT: DEPARTMENT OF EDUCATION

University of Pretoria
School of Health Systems and Public Health

FAX
TELEPHONE : +27 12 841-4189
FAX : +27 12 841-3659

FAX TO : Department of Education
ATTENTION : Mr Makofane
FAX NO : 012-341 6844
FROM : Juanette John
DATE : 30 May 2001
NO. OF PAGES, INCLUDING THIS ONE: 3

Dear Mr Makofane

PERMISSION TO UNDERTAKE A STUDY TO DETERMINE LEAD EXPOSURE OF PRE-SCHOOL CHILDREN

The University of Pretoria is currently doing a study focusing on the determination of lead exposure of children attending certain pre-school facilities in Pretoria, in relation to their activity patterns. This study will contribute towards an MSc degree in Community Health. Lead was selected as the pollutant because it is a pollutant of concern internationally when dealing when with the environmental health of developing children.

- Determination of exposure to lead (mainly from motor vehicles) by children attending pre-school facilities in two different areas in Pretoria (Garsfontein and Soshanguve) on a typical winter day, using a combination of existing exposure measurement tools with a view to
- Subsequently make recommendations to the Department of Education with regard future studies on exposure of developing children to environmental pollutants

The measurement tools that will be used are the following:

- Physical monitoring of pollutants by means of:
  - Stationary monitoring indoors and outdoors at the pre-school which will monitor airborne lead
  - Surface dust sampling on the playground and indoors on a floor where the children spend most of their time

- Observational monitoring by means of:
  - Time-activity diaries which will be completed by students who will observe a randomly selected sample of children over the period of a day. These diaries will record some personal information of the child and his/her whereabouts and exertion levels over the period of a day
  - Questionnaires which will be administered to at least one teacher at the pre-school. These will record information on sources of pollution and potential exposure in and around the pre-school

A sample of about 30 pre-school facilities will be selected from each area. The field work will be conducted by an MSc student, assisted by Environmental Health students from the Technikon Gauteng North in Sohanguve. The proposed time frame for the field work is between 17 an 31 July 2001.

We hereby request written permission to approach a sample of about 30 pre-school facilities in Garsfontein as part of this study.

Once written permission has been obtained from the Department, letters will be sent to the selected pre-schools to request permission to monitor at their school.

Yours sincerely

Juanette John
MSc student in Community Health

If you have any questions, please do not hesitate to contact any of the following people:

Juanette John	012 841 4189
Prof Kuku Voyi	012 841 3964
Prof Carel IJsselmuiden	012-841 3230

APPENDIX L. LETTER OF CONSENT: TSHWANE HEALTH SERVICES

STADSRAAD VAN PRETORIA
CITY COUNCIL OF PRETORIA

Departement Gesondheidsdienste
Sammy Marks Gesondheidskompleks
h/v Vermeulen- en Prinsloostraat
Posbus 284, Pretoria, 0001
Tel (012) 308 7911
Faks (012) 324-6135

Health Services Department
Sammy Marks Health Complex
cnr Vermeulen and Prinsloo Streets
PO Box 284, Pretoria, 0001
Tel (012) 308 7911
Fax (012) 324-6135

PRETORIA

DEPARTEMENT GESONDHEIDSDIENSTE • HEALTH SERVICES DEPARTMENT

U verw.
Your ref.

Ons verw. 2/1/1
Our ref.

Navrae.
Enquiries: I J van Rensburg/k

☎ 308 8721

11 JUN 2001

Enviromentek - CSIR
PO Box 395
PRETORIA
0001

Att: Juanette John

STUDY TO DETERMINE LEAD EXPOSURE OF CHILDREN ATTENDING PRE-SCHOOL FACILITIES IN SOSHANGUVE & GARSFONTEIN

The City of Tshwane Metropolitan Municipality has no objection in principle to the conducting of the abovementioned study.

Yours sincerely

2001/06/11

for J H OLIVIER
MEDICAL OFFICER OF HEALTH

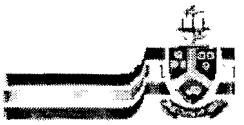
/kort

MEDICAL OFFICER OF HEALTH
STADSGESONDHEIDSHOOF
DR. J. H. OLIVIER
M.B. Ch.B. (U.P.)
BSC. FARM (P.U. VIR C.H.O.)
D.G.G.
D.G.A.

The CITY OF TSHWANE METROPOLITAN MUNICIPALITY, successor-in-law of the CITY COUNCIL OF PRETORIA, in terms of General Notice [illegible] of 2000, as amended.

DIE STAD TSHWANE METROPOLITAANSE MUNISIPALITEIT, opvolger in titel van die STADSRAAD VAN PRETORIA, ingevolge Algemene Kennisgewing [illegible] van 2000, soos gewysig

APPENDIX M. LETTER TO PRINCIPAL OF SELECTED SCHOOL



University of Pretoria
School of Health Systems and Public Health

__ July 2001

Dear Ms _____

PERMISSION TO DO A STUDY TO DETERMINE EXPOSURE OF PRE-SCHOOL CHILDREN TO LEAD

The University of Pretoria is currently doing a study to estimate lead exposure of children attending certain pre-school facilities in Pretoria (Soshanguve and Eastern suburbs such as Garsfontein/Faerie Glen/Menlopark/Newlands/Constantia Park etc), in relation to their activity patterns. In order to do this study, pre-school facilities are being selected in a random manner from each area. As there are less than 30 pre-school facilities in the relevant Eastern suburbs, all possible pre-schools have been selected from this area.

The main objectives of the study are:

- To contribute towards an MSc degree in Community Health. Lead was selected as pollutant because it is a pollutant of concern internationally when dealing when environmental health of developing children.
- Determination of exposure to lead (mainly from motor vehicles) by children attending pre-school facilities in two different areas in Pretoria (Garsfontein and Soshanguve) on a typical winter day, using a combination of existing exposure measurement tools with a view to
- Subsequently to make recommendations to the Department of Education and Health with regard future studies on exposure of developing children to environmental pollutants.

The measurement tools that will be used are the following:

- Physical monitoring of pollutants by means of:
    - Stationary monitoring indoors and outdoors at the pre-school which will monitor airborne lead
    - Surface dust sampling at the playground and indoors on a floor where the children spend most of their time

  Observational monitoring by means of:
    - Time-activity diaries which will be completed by students who will observe a randomly selected sample of four five-year old children over the period of a day. These diaries will record some personal information of the child and their whereabouts and exertion levels over the period of a day
    - Questionnaires which will be administered to at least one teacher at the pre-school. These will record information on sources of pollution and potential exposure in and around the pre-school

The field work will be conducted by an MSc student, assisted by Environmental Health students from the Technikon Northern Gauteng in Soshanguve. The proposed time frame for the field work is between 17 and 31 July 2001. It will involve one day per pre-school (from 07:00 to 17:00). The students will be present at all times during the day and will be responsible for ensuring that the monitors are not disturbed.

Participation of children will be voluntary and any information will be treated as confidential. The City Council of Pretoria – Health Services Department has indicated that they have no objection to the study. Please find attached the letter indicating this.

We hereby request your written permission to:

- Do monitoring of air and soil to determine potential exposure to lead
- Observe the children at the facility over the period of a day to determine their activity patterns, ie the duration and type of activities over the duration of the day
- Administer a questionnaire to at least one teacher at the facility

If necessary, an arrangement can be made to meet with you personally to discuss the study and answer any questions that you may have. The possibility of sponsorships for educational material for the schools that participate are also currently investigated.

Attached find a letter of consent. It will be appreciated if you could give us feedback in any of the following ways:

By signing the form and faxing it back
- By e-mailing a reply
- By phoning Juanette John, in which case we can arrange to fetch it if necessary

Kind regards

Juanette John
MSc student in Community Health

If you have any questions, please contact any of the following people:

Juanette John	012 841 4189/ 082 692 4380/ 083 227 0585
Prof Kuku Voyi	012 841 3964
Prof Carel IJsselmuiden	012-841 3230
Ms Riëtha Oosthuizen	012-841 4189

LETTER OF CONSENT

Name of pre-school: _____

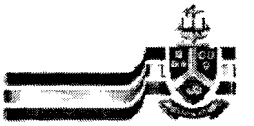
Yes, I give permission for my day care center to take part in this study _____
(signature) _____ (designation)

No, I do not give permission for my day care center to take part in this study
_____ (signature) _____ (designation)

Please send it back to Juanette John, in one of the following ways:

By phoning: Tel. 012-841 4189/082 692 4380
By fax: Fax no: 012-841 3659
e-mail to: jjohn@csir.co.za

APPENDIX N. INFORMATION SHEET TO PARENTS



University of Pretoria
School of Health Systems and Public Health

July 2001

BACKGROUND TO THE STUDY CONDUCTED AT YOUR CHILD'S DAY CARE CENTRE

The University of Pretoria is doing a study to find out what air and dust pollution levels at pre-schools are. The pre-school that your child attends was one of those selected.

In this study we are measuring air and soil inside and outside the pre-school. The children's activities are also observed to see how much time they spend outside and inside the building.

No personal information such as name or home address was collected from the children. This study has the approval of the school principal/owner of the pre-school.

If you want more information on this study, please contact one of the following people:

Juanette John	012 841 4189/082 692 4380
Prof Kuku Voyi	012 841 3964
Prof Carel IJsselmuiden	012-841 3230
Mr Fred Mololekwa	082 972 9522
Riëtha Oosthuizen	012-841 2035

Kind regards

Juanette John
MSc student in Community Health

University of Pretoria
School of Health Systems and Public Health

Julie 2001

AGTERGROND TOT DIE STUDIE GEDOEN BY U KIND SE DAGSENTRUM

Die Universiteit van Pretoria doen tans 'n studie om lug en grondbesoedelingsvlakke by kleuterskole te bepaal. Die kleuterskool wat u kind bywoon, is een van dié wat gekies is vir die studie.

Tydens hierdie studie sal lug en grond/stof vlakke binne en buite die fasiliteit gemoniteer word. Die aktiwiteite van 5-jarige kinders word ook waargeneem om die hoeveelheid tyd wat hulle binne en buite onderskeidelik spandeer, te bepaal.

Geen persoonlike inligting soos name en tuis-addres is van die kinders versamel nie. Hierdie studie dra die goedkeuring van die skoolhoof/eienaar van die kleuterskool weg.

As u meer inligting oor die studie verlang, kontak asb een van die volgende mense:

Juanette John	012 841 4189/082 692 4380
Prof Kuku Voyi	012 841 3964
Prof Carel IJsselmuiden	012-841 3230
Riëtha Oosthuizen	012-841 2035

Vriendelike groete.

Juanette John
MSc student in Gemeenskapsgesondheid

University of Pretoria
School of Health Systems and Public Health

July 2001

BACKGROUND TO THE STUDY CONDUCTED AT YOUR CHILD'S DAY CARE CENTRE

University ya Pretoria e dira dithuto go batlisisa gore tekano ya kgotlelego/tshilafatso ya moya le lerole e bakwa ke eng. Creche e ngwana wa gago a e tsaneng, ke e nngwe ya tse di tlhopilweng.

Mo dithutong tse, re dirisa seelo sa moya le mobu ka fa gare le ka fa ntle ga pre-school. Re lebelesisa le metshameko ya bana go bona gore ke nako e kana kang e e dirisiwang ka fa gare le ka fa ntle ga moago.

Ga gona tshedimoso ya botho jaaka leina kgotsa nomoro ya ntlu e kgobokantsweng go tswa mo baneng. Dithuto tse, di bone tetla gotswa go mogokgo wa pre-school.

Fa o batla tshedimoso ka dithuto tse, ikopanye le mongwe wa batho ba ba latelang:

Juanette John	012 841 4189/082 692 4380
Prof Kuku Voyi	012 841 3964
Prof Carel IJsselmuiden	012-841 3230
Mr Fred Mololekwa	082 972 9522

Kind regards

Juanette John
MSc student in Community Health

APPENDIX O. QUESTIONNAIRE STRUCTURE AS USED FOR DATA ANALYSES INCLUDING VARIABLE NAMES

QUESTIONNAIRE TO DETERMINE PERCEPTIONS ABOUT EXPOSURE

Questionnaire/pre-school [{Qesno}]: ##
1.1 {Area} of pre-school (1=Sosh 2= Pta East): #

1.2 If Pta E, what is sub-area? [{Earea}] ##
1.3 Type of area of pre-school (1=formal 2= informal) [{typarea}] #

1.4 {Name} of pre-school: _____

2. Name and surname/ID {teacher}: _____
3.1 {Date} of completion: <dd/mm/yy>
3.1.2 {Date2} of completion: <dd/mm/yyyy>

3.2 Today's date: {today} <today>

4. {Time} of questionnaire completion #

5. Interviewer name [{intervw}]: _____
6. {Pay}/month (R): R###
7. {Addres} of pre-school: _____

"MAKE-UP OF CHILDREN"

"Tot no of children"
8.1 Normally attending [{nochild}]: ### 8.2 On survey day [{nochldd}]: ###

No of 5-y olds:
9.1 Normally attending [{num5y}]: ## 9.2 On survey day: [{num5yday}] ##

MAKE-UP OF TEACHERS:

Tot no of teachers:
10.1 Normally at pre-school [{normtch}]: ## 10.2 On survey day [{tchday}] ##
10.3 Normally teaching 5-y olds[{nortch5y}]# 10.4 On survey d [{nortch5d}] #

FUELS AND APPLICATIONS AT CENTER

11.1.1 Is one type of fuel used for cooking [{onecook}]? # (1=Yes 2=No)

11.1.2 If YES, what type is it? [{flcook}] #

11.1.3 If YES, which time of the day do you use the particular fuelwood? [{timecook}] # (1=morning 2=afternoon 3=whole day 4=morning & afternoon 5=other)

11.2 Tot duration of use of fuel (in h)? [{durfuel}] ##

11.3 If more than 1 type is used, is it: (1=Yes 2=No)
11.3.1 {wood1} #
11.3.2 {paraff1} #
11.3.3 {gas1} #

11.3.4 {electr1} #
11.3.5 {charcl1} #
11.3.6 {anthrac1} #
11.3.7 {dung1} #
11.3.8 {otherck} # {specck} _____

11.4 Which time of day is the 1st type used? [{tmcook1}]? #
(1=morning 2=afternoon 3=whole day 4=morning & afternoon 5=other)

11.5 Which time of day is the 2nd type used? [{tmcook2}]? #
(1=morning 2=afternoon 3=whole day 4=morning & afternoon 5=other)

11.6 If applicable, tot duration of use of fuel 1 [{durfuel1}] ##

11.7 If applicable, tot duration of use of fuel 2 [{durfuel2}] ##

12. What cooking apparatus do you use? [{Cookapp}]? #

13. Where do you do cooking? [{cookplce}] #
(1=in kitchen 2=other areas 3=outside place)

14. Is kitchen separate enclosed area? [{kitsepar}] # (1=Yes 2=No)

15. Is any fuel type used for heating? [{anyheat}] # (1=Yes 2=No)

15.1 Is one type of fuel used for heating? [{oneheat}] # (1=Yes 2=No)

15.2 If YES, what is it? [{fuelheat}] #
15.3 Total duration of fuel use in hours [{fueldurh}] ##

15.4 If YES to (15.1), what time of day used? [{fueltime}] #
(1=morning 2=afternoon 3=whole day 4=morning & afternoon 5=other)

15.5 If more than 1 type is used, is it: (1=Yes 2=No)
15.5.1 {wood2} #
15.5.2 {paraff2} #
15.5.3 {gas2} #
15.5.4 {electr2} #
15.5.5 {charcl2} #
15.5.6 {anthrac2} #
15.5.7 {dung2} #
15.5.8 {otherht} # {specht} _____

15.6 If more than 1 type of fuel used, what time of day is 1st fuel used?
[{fuel1ttm}] # (1=morning 2=afternoon 3=whole day 4=morning & afternoon 5=other)

15.7 Total duration of use of fuel1 (h) [{fuel1dur}] ##

15.8 If more than 1 type of fuel used, what time of day is 2nd fuel used?
[{fuel2ttm}] # (1=morning 2=afternoon 3=whole day 4=morning& afternoon 5=other)

15.9 Total duration of use of fuel2 (h) [{fuel2dur}] ##

16. If applicable, which rooms are heated? [{roomheat}] #
(1=all rooms 2=rooms where 5-y old play 3=other)

BUILDING STRUCTURE

17. No of rooms of centre [{NumRoom}] ##

18. No of outside doors [{NumDoor}] ##

19. Outside doors open? [{dooropen}] # (1=All 2=some 3=none}

20. In how many rooms do 5-y olds play? [{5yrooms}] #

21.1 Surface area of room 1- in m2? [{Arearm1}] ####.#

21.2 If playing in more than one room, area of room 2 in m2? [{arearm2}] ####.#

22. No of outside windows:
22.1 In total? [{totwin}] ##
22.2 Per room where 5-y olds play? {winroom1} ## {winroom2} ##

23. Which windows normally open? [{winopen}] #
(1=all 2=none 3=certain)

24.1 If certain open, which ones? [{winwhcop}] #
(1=closest 2=furthest 3=various sides)

24.2 If various sides, specify [{winvar}] #

25. What types of material does building consist of? (1=Yes 2=No)
Is it:{bricks} #
Facebrick [{facebrck}] #
Corrugated iron [{coriron}] #
Stop-nonsense [{stop-non}] #
{Wood} #
Other type of material {otherbld} # Specify [{specbld}]

SMOKING STATUS OF TEACHERS

26.1 Do any teacher smoke? [{smoke}] # (1=Yes 2=No)

26.2 If yes, how many are smoking? [{numsmoke}] #

26.3 If yes, do teachers ever smoke when with children? [{smkechil}] # (1=Yes 2=No)

GENERAL ISSUES

Outside:
27. Is the type(s) of surface outside: (1=Yes 2=No)
{soilout} #
{grssout} #
{cmntout} #
{crptout} #
{otherout} # {specout} _____

28. Material of playground mainly [{surfplay}] #

29.1 Playground ever cleaned? [{outclean}] # (1=Yes 2=No)
29.2 If yes, how? [{metclout}] # or spec method [{spmetout}]

29.3 How often cleaned? [{frclnout}] # (1=daily 2=weekly 3=montly 4=less often)

30. Any sanding of any painted surface recently? [{sanding}] # (1=Yes 2=No)

Inside:
31. Type(s) of surface(s) indoors. Is it (1=Yes 2=No):
{Cementin}? #
{Carpetin}? #
{Tilein}? #
{Soilin}? #
{Otherin}? # {specin} _____

32.1 Are surfaces ever cleaned? [{inclean}] # (1=Yes 2=No)
32.2 How often are they cleaned? [{frqclnin}] #
32.3 What is used to clean surfaces? [{metclnin}] #
or specify method inside [{spmetin}] _____

TIME-TABLE & TAPs

33.1 Does school have time-table? [{timetab}] # (1=Yes 2=No)

33.2.1 Child 1:
Arrive: [{arr1}] #### Leave: [{leave1}] ####
Birthdate 1 [{birth1}] <dd/mm/yy>
Birthdate Y2K [{birthd1b}] <dd/mm/yyyy>
{Gender1} #
{Weight1} (kg): ##
Duration of attending (years): [{duratt1y}] # [{duratt1m) ##

{Comchld1}:_____
___

33.2.2 Child 2:
Arrive: [{arr2}] #### Leave: [{leave2}] ####
Birthdate 2 [{birth2}] <dd/mm/yy>
Birthdate Y2K [{birthd2b}] <dd/mm/yyyy>
{Gender2} #
{Weight2} (kg): ##
Duration of attending (years): [{duratt2y}] # [{duratt2m) ##

{Comchld2}:
_____

33.2.3 Child 3:
Arrive: [{arr3}] #### Leave: [{leave3}] ####
Birthdate 3 [{birth3}] <dd/mm/yy>
Birthdate Y2K [{birthd3b}] <dd/mm/yyyy>
{Gender3} #
{Weight3} (kg): ##
Duration of attending (years): [{duratt3y}] # [{duratt3m) ##

{Comchld3}:_____

33.2.4 Child 4:
Arrive: [{arr4}] #### Leave: [{leave4}] ####
Birthdate 4 [{birth4}] <dd/mm/yy>
Birthdate Y2K [{birthd4b}] <dd/mm/yyyy>
{Gender4} #
{Weight4} (kg): ##

```
     Duration of attending (years): [{duratt4y}] # [{duratt4m) ##

{Comchld4}:
```

```
33.2.5 Dur of time spent by 4 children observed (minutes):
     Child 1: Indoors [{durin1}] ###.# Outdoors [{durout1}] ###.#
     Child 2: Indoors [{durin2}] ###.# Outdoors [{durout2}] ###.#
     Child 3: Indoors [{durin3}] ###.# Outdoors [{durout3}] ###.#
     Child 4: Indoors [{durin4}] ###.# Outdoors [{durout4}] ###.#

33.2.6    Activities of 4 children observed (min):
   Child 1: High [{durhigh1}] ###.# Med [{durmed1}] ###.# Low [{durlow1}]
###.#
   Child 2: High [{durhigh2}] ###.# Med [{durmed2}] ###.# Low [{durlow2}]
###.#
   Child 3: High [{durhigh3}] ###.# Med [{durmed3}] ###.# Low [{durlow3}]
###.#
   Child 4: High [{durhigh4}] ###.# Med [{durmed4}] ###.# Low [{durlow4}]
###.#


33.3 Pollutant concentrations:

33.3.1 Conc of Pb indoors (TSP) (ug/m3) [{Pbin}] #.### ug/m3
     If no value, why? [{missPb1}] # (1=missing 2=below detection limit)

33.3.2 Conc of Pb outdoor (RSP) [{PboutRSP}] #.### ug/m3
     If no value, why? [{missPb2}] # (1=missing 2=below detection limit)

33.3.3 Conc of Pb outdoors (TSP) [{PboutTSP}] #.### ug/m3
    If no value, why? [{missPb3}] # (1=missing 2=below detection limit)


33.4.1 Conc of TSP indoors (ug/m3) [{TSPin}] ####.### ug/m3
     If no value, why? [{missPM1}] # (1=missing 2=below detection limit)

33.4.2 Conc PM10 outdoors [{RSPout}] ####.### ug/m3
     If no value, why? [{missPM2}] # (1=missing 2=below detection limit)

33.4.3 Conc of TSP outdoors [{TSPout}] ####.### ug/m3
     If no value, why? [{missPM3}] # (1=missing 2=below detection limit)

33.5  Conc of Pb in surface dust (ug/m2):
      Floor indoors ([{PbSD1}]: ####.###   Window sill [{PbSD2}]: ####.###
      Object such as book case [{PbSD3}]: ####.###
      Other surface [{PbSD4}]:  ####.###
     Specify [{spcsdloc}]  <A                                        >
```

33.6 Conc of Pb in surface soil (ug/g soil):
Near traffic [{PbS1}]: ####.### [{spctrflo}]
Sandpit [{PbS2}]: ####.### [{spcpitlo}]
Playground area [{PbS3}]: ####.### [{spcpgloc}]
Other location [{PbS4}]: ####.### Specify [{spcsoil}]

OTHER SOURCES OF POLLUTION

34. Is there a sandpit? [{sandpit}] # (1=Yes 2=No)
35. If yes, how often is sand changed? [{frqchnge}] #
36. If yes, when last was sand changed? [{whnchnge}] <dd/mm/yy>
Sand change Y2K [{whnchng2}] <dd/mm/yyyy>

37.1 Surface area of playground 1 in m2 [{srfpg1}] ####.# m2
37.1 If applicable, surf area of pground 2 in m2 [{srfpg2}] ####.# m2

38.1 Soil colour same all over? [{soilcol}] # (1=Yes 2=No)
38.2 If no, what are different colours? (1=Yes 2=No)
{Black}? #
{Red}? #
{Brown}? #
{Cream}? #
{White}? #
{Other}? # {specsoil} _____

39.1 Any small industries near pre-school? [{industry}] # (1=Yes 2=No)
39.2 If yes, what types? [{indspec}] #

40. Other sources of pollution? [{srcpol}] # (1=Yes 2=No)
40.1 If yes, what are these? [{polspec}] #

OBSERVATIONS AROUND CENTRE

41.2 Distance of closest street to fence of pre-school (m): [{strdist}] ### m
41.3 Material of this road? [{roadmat}] # (1=dust 2=tar 3=other)

41.4.1 Was a different street used for the traffic counts? [{strtrffc}] #
(1=Yes 2=No)
41.4.2 If different street used for traffic counts, what is distance of this
street from pre-school (m)? [{trfdist}] ###

41.5 Location of pre-school? [{loctostr}] #
(1=dir next to quiet road 2=dir next to busy road)
41.6 closest main (busy street) [{mainstr}]: _____

41.7 Stop street/robot near pre-school? [{stoprob}] # (1=Yes 2=No)
41.8 If yes, what is distance to fence of school? [{distrob}] # (1=0-10m 2=11-20m 3=>20m)

42.1 Is street at slope? [{strslpe}] # (1=Yes 2=No)
42.2 Which side are vehicles going uphill? [{uphill}] #
(1=on side of pre-school 2= on other side)

43. Tot motor counts:
43.1 08:00: closest pre-school [{MornRTL}] ### Furthest pre-school [{Morn LTR}] ###
Total [{MornTot}] ###
43.2 13:00: closest pre-school [{LnchRTL}] ### Furthest pre-school [{LnchLTR}] ###
Total [{LnchTot}] ###
43.3 16:00: closest pre-school [{AftRTL}] ### Furthest pre-school [{AftLTR}] ###
Total [{AftTot}] ###

44. Rate the traffic volumes of the road where traffic counts were taken
[{trfcnts}] # (1=high 2=med/high 3=medium 4=med/low 5=low)

OTHER OBSERVATIONS

45. Was it a particularly windy day? [{wind}] # (1=Yes 2=No}
46. When did wind blow? [{timewind}] # (1=morning 2=afternoon 3=whole day 4=other)
47. Was it exceptionally cold during the day? [{temp}] # (1=Yes 2=No)
48. Were children outdoors less often than normal? {outnrml} # (1=Yes 2=No)

Temperatures:
min for the day (deg C): [{mintemp}] ##.#
max for the day (deg C): [{maxtemp}] ##.#
avg for the day (deg C): [{avgtemp}] ##.#

GENERAL COMMENTS

{Comm1}_____
__{Comm2}
_____
{Comm3}
_____

APPENDIX P. FORMULAS USED FOR CREATION OF VARIABLES USED IN ANALYSES

Distance of pre-school to the road where traffic counts were taken

```
Generate trfmeas = .
Replace trfmeas = strdist if strtrffc ==2
Replace trfmeas = trfdist if strtrffc ==1
```

Location of the pre-school

```
Generate loctyprd-.
Replace loctyprd=1 if trfmeas<=60 & traftot >=200
Replace loctyprd=1 if trfmeas<=100 & traftot <600
Replace loctyprd=2 if trfmeas>60 & traftot <200
Replace loctyprd=2 if trfmeas<=60 & traftot <200
Replace loctyprd=2 if trfmeas>60 & traftot >200
```

Average lead in surface dust and surface soil

```
Generate Meanpbsd=.
Replace Meanpbsd=(pbsd1 +pbsd2 + pbsd3 + pbsd4 + pbsd5)/5

Generate Meansoil=.
Replace Meansoil=(pbs1 +pbs2 + pbs3 + pbs4)/4
```

Surface area/child indoors and outdoors

```
Generate srf5yin = num5y/arearoom → no of children/m2 indoors

Generate srf5yout = num5y/srfpgr → no of children/m2 on playground

Generate chlpsrin = arearoom/num5y → surface area/child indoors

Generate chpsrout = srfpgr/num5y → playground area/child outdoors
```

APPENDIX Q. RESULTS

Table 5. Number of pre-schools participating each day over the monitoring period.

Date	No of facilities visited on the particular day		
	Soshanguve*	Pretoria East*	Total no
17/07	3	3	6
18/07	3	2	5
19/07	3	2	5
20/07	3	2	6
23/07	3	0	3
24/07	3	3	6
25/07	3	3	6
26/07	3	2	4
27/07	0	3	3
30/07	3	2	5
31/07	3	2	5
Total number of facilities visited	30	24	54

* Names of pre-schools that were visited are indicated in Appendix A – visits were in the order as mentioned in this table.

Table 6. Distribution of children and teachers at pre-schools on the survey day

Variables	Soshanguve			Pretoria East		
	Mean	SD	Median [a]	Mean	SD	Median [a]
No of children	41.2	17.0	35	106.6	51.5	100
No of children on survey day	27.8	13.4	24.5	91.0	53.2	84.0
No of 5-y olds	11.3	7.9	9	21.3	7.8	20
No of 5-y olds on survey day	9.2	6.9	7.5	18.9	7.2	19.5
No of teachers	2.7	0.84	3.0	7.4	4.3	5.5
No of teachers on survey day	2.3	0.8	2.5	7.1	4.5	5.0
No of 5-y old teachers	1.2	0.48	1	1.6	0.9	1
No of 5-y old teachers on survey day	0.17	0.38	1	1.6	0.9	1
Ratio of children/teacher	15.7	5.6	16	16.4	6.6	16.5

a Median included in cases where the distribution is skew, ie where median and mean not the same

NA Not applicable – mean and median exactly the same

Table 7. Gender distribution of children observed in the two areas

	Soshanguve	Pta East		Total	
	N	N	%	N	%
Overall					
Boys	57	44		101	47
Girls	62	51		113	52.6
Unknown	0	1		1	0.4
Total	119	96		215	100
5-y olds attending>= 6 hours on day of survey					
Boys	43	39		82	51
Girls	42	38		80	49
Total	85	77		162	100

Table 8. Weight distribution of the children observed in the two areas

Variables	Soshanguve		Pretoria East	
	Mean	SD	Mean	SD
Weight	18.1	3.6	20.0	3.3
No of observations	21		40	
% of tot no of children for which weight was available	21/119 = 18%		40/96=42%	

Table 9. Types of energy sources used for cooking by area

	Area					
	Soshanguve		Pretoria East		Total	
Type of fuel if one type used						
	N	% (of 14*)	N	% (of 23*)	N	% (of 37*)
Paraffin	7	50	0	0	7	19
Gas	1	7	0	0	1	3
Electricity	5	36	23	100	28	75
Charcoal	1	7	0	0	1	3
Types of fuel indicated if more than one type used						
	N	% (of 16**)	N	% (of 1**)	N	% (of 17**)
Wood	4	25	0	0	4	23.5
Paraffin	5	31.3	0	0	5	29.4
Gas	3	18.7	1	4	4	23.5
Electricity	10	62.5	1	4	11	64.7
Charcoal	8	50	0	0	8	47.1
Anthracite	2	12.5	0	0	2	11.8

* No of pre-schools indicating that they use one type of fuel for cooking
** No of pre-schools indicating that they used more than one type of fuel

Table 10. Type of cooking apparatus used by area

	Soshanguve		Pretoria East		Total	
	N	% of 30	N	% of 24	N	% of 54
Stove	13	43	24	100	37	68
Primus	10	33	0	0	10	19
Stove & primus	1	4	0	0	1	2
Mbawula	4	13	0	0	4	7
Mbawula & stove/primus	2	7	0	0	2	4
Total	30	100	24	100	54	100

Table 11. Types of energy sources used for heating at pre-school facilities by area

Type of fuel	Soshanguve		Pretoria East		Total	
	N	% (of 7*)	N	% of 12*	N	% of 19*
Type of fuel if one type used						
Paraffin	1	14	0	0	1	5
Electricity	3	44	12	100	15	80
Charcoal	1	14	0	0	1	5
Anthracite	1	14	0	0	1	5
Types of fuel if more than one type used						
	N	% (of 1**)	N	% (of 1**)	N	%(of 2**)
Wood	1	100	0	0	1	50
Paraffin	1	100	0	0	1	50
Gas	0	0	1	100	1	50
Electricity	0	0	1	100	1	50
Charcoal	1	100	0	0	1	50

* No of pre-schools indicating that they use one type of energy source for heating – note that only 8 pre-schools in Soshanguve and 13 in Pta East indicated that they heat the interior at all.
** No of pre-schools indicating that they use more than one type of energy source for heating

Table 12. Distribution of types of building materials

Building material	Soshanguve		Pretoria East		Total	
	N	% of 30	N	% of 24	N	% of 54
Main floor material indoors						
Cement	19	63	2	8	21	39
Carpet	30	100	22	92	52	96
Tiles	2	7	21	88	23	43
Other*	1	3	1	4	2	4
Main building material of pre-school						
Bricks	8	27	16	67	24	44
Facebrick	7	23	14	58	21	39
Corrugated iron	17	57	1	4	18	33
Wood	6	20	0	0	6	11

* includes blankets on carpet, wood
Note: More than one type of material was indicated at some pre-schools

Table 13. Number of rooms that 5-y olds normally play in

No of rooms	Soshanguve		Pretoria East		Total	
	N	% of 30	N	% of 24	N	% of 54
1	24	80	11	46	35	64
2	6	20	10	42	16	30
3	0	0	2	8	2	4
4	0	0	1	4	1	2
Total	30	100	24	100	54	100

Table14. Characteristics of surface area of areas indoors and outdoors in which 5-year olds spend most of their time

Variables	Soshanguve			Pretoria East		
	Mean	SD	Median [a]	Mean	SD	Median [a]
Indoor areas						
Tot area of 5-y playroom	28.3	14.3	25.4	69.5	48.1	51.4
Surface area of 5-y room (m^2)/child	3.3	2.4	2.7	4.2	4.4	2.5
No of children/m^2 of playroom	0.4	0.3	NA	0.4	0.2	NA
Outdoor areas						
Tot area of playground (m^2)	381.8	406.3	264.3	888.6	805.5	714
Playground area (m^2)/child	42.7	56.9	27.8	48.7	40.8	31.4
No of children/m^2 of playground	0.4	0.3	NA	0.4	0.2	NA

a median included in cases where the distribution is skew, ie where median and mean not the same

NA Not applicable – mean and median exactly the same

Table 15. Distribution of types of materials of the playground that 5-year olds mainly play on

	Soshanguve		Pretoria East		Total	
Playground material	N	%	N	%	N	%
Sand	12	40	3	13	15	28
Sand & lawn	5	17	4	17	9	17
Cement	5	17	2	8	7	13
Lawn	1	3	6	24	7	13
Cement/sand/lawn	2	7	4	17	6	11
Sand & cement	3	10	2	8	5	9
Cement & lawn	1	3	3	13	4	7
Cement/sand/lawn/carpet	1	3	0	0	1	2
Total	30	100	24	100	54	100

Table 16a. Road and traffic parameters by area

Characteristic	Soshanguve	Pretoria East	Total	
	N	N	N	%
Non-tarred road	27	1	28	52%
Traffic light/stop street near pre-school	14	17	31	54%
No of pre-schools near busy road	3	13	16	30%

Table 16b. Motor vehicle counts in two areas

Variables	Soshanguve			Pretoria East			p-value
	Mean	SD	Median[c]	Mean	SD	Median[c]	
Total traffic counts [a]	66.3	105.8	21.5	421.1	418.7	274	<0.001
Dist of traffic count road from pre-school fence (m) [b]	25.3	32.2	6	18.0	24.0	10	0.365

a The max traffic count in Soshanguve was 458 and the maximum in Pretoria East was 1283.
b The maximum distance of a road where traffic counts were taken from the pre-school fence was 147 m in Soshanguve and 94 m in Pretoria East.
c The median was included since the distribution is skew

Table 17. Meteorological conditions on the survey day

Characteristic	Response rate (%)	Soshanguve		Pretoria East		Total	
		N	%	N	%	N	%
Wind blew on day of survey	100	22	73	11	46	33	61
Wind blew whole day	72	13	50	7	54	20	51
Indicated as being cold day	100	18	60	16	67	34	63
Children outdoors less than normal on account of weather	74	11	46	4	25	15	38

Table 18. Time-activity parameters for the two areas (in minutes, unless indicated otherwise)

Variables	Soshanguve			Pretoria East			p-value
	Mean	SD	Median [d]	Mean	SD	Median [d]	
Duration indoors	319.0	100.7	337.5	310.9	73.6	315.0	0.510
Duration indoors of 5y olds attending >=6 h	338.0	89.1	347.5	310.1	75.6	315	0.034
Duration outdoors	128.2	79.0	120	180.9	82.1	191.3	<0.001
Duration outdoors of 5y olds attending >=6h	122.7	77.1	112.5	185.1	76.2	195.0	<0.001
Duration of high activity levels[a]	97.6	42.7	NA	131.7	64.6	142.5	<0.001
Duration high activity of 5-y olds attending >=6 h	99.4	45.5	95.0	135.2	64.3	142.5	<0.001
Duration of medium activity levels[b]	216.9	61.0	217.5	205.6	53.1	205.0	0.154
Duration medium activity of 5y olds attending >=6 h	226.1	63.4	225.0	199.5	51.7	202.5	0.004
Duration of low activity levels[c]	132.3	51.4	135.0	154.6	62.3	157.5	0.005
Duration low activity of 5y olds attending >=6 h	134.3	44.8	135.0	160.7	61.0	165.0	0.002
Duration observed on survey day	447.2	60.1	453.0	491.8	67.8	512.5	<0.001
Duration observing 5y olds attending >=6 h	460.7	51.8	465.0	495.2	61.4	513	<0.001
Duration of stay on survey day (h)	7.6	1.0	7.7	8.4	1.2	8.8	<0.001
Duration of stay of 5y olds attending >=6 h	7.8	0.9	NA	8.5	1.1	8.8	<0.001
% of 5y olds attending >= 6h (%of tot no observed)	85/119=71%			77/96=80%			-

a-c Criteria for deciding on these activity levels are indicated in Appendix E.
d Median included to indicate skewness of distribution, NA indicated where median and mean were the same

Table 19. Distribution of pollutant concentrations in the two areas

Variables	No of observations/area	Soshanguve			Pretoria East			p-value
		Mean	SD	Median	Mean	SD	Median	
Lead concentrations in air (ug/m^3)								
SA 1-month guideline: 2.5 µg/m^3 *WHO 1-year guideline: 0.5 µg/m^3*								
Pb indoors (TSP)	S: 30 PE: 24	0.076	0.081	0.042	0.091	0.115	0.072	0.583
Pb outdoors (TSP)	S: 30 PE: 24	0.098	0.166	0.024	0.145	0.168	0.074	0.015
Pb outdoors RSP	S: 30 PE: 24	0.098	0.076	0.041	0.200	0.302	0.074	0.122
Lead concentrations in surface dust (µg/m^2)								
USEPA & HUD: 1000 µg/m^2 [60]								
Floor surface indoors	S: 27: PE: 20	87.8	88.2	57.2	51.7	62.1	31.3	0.127
Window sill	S: 13: PE: 21	558.2	580.0	262.7	100.1	129.8	56.1	0.004
Other object indoors eg book case, table	S: 22: PE: 18	120.0	150.2	43.8	40.7	43.7	27.0	0.043
Other surface(1)	S: 13: PE: 4	177.5	170.0	128.3	93.2	117.3	47.4	0.374
Other surface (2)	S: 3: PE: 1	118.0	143.0	60.7	87.8	-	87.8	NA
Avg lead in surface dust[1]		173.1	136.7	139.7	64.2	54.1	50.2	0.005
Lead concentrations in surface soil (µg/g soil)								
Dutch soil investigation criteria: 300 µg/g [71]								
Location near the gate near traffic	S: 28: PE: 22	22.4	23.8	14.1	15.5	14.0	9.8	0.233
Location in sandpit	S: 12: PE: 22	5.5	2.9	4.4	1.5	1.2	0.9	0.000
Other location (1)	S: 19: PE: 21	9.3	5.8	8.2	4.4	3.9	2.7	0.003
Other location (2)	S: 14: PE: 4	8.0	10.6	4.2	4.8	6.2	3.0	0.579
Avg lead in surface soil[1]		17.7	13.3	10.6	6.9	4.9	5.2	0.010

S=Soshanguve PE=Pretoria East

1 Represents avg of different samples taken at each location

Table 20. Exposure in the two areas (indicated in µg/m^3 * h)

Exposure	Soshanguve			Pretoria East			
	Mean	SD	Median	Mean	SD	Median	p-value
Individual level exposure							
n	119			96			
Exposure indoors	0.424	0.457	0.233	0.471	0.518	0.374	0.481
Exposure indoors of 5-y olds attending >=6 h	0.476	0.468	0.278	0.508	0.543	0.394	0.694
Exposure outdoors	0.143	0.261	0.045	0.456	0.530	0.245	<0.001
Exp outdoors of 5-y olds attending >=6 h	0.161	0.274	0.057	0.473	0.512	0.268	<0.001
Sum of indoor & outdoor exposure	0.567	0.575	0.352	0.926	0.818	0.686	<0.001
Sum of indoor & outdoor exposure of 5-y olds attending >=6 h	0.638	0.567	0.382	0.981	0.828	0.791	0.002
Pre-school level exposure							
n	30			24			
Mean exposure at pre-school on survey day	0.569	0.577	0.372	0.926	0.810	0.665	0.037*
Mean exposure at pre-school of 5-y olds attending >=6 h	0.576	0.576	0.373	0.930	0.806	0.690	0.030*

Table 21 is included in the results section (p76).

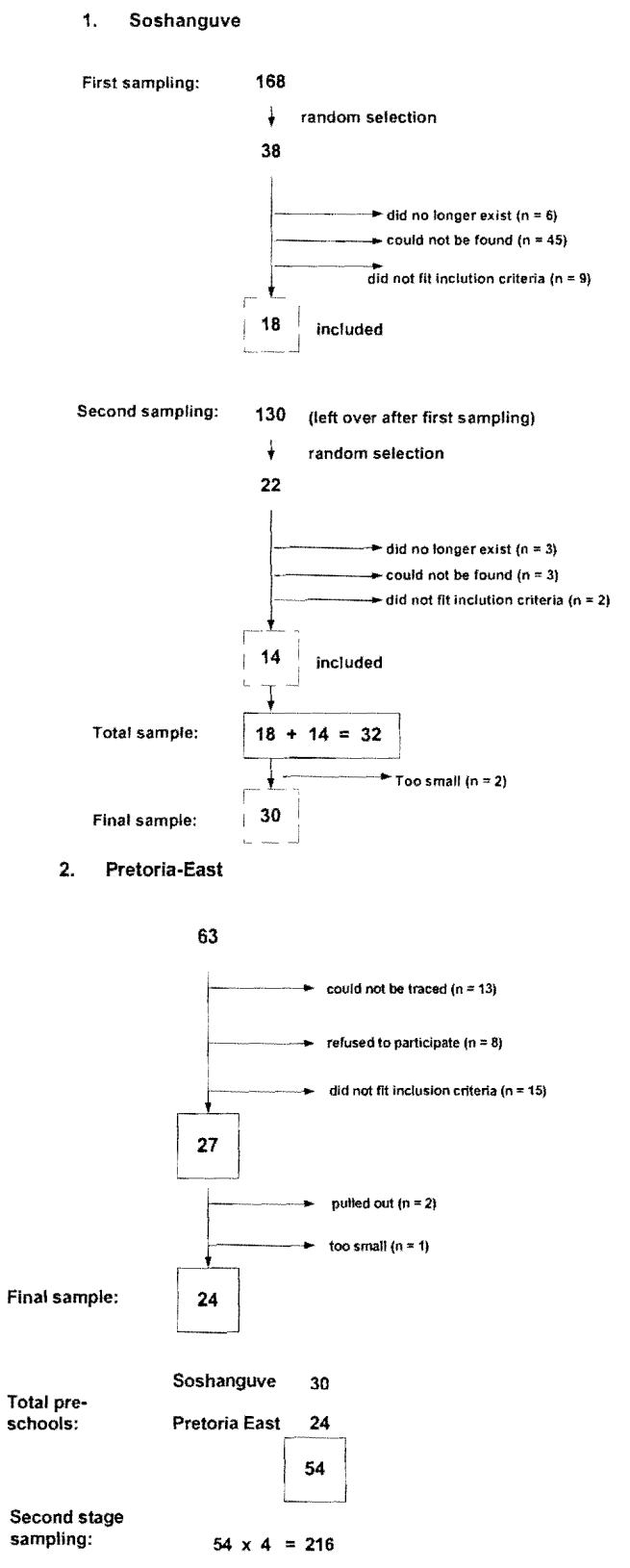


Figure 4. Diagram outlining the selection process in the two areas

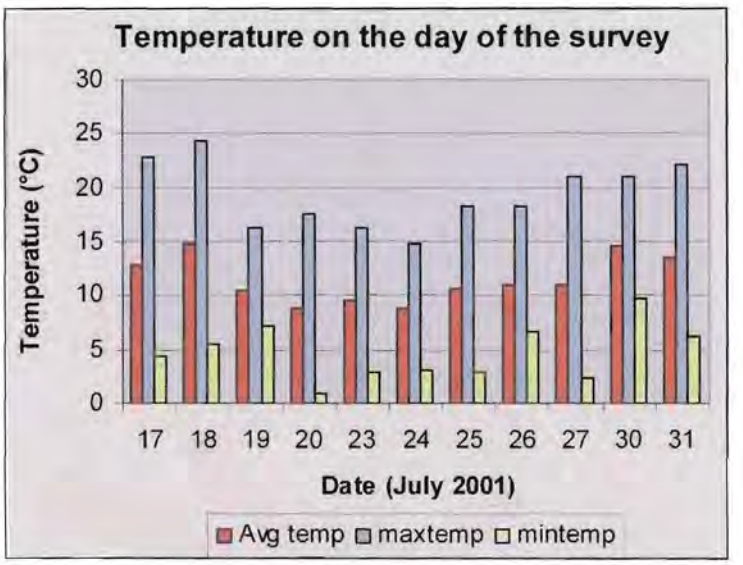


Figure 5. Temperature distribution on the various survey days (Source: SA Weather Service)

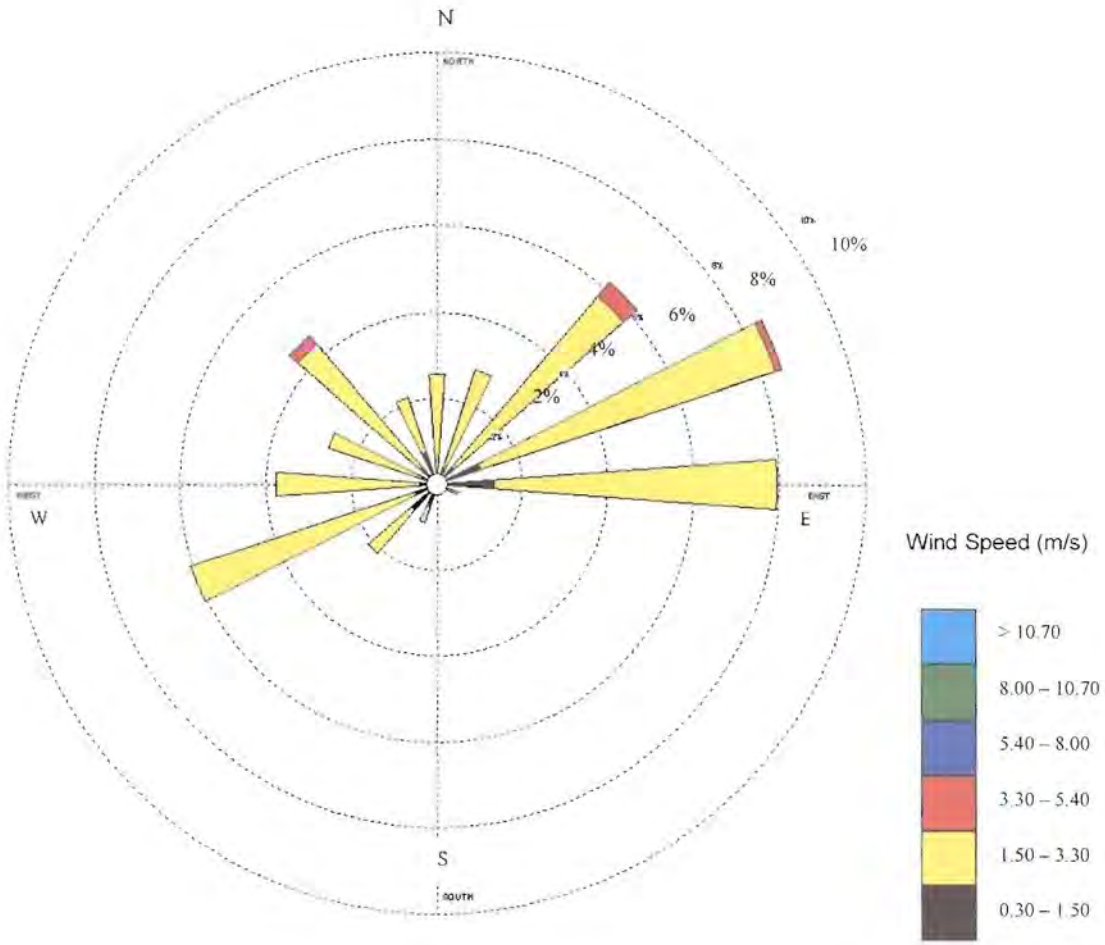


Figure 6. Wind rose indicating prevailing wind direction in July 2001 (Source: SA Weather service)

Figures 7 and 8 are in the results section (p71, 72).

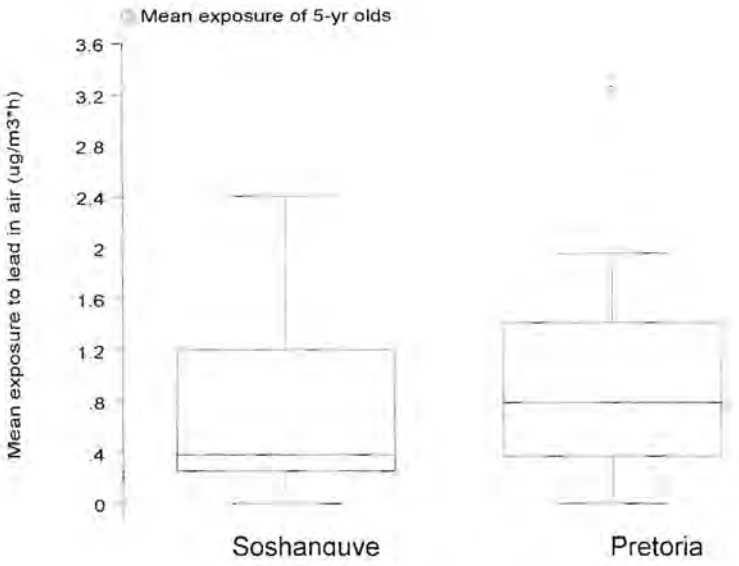


Figure 9. Box and whisker plot indicating distribution of mean exposure at pre-schools in (a) Soshanguve and (b) Pretoria East

Figure 10 is in the results section (p73).

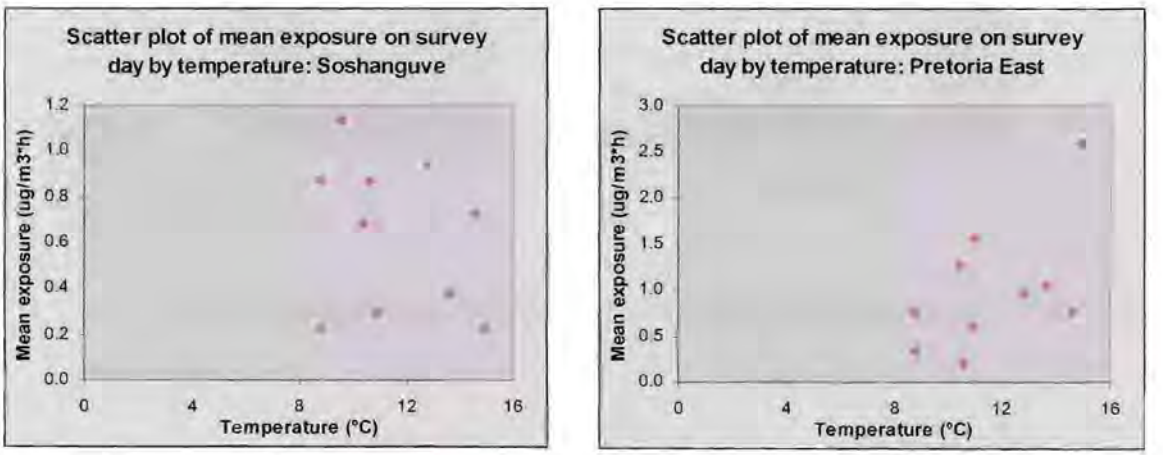


Figure 11. Scatter plot of mean exposure on the survey day by average temperature on the particular day for the two areas under consideration

Graphs illustrating 1) the exposure and 2) the log transformed exposure in Soshanguve and Pretoria East respectively, with the normal curve overlaid

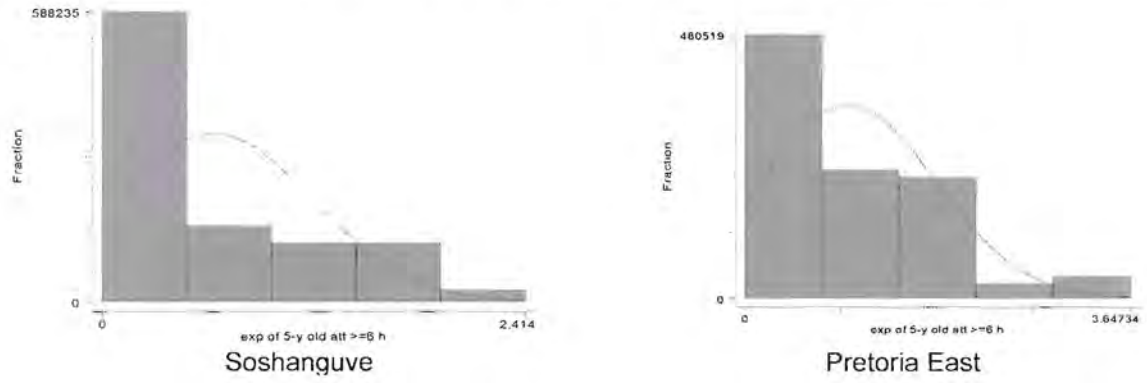


Figure 12a. Total exposure of individuals by area

Figure 12b. Log transformed total exposure of individuals by area

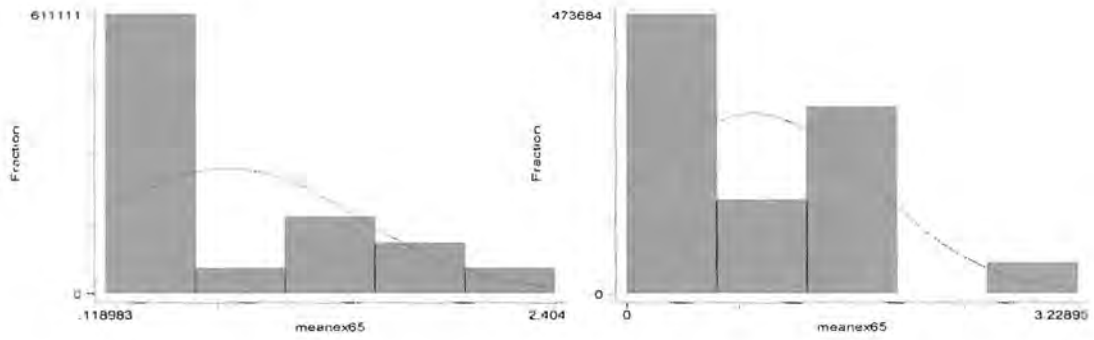


Figure 12c. Mean exposure at pre-schools by area

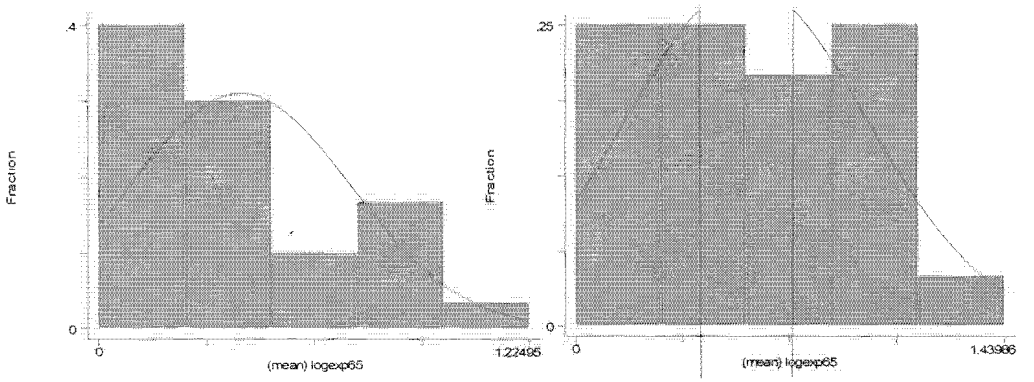


Figure 12d. Mean of logexposure at pre-schools by area

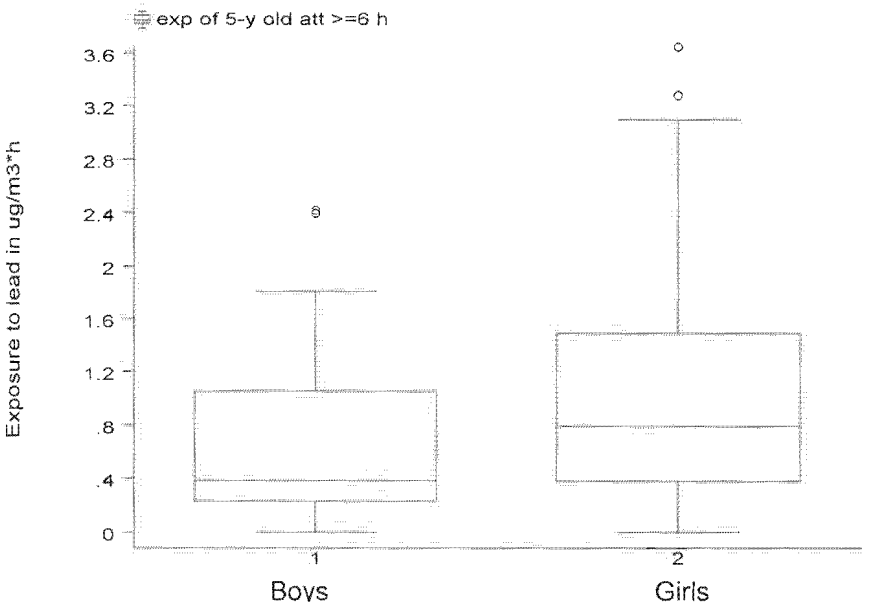


Figure 13. Box plot indicating the distribution of exposure by gender

APPENDIX R. STATA DATA OUTPUTS

Section 4.2

An Analysis of Variance (ANOVA) to determine the variability of exposure between pre-schools (using individual data)

```
. oneway extot6h5 qesno
                        Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      80.9698455      53   1.52773293     56.73      0.0000
 Within groups      2.90830532     108   .026928753
------------------------------------------------------------------------
    Total           83.8781508     161   .520982303
Bartlett's test for equal variances: chi2(43) = 228.8976  Prob>chi2 = 0.000
```

An ANOVA of the log transformed exposure variable was conducted, overall and by area (on individual data).

```
. oneway logexp65 qesno
                        Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      20.8280644      53   .392982347     84.83      0.0000
 Within groups      .500343073     108   .004632806
------------------------------------------------------------------------
    Total           21.3284075     161    .13247458
Bartlett's test for equal variances: chi2(43) = 166.3914  Prob>chi2 = 0.000
```

```
. by area: oneway logexp65 qesno
 -> area=       1
                        Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      8.01240322      29   .276289766    233.48      0.0000
 Within groups      .065083975      55   .001183345
------------------------------------------------------------------------
    Total            8.0774872      84   .096160562
Bartlett's test for equal variances: chi2(21) =  36.1339  Prob>chi2 = 0.021
Note: Bartlett's test performed on cells with positive variance:
      8 single-observation cells not used

-> area=       2
                        Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      11.7716787      23   .511812119     62.32      0.0000
 Within groups      .435259098      53   .008212436
------------------------------------------------------------------------
    Total           12.2069378      76   .160617603
Bartlett's test for equal variances: chi2(21) =  90.8330  Prob>chi2 = 0.000
Note: Bartlett's test performed on cells with positive variance:
```

Kruskall-Wallis oneway Anova by ranks used to test results found in the ANOVA above

```
kwallis logexp65, by (area)

Test: Equality of populations (Kruskal-Wallis Test)
    area          _Obs    _RankSum
       1            85     6167.00
       2            77     7036.00

chi-squared =     6.506 with 1 d.f.
probability =     0.0108
```

An Analysis of Variance (ANOVA) to determine whether there is a difference between the two areas, using individual exposure data

```
. oneway  logexp65 area, tabu (individual level data)
           |          Summary of logexp65
      area |        Mean   Std. Dev.       Freq.
-----------+------------------------------------
         1 |   .44230875   .31009767
         2 |   .60305812   .40077126          77
-----------+------------------------------------
     Total |   .51871432   .36397058         162
                      Analysis of Variance
    Source              SS         df      MS             F      Prob > F
------------------------------------------------------------------------
Between groups      1.04398242       1   1.04398242      8.23      0.0047
 Within groups       20.284425     160   .126777656
------------------------------------------------------------------------
    Total           21.3284075     161    .13247458
Bartlett's test for equal variances:  chi2(1) =   5.2053  Prob>chi2 = 0.023
```

An ANOVA done to determine whether the mean_exposure differed between boys and girls

```
. oneway logexp65 gender, tabu
           |          Summary of logexp65
     gender |        Mean   Std. Dev.       Freq.
-----------+------------------------------------
         1 |     .528924   .36445401          82
         2 |   .50824939    .3654741          80
-----------+------------------------------------
     Total |   .51871432   .36397058         162
                      Analysis of Variance
    Source              SS         df      MS             F      Prob > F
------------------------------------------------------------------------
Between groups       .01730865       1    .01730865      0.13      0.7190
 Within groups      21.3110988     160   .133194368
    Total           21.3284075     161    .13247458
Bartlett's test for equal variances:  chi2(1) =   0.0006  Prob>chi2 = 0.980
```

A regression model to determine the effect on mean log exposure and the duration of high activity after adjusting for area

```
. xi: regress logexp65 durhigh i.area (individual level data)
i.area                  Iarea_1-2    (naturally coded; Iarea_1 omitted)
  Source |       SS       df       MS                  Number of obs =     162
---------+------------------------------                F(  2,   159) =    4.44
   Model |   1.1279116     2  .563955801                Prob > F      =  0.0133
Residual |  20.2004958   159  .127047144                R-squared     =  0.0529
---------+------------------------------                Adj R-squared =  0.0410
   Total |  21.3284075   161   .13247458                Root MSE      =  .35644
------------------------------------------------------------------------------
logexp65 |      Coef.  Std. Err.      t    P>|t|     [95% Conf. Interval]
---------+--------------------------------------------------------------------
 durhigh |   .0004146  .0005101     0.813  0.418     -.0005929    .0014221
 Iarea_2 |   .1459298  .0589668     2.475  0.014      .0294706     .262389
   _cons |   .4010727   .063786     6.288  0.000      .2750957    .5270498
```

A t-test do determine whether gender affect the mean time spent by children indoors and outdoors respectively

```
. ttest durin5y6, by ( gender)
Two-sample t test with equal variances
------------------------------------------------------------------------------
--
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       1 |      82    319.4146    8.566788    77.57556    302.3694    336.4599
       2 |      80    330.1938    10.06318    90.00786    310.1635     350.224
---------+--------------------------------------------------------------------
combined |     162    324.7377    6.588488    83.85777    311.7267    337.7487
---------+--------------------------------------------------------------------
    diff |           -10.77912     13.1916               -36.83123     15.273
------------------------------------------------------------------------------
Degrees of freedom: 160
                     Ho: mean(1) - mean(2) = diff = 0
     Ha: diff < 0                 Ha: diff ~= 0                 Ha: diff > 0
       t =  -0.8171                 t =  -0.8171                  t =  -0.8171
   P < t =   0.2075           P > |t| =   0.4151           P > t =   0.7925
. ttest durout56, by ( gender)
Two-sample t test with equal variances
------------------------------------------------------------------------------
--
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf.
Interval]
---------+--------------------------------------------------------------------
--
       1 |      82    155.6768    8.731277    79.06508    138.3043    173.0493
       2 |      80    149.0063    9.668261    86.47556    129.7621    168.2504
---------+--------------------------------------------------------------------
combined |     162    152.3827    6.491014    82.61712    139.5642    165.2012
---------+--------------------------------------------------------------------
    diff |           6.670579    13.01284               -19.02851    32.36967
Degrees of freedom: 160
                     Ho: mean(1) - mean(2) = diff = 0
     Ha: diff < 0                 Ha: diff ~= 0                 Ha: diff > 0
       t =   0.5126                 t =   0.5126                  t =   0.5126
   P < t =   0.6955           P > |t| =   0.6089           P > t =   0.3045
```

Section 4.3

Determination of association between mean log exposure and surface dust levels in soil, by area

```
sort area

. by area: regress  logexp65 pbs3

-> area=         0
  Source |       SS       df       MS              Number of obs =      19
---------+------------------------------           F(  1,    17) =    0.70
   Model |  .036355904     1  .036355904            Prob > F      =  0.4154
Residual |    .8868983    17  .052170488            R-squared     =  0.0394
---------+------------------------------           Adj R-squared = -0.0171
   Total |  .923254204    18    .0512919            Root MSE      =  .22841

------------------------------------------------------------------------------
--
logexp65 |      Coef.   Std. Err.       t    P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
    pbs3 |  .0077861   .0093271     0.835   0.415      -.0118924    .0274647
   _cons |  .2627818   .1010027     2.602   0.019       .0496847    .4758789
------------------------------------------------------------------------------

-> area=         1
  Source |       SS       df       MS              Number of obs =      21
---------+------------------------------           F(  1,    19) =   14.67
   Model |  1.3943905     1   1.3943905            Prob > F      =  0.0011
Residual |  1.80583453    19  .095043923            R-squared     =  0.4357
---------+------------------------------           Adj R-squared =  0.4060
   Total |  3.20022503    20  .160011252            Root MSE      =  .30829

------------------------------------------------------------------------------
logexp65 |      Coef.   Std. Err.       t    P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
    pbs3 |  .0679927   .0177514     3.830   0.001       .0308386    .1051468
   _cons |  .2727029   .1027892     2.653   0.016       .0575626    .4878431
------------------------------------------------------------------------------
```

Final regression model run to determine factors associated with mean log exposure

```
. xi: regress  logexp65 i.area pay nochldd num5y  i.cookapp i.surfplay pboutrsp
i.strslpe  traftot  durhigh  durlow  totwin5y  i.loctyprd   srf5yout  chlpsrin  [fw
eight=numelg]
i.area                Iarea_0-1     (naturally coded; Iarea_0 omitted)
i.cookapp             Icooka_1-3    (naturally coded; Icooka_1 omitted)
i.surfplay            Isurfp_1-7    (naturally coded; Isurfp_1 omitted)
i.strslpe             Istrsl_0-1    (naturally coded; Istrsl_0 omitted)
i.loctyprd            Ilocty_0-1    (naturally coded; Ilocty_0 omitted)

  Source |       SS       df       MS                    Number of obs =     145
---------+------------------------------                 F( 21,   123) =   15.12
   Model |  13.4322725    21  .639632022                 Prob > F      =  0.0000
Residual |   5.2038064   123  .042307369                 R-squared     =  0.7208
---------+------------------------------                 Adj R-squared =  0.6731
   Total |  18.6360789   144  .129417214                 Root MSE      =  .20569

------------------------------------------------------------------------------
logexp65 |      Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
 Iarea_1 |  -.8907638   .2028388     -4.391   0.000      -1.292271   -.4892569
     pay |   .0015129   .0004092      3.698   0.000       .000703    .0023228
 nochldd |  -.0048141   .0005854     -8.224   0.000      -.0059728   -.0036554
   num5y |   .0150706   .0038102      3.955   0.000       .0075285    .0226128
Icooka_2 |  -.1920184   .0660477     -2.907   0.004      -.3227557   -.0612811
Icooka_3 |  -.2357809   .0795768     -2.963   0.004      -.3932983   -.0782636
Isurfp_2 |   .0570615   .0800146      0.713   0.477      -.1013225    .2154454
Isurfp_3 |   .2960821   .0741684      3.992   0.000       .1492704    .4428939
Isurfp_4 |    .429131   .0890921      4.817   0.000       .2527787    .6054832
Isurfp_5 |    .197701   .0522125      3.786   0.000       .0943495    .3010525
Isurfp_6 |   .1284587   .0954256      1.346   0.181      -.0604304    .3173478
Isurfp_7 |   .2784777   .0764847      3.641   0.000       .1270809    .4298745
pboutrsp |   .7646692   .1126157      6.790   0.000       .5417534    .9875851
Istrsl_1 |    .247276    .043197      5.724   0.000       .1617702    .3327818
 traftot |  -.0004865   .0001454     -3.346   0.001      -.0007743   -.0001987
 durhigh |   .0018309   .0004142      4.421   0.000       .0010111    .0026507
  durlow |   .0017671   .0003731      4.736   0.000       .0010285    .0025056
totwin5y |   .0244363   .0110134      2.219   0.028       .0026359    .0462367
Ilocty_1 |  -.7512964   .0843079     -8.911   0.000      -.9181787   -.5844141
srf5yout |  -.3076797    .117096     -2.628   0.010      -.5394641   -.0758954
chlpsrin |   -.014495    .006775     -2.139   0.034      -.0279058   -.0010843
    cons |   .3390737   .1345764      2.520   0.013       .072688    .6054595
```

Stata data used to test the selected regression model

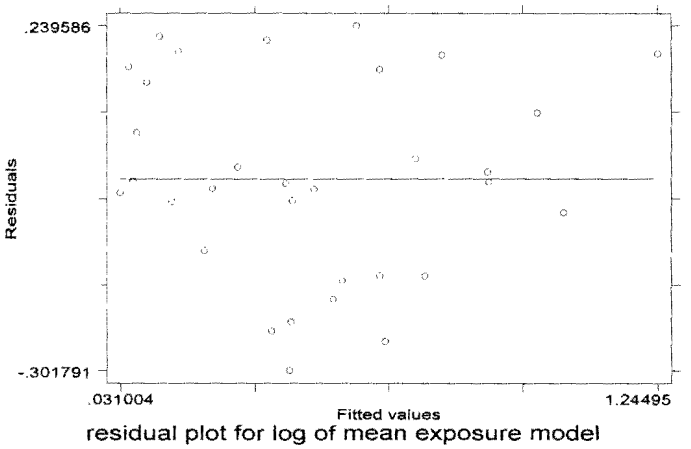
Section 4.4

In order to determine the validity of assumptions made in fitting this model, including the fact that deviations are assumed to be a) independent and b) normally distributed with mean 0 and constant variance, residuals of the dependent variable (mean exposure) were determined. This procedure also tested for homogeneity of variance.

After fitting model (excluding logexp65=0):

```
. xi: regress logexp65 i.area pay nochldd num5y normtch i.onecook
i.cookplce i.kitsepar i.bricks pboutrsp tspin pbs3 i.srcpol i.strslpe
traftot totwin5y durhigh durlow i.loctyprd srf5yout chpsrout chlpsrin
[fweight=numelg] if logexp65 >0
```

A plot of residuals against fitted values lead to the following graph:



residual plot for log of mean exposure model

```
rvfplot, border yline(0) ti("residual plot for log of mean exposure model")
```

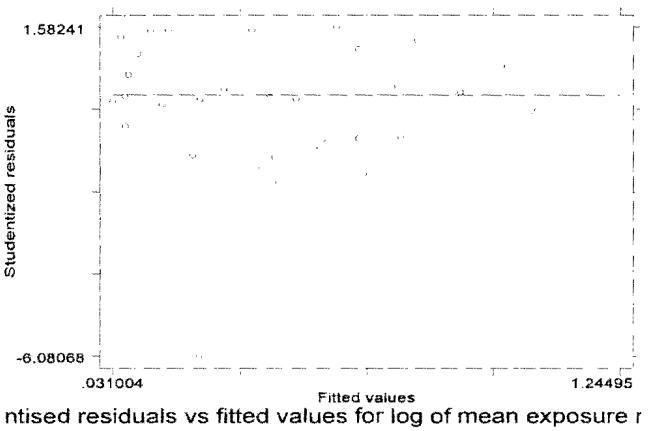
A test was also done to see whether there are any **omitted variables** in the regression model, ie whether the model can be improved by adding extra variables.

```
. ovtest
Ramsey RESET test using powers of the fitted values of logexp65
       Ho:  model has no omitted variables
                  F(3, 78) =     33.17
                  Prob > F =      0.0000
```

Homogeneity of variance

To test homogeneity of variance, the residuals were plotted against the fitted values.

```
predict exphat
(option xb assumed; fitted values)
(20 missing values generated)
predict stures, rstu
(20 missing values generated)
graph stures exphat, border yline(0) ti("studentised residuals vs fitted
values for log of mean exposure model")
```



ntised residuals vs fitted values for log of mean exposure r

Heterogeneity of variance

A test was subsequently conducted to test for heterogeneity of variance (non-constant variance).

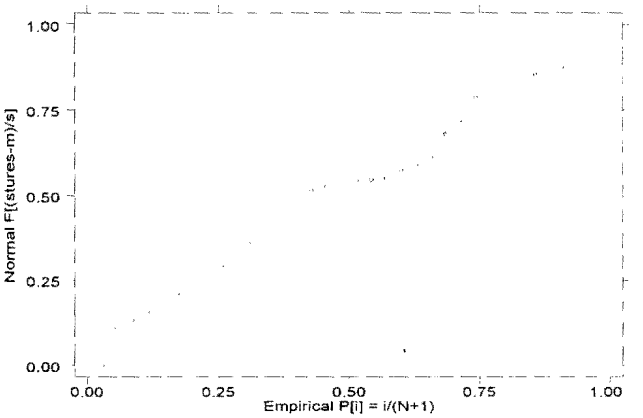
```
. hettest

Cook-Weisberg test for heteroscedasticity using fitted values of logexp65
     Ho: Constant variance
         chi2(1)      =      0.07
         Prob > chi2  =      0.7855
```

Testing For Normality

The test for normality was done by doing a normal probability plot which plotted the cumulative distribution of the residuals against the cumulative distribution of a standard normal variable.

```
. pnorm stures, gap(5)
```



7. REFERENCES

1 Van Leeuwen CJ, Hermens JLM, editors. Risk Assessment of Chemicals: An introduction. Dordrecht: Kluver Academic Publishers, 1995.

2 Guidelines for the gravimetric sampling of airborne particulates for risk assessment in terms of the occupational diseases in Mines and Works Act no 78 of 1973, Department of Mineral and Energy Affairs, 1973.

3 South African Weather Service. [Homepage of SA Weather Bureau]. Available from: http://www.weathersa.co.za

4 Wagener DK, Selevan SG, Sexton K. The importance of human exposure information: A need for exposure-related databases to protect and promote public health. *Annual Reviews in Public Health* 1995; **16**:105-121.

5 World Health Organisation. Health and Environment in sustainable development: Five years after the earth summit. Executive summary. [online] 1997 [cited 2000 29 Aug]. Available from: http://www.who.int/environmental_information/Information_resources/htmdocs/execsum.htm

6 Briggs D, Corbalan C, Nurminen M, editors. Linkage methods for environment and health analysis. General guidelines. Geneva: World Health Organisation; 1996.

7 Graham J, Walker KD, Berry M, Bryan EF, Callahan MA, Fan A, *et al.* Role of exposure databases in risk assessment. *Archives of Environmental Health* 1992; **47**(6):408-420.

8 American Chemical Society. 1998. *Understanding Risk Analysis: A short guide for Health, Safety and Environmental Policy Making,* USA.

9 Sexton K, Selevan SG, Wagener DK, Lybarger JA. Estimating human exposure to environmental pollutants: availability and utility of existing databases. *Archives of Environmental Health* 1992 **47**(6):398-407.

10 Vostal JJ. Physiologically based assessment of human exposure to urban air pollutants and its significance for public health risk evaluation. *Environmental Health Perspectives* 1994; **102**(4):101-106.

11 Isselbacher KR, Upton AC, Bailar JC, Bischoff KB, Bogen KT, Braumann JI, *et al.*, editors. Science and Judgement. Washington DC:National Academy Press; 1994.

12 Bruce N, Perez-Padilla R, Albalak R. Indoor air pollution in developing countries: a major environmental and public health challenge. *Bulletin of the World Health Organisation* 2000; **78**(9):1078-1092.

13 Hatch M, Thomas D. Measurement issues in environmental epidemiology. *Environmental Health Perspectives* 1993; **101**(4):49-57.

14 Katzenellenbogen JM, Joubert G, Abdool Karim SS, editors. Epidemiology: A manual for South Africa. 2nd ed. Cape Town: Oxford University Press; 1997.

15 Pershagen G. Lifetime activity patterns and assessment of long-term exposure. Air Pollution Epidemiology Report Series; Brussels;1995. Report no 6, EUR 15892 EN.

16 Landrigan PJ, Carlson, JE, Bearer CF, Cranmer JS, Bullard RD, Etzel RA. Children's health and the environment: A new agenda for prevention research. *Environmental Health Perspectives* 1998; **106**(3):1-14.

17 Lebowitz MD. Exposure assessment needs in studies of acute health effects. *The Science of the Total Environment* 1995; **168**:109-117.

18 Weaver VM, Buckley TJ, Groopman JD. Approaches to Environmental Exposure Assessment in Children. *Environmental Health Perspectives* 1998; **106**(3):827-832.

19 Reisman DJ, Brady-Roberts E. An overview of the US EPA's multiple pathway exposure methodology. *Waste Management* 1998; **18**:371-376.

20 Armstrong TW, Hushka LJ, Tell JG, Zaleski RT. A tiered approach for assessing children's exposure. *Environmental Health Perspectives* 2000;**108**(6):469-474.

21 World Health Organisation. Methodology for assessment of exposure to environmental factors in application to epidemiological studies. *The Science of the Total Environment* 1995; **168**:93-100.

22 Walsh S, Beer T. A new methodology for the assessment of exposure to ambient air pollution in Australia. Proceedings of the 14th International Clean Air and Environment Conference; 1998; Melbourne, Australia.

23 Dearry AD, Collman GW, Saint C, Fields N, Redd S. Building a network of research in children's environmental health. *Environmental Health Perspectives* 1999; **107**(3):391-392.

24 Anastopoulou A, Sarafidou E, Katsouyanni K, Nakou S. Assessment of short-term time-activities in children admitted to hospital for acute respiratory problems. Air Pollution Epidemiology Report Series. Brussels; 1995. Report no 6, EUR 15892 EN.

25 Goldman LR. Children – unique and vulnerable environmental risks facing children and recommendations for response, *Environmental Health Perspectives* 1995; **103**(6):13-18.

26 Cohen Hubal EA, Sheldon LS, Burke JM, McCurdy TR, Berry MR, Rigas ML, Zartarian VG, Freeman NCG. Children's exposure assessment: A review of factors influencing children's exposure and the data available to characterise and assess that exposure. *Environmental Health Perspectives* 2000; **108**(6):475-486.

27 Faustman EM, Silbernagel SM, Fenske RA, Burbacher TMK, Ponce, RA. Mechanisms underlying children's susceptibility to environmental toxicants. *Environmental Health Perspectives* 2000; **108**(1):13-21.

28 World Health Organisation. Children's environmental health: an issue of great concern [online] 2000 [cited 2000 Nov 15]. Available from: http://www.who.int/peh/child/index.html

29 Bearer CF. How are children different from adults? *Environmental Health Perspectives* 1995; **103**(6): 7-12.

30 Plopper CG, Fanucchi MV. Do urban pollutants exacerbated childhood lung diseases? *Environmental Health Perspectives* 2000; **108**(6).

31 Mukerjee D. Assessment of risk from multimedia exposures of children to environmental chemicals. *Journal of the Air and Waste Management Association* 1998; **48**:483-501.

32 Opperman L, Terblanche APS, Nel CME, Nyikos H. Personal monitoring of total suspended particulate matter in the Vaal Triangle. *Proceedings of NACA Conference: Air Pollution and the Environment;* 1991; Durban, South Africa.

33 Terblanche APS. Environmental health aspects of lead. Unleaded petrol seminar. *SA Instit. Mech. Eng* 1993.

34 English P, Neutra R, Scalf R, Sullivan M, Waller L, Zhu L. Examining Associations between Childhood Asthma and Traffic Flow Using a Geographic Information System. *Environmental Health Perspectives* 1999; **107**(9):761-767.

35 Guillette EA. Examining childhood development in contaminated urban settings. *Environmental Health Perspectives* 2000; **108(**3):389-393.

36 Alm S, Mukala K, Pasanen P, Tiittahen P, Ruuskanen J, Tuomisto J, et al. Personal NO_2 exposures of preschool children in Helsinki. *Journal of Exposure Analysis and Environmental Epidemiology* 1998; **8**(1):79-100.

37 Brunekreef B, Hoek G, Janssen N. Time-activity patterns in air pollution epidemiology. Air Pollution Epidemiology Report Series; Brussels; 1995. Report no 6, EUR 15892 EN.

38 Sharma S, Sethi GR, Rohtagi A. Indoor air quality and acute lower respiratory infection in Indian urban slums. *Environmental Health Perspectives* 1998, **106**(5)291-297.

39 Rice AL, Sacco L, Hyder A, Black RE. Malnutrition as an underlying cause of childhood deaths associated with infectious disesases in developing countries. *Bulletin of the World Health Organisation* 2000; **78**(10):1207-1221.

40 Sram RJ. Editorial: Impact of air pollution on reproductive health. *Environmental Health Perspectives* 1999; **107**(11):A542-A543.

41 Bruce N. Lowering exposure of children to indoor air pollution to prevent ARI: The need for information and action. *Capsule Report,* number 3; 1999 Jan [cited 2002 March 19]. Available from: http://www.ehproject.org/Pubs/Capsule.htm.

42 Aunan K. Exposure-response functions for health effects of air pollutants based on epidemiological findings. Center for International Climate and Environmental Research. University of Oslo; 1995. Report 1995:8.

43 Bruce N. Indoor air pollution: a neglected health problem for the world's poorest communities. [serial online] 1999 June [cited 2002 March 19]. Available from: http://www.mrc.ac.za/urbanbulletin/jun99.htm

44 Wilson WE, Mage DT, Grant LD. Estimating separately personal exposure to ambient and non-ambient matter for epidemiology and risk assessment: Why and how. *Journal of Air and Waste Management Association* 2000; **50**:1167-1183.

45 Crothers C. Levels of winter smoke pollution in South Africa: Establishing a need for policy to be developed. *South African Journal of Environmental Law and Policy* 1998; **5:**141-147.

46 Janssen NAH, Hoek G, Harssema H, Brunekreef B. Childhood exposure to PM_{10} : relation between personal, classroom, and outdoor concentrations. *Occupational and Environmental Medicine* 1997; **54**:888-894.

47 Ezzati M, Saleh H, Kammen DM. The contributions of emissions and spatial micro-environments to exposure to indoor air pollution from biomass combustion in Kenya. *Environmental Health Perspectives* 2000; **108**(9):833-839.

48 How do particulates enter the respiratory system? [online] 1999 [cited 2002 March 19]. Available from: http://www.ccohs.ca/oshanswers/chemicals/how_do.html.

49 Hubbard AK. What are we breathing? The Centre for Environmental Health Newsletter [serial online] 1998 Spring [cited 2002 March 19]; **7**(1). Available from: http://www.sp.uconn.edu/~an226vc/98newsltr.htm#breathing# .

50 Parkin RT, Balbus JM. Can varying concepts of susceptibility in risk assessment affect particulate matter standards? *Journal of the Air & Waste Management Association* 2000; **50**:1417-1425.

51 Environmental Protection Agency (EPA). Air they breathe. - Office of Children's Protection [online] 2000 [cited 2002 March 19]. Available from: http://www.epa.gov/children/air.htm.

52 Levy J, Hammit J, Spengler J. Estimating the mortality impacts of particulate matter: What can be learned from between-study variability? *Environmental Health Perspectives* 2000; **108**(2): 109-117.

53 Wilson R, Spengler J, editors. Particles in our air: Concentrations and health effects. : Harvard: Harvard University Press;1996.

54 Hester RE, Harrison RM, editors. Issues in Environmental Science and Technology. Air pollution and health: Cambridge: Royal Society of Chemistry; 1998.

55 Watson JG. Critical review discussion. Ambient particles and health: Lines that divide. *Journal of the Air and Waste Management Association 1997*; **47**:995-996.

56 Abramson M, Beer T. 1998. Something particular in the air we breathe? Journal of the Australian Medical Association. MJA. 169. 452-453. http://www.mja.com.au/index.html.

57 Ebelt T, Petkau AJ, Vedal S, Fisher TV, Brauer M. Exposure of chronic obstructive pulmonary disease patients to particulate matter: relationships between personal and ambient air concentrations. *Journal of the Air & Waste Management Association* 2000. J Air & Waste Manage Assoc; **50**:1081-1094.

58 Peterson J. NIH news release: Study shows air pollution slows lung function growth in children. National Institute of Health [online] 2000. Available from: http://www.nih.gov/news/pr/oct2000/niehs-20.htm.

59 Tong STY and Lam KC. Are nursery schools and kindergartens safe for our kids? *The Science of the Total Environment* 1998; **216**:217-225.

60 Liggans GL, and Nriagu JO. Lead poisoning of children in Africa, IV: Exposure to dust lead in primary schools in south-central Durban, South Africa. *The Science of the Total Environment* 1998; **221**:117-126.

61 Gossel TA, Bricker JD. Principles of clinical toxicology, 3rd edition, New York, NY. Raven Press Ltd. Toxnet. [online] 1994. Available from: http://www.toxnet.nlm.nih.gov/cgi-bin/sis/.

62 Xintaras C. Analysis paper: Impact of lead-contaminated soil on public health. Agency for Toxic Substances and Disease Registry (ATSDR). *ATSDR Science Corner [serial online]* 1992 May [cited 2000 Aug 31]. Available from: http://www.atsdr.cdc.gov/cslead.html.

63 Mielke HW, and Reagan PL. Soil is an important pathway of human lead exposure, *Environ Health Perspect* 1998; **106**(1): 217-229.

64 Diouf A. Automobile pollution and health. Dakar, Senegal: Faculty of Medicine and Pharmacy, UCAD; 2001 April. . SSATP Urban Mobility Orientation Committee, Accra.

65 Pfafflin JR, Ziegler EN, editors. Encyclopedia of Environmental Science and Engineering. 3rd ed. Amsterdam: Gordon and Breach Science Publishers; 1992.

66 Romieu I, Carreon T, Lopez L, Palazuelos E, Rios C, Manuel Y, and Hernandez-Avila M. Environmental urban lead exposure and blood lead levels in children of Mexico City, *Environmental Health Perspectives* 1995; **103**(11):1036-1040.

67 Heinze I, Gross R, Stehle P, Dillon D. Assessment of lead exposure in school children from Jakarta, *Environmental Health Perspectives* 1998; **106**(108):499-501.

68 Nriagu JO, Blankson ML, Ocran K. Childhood lead poisoning in Africa: a growing public health problem. *The Science of the Total Environment* 1996; **181**:93-100.

69 Diab RD. A note on changes in atmospheric lead content in seven cities in South Africa, *SA Journal of Science* 1999; **95**:117-121.

70 RM Harrison, editor. Understanding our environment. An introduction to environmental chemistry and pollution. 3rd ed. Cambridge, UK: The Royal Society of Chemistry. 1999.

71 Wong JWC, and Mak NK. Heavy metal pollution in children playgrounds in Hong Kong and its health implications, *Environmental Technology* 1997; **18**:109-115.

72 Kolluru RV, editor. Environmental strategies handbook. A guide to effective policies and practices. 1st ed. New York: US:McGraw-Hill, Inc; 1993.

73 Von Schirnding YER. Environmental lead exposure among inner-city Cape Town children: A study of associated risk factors [dissertation]. University of Cape Town; 1988.

74 Nriagu J, Oleru NT, Cudjoe C, Chine A. Lead poisoning of children in Africa, II. Kaduna, Nigeria. *The Science of the Total Environment* 1997; **197**:13-19.

75 Matthee A, Von Schirnding YER. Environmental lead exposure and child health in South Africa. *Urbanisation and Health Newsletter* 1999; **2**(3):58-62. Available from: http://www.mrc.ac.za/urbanbulletin/

76 Duan, N, Mage DT. Combination of direct and indirect approaches for exposure assessment. *Journal of Exposure Analysis & Environmental Epidemiology* 1997; **7**(4):439-470.

77 Klepeis N. An Introduction to the Indirect Exposure Assessment Approach: Modeling Human Exposure Using Micro-environmental Measurements and the Recent National Human Activity Pattern Survey. *Environmental Health Perspectives* 1999; **107**(2):365-374.

78 Terblanche APS, Opperman, L. Personal exposure to total suspended particulates of dolescents living in Vanderbijlpark. *South Africa. Journal of Science* 1995; **91**:320-322.

79 Janssen NAH, Hoek G, Harssema H, Brunekreef B. Personal sampling of airborne particles: Method performance and data quality. *Journal of Exposure Assessment and Environmental Epidemiology* 1998; **8**(1):37-43.

80 Kleinman MT. The health effects of air pollution on children [online] 2000.Available from: http://www.aqmd.gov/forstudents/Kleinman_article.htm.

81 Mushak P. Uses and limits of empirical data in measuring and modeling human lead exposure. *Environmental Health Perspectives* 1998; **196**(6):1467-1484.

82 Blaurock-Busch E and Griffin V. Mineral and Trace Element analysis. TMI Incorporated, Bolder; 1996. Contact: tracemin@usa.net.

83 Chisolm and O'Hara. Lead absorption in children. Management, clinical and environmental aspects. Baltimore: Urban & Schwartzenberg; 1982.

84 Leaderer BP, Lioy PJ, Spengler JD. Assessing exposures to inhaled complex mixtures. *Environmental Health Perspectives* 1993; **101**(4):167-177.

85 Seifert B. Validity criteria for exposure assessment methods. *The Science of the Total Environment* 1995; **168**:101-107.

86 Coggon D. Questionnaire based exposure assessment methods. *The Science of the total Environment* 1995; **168**.175-178.

87 Forastiere F, Agabiti N, Dell'Orco V, Corbo GM, Pistelli R. Time activity patterns and biological indicators of exposure to ETS and carbon monoxide in children and adolescents in Central Italy. Air Pollution Epidemiology Report Series; Brussels; 1995. Report no 6, EUR 15892 EN.

88 Lebret E, Fischer P, de Hollander G. Time acitvity patterns at population level: Regional Population and subpopulation variations and their assessment. Air Pollution Epidemiology Report Series; Brussels; 1995. Report no 6, EUR 15892 EN.

89 Jantunen, MJ. Time activity monitoring by active or passive instruments. Air Pollution Epidemiology Report Series; Brussels; 1995. Report no 6, EUR 15892 EN.

90 Janssen N, Zock JP, Brunekreef B. Prospective time-activity diaries in air pollution epidemiology: Design, reliability, relationship with measured heart rates. Air Pollution Epidemiology Report Series; Brussels; 1995. Report no 6, EUR 15892 EN.

91 Schwab M, Spengler JD, Ozkaynak H, Terblanche P. The Time/Activity Component of the Kanawha County Health Study. Proceedings of the Total Exposure Assessment Method Symposium, Las Vegas, Nevada; 1989 November.

92 Terblanche APS, Nel CME, Nyikos H. Exposure to air pollution from transitional household fuels in a South African population. *Journal of Exposure Analysis and Environmental Epidemiology 1993;* **3**(1):1-8.

93 Dörre WH. Time-activity patterns of some selected small groups as a basis for exposure estimation: A methodological study. *Journal of Exposure Analysis and Environmental Epidemiology* 1997; **7**(4):471-491.

94 Levy JI, Houseman EA, Ryan L, Richardson D, Spengler JD. Particle Concentrations in urban micro-environments. *Environmental Health Perspectives* 2000; **108**(11):1051-1057.

95 Zartarian VA, Ferguson AC, Leckie JO. Quantified dermal activity data from a four-child pilot field study. *Journal of Exposure Analysis and Environmental Epidemiology* 1997; **7**(4):543-552.

96 Katsouyanni K. Assessment of time-activity patterns in exposure assessment in air pollution epidemiology: Conclusions and recommendations. Air Pollution Epidemiology Report Series; Brussels; 1995. Report no 6, EUR 15892 EN.

97 Williams ML. Monitoring of exposure to air pollution. *The Science of the Total Environment* 1995; **168**:169-174.

98 Constitution of the Republic of South Africa, 1996. (Act 108 of 1996). Available from: www.gov.za/constitution/1996/96cons.htm.

99 Zwi S, Goldman HI, Kallenbach JM, Davies JCA, Becklake MR, Reinach SG. Respiratory health status of children in the Eastern Transvaal Highveld. *South African Medical Journal* 1990; **78**:647-653.

100 Terblanche APS, Opperman L, Theron A, Reinach SG, FCA Smith, CME Nel. Health survey of adolescents living in the Vaal Triangle: Methodology and descriptive statistics. *CHASA – Journal of Comprehensive Health* 1994; **5**(3&4):41-45.

101 Coetzee AM, Smith FCA, Van der Merwe CA., Dreyer RJ. Die invloed van lugbesoedeling op gesondheid in the Sasolburg-gebied. *Suid Afrikaanse Mediese Tydskrif* 1986; **70**:339-343.

102 Govender S. Lead in air samples in the vicinity of schools in the Greater Chatsworth Area [MTech dissertation]. Durban: MS Sultan Technikon; 2000.

103 Von Schirnding, YER, Fuggle, RF and Bradshaw, D. Factors associated with elevated blood lead levels inner city Cape Town children. *South African Medical Journal* 1991; **79**:454-456.

104 Mathee A, Von Schirnding, Y, Ismail, A, and Huntley, R. Surveys of blood lead burdens among school children and newborns in Greater Johannesburg. *Urbanisation and Health Newsletter* 1996; **29**:43-49.

105 National Centre for Environmental Assessment [online] 2002 Cited [24 January 2003]. Available from: http://cfpub.epa.gov/ncea/cfm/efprog.cfm.

106 Snedecor GW, Cochran WG, editors. Statistical methods, 7th edition. Iowa State University Press, USA; 1980.

107 Gondwe M. Modelling the dispersion and chemical transformation of motor vehicle emissions in Pretoria City [MSc dissertation]. Johannesburg: University of Witwatersrand; 1997.

108 Needham LL, Sexton K. Introduction and overview: Assessing children's exposure to hazardous environmental chemicals: an overview of selected research challenges and complexities. *Journal of Exposure Analysis & Environmental Epidemiology* 2000; **10**:611-629.

109 AIRSAMPLING.COM [online] 2002 Cited [16 October 2002]. Available from: http://www.airsampling.com/index.html.

110 Chamber of Mines of South Africa. Measurements in mine environmental control, 2nd ed. p 14-21. Department of Mineral and Energy Affairs, Cape Town; 1988.

111 Evans GF, Highsmith RV, Sheldon LS, Suggs JC, Williams RW, Zweidinger RB, *et al.* The 1999 Fresno particulate matter exposure studies: Comparison of community, outdoor, and residential PM mass measurements. *Journal of Air & Waste Management Association* 2000; **50**:1887-1896.

112 Alison Geyh, Johns Hopkins School of Public Health, personal communication: e-mail: ageyh@jhsph.edu.

113 SABS method 1164-1990. South African Bureau of Standards. 'Bepaling van lood (anorganies en tetra-alkiel) in werksomgewingslug dmv atoomabsorbsie-spektrofotometrie'; 1990.

114 Thembi Mphokeng, personal communication; Tel 012-805 4797.

115 US EPA method 3050B. Acid digestion of sediments, sludges and soils. Test methods for evaluating solid waste, Physical/chemical methods. EPA Publ No SW-846. Washington, DC:US. Environmental Protection Agency; 1996.

116 National Institute for Occupational Safety and Health. Lead in Surface wipe samples. Method 9100. [online 1994 15 August] cited [2002 March 20]. Available from: http://www.cdc.gov/niosh/nmam/pdfs/9100.pdf

117 Oosthuizen, MA. Standard operating procedures for the gravimetric analysis method, CSIR Internal STEP report; 1990.

118 National Institute for Occupational Safety and Health. Lead by GFAAS. Method 7105. [online 15 August 1994] cited [2002 March 20]. Available from: http://www.cdc.gov/niosh/nmam/pdfs/7105.pdf.

119 Wikus Jordaan, Council for Geosciences, personal communication: Tel 012-841 1275.

120 Epi Info v6.04d. 2001. [cited 2002 November 18]. Available from: http://www.cdc.gov/epiinfo.

121 Stata v6.0 [cited 2002 November 18]. Available from: http://stata.com.

122 Von Schirnding Y, Mathee A, Robertson P, Strauss N, Kibel M. Distribution of blood lead levels in school children in selected Cape Peninsula suburbs subsequent to reductions in petrol lead. *South African Medical Journal* 2001; **91**(10):870-872.

123 Terblanche APS, Opperman L., Nel CME, Reinach SG, Tosen G, Cadman A. Preliminary results of exposure measurement and health effects of Vaal Triangle Air Pollution Health Study. *South African Medical Journal* 1992; **81**:550-556.

124 Terblanche APS, Ozkaynak H, Spengler J, Butler DA. Relationship between self-reported activity levels and actual heart rates in teenagers. *Journal of the Air and Waste Management Association* 1991; **41**(7):942-946.

125 Von Schirnding YE, and Fuggle RF. [Abstract of: A study of the distribution of urban environmental lead levels in Cape Town, South Africa. *The Science of the Total Environment* 1996; **188**(1):1-8 [cited 2000 March 20]. Available from: http://www.info.sciencedirect.com/.

126 Romieu I, Palazzuelos E, Hernandez-Avila M, Rios C, Muños, Jimenez C, and Cahero G. *Environmental Health Perspectives* 1994; **102**:384-389.

127 Hien PD, Binh NT, Ngo NT, Ha VT, Truong Y, An NH. Monitoring lead in suspended particulate matter in Ho Chi Minh City, *Atmospheric Environment* 1997; **31**:1073-1076.

128 Chan LY, Kwok WS. Roadside suspended particulates at heavily trafficked urban sites of Hong Kong – seasonal variation and dependence on meteorological conditions. *Atmospheric Environment* 2001, **35**:3177-3182.

129 Chuang HY, Swartz J, Gonzales-Cossio T, Lugo MC, Palazuelos E, Aro A, Hu H, and Hernandez-Avila M. Interrelations of lead levels in bone, venous blood, and umbilical cord blood with exogenous lead exposure through maternal plasma lead in peripartum women. *Environmental Health Perspectives* 2001; **109**(5):527-532.

130 Nriagu J, Jinabhai CC, Naidoo R, Coutsoudis A. L. Lead poisoning of children in Africa, II Kwazulu/Natal, South Africa 1997. *The Science of the Total Environment* 1997; **197**:1-11.

131 Elizabeth (Norma) Aphane, Acacia City Council, personal communication. Tel 082-896 0978.

132 Hilde Maritz, Council for Geosciences, personal communication. Tel 012-841 1275.

133 Shorten CV, Hooven MK. Methods of exposure assessment: Lead contaminated dust in Philadelphia schools. *Environmental Health Perspectives* 2000; **108**(7):663-666.

134 Leroyer A, Hemon D, Nisse C, Bazerques J, Salomez J-L, Haguenoer JM. Environmental exposure to lead in a population of adults living in northern France: lead burden levels and their determinants. *The Science of the Total Environment* 2001; **267:** 87-99.

135 Carlson JE and Sokoloff K. Preventing child exposures to environmental hazards: research and policy issues. *Environmental Health Perspectives* 1995; **103**(6):3-5.

136 Ebelt T, Petkau AJ, Vedal S, Fisher TV, Brauer M. Exposure of chronic obstructive pulmonary disease patients to particulate matter: relationships between personal and ambient air concentrations. *Journal of the Air & Waste Management Association* 2000; **50**:1081-1094.