EFFECTS OF HIV EXPOSURE ON CHILD GROWTH IN THE FREE STATE & WESTERN CAPE PROVINCES, SOUTH AFRICA

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DECLARATION

MPH Course Code: PPH 7015W

I, HLENGANI THOZAMA MATHEMA, Student No. MTHHLE006, declare that the work that I have submitted is my own and where the work of others has been used (whether quoted verbatim, paraphrased or referred to) it has been attributed and acknowledged.

Signature: Signed by candidate

Date: **11 FEBRUARY 2013**

ABSTRACT

BACKGROUND. Undernutrition is a major threat to public health, especially for women and children in developing countries. In sub-Saharan Africa, little progress has been reported in the reduction of child undernutrition over the last two decades with South Africa showing an increase during the same period. HIV infection is a known risk factor for undernutrition; however the effects of child exposure to HIV in utero or during breastfeeding are less understood. Due to prevention of mother-to-child transmission (PMTCT) of HIV programmes, the number of HIV-exposed but uninfected children is rapidly increasing, and it is important to understand their risks for undernutrition, especially in the first two years of life, in order to intervene appropriately. The aim of this analysis was to determine the effects of HIV exposure on child growth and nutritional status in children less than two years of age in the Free State (FS) and Western Cape (WC) Provinces, South Africa.

METHODS. A secondary analysis was done using the South African community survey data from the **P**MTCT **E**ffectiveness in **A**frica: **R**esearch and **L**inkages to Care (PEARL) Study – a multi-country, cross-sectional evaluation of PMTCT programmes. To measure child growth and determine nutritional status, Z-scores were calculated using child weights and heights according to WHO growth reference standards. The growth indicators used were weight-for-age (WAZ), length-for-age (LAZ) and weight-for-length (WLZ).

RESULTS. The prevalence of HIV exposure in children was 20.6% (343/1666), and vertical transmission rate at the time of the interview was 11.2% (37/329). The mean WLZ was 0.91 (0.36; 1.47), and the prevalence of wasting was 8.7%. The adjusted association between HIV exposure and WLZ was insignificant (p=0.696), and the prevalence of wasting was also similar in both groups (p=0.751). WLZs and wasting were statistically similar in the FS and WC (p=0.948; p=0.156). The mean WAZ was -0.04 (CI: -0.29; 0.21), and the prevalence of underweight was 11.1%. HIV-exposed children had lower WAZs, but the difference was only significant in unadjusted comparisons (p=0.049). Underweight was more prevalent in the exposed but this was not significant (p=0.755). Children in the FS had significantly lower WAZs compared to WC (p=0.044) 3.02 times the odds of

underweight ($p<0.001$). Children in the study had low LAZs with less than a quarter (23.9%) having a LAZ above the WHO average. The mean LAZ was -1.28 (CI: -1.61; -0.94) and 38.4% of children were stunted. There was no significant difference in LAZ or stunting by HIV exposure ($p=0.513$; $p=0.380$). Children in the FS had lower LAZs ($p=0.029$) and had 2.12 times the odds of stunting ($p=0.001$). Birth weight was a predictor of all outcome measures ($p<0.01$), and maternal body mass index predicted all outcome measures, except stunting ($p<0.05$). Other predictors included HIV infection, age, sex, breastfeeding at time of interview, and possession of selected household assets.

CONCLUSION. Child undernutrition, particularly chronic undernutrition stunting, is very high in the FS and WC provinces of South Africa. HIV exposure does not have an impact on child undernutrition with low birth weight, low maternal weight, and residence in the FS being the most consistent risks for growth faltering and undernutrition.

ACKNOWLEDGEMENTS

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A: PROTOCOL

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INTRODUCTION

Background

After an analysis of 2001 global health data, Lopez and colleagues concluded that "Undernutrition remains the leading risk factor for health loss."(1) While undernutrition is not often the primary cause of death, 54% of deaths in children under five years in developing countries were associated with undernutrition in 2001.(2) It follows that public health monitoring activities must include regular assessment of population indicators of nutritional status e.g. weight for age, length/height for age and weight for length/height. These three indicators reflect underweight, stunting and wasting respectively. In South Africa, at the turn of the millennium it was demonstrated that 21.6% of the nation's children from 1-9 years of age were stunted(3) while 11.8% of children under five years were underweight.(4) In addition, sub-Saharan African countries face the challenge of a generalized HIV (human immunodeficiency virus) epidemic,(5) with HIV also being a risk factor for undernutrition.(6) The relationship between undernutrition and HIV requires periodic review.

HIV and Child Growth

Since the mid-to-late 1980s research into the effects of HIV on child health and in particular child growth, has received increased attention globally, and particularly in sub-Saharan Africa. A study in Rwanda between 1988 and 1993 found that HIV-infected children had significantly lower weight-for-age compared to HIV-exposed but uninfected children. In turn, the latter had lower weight-for-age compared to unexposed children. This effect was most marked at 12 and 36 months of age. The mean height-for-age of infected children was two standard deviations below the mean for uninfected children from nine months of age.(7) Research from the Democratic Republic of Congo between 1989 and 1992, reported that HIV-infected infants were significantly more likely to be underweight and wasted from birth and stunted from three months of age.(8) Studies in Malawi(9) and in South Africa(10,11) also showed that HIV infection was associated with poor infant growth. A Ugandan study went further and showed that poor growth predicts mortality. Z-scores were calculated for infants and those with weight-for-age scores on average below -1.5 in the first year of life were almost five times more likely to die before reaching 25 months of age ($p = 0.024$).(12)

Studies on HIV-exposed but uninfected children have provided conflicting results on undernutrition. In Rwanda, the Democratic Republic of Congo and Uganda no difference found in growth indices between HIV-exposed but uninfected children compared to unexposed children.(7,8,12) An analysis of longitudinal data from South Africa a decade later also showed that there was no difference between uninfected children that differ by HIV exposure.(13) However, a study in Kwazulu-Natal showed that exposed uninfected children had height-for-age scores that were significantly lower than the international standards.(10) Furthermore, a case-control study on severe malnutrition in the Limpopo province showed that the presence HIV in a child's family increased the odds of severe malnutrition 217.7 times irrespective of the HIV-status of the child.(14)

Child Undernutrition in South Africa

Studies conducted within the past two decades show that there is significant stunting in South African children with a considerable number being underweight. The National Food Consumption Survey (NFCS), a population-based survey conducted in 1999 showed that 21.6% of children in South Africa between one and nine years of age were stunted while 11.8% of children under 5 years were underweight.(3,4) In 2003, the national Demographic and Health Survey(15) showed that burden of stunting and underweight in children under five years was 27.4% and 11.5%, respectively, while the follow-up NFCS in 2005 showed that the burden of stunting and underweight was 18% and 9%, respectively.(16) Therefore, about one in five children is stunted and one in ten underweight in South Africa, indicating a significant public health threat as undernutrition contributes to 12.3% of deaths and 10.8% of disability-adjusted life years in children less than five years of age.(4)

Rationale

In 2010, the prevalence of HIV among South African women beginning antenatal care was 30.2%.(17) Over the last decade, the rollout of a national prevention of mother-to-child transmission (PMTCT) programme has contributed to a significant reduction in vertical transmission of HIV. There has been an increase in the number of children exposed to HIV who remain uninfected, and morbidity and mortality rates among these children are higher compared to uninfected children.(5) HIV-exposed but uninfected children may be at risk for undernutrition as measured by child growth indices over and above the general risk of undernutrition in South Africa.(3–5,14) It is therefore

important that the relationship between HIV exposure and undernutrition be monitored for the promotion of optimal child health outcomes.

Aims & Objectives

The aim of this analysis will be to determine the effects of HIV exposure on child growth, and to describe the nutritional status of HIV-exposed and -unexposed children under two years of age in the Free State (FS) and Western Cape (WC) Provinces, South Africa. The objectives of the analysis are to:

- Determine the prevalence of HIV exposure in children
- Describe the growth indices of children
- Determine the prevalence of undernutrition among children (underweight, stunting and wasting)
- Determine the relationship between HIV-exposure and child growth/undernutrition

METHODS

Study Design & Setting

The PEARL Study (**P**MTCT **E**ffectiveness in **A**frica: **R**esearch and **L**inkages to Care Study) was a multi-country, cross-sectional evaluation of PMTCT programmes. This evaluation included two components: a facility-based component, which has been described previously(18–22), as well as a community-based survey. The countries involved in this evaluation were Cameroon, Côte d'Ivoire, South Africa and Zambia. This research proposal is for a secondary analysis of South African data from the PEARL Study.

Sampling & Recruitment

The sampling for the community survey was predicated on the catchment area for the facility-based component of the study. Investigators used a stratified multistage cluster sampling plan. Each country represented a single stratum, and in South Africa two provincial clusters were selected: the FS and

the WC provinces. Within each province, three sub-district clusters were selected to be representative of the coverage of PMTCT services in the province. Each sub-district had a health facility with an antenatal service as the focal point from which health catchment areas were mapped. For the community survey, households were randomly sampled within the health catchment areas of these facilities for participation in the survey.

The primary outcome of the community survey was HIV-free survival in children less than two years of age, therefore the sample size calculations were based on the average number of children under the age of two per household in the African population of the urban WC and rural FS as described by the 2007 Community Survey conducted by Statistics South Africa(23). This estimate was used to calculate the number of households that needed to be visited, based on an assumed response rate of 87%. From this, the aim was to complete between 200 and 400 surveys in each sub-district, and the specimen targets for children under two years were pre-set by the PEARL statistician at a total of 924 specimens and 1 008 specimens for urban and rural districts respectively.

However, for the proposed analysis, the outcome of interest is undernutrition in children under the age of two. Data from the 2003 South African Demographic and Health Survey(15) was used to calculate the required sample size to accurately estimate the prevalence of underweight, stunting and wasting in the FS and WC with 80% statistical power (Table 1).

Table 1: Sample Size Calculations

Indicator	Province	Provincial %	National %	Sample Size
Underweight	FS	15.9	11.5	450
	WC	10.9	11.5	21882
Stunting	FS	32.9	27.4	533
	WC	34.7	27.4	305
Wasting	FS	8.4	5.2	437
	WC	6.2	5.2	4073

The national estimates were assumed to reflect the true occurrence of undernutrition and the provincial estimates provided alternate estimates needed in the calculations. Statistical power for the proposed analysis will be calculated using the sample sizes obtained from the community survey database.

Prior to recruitment, community sensitization was done. A survey company was hired to do the fieldwork for the study including the community sensitization. Sensitization activities included meetings with ward councillors, sub-district health managers and farmers' unions, distribution of survey information brochures, and radio announcements. Field staff went to all households identified through the sampling procedure. Teams were made up of at least two members, including a registered nurse and at least one member able to speak the local language. In each household a complete list of people in the house was requested, including age and sex, and data on all births and deaths of children less than five years of age within the preceding three years (Appendix A). For a household to be eligible for recruitment, a child must have been born in the household within the two years prior to the date of interview (living or deceased). The youngest child under two years born to each mother was the index child, and the mother/primary caregiver of this child was the primary survey respondent. Once selected the mother /primary caregiver provided informed consent before further data or blood was collected (Appendix B).

Data Collection & Measurement

A Maternal and Child Questionnaire was completed by mother/child pairs (Appendices C and D). The questionnaire was divided into sections as numbered below and the following variables were collected:

Maternal

1) Household information: source of drinking water, electricity, toilet facilities, wealth, transport, food security
2) Educational background: level of schooling attained
3) Occupation and family support for decision making
4) Marital/Intimate partner history and reproduction, for example, parity and contraception
5) Knowledge of HIV, mother-to-child transmission of HIV and optimum infant feeding practice in first six months of life
6) Knowledge of antiretroviral drugs and their use in pregnant women and children
7) HIV testing history and disclosure, including that of husband/partner
8) Pregnancy at time of survey interview

Child

10) Antenatal history , including first visit, HIV test, syphilis test and PMTCT cascade (for example, HIV-infected mother's antiretroviral information) for child where survey respondent is biological mother
11) Antenatal history for child where survey respondent is caregiver other than biological mother
12) Antenatal laboratory test results from antenatal card
13) Birth history for each child, for example,. place of birth, birthweight, infant feeding, HIV and pneumonia prophylaxis etc.
14) Child health card: immunization dates, vitamin A supplementation, HIV exposure and status
15) Anthropometry and specimen collection

All children under two years of age completed the child questionnaire. Verbal autopsy reports were completed, using the international standard verbal autopsy questionnaires provided by the World Health Organization (WHO),(24) in cases where index children or their mothers were deceased.

The height and weight of the mothers and children were measured and recorded. Five millilitres of blood was collected from mothers using anticoagulated vacuum tubes, while five blood spots were taken from children. In an offsite laboratory, the Abbott Determine® rapid (HIV antibody) test was used to determine HIV infection in mothers. If a mother tested positive for HIV, then an HIV DNA (deoxyribonucleic acid) PCR (polymerase chain reaction) was done for her child[ren]. All HIV testing was done in a laboratory after specimens were anonymised. Report back on test results was not carried out, and all respondents were encouraged to access local HIV testing services to find out their results.

Data Management & Analysis

All data were received in a secure Microsoft Access database. Data will be exported and analysed using STATA version 11.2.(25) The data will be cleaned and then univariate and bivariate exploration of the data will be done to audit the cleaning process in preparation for statistical analysis. Analysis will be done using the STATA survey suite of commands and the following restrictions will be applied:

- Only children that were alive at the time of the survey interview will be included because the research question requires that growth measurements be available from the time of the survey.
- In order to eliminate reporting bias, only children with HIV-exposure that was determined using specimen collected from mothers will be included in the analysis.

Z-scores will be calculated using child weights and heights according to the international standards and guidelines provided by the WHO.(26) These will be used to determine the association between HIV exposure, child growth and nutritional status. HIV-exposure and/or –infection will be determined by specimen test results at the time of the survey. The growth indices that will be calculated are:

1) Weight-for-age – WAZ
2) Length-for-age – LAZ
3) Weight-for-length – WLZ

These 3 indicators have been selected for two reasons. Firstly, given the design of the study and the measurements taken, only four of all the indicators provided by the WHO may be calculated, the fourth being body mass index-for age. Secondly body mass index is not used to monitor child growth in South Africa.

The association between HIV exposure and child growth will be determined using linear regression. Each of the z-score variables will be regressed on HIV exposure, status, and other variables likely to be of significance, i.e. confounders or effect-modifiers, from the data exploration as well as from the available literature. For the association between HIV exposure and nutritional status, the z-scores will be used to classify the children as well- or under- nourished (0 being the code for normal or over nutrition, and 1 being a positive score for undernutrition i.e. $z < -2$) as shown below:

1) WAZ – Underweight – 0 or 1
2) HAZ – Stunted – 0 or 1
3) WLZ – Wasted – 0 or 1

Using logistic regression models, nutritional status will then be regressed on HIV exposure, status and other key variables. The 5% significance level will be used to guide interpretation of all p-values.

ETHICS

Informed consent was obtained prior to questionnaire administration and prior to specimen collection. Where there was an illiterate respondent, an objective party was included in the informed consent process to insure the ethical standards of the study were maintained.

Confidentiality and privacy were maintained through several procedures determined by the study protocol. Once blood specimens had been obtained, HIV testing was performed anonymously off site to respect participant privacy and confidentiality Field staff were blinded to the HIV results, and laboratory technicians to the questionnaire data. Participants were given an information brochure on HIV testing and a list of nearby clinics that offered HIV testing services, and encouraged to find out their HIV status.

For this secondary analysis confidentiality remains a high priority. Data gathered will continue to be accessible only to South African investigators for the PEARL Study and selected data analysts.

Ethical approval for the PEARL Study was obtained from institutional review boards at the University of Alabama, the Centre for Disease Control and Prevention in Atlanta, Georgia, the University of Cape Town (Appendix E) and the Departments of Health in the Free State and Western Cape provinces.

REPORTING & COMMUNICATION

This analysis will be carried out in partial fulfilment of the requirements of the Master of Public Health degree at the University of Cape Town, so preparatory work and final results will be written up as an academic mini-dissertation available in the University of Cape Town libraries. The results of the analysis will also be reported to health services managers in the survey districts and published in a peer-reviewed academic journal.

BUDGET

No budget has been allocated to this protocol since the PEARL study is complete, and this constitutes secondary analyses for the purposes of completing a mini-dissertation.

TIMELINE

Proposal development for this study began in June 2012. Work will continue until the report is ready for dissemination. The Gantt chart below gives a summary of project activities and projected timelines:

YEAR	2012							2013	
MONTH	J	J	A	S	O	N	D	J	F
Protocol – part A									
Submission for Approval									
Data Analysis									
Literature Review – part B									
Article – part C									
First full Thesis draft									
Final Draft & Submission									

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VIII. APPENDICES

A. Eligibility Questionnaire - Identification of Household

Pearl Community Survey

IDENTIFICATION OF HOUSEHOLD

Knock on the door and say you would like to ask them a few questions about the members of their household.

Get verbal permission

GPS coordinates _____

Household Number _____ Study Site Code _____

Name of head of household _____ Address *(optional)* _____

Date _____ Contact Phone Number *(optional)* _____

Time start questions eligibility _____

INTERVIEWER VISITS

Community name_____				
	1	2	3	Final visit
Interviewer name				
Result				
Next visit date & time *(optional, only when new visit is needed)*	xxxxxxxxxxxxx			
CODES : 1-COMPLETED 2- NO HOUSEHOLD MEMBER AT HOME OR NO COMPETENT HH MEMBER PRESENT 3- ENTIRE HOUSEHOLD ABSENT 4-REFUSED 5- POSTPONED 6-DWELLING VACANT OR NOT FOUND				

Household listing: **"Please give me the names of the persons who usually <u>live</u> in your household, starting with the head of the household."**

Client ID No	Usual residents and visitors	Relationship to head of household	Residence	Sex	Age	Mother child < 24 months	Mother alive	Eligibility	
	Please give me the names (or initials) of the persons who usually live in your household, starting with the head of the household	What is the relationsip of [name] to the head of the household? *(use codes below)*	Does [name] usually live here? (probe on also listing people-relatives- that are temporarily staying for some time)	Is [name]male or female?	How old is [name]?	Is [name]'s natural mother alive?	If alive, does [name's] natural mother live here? If yes, record the mother's line number. *If no, record line of caregiver*	Circle line eligibility of all children <24 months and their siblings	Cicle line eligibility for all women who have had a child in the past 24 months
1	2	3	4	5	6	7	8	9	10
H-1									
H-2									
H-3									
H-4									
H-5									
H-6									
H-7									
H-8									
H-9									
H-10									
H-11									
H-12									
H-13									
H-14									
H-15									

Codes for relationship to head of household 1-HEAD; 2-WIFE OR HUSBAND; 3-SON OR DAUGHTER;4-SON-IN-LAW OR DAUGHTER-IN-LAW; 5-GRANDCHILD; 6-PARENT; 7-PARENT-IN-LAW; 8-BROTHER OR SISTER; 9-BROTHER-IN-LAW/SISTER-IN-LAW;10-NEPHEW OR NIECE; 11-CO-WIFE; 12-OTHER RELATIVE; 13-ADOPTED/FOSTER/STEPCHILD; 14-NOT RELATED; 15-DON'T KNOW

"Now I would like to ask you about any persons who have died in the household in the past three years. I know that this can be sensitive, but if you can do your best to remember."

(Note: we are interested in deaths in last 2 years, but ask last 3 years so we don't miss any)(Ask following questions to make sure no death cases are being missed)

1) Did anyone die in this household this year?	2) What about last year, in 2007?	3) And the year before, in 2006?	4) And the year before that, in 2005?
5) Did any funerals take place in this household?	6) What about last year, in 2007?	7) And the year before, in 2006?	8) And the year before that, in 2005?
If "Yes" on any of the previous questions:	9) "Was this person usually staying in this household while he/she was alive?"		
10) Were there any small babies/newborn babies in the household that were born but died soon after delivery (hours, days, some weeks) this year, including still births (fresh or macerated)?	11) What about last year, in 2007?	12) And the year before, in 2006?	13) And the year before that, in 2005?

(Fill out any deaths on the next page)

Line listing Client ID No	Date of death	Age at death	Relationship to head of household	Residence	Sex	Parental survivorship for persons <24 months of age	Eligibility	Eligibility
Write name of person that passed away (enter babies that did not get a name as baby boy, baby girl or baby of [name mother])	When did [name]die? dd/mm/yy	How old was [name] when he/she died?	What is the relationsip of [name] to the head of the household?	Did [name] usually live here? (Yes or No)	Is [name] male or female?	Is [name]'s natural mother alive? *(if Yes, write line mumber in column of child)* (Yes or No)	Circle line number if child was born in last 24 months AND died in last 24 months	Circle line number of all women who died and who have given birth to a child in the last 24 months
D-1								
D-2								
D-3								
D-4								
D-5								
D-6								
D-7								
D-8								
D-9								
D-10								
Codes for relationship to head of household 1-HEAD; 2-WIFE OR HUSBAND; 3-SON OR DAUGHTER;4-SON-IN-LAW OR DAUGHTER-IN-LAW; 5-GRANDCHILD; 6-PARENT; 7-PARENT-IN-LAW; 8-BROTHER OR SISTER; 9-BROTHER-IN-LAW/SISTER-IN-LAW;10-NEPHEW OR NIECE; 11-CO-WEIFE; 12-OTHER RELATIVE; 13-ADOPTED/FOSTER/STEPCHILD; 14-NOT RELATED; 15-DON'T KNOW								

" So, just to make sure: Are there any adults who died in the past 24 months? " *If yes, make sure they are listed in the table.*

" What about any children?" *If yes, make sure thery are listed in the table*

"And what about any small babies that died soon after delivery?" *If yes, make sure they are listed in the table*

" And what about any deliveries in which you have had a still birth (fresh/macerated) after 28 weeks of pregnancy?" *if yes, make sure they are listed in the table*

"Now I would like to record the names of all your deliveries, whether still alive or not, starting with the most recent one you have had. This would also include any still births you might have had." *(list all your deliveries -alive or dead- that occurred starting with the last bor. If no name was given write 'No Name')(Deliveries include also still births)*						
Line listing Client ID No	Were any of these births twins?	Is [name] a boy or girl? *(write also name)*	In what mo and year was [name] born? Probe: what is his/her bday? *(options on years: 2003 up to 2008)*	If alive, how old is [name] at his/her last bday?	If alive, is [name] living with you?	If deceased, how old was [name] at time of death?
Write name of child/baby below (enter baby that did not get a names baby boy, baby girl or baby of [name moter])				Record age *(months or years)*		Record age *(months or years)*
B-1						
B-2						
B-3						
B-4						
B-5						
B-6						
B-7						

TIME END _____

If household is not eligible, then thank the household, and move to the next house (keep this eligibility form as record)

If household is eligible, continue with the Informed Consent procedure

B. Consent Form

PEARL	PMTCT Effectiveness in Africa: Research and Linkages to Care

CONSENT FORM

STUDY NUMBER: _____

Purpose of the Study:
The University of Cape Town is currently undertaking a survey of the programme for the prevention of mother to child transmission of HIV in the Western Cape and the Free State. The government has expanded these services and wants to provide the best services possible. The survey will provide information for people who run health programmes related to HIV/AIDS. If you agree, we will ask you questions about yourself and members of your household, your house, your children, and services you received when you were pregnant.

Your honest answers to these questions will help us better understand what people think, say and do about certain kinds of behaviours. We would greatly appreciate your help in responding to this survey. The interview will take about 30-45 minutes to ask the questions.

Another part of this survey involves collecting less than a tablespoon (3ml) of blood from you for HIV testing. We use new needles that are clean and without risk and a nurse draws the blood. Your blood will be analysed at a local laboratory.

We are also looking at HIV among children under the age of five, and will test that by collecting five spots of blood on a small card.

To ensure confidentiality of these tests, no individual names will be attached to the blood sample, therefore, we cannot give you your results of your HIV test, and no one will be able to trace the HIV test back to you. However, if you want to know your HIV status or the HIV status of any child living in this household, you will be given an information brochure on HIV/AIDS, as well as a list of clinic contacts in your area, where you can go for voluntary testing and counseling. Knowing your HIV status and/or the HIV status of your child is the first step to life saving therapy.

"At this moment do you have any questions?"

Participant's Signature _____
(Thumbprint if illiterate)

Potential Risks/Discomforts: Some of the questions are sensitive, but you do not have to answer any questions that you do not want to answer. Drawing blood might be slightly painful or leave a bruise on your arm. The only people that are drawing blood are trained nurses.

Potential Benefits: You may not receive any personal benefit by participating in this study, however, the information gained in this study will help the government to better understand how to monitor and improve programmes that prevent mother to child transmission of HIV.

Alternatives: The alternative to this study is not to participate.

Confidentiality: Your household has been selected at random. If you agree, I am going to ask you some questions that some people find difficult to answer. Your answers will be kept completely confidential. Your name will not be written on the study forms, and will never be used in connection with any of the information you tell me. We will only use numbers that cannot be traced back to your name. The Ethics Committee of the University of Cape Town is monitoring this study.

Withdrawal without Prejudice: You are free to end this interview at any time you want but this will not prejudice you in any way.

Cost of Participation: There will be no costs to you for taking part in this study.

Payment for Participation in Research: You will receive a voucher worth R20 for the time you have given us to complete this interview.

Questions and contact information: If you have any questions or comments either about this study, or being a participant in this study, you may contact Dr David Coetzee, at the Infectious Diseases Epidemiology Unit, School of Public Health and Family Medicine, University of Cape Town (tel 021 406 6262).

Participant's signature _____

Thumb print if participant unable to sign

PARTICIPANT SIGNATURE/AGREEMENT

If you have read the informed consent or had it read and explained to you, and you voluntarily agree to join this study, please sign your name or place your thumbprint below. By signing below (or placing your thumbprint), you are also agreeing that your child may be enrolled in this study.

- ☐ I agree to the questionnaire
- ☐ I agree to the blood collection for myself
- ☐ I refuse blood collection for myself, but agree to an oral swab
- ☐ I agree to the blood collection for my children
- ☐ I refuse blood collection for my child, but agree to an oral swab

_____
Signature of Participant

_____ _____
Printed Name of Participant Date

_____
_____
Thumbprint of person who cannot sign name Date

_____
Printed Name of Person Who Obtained Consent

_____ _____
Signature of Person Who Obtained Consent Date

I was present throughout the entire informed consent process with the volunteer. All questions from volunteer were answered and the volunteer agreed to take part in the exercise.

UNIVERSITY OF CAPE TOWN
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SPONSORS:

THE CENTERS FOR DISEASE CONTROL AND PREVENTION, UNITED STATES OF AMERICA

C. Mother/Child Questionnaire

	House Number _____	Study Site Code _____		
	QUESTIONS AND FILTERS	**CATEGORIES**	**CODE**	**SKIP**
99	**99. SECTION 1:** HOUSEHOLD INFORMATION	Continue		→100
		Back to index		→21
100	100. Record date interview is taken:	Date _____		→101
101	101. Record the time interview starts	Time: _____		→102
102	102. Record line number and name of respondent from eligibility table.	_____		→103
103	103. Status of Respondent	Natural Mother	1	→104
		Foster/adoptive mother	2	
		Caregiver	3	
		Other	4	
104	104. What is your birthdate?	Date _____		→105
105	105. How old were you at your last birthday?	Age in years _____		→106
106	106. There is/could be a conflict between your birthdate and your current age	Agreed	1	→104
		Disagreed	2	→107
107	107. What is the main source of drinking water for members of your household?	Piped water into house	1	→108
		Piped water outside but available within plot	2	
		Public tap	3	
		Tube well or borehole	4	
		Protected well	5	
		Unprotected well	6	
		Protected spring	7	
		Unprotected spring	8	
		Rainwater	9	
		Tanker truck	10	
		Cart with small tank	11	
		Surface	12	
		Bottled water	13	
		Other	14	
108	108. Do you do anything to the water to make it safer to drink?	Yes	1	→109
		No	2	→110
		Don't know	3	
109	109. What do you usually do to make the water safer to drink? (circle all that apply)	Boil	1	→110
		Add bleach/chlorine	2	
		Use water filter	3	
		Solar disinfection	4	
		Other	5	
		Don't know	6	

110	110. What kind of toilet facilities does your household have?	Flush Toilet to Piped Sewer System	1	→111
		Flush Toilet to pit/tank	2	
		Traditional pit latrine	3	
		Ventilated improved pit latrine (VIP)	4	
		Bucket Toilet	5	
		No Facility/Bush/Field	6	
		Other	7	
111	111. Does your household have electricity?	Yes	1	→112
		No	2	
112	112. Does your household have a television?	Yes	1	→113
		No	2	
113	113. Does your household have a cell phone?	Yes	1	→114
		No	2	→115
114	114. How many cells phones does your house own?	1 cell phone	1	→115
		2 cell phones	2	
		3 cell phones	3	
		4 cell phones	4	
		more than 4 cell phones	5	
		I don't know	6	
		I don't want to tell you	7	
115	115. Does your household have a refrigerator?	Yes	1	→116
		No	2	
116	116. Does your household have a bicycle?	Yes	1	→117
		No	2	
117	117. Does your household have a motorcycle?	Yes	1	→118
		No	2	
118	118. Does your household have a car?	Yes	1	→119
		No	2	
119	119. Main material of floor (observation)	Natural floor (earth/mud/dung)	1	→120
		Wood Planks	2	
		Finished Floor (cement/tiles)	3	
		Other	4	
120	120. In the past month, would you say that this household usually has enough food to eat, sometimes has enough food to eat, seldom has enough food to eat, or never has enough food to eat?	Usually/Always	1	→121
		Sometimes	2	
		Seldom	3	
		Never	4	
121	121. Does your household have any mosquito nets that can be used while sleeping?	Yes	1	→200
		No	2	

	QUESTIONS AND FILTERS	CATEGORIES	CODE	SKIP
200	**200. SECTION 2:** EDUCATIONAL BACKGROUND	Continue	1	→201
		Back to index	2	→22
201	201. Have you ever attended school?	Yes	1	→202
		No	2	→204
202	202. What is the highest level of school you attended: primary, secondary, or higher?	Primary	1	→203
		Secondary	2	
		Higher	3	
203	203. What is the highest grade you completed at this level?	Grade 1-6	1	→204
		Grade 7	2	
		Grade 8	3	
		Grade 9	4	
		Grade 10	5	
		Grade 11	6	
		Grade 12	7	
204	204. Now I would like you to read this sentence to me. *(show card to respondent)*	Able to read whole sentence	1	→300
		Able to read only parts of sentence	2	
		Not able to read any part of sentence	3	
		No card with required language	4	
		Blind/visually impaired	5	
		Refused to answer	6	
	QUESTIONS AND FILTERS	**CATEGORIES**	**CODE**	**SKIP**
300	**300. SECTION 3:** WOMAN'S WORK AND FAMILY SUPPORT	Continue	1	→301
		Back to index	2	→23
301	301. Aside from your own housework, are you currently working, including work on a farm?	Yes	1	→302
		No	2	→303
302	302. What is your occupation, that is, what kind of work do you mainly do?	Farmer	1	→303
		Health care worker	2	
		Small business owner	3	
		Secretary	4	
		Trader	5	
		Student	6	
		Government worker	7	
		Manager in company	8	
		Employer in company	9	
		Employer in organisation/NGO	10	
		Other	11	

303	303. Who in your family usually has the final say on the following decision: Your own health care?	You	1	→304
		Husband/partner	2	
		You and your husband/partner	3	
		Someone else	4	
		Decision not made/Not applicable	5	
304	304. Who in your family usually has the final say on the following decision: Making large household purchase?	You	1	→305
		Husband/partner	2	
		You and your husband/partner	3	
		Someone else	4	
		Decision not made/Not applicable	5	
305	305. Who in your family usually has the final say on the following decision: On the schooling of children?	You	1	→306
		Husband/partner	2	
		You and your husband/partner	3	
		Someone else	4	
		Decision not made/Not applicable	5	
306	306. Who in your family usually has the final say on the following decision: On the health care of children?	You	1	→400
		Husband/partner	2	
		You and your husband/partner	3	
		Someone else	4	
		Decision not made/Not applicable	5	
	QUESTIONS AND FILTERS	**CATEGORIES**	**CODE**	**SKIP**
400	**400. SECTION 4:** MARRIAGE AND REPRODUCTION	Continue	1	→401
		Back to index	2	→24
401	401. Are you currently married or living with a man?	Married	1	→405
		Living together	2	
		Not in union	3	→402
402	402. Have you ever been married or lived with a man?	Yes, in the past I was married	1	→403
		Yes, in the past lived with a man	2	
		No	3	→408
403	403. What is your marital status now?	Widowed	1	→404
		Divorced	2	
		Separated	3	

404	404. Did your late/ex husband have other wives/women besides yourself?	Yes	1	→407
		No	2	→408
405	405. Is your husband/partner living with you or is he staying elsewhere?	Lives with me	1	→406
		Lives somewhere else	2	
406	406. Does your husband/partner have other wives/women besides yourself?	Yes	1	→407
		No	2	→408
407	407. How many other wives/women does your husband have?	1 Other wife/woman next to me	1	→408
		2 Other wives/women next to me	2	
		3 Other wives/women next to me	3	
		More that 3 wives/women next to me	4	
		Don't know	5	
408	408. Now I would like to ask about all the pregnancies you have had during your life. Have you ever been pregnant?	Yes	1	→409
		No	2	*To household*
409	409. Do you have any sons or daughters to whom you have given birth who are alive and live with you?	Yes	1	→410
		No	2	→412
410	410. How many sons live with you?	1 Son at home	1	→411
		2 Sons at home	2	
		3 Sons at home	3	
		More than 4 sons at home	4	
		No sons	5	
411	411. How many daughters live with you?	1 Daughter at home	1	→412
		2 Daughters at home	2	
		3 Daughters at home	3	
		More than 4 daughters at home	4	
		No daughters	5	
412	412. Do you have any sons or daughters to whom you have given birth who are alive but do not live with you?	Yes	1	→413
		No	2	→415
413	413. How many sons are alive but live elsewhere?	1 Son elsewhere	1	→414
		2 Sons elsewhere	2	
		3 Sons elsewhere	3	
		More than 4 sons elsewhere	4	
		No sons	5	
414	414. How many daughters are alive but live elsewhere?	1 Daughter elsewhere	1	→415
		2 Daughters elsewhere	2	
		3 Daughters elsewhere	3	
		More than 4 daughters elsewhere	4	
		No daughters elsewhere	5	

415	415. Have you ever given birth to a boy or girl who was born alive but later died? If no probe	Yes	1	→416
		No	2	
416	416. Have you ever given birth to a boy or a girl who was born dead?	Yes	1	→417
		No	2	→419
417	417. How many boys have died?	1 Boy died	1	→418
		2 Boys died	2	
		3 Boys died	3	
		More than 4 boys	4	
		Unclear gender 1 still birth	5	
		Unclear gender 2 still births	6	
		Unclear gender 3 still births	7	
		Unclear gender more than 3 still births	8	
		Not applicable	9	
418	418. And how many girls have died?	1 Girl died	1	→419
		2 Girls died	2	
		3 Girls died	3	
		More than 4 girls died	4	
		Not applicable	9	
419	419. JUST TO MAKE SURE I HAVE THIS RIGHT. You have had a total of (count) births during your life, is that correct?	Yes	1	→420
		No, probe and correct in eligibility chapter	2	
420	420. Have you ever used anything or tried in any way to delay or avoid getting pregnant?	Yes	1	→421
		No	2	→500
421	421. Which method(s) have you used? (more than one answer possible)	Female sterilization/hysterectomy	1	→422
		Male sterilization	2	
		Pill	3	
		IUD	4	
		Injectables	5	
		Implants	6	
		Condom	7	
		Female condom	8	
		Diaphragm/Foam/Jelly	9	
		Lactational Amen. Method	10	
		Natural Family Planning	11	
		Withdrawal	12	
422	422. Where were you offered these method(s)?	Public clinic	1	→500
		Private clinic	2	
		Pharmacy	3	
		Traditional healer	4	
		Other	5	

	QUESTIONS AND FILTERS	CATEGORIES	CODE	SKIP
500	**500. SECTION 5:** HIV Knowledge and Experiences	Continue	1	→501
		Back to index	2	→25
501	501. Have you ever heard of HIV/AIDS?	Yes	1	→502
		No	2	→601
502	502. Can the virus that causes AIDS be transmitted from a mother to a child during pregnancy?	Yes	1	→503
		No	2	
		Don't know	3	
503	503. Can the virus that causes AIDS be transmitted from a mother to a child during delivery?	Yes	1	→504
		No	2	
		Don't know	3	
504	504. Can the virus that causes AIDS be transmitted from a mother to a child during breastfeeding?	Yes	1	→505
		No	2	
		Don't know	3	
505	505. Are there special drugs that a doctor or nurse can give to a woman infected with the AIDS virus to reduce the risk of transmission to the baby?	Yes	1	→506
		No	2	
		Don't know	3	
506	506. What is the best way to feed your baby in the first six months of its life?	Breast milk plus water only	1	→600
		Breast milk plus artificial milk	2	
		Only breast milk	3	
		Breast milk plus other foods	4	
	QUESTIONS AND FILTERS	**CATEGORIES**	**CODE**	**SKIP**
600	**600. SECTION 6:** ANTI RETROVIRAL INFORMATION *-Ask all mothers*	Continue	1	→601
		Back to index	2	→26
601	601. Have you heard about special antitretroviral drugs (ART) that people infected with the AIDS virus can get from a doctor or a nurse to help them live longer?	Yes	1	→602
		No	2	→700
		Don't know	3	

602	602. Can pregnant women receive these drugs?	Yes	1	→603
		No	2	
		Don't Know	3	
603	603. Can children receive these drugs?	Yes	1	→700
		No	2	
		Don't Know	3	
	QUESTIONS AND FILTERS	**CATEGORIES**	**CODE**	**SKIP**
700	**700. SECTION 7:** HIV TESTING	Continue	1	→701
		Back to index	2	→27
701	701. Have you ever been tested for the AIDS virus?	Yes	1	→702
		No	2	→710
		Don't know	3	
		Don't want to tell you	4	
702	702. What was the date of the most recent test? *(fill out '1/1/2010' if unknown)*	Date _____		→703
703	703. Was this the first time you have been tested?	Yes	1	→704
		No	2	
704	704. What was the result of the most recent test?	HIV positive	1	→705
		HIV negative	2	→708
		Don't know	3	→710
		Don't want to tell you	4	→706
705	705. When did you learn you had HIV? *(fill out '1/1/2010' if unknown)*	Date _____		→706
706	706. Are you currently taking special antiretroviral drugs (ART) HAART?	Yes	1	→707
		No	2	→710
		Don't Know	3	
		Don't want to tell you	4	
707	707. When did you start taking special antiretroviral drugs (or use local name)? (*fill out '1/1/2010' if unknown)*	Date _____		→708
708	708. Did you tell anyone the results?	Yes	1	→709
		No	2	→710

709	709. Whom did you tell about your HIV test result? *(more than 1 answer possible)*	Partner(s)	1	→710
		Children	2	
		Other Family Member	3	
		Pastor	4	
		Friend(s)	5	
		Other	6	
710	710. Has your husband/partner ever been tested for HIV?	Yes	1	→711
		No	2	→800
		Don't know	3	
711	711. What was the result?	Positive	1	→800
		Negative	2	
		Don't know	3	
		I don't want to tell you	4	
	QUESTIONS AND FILTERS	**CATEGORIES**	**CODE**	**SKIP**
800	**800. SECTION 8:** PREGNANCY	Continue	1	→801
		Back to index	2	→28
801	801. Are you pregnant now?	Yes	1	→802
		No	2	→999
802	802. Where do you intend to deliver?	Home	1	→999
		Public Sector: Govt Hosp	2	→803
		Public Sector: Govt Health Centre	3	
		Public Sector: Govt Health Post	4	
		Private Sector: Pvt Hospital	5	
		Private Sector: Private clinic/surgery	6	
		Private Sector: Mission Hospital	7	
		Private Sector: Mission Health Centerr	8	
		Private Sector: Mission Health Post (Primary	9	
		Other	10	
803	803. Name of health facility you intend to deliver:	Name _____		→999

	House Number _____	Study Site Code _____		
NO	**QUESTIONS AND FILTERS**	**CATEGORIES**	**CODE**	**SKIP**
999	**SECTION 10. PREGNANCY CARE FOR EACH CHILD.** Now I would like to ask you some questions about the health of your children born in the last five years. We will talk about each child separately, starting with the most recent birth. This also includes any child that was born but passed away before it turned 2 years old in the last 2 years.			→1000
1000	1000. Record line number of [name] from the household listing.	Line number___		→1001
1001	1001. From HH listing Name living or not.	Living	1	→1002
		Not living	2	→1002
1002	1002. When was [name] born?	_____	Date	→1003
1003	1003. Are you [name's] biologic mother?	Yes	1	→1004
		No	2	→1100
1004	1004. When you were pregnant with [name], did you consult for antenatal care for this pregnancy?	Yes	1	→1005
		No	2	→1300
1005	1005. Is there any antenatal record or consultation book for [name] where his/her antenatal care is written down.	Yes	1	→1006
		No	2	→1007
1006	1006. May I see it? *(if reluctant response, encourage to view booklet)*	Yes	1	→1007
		No	2	
		I can not find booklet at the moment	3	
1007	1007. Where did you first receive antenatal care?	Home ("unbooked")	1	→1010
		Govt Hosp	2	→1008
		Govt Health Centre	3	
		Govt Health Post	4	
		Private sector Clinic	5	
		Mission Hospital	6	
		Mission Health Centre	7	
		Mission Health Post (primary health center)	8	
		Other	9	
1008	1008. Please tick source of information .	Only Recall	1	→1009
		Only Medical record	2	
		Medical record and Recall	3	
		Other	4	
1009	1009. Name of Health Facility *(fill out 'unknown' if not known)*	Name _____	Text	→1010

1010	1010. Please tick source of information.	Only Recall	1	→1011
		Only Medical record	2	
		Medical record and Recall	3	
		Other	4	
1011	1011. During [name's] pregnancy how many months pregnant were you when you first received antenatal care?	2 Months	1	→1012
		3 Months	2	
		4 Months	3	
		5 Months	4	
		6 Months	5	
		7 Months	6	
		8 Months	7	
		9 Months	8	
		Don't know	9	
1012	1012. Please tick source of information .	Only Recall	1	→1013
		Only Medical record	2	
		Medical record and Recall	3	
		Other	4	
1013	1013. During [Name's] pregnancy, were you tested for syphilis?	Yes	1	→1014
		No	2	
		Don't know	3	→1017
1014	1014. Please tick source of information .	Only Recall	1	→1015
		Only Medical record	2	
		Medical record and Recall	3	
		Other	4	
1015	1015. Were you told the result of your syphilis test?	Yes	1	→1016
		No	2	
1016	1016. Please tick source of information.	Only Recall	1	→1017
		Only Medical record	2	
		Medical record and Recall	3	
		Other	4	
1017	1017. During [name's] pregnancy what was the result of your syphilis test?	Positive	1	→1018
		Negative	2	
		Don't want to tell you	3	→1019
		Don't know	4	
1018	1018. Please tick source of information.	Only Recall	1	→1019
		Only Medical record	2	
		Medical record and Recall	3	
		Other	4	
1019	1019. Were you given an injection for treatment of syphilis?	Yes	1	→1020
		No	2	
		Don't know	3	

1020	1020. Please tick source of information.	Only Recall	1	→1021
		Only Medical record	2	
		Medical Record and Recall	3	
		Other	4	
1021	1021. During [name's] pregnancy were you tested for HIV?	Yes	1	→1022
		No	2	
		Don't know	3	→1025
		Don't want to tell you	4	→1100
1022	1022. Please tick source of information.	Only Recall	1	→1023
		Only Medical record	2	
		Medical Record and Recall	3	
		Other	4	
1023	1023. What was the result of this test?	HIV positive	1	→1024
		HIV negative	2	
		Don't know	3	→1025
		Don't want to tell you	4	→1200
1024	1024. Please tick source of information.	Only Recall	1	→1025
		Only Medical record	2	
		Medical Record and Recall	3	
		Other	4	
1025	1025. During (Name's) pregnancy, were you given any drugs to prevent mother to child transmission of HIV? *(show picture of Nevirapine and AZT)*	Yes	1	→1026
		No	2	
		No, I am already taking HAART	3	→1035
		No, I tested HIV negative	4	→1200
		Can not remember	5	
1026	1026. Please tick source of information.	Only Recall	1	→1027
		Only Medical record	2	
		Medical Record and Recall	3	
		Other	4	
1027	1027. What medications were you given? *(show pictures to help remember)*	NVP only	1	→1028
		AZT only	2	
		NVP and AZT	3	
		HAART (or local name)	4	→1035
		Can not remember	6	→1200
		Other	7	→1200
1028	1028. Please tick source of information.	Only Recall	1	→1029
		Only Medical record	2	
		Medical Record and Recall	3	
		Other	4	
1029	1029. Did you take the Nevirapine tablet?	Yes	1	→1030
		No	2	→1034
		Can not remember	3	→1032

1030	1030. When did you take the Nevirapine tablet?	When I went into labor	1	→1031
		After I delivered	2	
		1-7 days before delivery	3	
		Can not remember	4	→1034
1031	1031. How many times did you take the Nevirapine tab?	One time	1	→1034
		Two times	2	
		More than 2 times	3	
		Can not remember	4	
1032	1032. Did you take the AZT?	Yes	1	→1033
		No	2	→1200
		I was not given AZT tablets	3	
		Can not remember	4	
1033	1033. If you were given AZT, how many tablets did you take?	All of the tablets	1	→1034
		Some Of The Tablets	2	
		None of the tablets	3	→1200
		Can not remember	4	
1034	1034. During [Name's] pregnancy, when did you start taking the AZT tablets?	8 Weeks	1	→1200
		12 Weeks	2	
		16 Weeks	3	
		20 Weeks	4	
		24 Weeks	5	
		28 Weeks	6	
		32 Weeks	7	
		36 Weeks	8	
		38 Weeks	9	
		Can not remember	10	
1035	1035. When did you start taking HAART?	Before pregnancy	1	→1200
		During pregnancy	2	
		After delivery	3	
		Can not remember	4	
NO	**QUESTIONS AND FILTERS**	**CATEGORIES**	**CODE**	**SKIP**
1100	**SECTION 11:** QUESTIONS FOR CAREGIVER OTHER THAN MOTHER	Continue	1	→1101
		back to index	2	→31
1101	1101. What is reason that [name] is not staying with the mother?	Mother has passed away	1	→1102
		Mother lives elsewhere	2	→1102
1102	1102. Did the mother consult for antental care in this pregnancy?	Yes	1	→1103
		No	2	→1200
		Don't Know	3	→1200
1103	1103. Where did her first ANC visit take place? *(fill in 'unknown' if unknown)*	Place _____	text	→1104
1104	1104. Name of Health Facility	Name _____	text	→1105

1105	1105. How many months pregnant was she when she first received antenatal care?	1 Month	1	→1200
		2 Months	2	
		3 Months	3	
		4 Months	4	
		5 Months	5	
		6 Months	6	
		7 Months	7	
		8 Months	8	
		9 Months	9	
		Don't know	10	
NO	**QUESTIONS AND FILTERS**	**CATEGORIES**	**CODE**	**SKIP**
1200	**SECTION 12**: REVIEW OF ANTENATAL RECORD LAB TESTS *(for both living and dead mothers-if possible)*	Continue	1	→1201
		Back to index	2	→32
1201	1201. Do you have the ANC card from this pregancy? If so, can it be shown? *(verfiy Q 1202-1204)*	Yes, Seen	1	→1202
		Yes, Not Seen	2	→1300
		No Card	3	→1300
1202	1202. Maternal HIV antibody test	Pos	1	→1203
		Neg	2	
		Indeterminate	3	
		Not done	4	
		Nothing written on card	5	
1203	1203. Syphilis test result	Pos	1	→1204
		Neg	2	
		Not done	3	
		Nothing written on card	4	
1204	1204. Hemoglobin *(fill out '00' if unknown)*	Grams _____	text	→1300
NO	**QUESTIONS AND FILTERS**	**CATEGORIES**	**CODE**	
1300	**SECTION 13:** BIRTH HISTORY FOR EACH CHILD *(if biological mother has passed away ask a reliable family member)*	Continue	1	→1301
		Back to index	2	→33
1301	1301. Where did the birth of [name] take place?	Your Home	1	→1302
		Other Home	2	
		Govt Hospital	3	→1303
		Govt Health Clinic	4	
		Govt Health Post	5	
		Private Hospital/Clinic	6	
		Mission Hospital	7	
		Mission Health Clinic	8	
		Mission Health Post (primary health center)	9	
		Don't know	10	→1304

1302	1302. Was [name] taken to a health center after delivery within 3 days of birth?	Yes	1	→1303
		No	2	→1305
		Don't Know	3	
1303	1303. Name of Health Facility *(fill in 'unknown' if unknown)*	Name _____		→1304
1304	1304. Was [name] delivered by cesarean section	Yes	1	→1305
		No	2	
		Don't know	3	
1305	1305. Who assisted with the delivery of [name]?	HEALTH PROFESSIONAL:Doctor	1	→1306
		HEALTH PROFESSIONAL: Nurse/Midwife	2	
		HEALTH PROFESSIONAL : Unskilled Worker at Health Centre	3	
		Traditional/Trained Birth Attendant	5	
		Friend/neighbour	6	
		Family Member	7	
		No one	8	
		Other	9	
		Don't know	10	
1306	1306. Was [name] weighed at birth?	Yes	1	→1307
		No	2	→1308
		Don't know/not recorded	9	
1307	1307. How much did [name] weigh? (fill out '00' if unknown)	_____ grams		→1308
1308	1308. Did [name] receive any Polio vaccination before discharge from the clinic or hospital?	Yes	1	→1309
		No	2	
		Do not remember/Do not know	3	
1309	1309. Did [name] receive any AZT syrup in his mouth before discharge from the clinic or hospital?	Yes	1	→1310
		No	2	
		Do not remember/Do not know	3	
		Not applicable (mother HIVneg)	4	→1312
1310	1310. Did [name] receive any Nevirapine syrup in his mouth before discharge from the clinic or hospital?	Yes	1	→1311
		No	2	
		Do not remember	3	
		Not applicable (mother HIVneg)	4	
1311	1311. Was [name] given Bactrim/Cozole to take every day beginning at 6 weeks even when [name] was not sick?	Yes	1	→ 1312
		No	2	
		Do not know	3	
1312	1312. Was [name] ever breastfed?	Yes	1	→1313
		No	2	→1315
1313	1313. Is [name] still breastfeeding? *(ONLY ASK IF CHILD STILL LIVING)*	Yes	1	→1315
		No	2	→1314

1314	1314. For how many months was [name] breastfed?	1 Month	1	→1315
		2 Months	2	
		3 Months	3	
		4 Months	4	
		5 Months	5	
		6 Months	6	
		7 Months	7	
		8-10 Months	8	
		11-12 Months	9	
		13-18 Months	10	
		19-24 Months	11	
		Longer than 2 years	12	
1315	1315. How old was [name] when you first gave him/her water?	0-7 Days after birth	1	→1316
		2-4 Weeks after birth	2	
		1-2 Months after birth	3	
		3-4 Months after birth	4	
		5-6 Months after birth	5	
		More than 6 months after birth	6	
		Child was never given water	7	
		Do not remember	8	
1316	1316. Was [name] ever given formula? *(Note: formula is a specially prepared commercial product/food for babies like Pelargon/NAN/SMA)*	Yes	1	→1317
		No	2	→1319
		Do not know	9	
1317	1317. How old was [name] when formula was given for the first time? *(fill in 1/1/2010 if unknown)*	_____	Date	→1318
1318	1318. Why was [name] given formula feeding? *(circle all that apply) (Note: formula is a specially prepared commercial product/food for babies like Pelargon/NAN/SMA)*	Mother too sick to breast feed	1	→1319
		Mother died	2	
		Mother didn't have enough milk	3	
		[Name] was not staying with the mother	4	
		To prevent HIV transmission	5	
		Thought it was good for [name]	6	
		Mother had to go back to school/work	7	
		Other	8	
		Do not know/Do not remember	9	
1319	1319. Has [name] ever had tinned, powdered or fresh animal milk?	Yes	1	→1320
		No	2	→1322
		Do not know/Do not remember	3	

1320	1320. How old was [name] when milk such as tinned, powdered or fresh animal milk was given for the first time? *(fill in '1/1/2010' if unknown)*	_____	Date	→1321
1321	1321. Why was [name] given milk? *(circle all that apply)*	Mother too sick to feed	1	→1322
		Mother died	2	
		Mother did not produce enough milk	3	
		Baby was not staying with the mother	4	
		To prevent HIV transmission	5	
		Thought it was good for the child	6	
		Mother had to go back to school/work	7	
		Other	8	
		Do not know/Do not remember	9	
1322	1322. Has [name] ever been given tea, coffee or juice?	Yes	1	→1323
		No	2	→1324
		Do not know/Do not remember	3	
1323	1323. How old was [name] when tea, coffee or juice were given for the first time?	0-2 Months	1	→1324
		3-4 Months after birth	2	
		5-7 Months	3	
		8-10 Months	4	
		11-12 Months	5	
		More than 12 months	6	
		Can not remember	7	
1324	1324. Has [name] ever been given porridge or semi solid food?	Yes	1	→1325
		No	2	→1326
		Do not know/Do not remember	9	
1325	1325. How old was [name] when porridge or other semi solid food were given to him?	0-2 Months	1	→1326
		3-4 Months after birth	2	
		5-7 Months	3	
		8-10 Months	4	
		11-12 Months	5	
		More than 12 months	6	
		Can not remember	7	
1326	1326. Has [name] had family food? (solid food)	Yes	1	→1327
		No	2	→1328
		Do not know/Do not remember	3	

1327	1327. How old was [name] when family food (solid food) was given for the first time?	0-2 Months	1	→1328
		3-4 Months after birth	2	
		5-7 Months	3	
		8-10 Months	4	
		11-12 Months	5	
		More than 12 months	6	
		Can not remember	7	
1328	1328. What did [name] eat and drink yesterday? *(Mark all that apply)*	Breast milk	1	→1329
		Plain water	2	
		Formula milk	3	
		Animal milk	4	
		Porridge	5	
		Family food	6	
		Juice	7	
		Other	8	
1329	1329. Did anyone at the health facility instruct you on how to feed your infant after you were discharged or when you came for Post Natal Care?	Yes	1	→1330
		No	2	
1330	1330. Has [name] been tested for HIV?	Yes	1	→1331
		No	2	→1332
1331	1331. When was [name] tested for HIV? *(fill in '1/1/2010' if unknown)*	_____	Date	→1332
1332	1332. What was the result?	HIV Positive	1	→1333
		HIV negative	2	
		Indeterminant	3	
		Do not know	4	
		Do not want to tell you	5	
1333	1333. Has [name] ever spent the night in a clinic or hospital (AFTER being discharged from birth facility)?	Yes	1	→1334
		No	2	→1336
		Do not know/Do not remember	9	
1334	1334. How many times has [name] been hospitalized?	1 Time hospitalized	1	→1335
		2 Times hospitalized	2	
		3 Times hospitalized	3	
		4 Times hospitalized	4	
		More than 4 times hospitalized	5	
		Do not know	6	
1335	1335. What were the reasons for hospitalization?	Diarrhea	1	→1336
		Breathing problems	2	
		Fever	3	
		Vomiting	4	
		Other reason	5	
1336	1336. Did [name] sleep under a malaria net last night?	Yes	1	→1400
		No	2	

NO	QUESTIONS AND FILTERS	CATEGORIES	CODE	SKIP
1400	**SECTION 14:** CHILD HEALTH CARD	Continue	1	→1401
		Back to index	2	→34
1401	1401. Do you have an under 5 card where [name's] vaccinations are written down? If Yes, may I please see it?	Yes, Seen	1	→1402
		Yes, Not Seen	2	
		No Card	3	
1402	1402. BCG	Yes	1	→1403
		No	2	
1403	1403. Date BCG: *(fill out '1/1/2010' if unknown)*	Date: _____		→1404
1404	1404. OPV0	Yes	1	→1405
		No	2	
1405	1405. Date OPV0: *(fill out '1/1/2010' if unknown)*	Date: _____		→1406
1406	1406. OPV1	Yes	1	→1407
		No	2	
1407	1407. Date OPV1: *(fill out '1/1/2010' if unknown)*	Date: _____		→1408
1408	1408. OPV2	Yes	1	→1409
		No	2	
1409	1409. Date OPV2: *(fill out '1/1/2010' if unknown)*	Date: _____		→1410
1410	1410. OPV3	Yes	1	→14011
		No	2	
1411	1411. Date OPV3: *(fill out '1/1/2010' if unknown)*	Date: _____		→1412
1412	1412. DPT1	Yes	1	→14013
		No	2	
1413	1413. Date DTP1: *(fill out '1/1/2010' if unknown)*	Date: _____		→1414
1414	1414. DPT2	Yes	1	→1415
		No	2	
1415	1415. Date DTP2: *(fill out '1/1/2010' if unknown)*	Date: _____		→1416
1416	1416. DPT3	Yes	1	→1417
		No	2	
1417	1417. Date DTP3: *(fill out '1/1/2010' if unknown)*	Date: _____		→1418
1418	1418. Measles	Yes	1	→1419
		No	2	
1419	1419. Date Measles: *(fill out '1/1/2010' if unknown)*	Date: _____		→1420

1420	1420. Vitamin A	Yes	1	→1421
		No	2	
1421	1421. Date Vitamin A: *(fill out '1/1/2010' if unknown)*	Date: _____		→1422
1422	1422. IF CARD IS AVAILABLE: Is there an indication on [name's] card that the mother is HIV infected?	Yes	1	→1423
		No	2	
1423	1423. Is there any indication that [name] received PMTCT? *(Check all that apply)*	Mother's HIV status noted	1	→1414
		NVP given to mother	2	
		NVP given to [name]	3	
		AZT given to mother	4	
		AZT given to [name]	5	
		HAART given to mother	6	
		Other	7	
		No	8	
1424	1424. Is [name's] HIV test result on card?	Yes	1	→ 1425
		No	2	→ 1426
1425	1425. Is [name] HIV infected?	Yes	1	→ 1426
		No	2	
		Unknown, because [name] is not tested yet	3	
		Unknown	4	
1426	1426. Do you have more children below the age of 5 years living in this house? *(refer to children biological mother)*	Yes	1	→ 1000
		No	2	→ 1500

	House Number _____	Study Site Code _____		
NO	**QUESTIONS AND FILTERS**	**CATEGORIES**	**CODE**	**SKIP**
1500	1500. **SECTION 15** PHYSICAL EXAM/LAB TESTS. Enter Line number mother *(drop down list)*	Line number _____		→1501
1501	1501. Was Mother's Height (cm) (record to nearest 0.5 cm) recorded?	Yes, Height of the mother was recorded	1	→1502
		No, Height of the mother was not recorded	2	→1503
1502	1502. What was the Height of the mother?	Height in cm _____		→1504
1503	1503. The Height of the Mother was not collected. Reason:	Equipment did not work	1	→1504
		Equipment was not complete	2	
		Mother has physical handicap, which makes measurment not possible	3	
		Refusal during informed consent	4	
		Refused after informed consent was approved	5	
		Other	6	
1504	1504. Was Mother's Weight (kg) (record digital read out) collected?	Yes, Weight of the mother was recorded	1	→1505
		No, Weight of the mother was not recorded	2	→1506
1505	1505. What was the Weight of the mother?	Weight in kg _____		→1507
1506	1506. The Weight of the Mother was not collected. Reason:	Equipment did not work	1	→1507
		Equipment was not complete	2	
		Child has physical handicap, which makes measurment not possible	3	
		Refusal during informed consent	4	
		Refused after informed consent was approved	5	
		Other	6	
1507	1507. Was Mother's Blood Obtained?	Yes	1	→1509
		No	2	→1508
1508	1508. The blood sample was not collected from the mother. Reason:	Refusal during the Informed Consent	1	→1509
		Mother changed her mind after Informed Consent approval	2	
		Could not find a vein	3	
		Other	4	
1509	1509. This survey takes place in:	South Africa	1	→1511
		Zambia	2	
		Ivory Coast	3	
		Cameroon	4	→1510

1510	1510. Result Mother's HIV Test (for Cameroon only)	Positive	1	→1511
		Negative	2	
		Indeterminant	3	
		Not possible to do test, because could not be collected	4	
1511	1511. Was an Oraquick swab obtained from the mother?	Yes	1	→1512
		No, blood sample already collected	2	
		No, refusal during informed consent	3	
		No, refused after approval informed consent	4	
		No, test not done in country	5	
1512	1512. Enter line number Child	Line number _____		→1513
1513	1513. Was the Height of [Child Name's] recorded?	Yes, Height of the child was recorded	1	→1514
		No, Height of the child was not recorded	2	→1515
1514	1514. What was the Height of the child?	Height in cm: _____		→1516
1515	1515. The Height of [Child Name] was not recorded. Reason:	Equipment did not work	1	→1516
		Equipment was not complete	2	
		Child was so upset, it could not be measured properly	3	
		Child has physical handicap, which makes measurment not possible	4	
		Refusal during informed consent	5	
		Refused after informed consent was approved	6	
		Other	7	
1516	1516. Was the Weight of [Child Name] recorded? (in kg to nearest 0.1 kg)	Yes, the Weight of the child was recorded	1	→1517
		No, the Weight of the child was not recorded	2	→1518
1517	1517. What was the Weight of the child?	Weight in kg; _____		→1519
1518	1518. The Weight of [Child Name] was not recorded. Reason:	Equipment did not work	1	→1519
		Equipment was not complete	2	
		Child was so upset, it could not be measured properly	3	
		Child has physical handicap, which makes measurment not possible	4	
		Refused after informed consent was approved	5	
		Refused during informed consent	6	
		Other	7	

1519	1519. Was an antibody test performed on this child? *(circle all results that were obtained)* *(Cameroon only)*	Test not performed	1	→1520
		Determine Positive	2	
		Determine negative	3	
		Bioline HIV1 negative	4	
		Bioline HIV1 positive	5	
		Biolone HIV2 negative	6	
		Bioline HIV2 positive	7	
		Acon negative	8	
		Acon positive	9	
		Not appplicable/other country than Cameroon	10	
1520	1520. Was [Child Name's] Blood Obtained on a Dried Blood Spot Card?	Yes	1	→1522
		No	2	→1521
1521	1521. The Blood was not obtained on the Dried Blood Spot Card of [Child Name]. Reason:	Equipment did not work	1	→1522
		Equipment was not complete	2	
		Child was so upset, it could not be measured properly	3	
		Child has physical handicap, which makes measurment not possible	4	
		Refusal during informed consent	5	
		Refused after informed consent was approved	6	
		Other	7	
1522	1522. Was [Child Name's] Hemoglobin Result Obtained? *(only for interviewed children)*	Yes	1	→1523
		No	2	→1524
1523	1523. What was the result of the Hemoglobin test?	Result --.-- g/dl		→1525
1524	1524. The Hemoglobin result was not collected. Reason:	Equipment did not work	1	→1525
		Equipment was not complete	2	
		Child was so upset, it could not be measured properly	3	
		Child has physical handicap, which makes measurment not possible	4	
		Refused after informed consent was approved	5	
		Other	6	
1525	1525. Any other children from this biological mother, that are below 5 years and were interviewed in this questionnaire?	Yes	1	→1512
		No	2	→End

D. Mother/Child Questionnaire Amendments

	QUESTIONS AND FILTERS	CATEGORIES	CODE	SKIP
500	**500. SECTION 5:** HIV Knowledge and Experiences	Continue	1	→501
		Back to index	2	→25
501	501. Have you ever heard of HIV/AIDS?	Yes	1	→502
		No	2	→601
502	502. Can the virus that causes AIDS be transmitted from a mother to a child during pregnancy?	Yes	1	→503
		No	2	
		Don't know	3	
503	503. Can the virus that causes AIDS be transmitted from a mother to a child during delivery?	Yes	1	→504
		No	2	
		Don't know	3	
504	504. Can the virus that causes AIDS be transmitted from a mother to a child during breastfeeding?	Yes	1	→505
		No	2	
		Don't know	3	
505	505. Are there special drugs that a doctor or nurse can give to a woman infected with the AIDS virus to reduce the risk of transmission to the baby?	Yes	1	→506
		No	2	
		Don't know	3	
506	506. What is the best way to feed your baby in the first six months of its life?	Breast milk plus water only	1	→600
		Breast milk plus artificial milk	2	
		Only breast milk	3	
		Breast milk plus other foods	4	
	QUESTIONS AND FILTERS	**CATEGORIES**	**CODE**	**SKIP**
600	**600. SECTION 6:** ANTI RETROVIRAL INFORMATION *-Ask all mothers*	Continue	1	→601
		Back to index	2	→26
601	601. Have you heard about special antitretroviral drugs (or use local name) that people infected with the AIDS virus can get from a doctor or a nurse to help them live longer?	Yes	1	→602
		No	2	→700
		Don't know	3	

add: → ART"/"ARTs" or treatment"

MOTHER QUESTIONNAIRE

Final Paper version

15 MAY 08

602	602. Can pregnant women receive these drugs?	Yes	1	→603
		No	2	
		Don't Know	3	
603	603. Can children receive these drugs?	Yes	1	→700
		No	2	
		Don't Know	3	
	QUESTIONS AND FILTERS	**CATEGORIES**	**CODE**	**SKIP**
700	**700. SECTION 7:** HIV TESTING	Continue	1	→701
		Back to index	2	→27
701	701. Have you ever been tested for the AIDS virus?	Yes	1	→702
		No	2	→710
		Don't know	3	
		Don't want to tell you	4	
702	702. What was the date of the most recent test? *(fill out '1/1/2010' if unknown)*	Date _____		→703
703	703. Was this the first time you have been tested?	Yes	1	→704
		No	2	
704	704. What was the result of the most recent test?	HIV positive	1	→705
		HIV negative	2	→708
		Don't know	3	→710
		Don't want to tell you	4	→706
705	705. When did you learn you had HIV? *(fill out '1/1/2010' if unknown)*	Date _____		→706
706	706. Are you currently taking special antiretroviral drugs (USE LOCAL NAME) HAART?	Yes	1	→707
		No	2	→710
		Don't Know	3	
		Don't want to tell you	4	
707	707. When did you start taking special antiretroviral drugs (or use local name)? *(fill out '1/1/2010' if unknown)*	Date _____		→708
708	708. Did you tell anyone the results?	Yes	1	→709
		No	2	→710

add: "ART" / "HAART"

MOTHER QUESTIONNAIRE
Final PAPER version
15 MAY 08

709	709. Whom did you tell about your HIV test result? *(more than 1 answer possible)*	Partner(s)	1	→710
		Children	2	
		Other Family Member	3	
		Pastor	4	
		Friend(s)	5	
		Other	6	
710	710. Has your husband/partner ever been tested for HIV?	Yes	1	→711
		No	2	→800
		Don't know	3	
711	711. What was the result?	Positive	1	→800
		Negative	2	
		Don't know	3	
		I don't want to tell you	4	
	QUESTIONS AND FILTERS	**CATEGORIES**	**CODE**	**SKIP**
800	**800. SECTION 8:** PREGNANCY	Continue	1	→801
		Back to index	2	→28
801	801. Are you pregnant now?	Yes	1	→802
		No	2	→999
802	802. Where do you intend to deliver?	Home	1	→999
		Public Sector: Govt Hosp	2	→803
		Public Sector: Govt Health Centre	3	
		Public Sector: Govt Health Post	4	
		Private Sector: Pvt Hospital	5	
		Private Sector: *Private clinic/surgery*	6	
		Private Sector: Mission Hospital	7	
		Private Sector: Mission Health Centerr	8	
		Private Sector: Mission Health Post (Primary	9	
		Other	10	
803	803. Name of health facility you intend to deliver:	Name _____		→999

QUERY (Primary ...)?

MOTHER QUESTIONNAIRE
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	House Number _____	Study Site Code _____		
NO	**QUESTIONS AND FILTERS**	**CATEGORIES**	**CODE**	**SKIP**
999	**FOR EACH CHILD.** Now I would like to ask you some questions about the health of your children born in the last five years. We will talk about each child separately, starting with the most recent birth. This also includes any child that was born but passed away before it turned 2 years old in the last 2 years.			→1000
1000	1000. Record line number of [name] from the household listing.	Line number___		→1001
1001	1001. From HH listing Name living or not.	Living	1	→1002
		Not living	2	→1002
1002	1002. When was [name] born?	_____	Date	→1003
1003	1003. Are you [name's] biologic mother?	Yes	1	→1004
		No	2	→1100
1004	1004. When you were pregnant with [name], did you consult for antenatal care for this pregnancy?	Yes	1	→1005
		No	2	→1300
1005	1005. Is there any antenatal record or consultation book for [name] where his/her antenatal care is written down.	Yes	1	→1006
		No	2	→1007
1006	1006. May I see it? *(if reluctant response, encourage to view booklet)*	Yes	1	→1007
		No	2	
		I can not find booklet at the moment	3	
Add: → 1007	1007. Where did you first receive antenatal care?	Home ("unbooked")	1	→1010
		Govt Hosp	2	→1008
		Govt Health Centre	3	
		Govt Health Post	4	
		Private sector Clinic	5	
		Mission Hospital	6	
		Mission Health Centre	7	
		Mission Health Post (primary health center)	8	
		Other	9	
1008	1008. Please tick source of information.	Only Recall	1	→1009
		Only Medical record	2	
		Medical record and Recall	3	
		Other	4	
1009	1009. Name of Health Facility *(fill out 'unknown' if not known)*	Name _____	Text	→1010

CHILD QUEST.
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1302	1302. Was [name] taken to a health center after delivery within 3 days of birth?	Yes	1	→1303
		No	2	→1305
		Don't Know	3	
1303	1303. Name of Health Facility *(fill in 'unknown' if unknown)*	Name _____		→1304
1304	1304. Was [name] delivered by cesarean section	Yes	1	→1305
		No	2	
		Don't know	3	
1305	1305. Who assisted with the delivery of [name]?	HEALTH PROFESSIONAL:Doctor	1	→1306
		HEALTH PROFESSIONAL: Nurse/Midwife	2	
		HEALTH PROFESSIONAL : Unskilled Worker at Health Centre	3	
		Traditional/Trained Birth Attendant	5	
		Friend/neighbour	6	
		Family Member	7	
		No one	8	
		Other	9	
		Don't know	10	
1306	1306. Was [name] weighed at birth?	Yes	1	→1307
		No	2	→1308
		Don't know/not recorded	9	
1307	1307. How much did [name] weigh? (fill out '00' if unknown)	_____ grams		→1308
1308	1308. Did [name] receive any Polio vaccination before discharge from the clinic or hospital?	Yes	1	→1309
		No	2	
		Do not remember/Do not know	3	
1309	1309. Did [name] receive any AZT syrup in his mouth before discharge from the clinic or hospital?	Yes	1	→1310
		No	2	
		Do not remember/Do not know	3	
		Not applicable (mother HIVneg)	4	→1312
1310	1310. Did [name] receive any Nevirapine syrup in his mouth before discharge from the clinic or hospital?	Yes	1	→1311
		No	2	
		Do not remember	3	
		Not applicable (mother HIVneg)	4	
1311	1311. Was [name] given cotrimoxazole to take every day beginning at 6 weeks even when [name] was not sick?	Yes	1	→ 1312
		No	2	
		Do not know	3	
1312	1312. Was [name] ever breastfed?	Yes	1	→1313
		No	2	→1315
1313	1313. Is [name] still breastfeeding? *(ONLY ASK IF CHILD STILL LIVING)*	Yes	1	→1315
		No	2	→1314

QUERY "Do not KNOW"? → 1308

QUERY "Do not KNOW"? → 1309

ADD: "BACTRIM"/ "COZOLE" → 1311

Child Questionnaire
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1314	1314. For how many months was [name] breastfed?	1 Month	1	→1315
		2 Months	2	
		3 Months	3	
		4 Months	4	
		5 Months	5	
		6 Months	6	
		7 Months	7	
		8-10 Months	8	
		11-12 Months	9	
		13-18 Months	10	
		19-24 Months	11	
		Longer than 2 years	12	
1315	1315. How old was [name] when you first gave him/her water?	0-7 Days after birth	1	→1316
		2-4 Weeks after birth	2	
		1-2 Months after birth	3	
		3-4 Months after birth	4	
		5-6 Months after birth	5	
		More than 6 months after birth	6	
		Child was never given water	7	
		Do not remember	8	
1316	1316. Was [name] ever given formula? *(Note: formula is a specially prepared commercial product/food for babies like ~~Similac, Cerelac or Guigos~~)*	Yes	1	→1317
		No	2	→1319
		Do not know	9	
1317	1317. How old was [name] when formula was given for the first time? *(fill in 1/1/2010 if unknown)*	_____	Date	→1318
1318	1318. Why was [name] given formula feeding? *(circle all that apply) (Note: formula is a specially prepared commercial product/food for babies like ~~Similac, Cerelac or Guigos~~)*	Mother too sick to breast feed	1	→1319
		Mother died	2	
		Mother didn't have enough	3	
		[Name] was not staying with the mother	4	
		To prevent HIV transmission	5	
		Thought it was good for _____	6	
		Mother had to go back to _____	7	
		Other	8	
		Do not know/Do not _____	9	
1319	1319. Has [name] ever had tinned, powdered or fresh animal milk?	Yes	1	→1320
		No	2	→1322
		Do not know/Do not remember	3	

DELETE → ~~Similac, Cerelac or Guigos~~

ADD: Pelargon/ NAN/SMA

DELETE → ~~Similac, Cerelac or Guigos~~

ADD: Pelargon/ NAN/SMA

QUERY
- good for BABY/CHILD
- back to WORK/SCHOOL
- Do not REMEMBER

Child Questionnaire
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1320	1320. How old was [name] when milk such as tinned, powdered or fresh animal milk was given for the first time? *(fill in '1/1/2010' if unknown)*	_____	Date	→1321
1321	1321. Why was [name] given milk? *(circle all that apply)*	Mother too sick to feed	1	→1322
		Mother died	2	
		Mother did not produce enough milk	3	
		Baby was not staying with the mother	4	
		To prevent HIV transmission	5	
		Thought it was good for the child	6	
		Mother had to go back to school	7	
		Other	8	
		Do not know/Do not remember	9	
1322	1322. Has [name] ever been given tea, coffee or juice?	Yes	1	→1323
		No	2	→1324
		Do not know/Do not _____	3	
1323	1323. How old was [name] when tea, coffee or juice were given for the first time?	0-2 Months	1	→1324
		3-4 Months after birth	2	
		5-7 Months	3	
		8-10 Months	4	
		11-12 Months	5	
		More than 12 months	6	
		Can not remember	7	
1324	1324. Has [name] ever been given porridge or semi solid food?	Yes	1	→1325
		No	2	→1326
		Do not know/Do not _____	9	
1325	1325. How old was [name] when porridge or other semi solid food were given to him?	0-2 Months	1	→1326
		3-4 Months after birth	2	
		5-7 Months	3	
		8-10 Months	4	
		11-12 Months	5	
		More than 12 months	6	
		Can not remember	7	
1326	1326. Has [name] had family food? (solid food)	Yes	1	→1327
		No	2	→1328
		Do not know/Do not _____	3	

Query: what about "work"?

ADD: "remember"

ADD: "remember"

ADD: "remember"

E. University of Cape Town Ethics Approval Letter

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: shuretta.thomas@uct.ac.za

21 January 2013

HREC REF: 035/2013

Mr H Mathema
c/o Dr K Stinson
Paediatrics & Child Health
Red Cross War Memorial Children's Hospital

Dear Mr Mathema

PROJECT TITLE: EFFECTS OF HIV EXPOSURE ON CHILD GROWTH IN THE FREE STATE AND WESTERN CAPE PROVINCES, SOUTH AFRICA

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year till the 30th January 2014

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/research/humanethics/forms)

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.

Institutional Review Board (IRB) number: IRB00001938
This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.
The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

s.thomas

B. STRUCTURED LITERATURE REVIEW

TABLE OF CONTENTS

INTRODUCTION

Malnutrition is the largest contributor to the global burden of disease.(1) It includes undernutrition which continues to be a major threat to public health in developing countries,(2) particularly in women and children.(3) Undernutrition accounts for more than a third of the mortality in children less than five years of age.(4) Global efforts to fight undernutrition have met with some successes, reducing the proportion of children that are underweight from 29% to 18% and the prevalence of chronic undernutrition (i.e. stunting – low height-for-age) from 44% to 29% between 1990 and 2010.(5) In sub-Saharan Africa (SSA), similar successes have been reported in the reduction of childhood underweight,(5) however the southern sub-region did not show any progress with the burden of childhood underweight as it increased from 11.7% to 13.2% between 1990 and 2007.(6) In addition, there has been little progress in efforts against chronic undernutrition in SSA, decreasing from 40.3% to 38.5% between 1990 and 2007.(6) In South Africa, the evidence points to a general increase in child undernutrition over the last two decades.(4,7) Given the commitment to global development as outlined in the United Nations (UN) Millennium Development Goals,(5) it is important that progress regarding nutrition be realised and monitored as nutrition affects, and is affected by, each development goal.(8)

The HIV (human immunodeficiency virus) epidemic also poses direct and indirect health and development challenges in SSA, including undernutrition.(5,9) SSA accounts for 69% of the people living with HIV worldwide. However, significant strides have been made to reduce new infections in the region, especially mother-to-child transmission of HIV. The number of children newly infected declined by 40-59% between 2009 and 2011 in some countries, including South Africa.(10) Therefore, since the number of HIV-exposed but uninfected children is rapidly increasing, a comprehensive understanding of their health risk profile as it relates to undernutrition would be valuable in child health programming. Studies have shown that HIV-exposed but uninfected children may have an increased risk of growth faltering(11) which may be partly mediated by reduced breastfeeding, poor maternal health, inadequate infant care, and increased morbidity and exposure to other infections.(11–13)

Defining and Measuring Undernutrition

Malnutrition results from dietary inadequacies or imbalances, infection, social, cultural, economic and environmental factors. Nutritional status in children is typically measured using anthropometry, the scientific study of the measurements and proportions of the human body. Undernutrition is a condition, a type of malnutrition, that results in subnormal anthropometry and/or micronutrient malnutrition.(6) In 2006, the World Health Organization (WHO) released the first internationally standardised child growth reference standards that included 12 anthropometric indicators.(14) The most frequently used indicators and those that will be included in this review are weight-for-height/length, weight-for-age, and height- or length for-age; length is used to refer to the linear growth of children under the age of two, as opposed to height which is used for the linear growth of people older than two. In this review, height will be used to refer to linear growth of children of all ages.

Weight-for-height, weight-for-age and height-for-age are used to determine nutritional status and correspond to wasting, underweight, and stunting, respectively. One is classified as being wasted, underweight, or stunted when the anthropometric score is more than two standard deviations below the average of the reference population or standards.(2) Wasting occurs when one has a low weight-for-height. It is an indicator for acute weight loss caused by recent illness or inadequate food intake. Underweight refers to low weight-for-age; however, underweight may also be a function of low weight-for-height. Therefore it may be caused by acute and/or chronic exposures, making it a composite indicator. Chronic undernutrition is indicated by stunting or low height-for-age. Stunting may also be caused by chronic illness. While underweight is the main indicator related to hunger and undernutrition, stunting is the most reliable measure of undernutrition in public health and development because of its dependence solely on chronic risks.(2,4,6,15)

Aim

Since the mid-to-late 1980s, research into the effects of HIV exposure on child nutritional status has been conducted, yielding conflicting results for the association between HIV exposure and undernutrition. Therefore, the aim of this literature review is to summarize and synthesize the

evidence of the relationship between HIV exposure and undernutrition, as measured by child anthropometry, in SSA.

METHODS

Literature searches were conducted using PubMed. Keywords (child*, HIV, growth, undernutrition, and Africa) were used to search for and retrieve relevant articles. Studies were selected if any inference made from the data presented included the effects of HIV on growth and nutritional status of uninfected children. The articles reviewed included evidence reported from varying study designs reporting direct HIV exposure (mother HIV-infected) and indirect exposure (household exposure i.e. at least one person living with HIV, or population level exposure i.e. prevalence). The evidence for an association between HIV exposure and undernutrition will be discussed by type of HIV exposure as it falls into four study design categories, viz. ecological, cross-sectional, case-control, and longitudinal.

UNDERNUTRITION AND INDIRECT HIV EXPOSURE

Ecological Design

In a study to determine the effect of HIV on child nutrition in Southern Africa, Mason and colleagues(16) analysed secondary area-level data from national surveys, surveillance systems, and UN sources spanning from 1992 to 2003. Areas were defined as provinces or similar groups of enumeration areas in surveys. The results showed a bivariate association for HIV prevalence and underweight. A second analysis including East Africa(17) using data from similar sources from 1995 to 2006 showed the same association between HIV prevalence and underweight of age. Areas with higher HIV prevalence had a lower burden of underweight. However, these associations were not maintained when socioeconomic variables (e.g. level of women's education) were accounted for. The change in prevalence over time in Zambia and Zimbabwe showed that areas with high and increasing prevalence recorded increases in childhood underweight. In Southern Africa, the interaction between HIV prevalence and drought in high burden areas led to a significant increase in the prevalence of underweight

A key limitation to these ecologic study findings is that HIV prevalence was used as a measure of HIV exposure i.e. exposure was measured at the population rather than the individual level. As the most upstream form of child HIV exposure, one is unable to parse out the effect of direct exposure on undernutrition therefore allowing one to make area-level inferences about that may not be valid at the individual level. The other limitation is that despite the identified confounding effect of women's education, data on other measures of socioeconomic status were not shown. Nevertheless, the authors maintained that there was value in referring to an inverse relationship between HIV prevalence and undernutrition in Southern Africa despite a non-significant as association as shown by the p-value (p=0.056).

Cross-sectional Design

In 2006 a group in Kenya sought to determine the nutritional status of children less than five years of age in HIV-affected and -unaffected households.(18) A household was classified as HIV-affected if any resident adult reported being HIV-positive, or if an HIV-related orphan lived in the household. There was no significant difference in the prevalence of wasting and underweight in the two groups, but more stunting was observed in the HIV-affected households (25.5% vs. 9.1%; p = 0.002). Households with an HIV-positive adult were more likely to have stunted children (41.7%) compared to those with orphans alone (20.9%; p = 0.013) or those unaffected (9.1%; p = 0.0001). A major limitation of this study was that HIV-related status of the household was self-reported. Although the sex of the HIV-positive person(s) was not identified, the study reported that 41% of the HIV-affected household were female-headed, compared to 8.3% in the unaffected households ($p < 0.01$). No multivariate analyses were performed to adjust for possible confounding variables and to determine the independent contribution to the burden of stunting.

Case-control Design

Between 2003 and 2004, a study on severe malnutrition in children under the age of five was conducted in the Limpopo province of South Africa.(19) Classification as having household HIV exposure was determined empirically in children under 12 months based on symptoms and mother's reported status, and using laboratory tests in older children at a clinician's discretion. Children with HIV in the family (parent or child) had 217.7 times the odds of severe malnutrition. A key limitation

with this association is that HIV exposure and HIV infection were grouped under one variable. Due to the known risk of HIV infection on undernutrition, this would artificially inflate the association between exposure and undernutrition. Secondly, determination of HIV exposure was dependent on the discretion of a clinician. There was no indication that decisions to confirm HIV status and diagnoses of probable infection were made using standardized procedures. Study controls were also not tested for HIV or exposure. Thirty-four of 100 malnutrition cases had confirmed as being HIV-infected and the rest of the exposure was determined empirically increasing the probability of differential misclassification, given the high prevalence of HIV in the cases and the association between HIV and undernutrition.

UNDERNUTRITION AND DIRECT HIV EXPOSURE

Cross-sectional Design

A population-based survey conducted in Uganda from 2004 to 2005 reported no significant association between undernutrition and HIV exposure at the individual level.(20) HIV status was determined in children between two and 12 years of age and their mothers, however the authors did not account of the potential confounding effect of other variables in a multivariate analysis. In a pooled analysis of Demographic and Health Surveys (2003-2008) from 18 African countries, children of HIV-infected mothers from low HIV-burdened countries were more wasted and underweight compared to HIV-exposed children from high HIV-burdened countries ($p < 0.05$).(21) Unlike the finding for this association from the ecological study discussed above,(17) this association was present after adjusting for confounding by socioeconomic status i.e. wealth index, and other variables e.g. age, sex, being average size at birth, mother's age and education, etc. In this study HIV status was determined in mothers, and HIV-exposed children were more likely to be stunted, wasted and underweight (odds ratios: 1.28, 1.26, and 1.26 respectively; $p < 0.05$).(21) In addition, other predictors of undernutrition interacted with maternal HIV infection to modify the effect on undernutrition. Maternal HIV infection interacted with younger age, multiple/twin births, and single parent status to increase the odds of undernutrition while female sex of the child, larger than average size at birth, greater than 36-month birth interval since the last child, and wealth index were protective against undernutrition.(21) A limitation in this study was the unknown HIV status of the

children. In addition, a limitation to the studies described above,(18,20,21) as with all cross-sectional studies, the temporal relationship between HIV-exposure and undernutrition could not be ascertained.

Longitudinal Design

Seventeen studies were found that reported findings from longitudinal studies, including cohort studies and randomized trials for different interventions, typically breastfeeding or micronutrient supplementation. In seven studies, only HIV-exposed infants were followed, so child growth and nutritional status were only measured but not compared by HIV exposure.(22–28) Because of the high prevalence of undernutrition in SSA,(6) inferences that could be made about HIV exposure were limited as the population trends are often different from the ideals in reference standards. Stunting was the most frequently reported measure of undernutrition with prevalence varying from 4.5%(29) to almost 60%.(26) While occurrences of undernutrition could be compared to population estimates, no statistical tests were done to verify the impact of HIV exposure. These studies have been included in this review because while investigators did not seek to answer the question of HIV exposure, it was often addressed in discussions of and recommendations from their findings, especially where undernutrition was high.

In the 10 remaining studies, growth outcomes were compared between HIV-exposed and unexposed children. Three studies reported that Z-scores were lower and undernutrition higher due to HIV exposure(30–32) while seven found no difference between exposure groups.(33–39) Four studies found no association reported on data collected between the mid-1980s and early 1990s.(33,37,38,40) HIV epidemics were not yet mature in SSA therefore the effects of exposure on child growth may not have been apparent. The prevalence of HIV has increased substantially in the last two decades(10) and the individual risk profile may have changed. A population-based cohort in Malawi reported an average increase in undernutrition by a factor of two in HIV-exposed children.(30) Data for this study was collected between 1995 and 1996 when there were no PMTCT programmes and child HIV status was not available. Vertical transmission of HIV may have been high thus confounding the association. From 2001 to 2003, children were followed for 18 months in a Zambian study.(36) No differences in growth were reported by HIV exposure. Investigators reported that population estimates placed the prevalence of HIV exposure in children at 22%. At the turn of the millennium, PMTCT programmes were still in their infancy therefore the number of new child infections may

have been high.(10) In a South African cohort assembled between 2002 and 2004, HIV-exposed children had similar growth patterns to those unexposed at 36 weeks.(35) The limitation of this study was that the time of follow-up was short. The growth patterns observed at 36 weeks are likely to have changed after study follow-up as growth trends stabilize at two years of age.(41–43) In Ghana, maternal HIV was found to be predictive of poor growth in a study conducted between 2003 and 2008.(31) Children were not tested for HIV, but coverage of PMTCT interventions is reported to be high in Ghana.(10) Therefore, the number of children that were HIV-infected is not likely to change the reported predictive association of HIV exposure on child growth. A randomized controlled trial for micronutrient supplementation conducted in Zambia also showed a significant drop in Z-scores among HIV-exposed children.(44) Finally, a trial conducted in Malawi from 2004 to 2010 showed that there was no association between HIV exposure and child growth and nutritional status.(39) However, given that the intervention promoted breastfeeding in the exposed, it is likely that these findings are not generalizable to the population as there may have been differential failure to thrive in the unexposed children due to lower levels of breastfeeding. In addition, growth velocity tended to be slower in HIV-exposed children, and was significantly slower in HIV-exposed girls compared to those unexposed. This could suggest the possibility of long-term growth faltering in HIV-exposed children without the breastfeeding intervention.

CONCLUSION

The aim of this review was to summarize the evidence for the relationship between child HIV exposure and child growth and nutritional status in SSA, as measured by weight-for-height, weight-for-age, and height-for-age indicators and their corresponding nutritional status indicators viz. wasting, underweight, and stunting. In this review, the most consistent finding is that the prevalence of undernutrition is unacceptably high in SSA. Growth promotion is desperately needed, especially to combat stunting right from pregnancy through the first two years of life.

The link between HIV exposure and child undernutrition remains unclear. Ecologic evidence suggests that an increase in population-level HIV exposure i.e. prevalence, is associated with undernutrition. Household level exposures are consistently associated with undernutrition. The most compelling evidence from cross-sectional analyses also suggests that maternal HIV contributes to increase decline in growth. Longitudinal studies formed the bulk of the evidence included in this

review. However, most of the evidence was unable to adequately answer the question of HIV exposure and undernutrition due to inappropriate comparison groups. In addition, some of the evidence reviewed may now be irrelevant due to the advances made in the epidemic in terms of prevalence, long-term survival, and vertical transmission of HIV. More research is needed to understand the relationship between the dual epidemics of undernutrition and HIV exposure.

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C. MANUSCRIPT

TABLE OF CONTENTS

ABSTRACT

AIM. To determine the effects of HIV exposure on growth in children under two in the Free State (FS) and Western Cape (WC) Provinces, South Africa.

METHODS. Secondary analysis of survey data from PMTCT Effectiveness in Africa: Research and Linkages to Care (PEARL) Study. To measure child growth and determine nutritional status, weight-for-age (WAZ), length-for-age (LAZ) and weight-for-length (WLZ) Z-scores were calculated according to WHO growth reference standards.

RESULTS. Prevalence of HIV exposure in children was 20.6%. The mean WLZ was 0.91 (0.36; 1.47), and the prevalence of wasting was 8.7%. The adjusted association between HIV exposure and WLZ was insignificant and the prevalence of wasting was also similar in both groups. WLZs and wasting were statistically similar in the FS and WC. The mean WAZ was -0.04 (CI: -0.29; 0.21), and the prevalence of underweight was 11.1%. HIV-exposed children had lower WAZs, but the difference was only significant in unadjusted comparisons (p=0.049). Underweight was more prevalent in the exposed but this was not significant. Children in the FS had significantly lower WAZs compared to WC (p=0.044) and had 3.02 times the odds of underweight (p<0.001). The mean LAZ was -1.28 (CI: -1.61; -0.94) and 38.4% of children were stunted. There was no significant difference in LAZ or stunting by HIV exposure. Children in the FS had lower LAZs (p=0.029) and had 2.12 times the odds of stunting (p=0.001).

CONCLUSION. Child undernutrition is high in the FS and WC provinces. HIV exposure does not have an impact on child undernutrition.

Word count – 250

INTRODUCTION

Undernutrition continues to be a major threat to public health in developing countries,[1] with children being particularly vulnerable to its deleterious effects.[2] In sub-Saharan Africa (SSA), efforts to fight undernutrition have resulted in insufficient progress toward achieving development targets, with some countries showing no progress at all.[3,4] In South Africa, there has been an increase in child undernutrition over the last two decades.[5,6] This evidence is alarming given the commitment to global development as outlined in the United Nations (UN) Millennium Development Goals (MDGs).[4] Nutrition affects, and is affected by, each MDG.[7] For instance, an increase in undernutrition indicates a failure to reduce poverty and hunger (MDG1), and has been associated with an increase in child mortality (MDG4).[6] Growth faltering in the first two years of life has been associated with poor schooling outcomes (drop in highest grade attained, failing a grade, and older age at school entry),[8] which affects MDG2. Therefore it is important that progress regarding undernutrition be realized and monitored.

The HIV epidemic poses direct and indirect health and development challenges in SSA,[4] including undernutrition. In SSA, the number of people living with HIV increased from 20.9million in 2001 to 23.5million in 2011.[9] However, due to programmes to prevent mother-to-child transmission (PMTCT) of HIV, the number of new child infections declined by 40-59% between 2009 and 2011 in some countries, including South Africa.[9] Therefore, because of the increasing number of HIV-exposed but uninfected children, it is important that the relationship between HIV exposure and undernutrition be monitored. Studies have shown that HIV-exposed but uninfected children may have an increased risk of growth faltering[10] which may be partly mediated by reduced breastfeeding, poor maternal health, inadequate infant care, and increased morbidity and exposure to other infections.[10–12] However, research into the association between HIV exposure and undernutrition in SSA has yielded conflicting results; some studies that showed that HIV exposure increased growth faltering[13,14] and others that revealed no association with child growth.[16–21] Growth faltering often starts immediately after birth, and trends in child growth at age two persist until age five.[21,22] The process of stunting occurs before the age of two and trends in height in adulthood are similar to those at age two.[23]

Therefore, the aim of this study was to determine the effects of HIV exposure on postnatal child growth and nutritional status in children under two.

METHODS

Design and Setting

The **P**MTCT **E**ffectiveness in **A**frica: **R**esearch and **L**inkages to Care (PEARL) Study was a cross-sectional evaluation of PMTCT programmes in four countries which included two components: a facility-based component, which has been described previously,[24–28] as well as a community-based survey.[29] The countries involved in this evaluation were Cameroon, Côte d'Ivoire, South Africa and Zambia.

The primary outcome for the community survey was HIV-free survival in children under the age of two. The prevalence of HIV and life expectancy at birth are different across all provinces in South Africa, particularly in the Free State (FS) and Western Cape (WC) provinces. The PEARL study was conducted when the antenatal seroprevalence of HIV was 32.9% and 16.1% in the FS and WC provinces respectively, the WC having the lowest provincial prevalence and the FS having the third highest.[30] Life expectancy at birth was also documented as being the lowest in the FS and highest in the WC.[31] Therefore inclusion of these provinces allows for an investigation of disparities that may be useful for planning service delivery. This study is a secondary analysis of the South African community survey data collected in the FS and WC provinces between August 2008 and May 2009.

Sampling and Recruitment

The sampling for the community survey was predicated on the catchment areas for the facility-based component of the study. Sampling was done in the FS and the WC provincial strata, and within each province, three sub-district clusters were selected to be representative of the coverage of PMTCT services in the province. Each sub-district had a health facility with an antenatal service as the focal point from which health catchment areas were mapped. Households

were randomly sampled within the health catchment areas for participation in the survey. Sample size calculations were based on the average number of children under the age of two per household in the African population of the urban WC and rural FS as described by the 2007 Community Survey conducted by Statistics South Africa.[32] For a household to be eligible for recruitment, a child must have been born in the household within the 2 years prior to the date of interview (living or deceased).

Data Collection and Measurement

In recruited households, after maternal consent for further data and blood collection, all mother/child pairs completed a questionnaire including household, maternal and child characteristics. The questionnaire covered household access to municipal services and proxies for socioeconomic status, maternal education, occupation and HIV-related history, as well as child antenatal, birth and health history. In cases where children under two or their mothers were deceased, verbal autopsy reports were completed.[33]

Every team included a registered nurse who was primarily responsible for measuring heights and weights, and for collecting blood samples from the mothers and children. Digital scales were used for weighing participants who could stand and suspended scales were used for infants who could not stand. Infant lengths were measured using a clinic-standard baby length measurement scale while a stadiometer was used to measure the height of older children and mothers. Five millilitres of blood was collected from mothers using anti-coagulated vacuum tubes, while five blood spots were taken from children. The Abbott Determine® rapid (HIV antibody) test (Abbott Laboratories, Chicago, Illinois) was used to determine HIV infection in mothers. If a mother tested positive for HIV, then a Roche Amplicor v. 1.5 HIV DNA (deoxyribonucleic acid) PCR (polymerase chain reaction) was done for her child. Specimens were linked to questionnaires using a unique study number (anonymous, linked testing). Laboratory staff did not have access to the questionnaires, and field staff did not have access to the laboratory results. Report back on test results was not carried out, and all respondents were encouraged to access local HIV testing services to find out their status.

Statistical analysis

Analyses were performed in Stata® version 11.2 (StataCorp. College Station, TX), using the survey suite of commands to account for the study design and sampling procedure. Children were included in the analysis if HIV-exposure was determined using specimen collected from mothers and child anthropometric data were collected, both at the time of the interview. To measure child growth, Z-scores were calculated using child weights and heights according to WHO growth reference standards using WHO Anthro Software (version 3.2.2). The growth indicators used were weight-for-length (WLZ), weight-for-age (WAZ) and length-for-age (LAZ). Children were classified as wasted, underweight or stunted based on their Z-scores (<-2). The association between HIV exposure and child growth was determined using linear regression while logistic regression models were used for the association between nutritional status and HIV exposure. HIV infection and province were included in all adjusted models due to their known confounding effect, while all other variables were included in multivariate analyses only if $p < 0.1$ for bivariate associations with HIV exposure or each of the growth and nutritional status variables (data not shown).

Statistical power was calculated based on final sample in the database for analysis. Data from the 2003 South African Demographic and Health Survey[34] were used to calculate the power to accurately estimate the prevalence of wasting, underweight, and stunting in the FS and WC relative to the national occurrence. There was sufficient power for estimates of the prevalence of wasting in both provinces as well as underweight and stunting in the FS (≥89%). The power for the prevalence estimates of underweight and stunting in the WC was 30% and 8% respectively.

Ethical approvals

Ethical approval for this analysis was obtained from the Human Research Ethics Committee at the University of Cape Town.

RESULTS

Recruitment

During the sampling process, 16 653 households were visited and 2 394 (14.4%) of them were found to be eligible for the study. The overall survey household response rate was 86.0% (2059/2394) and the survey interview was completed for a total of 2 086 children less than two years of age. A total of 420 children were excluded from the analysis as they were deceased, or if HIV exposure was not determined or anthropometric data were faulty or missing (Figure 1). Children from the WC were 1.22 times more likely to have been excluded from the analysis ($p = 0.018$) mainly due to failure to establish mother's HIV status.

Participants

The prevalence of HIV exposure in children was 20.6% (343/1666). One hundred and forty-four of the 343 (41.9%) mothers that were found to be HIV-infected at the time of the interview reported a positive result for most recent HIV test. The MTCT rate at the time of the interview was 11.2% (37/329) making the prevalence of HIV in children 2.2%.

Table 1 gives a summary of the sample characteristics, including maternal and household variables, and how they relate to HIV exposure. Nearly half of the children were female (47.8%) and the mean age was 11.8 months (Confidence Interval [CI]: 11.1–12.4). Sex and age distributions did not differ between the exposure groups, and over 85% of children had a birth weight of at least 2 500g. The majority of children had ever been breastfed (86.9%, 1445/1666) and 923 (63.9%) were still breastfeeding at the time of the interview. There was significantly less breastfeeding among the HIV-exposed children with 57.5% ever having been breastfed compared to 94.6% in the unexposed, and 54.1% were still breastfeeding compared to 65.4% in the unexposed ($p=0.001$ and $p=0.0053$, respectively).

Maternal Characteristics

The mean age of mothers in the study was 26.0 years (CI: 25.5-26.6) with HIV-exposed children being born to slightly, but significantly, older women than unexposed children ($p=0.010$). More than half the children in the study had mothers that were either overweight or obese (52.2%,

823/1577), 86.9% (1429/1644) had at least a secondary education, and 19.3% (322/1666) were employed. Maternal weight, education and employment were similar in HIV-exposed and unexposed children.

Household

Most children in the study sample lived in households with private access to piped water (89.4%, 1483/1659), and 64.3% (1070/1663) lived with access to flush toilet systems. Nearly 95% of children lived in households with access to electricity (1484/1567), and 80.8% (1341/1660) had finished visible flooring. More than 80% (1339/1658) of the children lived in homes with a television, and almost three-quarters (1237/1666) owned a refrigerator. In all household characteristics, except water source and access to electricity, HIV-exposed children lived in households with at least 5% less access; however most of these differences were insignificant. Four hundred and fifty-three of 1644 (27.6%) children lived in homes with at least one vehicle, and 46.6% (776/1665) in homes that reported usually having enough food to eat; these were the only household characteristics significantly associated with HIV exposure (p=0.0391 and 0.0415, respectively).

Anthropometry

Weight-for-Length & Wasting

The distribution of z-scores in Figure 2a shows that the children in the study had, on average, higher WLZs compared to the WHO standards. The mean WLZ was 0.91 (CI: 0.36; 1.47), with higher proportions of over- and under-nourished children. Twenty-six and a half per cent of children were overweight or obese, and the prevalence of wasting was 8.7% (Table 2). WLZs were similar between HIV exposure groups despite the trend of lower indices in the exposed, especially in children between 3-6 and 15-18 months of age (Figure 3a). The adjusted association between HIV exposure and WLZ was insignificant (p=0.696; Table3), and the prevalence of wasting was also similar in both groups (9.0% in the exposed vs. 8.6% in the unexposed; p=0.751). WLZs and wasting were statistically similar in the FS and WC (p=0.948 and p=0.156 respectively; 10.2% wasting in the FS vs. 6.4% in the WC), and while HIV infection tended to lower WLZ (β=-1.3; p=0.082)) and increase the odds of wasting (OR=2.22; p=0.097), these

associations were unstable. Every monthly increase in age increased WLZ by 0.06 points (p=0.004), a trend demonstrated in Figures 3a and 3b. Having a birth weight of at least 2500g was associated with a unit increase in WLZ (p=0.002), while having an overweight/obese mother was associated with a 0.65 unit increase in WLZ (p=0.001). A birth weight of at least 2 500g reduced the odds of wasting by 60% (p=0.009) while children with overweight/obese mothers had 52% less odds of wasting. Children that continued to breastfeed at the time of the interview had a 56% increase in the odds of wasting (p=0.045).

Weight-for-Age & Underweight

Figure 2b shows that the sample WAZs were similar to the WHO standards with a mean WAZ of -0.04 (CI: -0.29; 0.21), but fewer children were of average weight and more were either overweight or underweight. The prevalence of underweight was 11.1% (Table 2). HIV-exposed children had lower WAZs (Figure 3c), but the difference was only significant in unadjusted comparisons (p=0.049; data not shown). Underweight was more prevalent in the exposed (14.3% vs. 10.5%) but this was not significant (p=0.755; Table 3). Children in the FS had significantly lower WAZs compared to children in the WC (Figure 3d; p=0.044) and had more than three times the odds of being underweight (p<0.001) with 14.8% being underweight in the FS compared to 5.3% in the WC (Table 2). HIV infection was also associated with lower WAZs (p=0.016) and increased the odds of underweight 5.23 times. A birth weight of at least 2 500g, and having an overweight/obese mother were associated with higher WAZs (p=0.001 and p<0.001, respectively); these were also associated with reduced odds of underweight by 83% (p=0.001) and 47% (p=0.002) respectively. Living in a household with refrigerator was also associated with higher WAZs (p=0.041).

Length-for-Age & Stunting

The children in the study had low LAZs with less than a quarter (23.9%) having a LAZ above the WHO standard average (Figure 2c). The mean LAZ was -1.28 (CI: -1.61; -0.94) and 38.4% of children were stunted (Table 2). There was no significant difference in LAZ by HIV exposure (Figure 3e; p=0.513), and despite nearly an 8% difference in stunting (Table 2), the adjusted association between HIV exposure and stunting was insignificant (p=0.380). Children in the FS had lower LAZs compared to WC children (Figure 3f; p=0.029) and had 2.12 times the odds of

stunting (p=0.001). In the WC, 28.2% of children were stunted compared to 45.0% in the FS. HIV infection did not have an independent effect on linear growth (p=0.227) or the prevalence of stunting (p=0.393), but male children had lower LAZs (p=0.029) and a 52% increase in the odds of stunting (p=0.018). Age was significantly associated with LAZ (Figure 3f), reducing it by 0.13 units for every monthly increase in age (p<0.001) while increasing the odds of stunting by 12% (p=0.002). Children with a birth weight of at least 2 500g, and those with an overweight/obese mother were more likely to have higher LAZs (p=0.001 and p=0.002 respectively). A birth weight of at least 2 500g reduced the odds of stunting by 62% (p=0.001), and children that lived in households with a refrigerator or a vehicle had 20% and 23% less odds of stunting respectively (p=0.046 and p=0.017 respectively).

DISCUSSION

HIV Exposure and Child Growth

The aim of this study was to determine the effect of direct HIV exposure on postnatal child growth in a pooled analysis of survey data from two South African provinces. The prevalence of HIV exposure in the study was 24.4% and 14.8% in the FS and WC respectively. The prevalence was similar to the prevalence at the time, as reported by the national Department of Health,[30] in the WC (CI: 12.6; 20.2). The prevalence in the FS fell outside the CI for prevalence described by the Department of Health (CI: 30.5; 35.3). This may be explained by differences in target populations. The prevalence reported in the national survey relies on institutional antenatal booking of pregnancies and does not account for those not booked at study sites or those not booked at all. In this study, the possible inclusion of late antenatal and postnatal maternal seroconverters would have the effect of increasing sample prevalence; however this may have been countered and reversed by the exclusion of children as described in Figure 1. HIV exposure did not have an effect on child growth or nutritional status, a trend also described in previous studies.[15–18,20,35,36] There are studies that have reported that HIV exposure is associated with decreased growth Z-scores and increased undernutrition, but these are often based on comparison with international growth reference standards.[37–42] Given the high rates of undernutrition in SSA, especially stunting,[3] it is important for HIV-exposed children to be compared to

unexposed children to determine a true association. In studies reporting increased risk of growth faltering and undernutrition in HIV-exposed children compared to those unexposed, HIV infection in children was not accounted for which may have confounded the association.[13,14]

Other Factors related to Child Growth

HIV infection is a known risk factor for all growth faltering and undernutrition.[15–18] In this study, HIV-infected children only faltered in WAZ and were more likely to be underweight. Wasting is caused by recent illness or inadequate food intake while stunting may be caused by chronic exposure to these. Underweight is a composite indicator being affected by both long and short term exposures.[6] In this study, child morbidity and adequate food intake were not measured, but may have interacted resulting in low WAZs and underweight in HIV-infected children. The failure of HIV infection to consistently predict poor growth and undernutrition suggests that public health promotions and programmes for exclusive breastfeeding, micronutrient supplementation, provision of antiretroviral treatment, etc., could explain the mitigation of some of the deleterious effects of infection.

Childhood underweight and stunting decreased in the WC while stunting and wasting increased in the FS compared to the provincial occurrences in 2003.[34] According to the sampling methodology, participants in the FS were predominantly from rural areas while the WC participants were from urban areas. Assuming increased levels of poverty in rural areas, this may explain the apparent differences in the occurrence of undernutrition between the two provinces.

Breastfeeding was not associated with child growth despite previous studies showing the benefits of breastfeeding, especially in the first six months of life.[36,38,42,43] Unexpectedly, children still breastfeeding at the time of the survey interview were more likely to be wasted. Similar findings were reported in Kenya were children that were formula fed had slower decline in growth compared to those that were breastfed.[41] The investigators ascribed this to inadequate complimentary feeding after six months, this was not likely in this study because of the wasted children that were still breastfeeding, just over 60% were less than six months of age. Low birth weight was also associated with all measures of growth faltering and undernutrition in this study

and others.[14,40,41,44] Therefore wasting may be due to low birth weight or mixed feeding and resultant illness due to compromised immunity.

Higher maternal BMI was associated with better child growth outcomes, consistent with previous research.[17,41,44] Proxies of household wealth were mainly associated with chronic undernutrition, having a protective effect as reported in other studies.[40,43] Male sex was found to increase the risk of growth faltering in this and other studies.[13,40] Older children had greater WLZs indicating an increase in obesity with age while stunting also steadily increased in the first two years of life demonstrating the process of stunting. Both trends highlight the importance of nutritional intervention within the first two years of life to avoid childhood obesity and stunting.

Strengths and Limitations

This study was based on community survey data therefore results are generalizable at population level. Given the push to focus on child growth up to two years of age,[3] the findings of this study are valuable for planning nutritional interventions as they quantify the magnitude of the challenge within the window of opportunity in the FS and WC. However, a limitation to this study was the HIV exposure variable. Despite testing mothers at the time of the survey interview, whether exposure was intrauterine or from breastfeeding, and length of exposure could not be confirmed. Therefore the temporal relationship between HIV exposure and nutritional outcomes remained unknown, as well as the impact of cumulative exposure. Secondly, the unmeasured HIV exposure, growth faltering and undernutrition due to maternal and child mortality may have created a sampling bias. Another source of sampling bias was the differential exclusion from analysis by province primarily because HIV tests were not performed or results were missing from the data. Fourthly, data was not collected for some potential confounders e.g. maternal and child morbidity. Finally, low power for the underweight and stunting estimates in the WC may have compromised the validity of these findings.

Conclusion

In this study, HIV exposure did not have an impact on child undernutrition. However, child undernutrition, particularly stunting, was very high in the FS and WC provinces of South Africa. There was also a very high occurrence of overweight/obesity in children under two years of age, with about one in four have a z-score > 2. Interventions are needed to reduce low birth weight and improve maternal weight. Further research must address the concerns around measuring HIV exposure, the apparent epidemic of childhood obesity, comprehensively account for possible confounders of the association between HIV exposure and child growth and nutrition, identify inter-provincial differences that increase the risk for growth faltering and malnutrition, as well as monitor existing programmes to combat them.

Word count – 3575

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APPENDICES

A. Figures and Tables

Figure 1: Flow chart of sampling procedure from eligibility screening to determination of HIV exposure and status

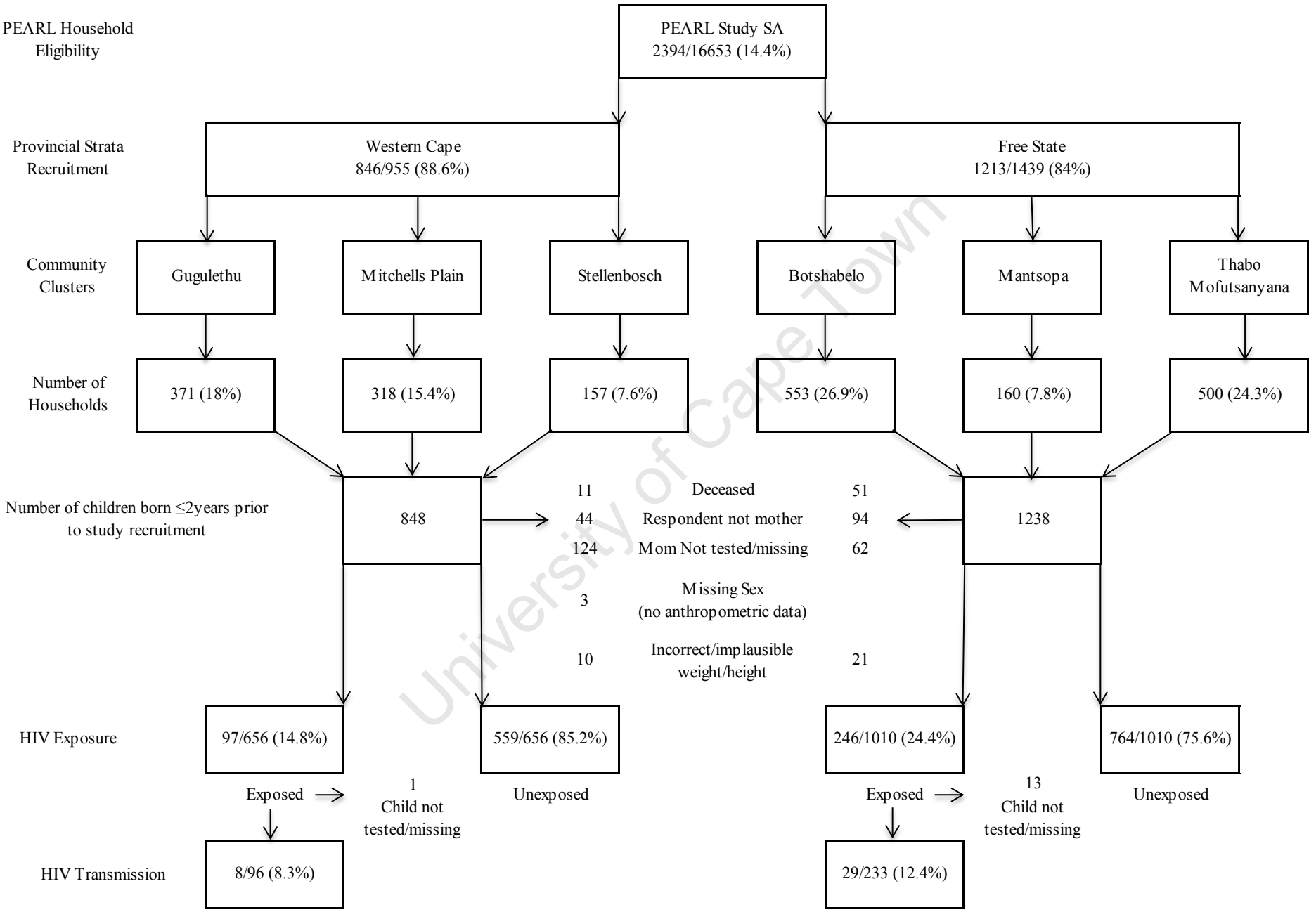


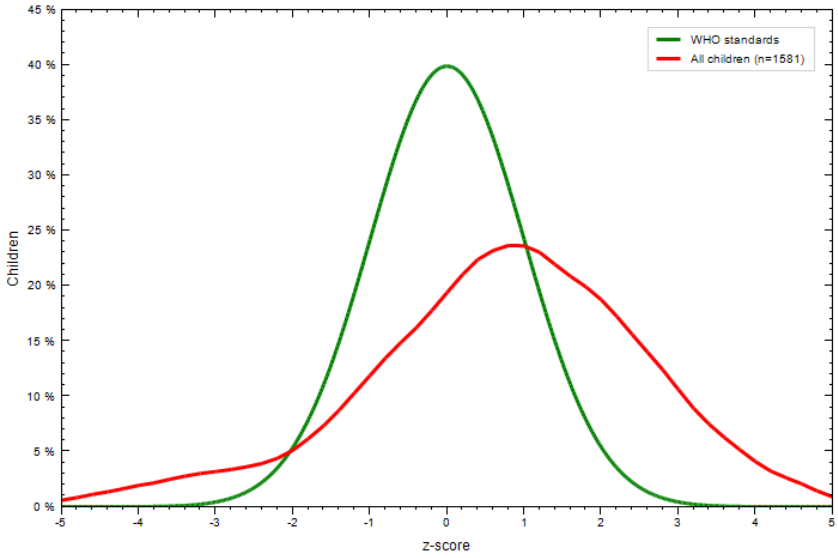
Table 1: Characteristics of Unexposed vs. Exposed Children

	Exposed (343)	n	Unexposed (1323)	n	Overall (1666)	N	p-value
CHILD							
Province WC (%)	97 (28.3)	343	559 (42.2)	1323	656 (39.4)	1666	0.4816
Sex Female (%)	162 (47.2)	343	634 (47.9)	1323	796 (47.8)	1666	0.5065
Mean Age (months)	12.3 (11.8; 12.7)	343	11.6 (10.8; 12.4)	1323	11.8 (11.1; 12.4)	1666	0.135
Mean Birth ≥ 2500 grams (%)	268 (85.9)	312	1095 (88.3)	1240	1363 (87.8)	1552	0.1768
Ever Breastfed (%)	196 (57.5)	341	1249 (94.6)	1321	1445 (86.9)	1662	0.001*
Still Breastfeeding (%)	106 (54.1)	196	817 (65.4)	1249	923 (63.9)	1445	0.0053*
MATERNAL							
Mean Age (years)	27.7 (26.8; 28.6)	343	25.6 (24.8; 26.4)	1322	26.0 (25.5; 26.6)	1665	0.010*
Overweight/Obese (%)	167 (50.6)	330	656 (52.6)	1247	823 (52.2)	1577	0.5037
Secondary education or higher (%)	285 (83.8)	340	1144 (87.7)	1304	1429 (86.9)	1644	0.2767
Employment (%)	56 (16.3)	343	266 (20.1)	1323	322 (19.3)	1666	0.5057
HOUSEHOLD							
Private source of tapped water (%)	308 (90.1)	342	1175 (89.2)	1317	1483 (89.4)	1659	0.6708
Flush toilet (%)	207 (60.4)	343	863 (65.4)	1320	1070 (64.3)	1663	0.6421
Electricity (%)	322 (93.9)	343	1253 (94.7)	1323	1575 (94.5)	1666	0.6602
Television (%)	263 (76.7)	343	1076 (81.8)	1315	1339 (80.8)	1658	0.3801
Refrigerator (%)	233 (67.9)	343	1004 (75.9)	1323	1237 (74.2)	1666	0.1641
Finished floor (%)	270 (78.7)	343	1071 (81.3)	1317	1341 (80.8)	1660	0.4566
Vehicle[#] (%)	55 (16.2)	339	398 (30.5)	1305	453 (27.6)	1644	0.0391 *
Food security (%)	123 (35.9)	343	653 (49.4)	1322	776 (46.6)	1665	0.0415*

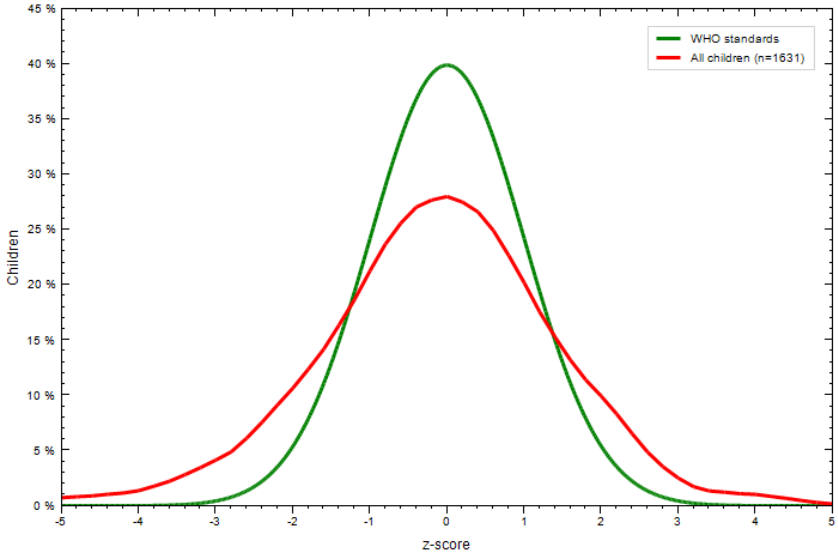
- * - indicates significant ($p<0.05$) difference between HIV-exposed and unexposed children
- [#] - household owns one or more of the following: bicycle, motorcycle, car

Figure 2: Distribution of Nutritional Indicators compared to WHO Reference Curve

a) Weight-for-Length



b) Weight-for-Age



c) Length-for-Age

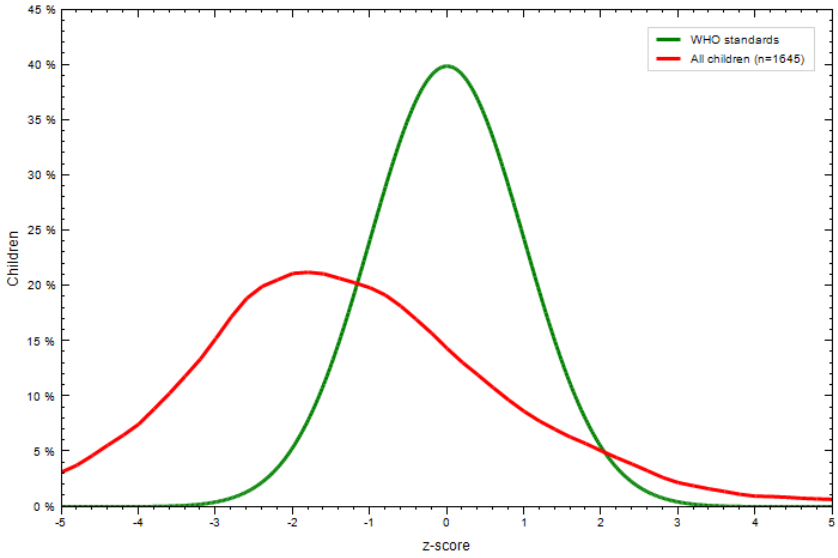
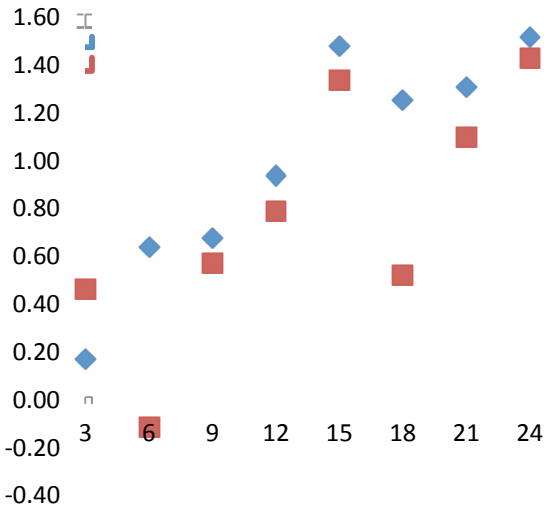


Table 2: Distribution of Undernutrition in Children

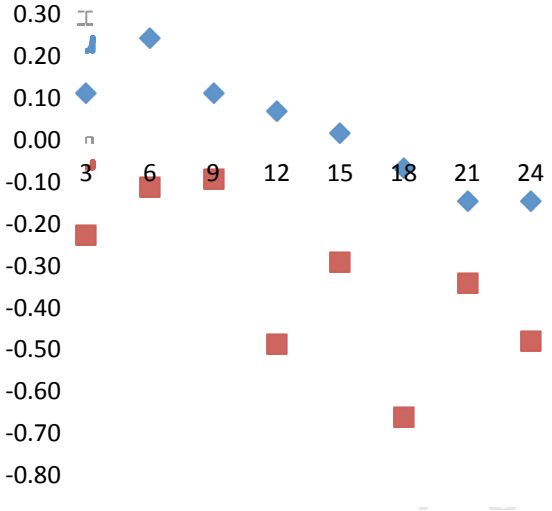
Nutritional status variables			Wasting		Underweight		Stunting	
		N	n	%	n	%	n	%
Overall prevalence		1666	145	8.7	185	11.1	640	38.4
HIV Exposure	Exposed	343	31	9.0	49	14.3	153	44.6
	Unexposed	1323	114	8.6	136	10.5	487	36.8
Province	Free State	1010	103	10.2	150	14.8	455	45.0
	Western Cape	656	42	6.4	35	5.3	185	28.2

Figure 3: Distribution of Nutritional Indicators by HIV Exposure and Province

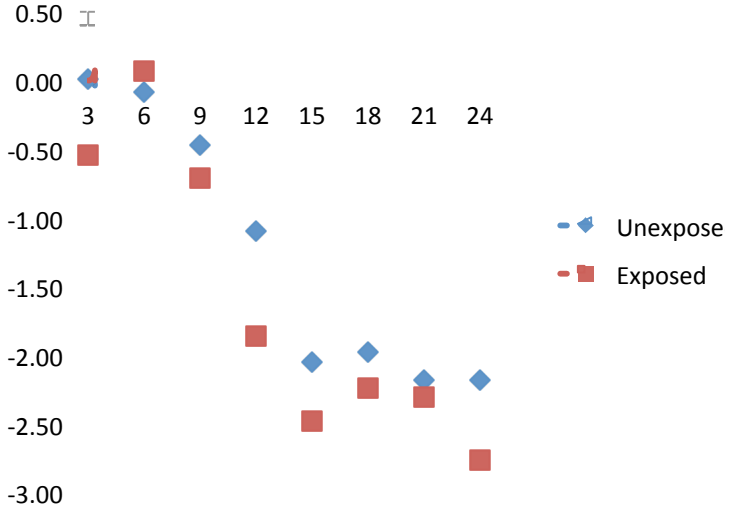
a) Weight-for-Length by HIV Exposure



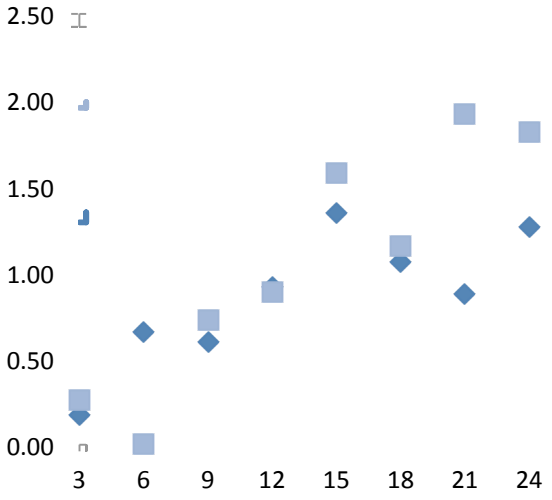
c) Weight-for-Age by HIV Exposure



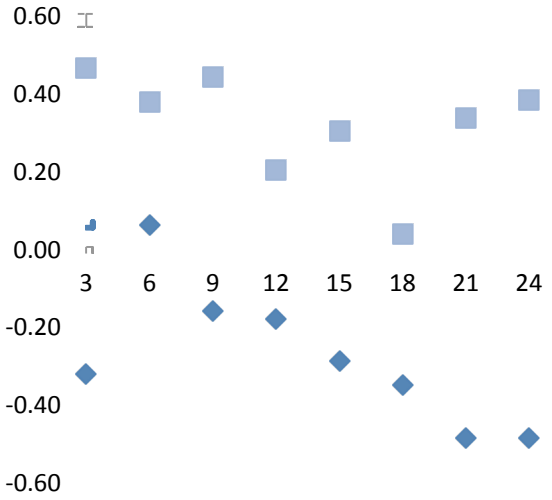
e) Length-for-Age by HIV Exposure



b) Weight-for-Length by Province



d) Weight-for-Age by Province



f) Length-for-Age by Province

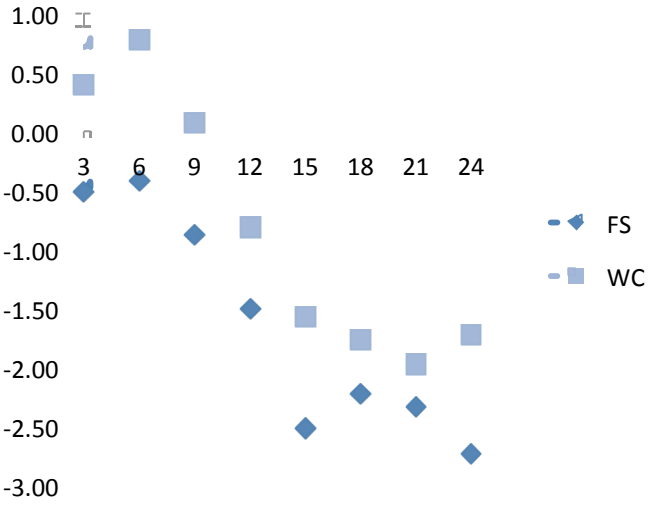


Table 3: Adjusted Models for Child Growth/Nutritional Status and Child, Maternal, and Household Characteristics

	Weight-for-Length Z (CI)	p	Wasting OR (CI)	p	Weight-for-Age Z (CI)	p	Underweight OR (CI)	p	Length-for-Age Z (CI)	p	Stunting OR (CI)	p
CHILD												
HIV-exposed	-0.05 (-0.38; 0.28)	0.696	0.87 (0.28; 2.73)	0.751	-0.08 (-0.25; 0.10)	0.281	0.87 (0.27; 2.82)	0.755	-0.10 (-0.47; 0.28)	0.513	1.21 (0.71; 2.04)	0.38
HIV-infected	-1.30 (-2.87; 0.26)	0.082	2.22 (0.80; 6.22)	0.097	-1.25 (-2.12; -0.38)	0.016*	5.23 (1.93; 14.16)	0.010*	-0.53 (-1.57; 0.51)	0.227	1.38 (0.54; 3.52)	0.39
Province (FS)	-0.02 (-0.94; 0.90)	0.948	1.33 (0.84; 2.09)	0.156	-0.44 (-0.86; -0.02)	0.044*	3.02 (2.26; 4.04)	<0.001*	-0.74 (-1.35; -0.13)	0.029*	2.12 (1.63; 2.75)	0.001
Sex (Male)	n/a		n/a		n/a		n/a		-0.41 (-0.76; -0.07)	0.029*	1.52 (1.13; 2.05)	0.018
Age (Months)	0.06 (0.03; 0.09)	0.004*	n/a		n/a		n/a		-0.13 (-0.16; -0.10)	<0.001*	1.12 (1.07; 1.16)	0.002
BW ≥ 2500g	1.00 (0.59; 1.38)	0.002*	0.40 (0.24; 0.68)	0.009*	1.28 (0.90; 1.66)	0.001*	0.17 (0.09; 0.33)	0.001*	1.01 (0.66; 1.36)	0.001*	0.38 (0.28; 0.52)	0.001
Still Breastfeeding	n/a		1.56 (1.02; 2.39)	0.045*	n/a		n/a		n/a		n/a	
MATERNAL												
BMI:												
≥ Overweight	0.65 (0.46; 0.84)	0.001*	0.48 (0.28; 0.80)	0.017*	0.69 (0.50; 0.88)	<0.001*	0.53 (0.42; 0.68)	0.002*	0.19 (0.11; 0.27)	0.002*	n/a	
HOUSEHOLD												
Own refrigerator	n/a		n/a		0.27 (0.02; 0.52)	0.041*	n/a		n/a		0.80 (0.64; 0.99)	0.046
Own vehicle[#]	n/a		n/a		n/a		n/a		n/a		0.77 (0.64; 0.93)	0.017

- n/a - not applicable to model
- * - indicates variable as significant predictor of outcome ($p<0.05$)
- [#] - household owns one or more of the following: bicycle, motorcycle, car

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References to material available on websites should include the full Internet address, and the date of the version cited. Thus:

20. Department of Health (1997) Committee on Toxicity of Chemicals in Food Consumer Products and the Environment. Statement on vitamin B_6 (pyridoxine) toxicity. http://www.open.gov.uk/doh/hef/B6.htm
21. Kramer MS & Kakuma R (2002) *The Optimal Duration of Exclusive Breastfeeding: A Systematic Review*. Rome: WHO; available at http://www.who.int/nut/documents/optimal_duration_of_exc_bfeeding_review_eng.pd
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23. Nationmaster (2005) HIV AIDS – Adult prevalence rate. http://www.nationmaster.com/graph-T/hea_hiv_aid_adu_pre_rat (accessed June 2005).

(j) *Supplementary data:* Additional data (e.g. data files, large tables) relevant to the paper can be submitted for publication online only, where they are made available via a link from the abstract and the paper. The paper should stand alone without these data. Supplementary data should be supplied as a PDF for the review process and must be cited in a relevant place in the text of the paper.

Mathematical modelling of nutritional processes. Papers in which mathematical modelling of nutritional processes forms the principal element will be considered for publication provided: (a) they are based on sound biological and mathematical principles; (b) they advance nutritional concepts or identify new avenues likely to lead to such advances; (c) assumptions used in their construction are fully described and supported by appropriate argument; (d) they are described in such a way that the nutritional purpose is clearly apparent; (e) the contribution of the model to the design of future experimentation is clearly defined.

Units. Results should be presented in metric units according to the International System of Units (see Quantities, Units and Symbols in Physical Chemistry, 3rd ed. (2007) Cambridge: RSC Publishing), and Metric Units, Conversion Factors and Nomenclature in Nutritional and Food Sciences (1972) London: The Royal Society – as reproduced in *Proceedings of the Nutrition Society* (1972) **31**, 239–247). SI units should be used throughout the paper. The author will be asked to convert any values that are given in any other form. The only exception is where there is a unique way of expressing a particular variable that is in widespread use. Energy values must be given in Joules (MJ or kJ) using the conversion factor 1 kcal = 4·184 kJ. If required by the author, the value in kcal can be given afterwards in parentheses. Temperature is given in degrees Celsius (ºC). Vitamins should be given as mg or µg, not as IU.

For substances of known molecular mass (Da) or relative molecular mass, e.g. glucose, urea, Ca, Na, Fe, K, P, values should be expressed as mol/l; for substances of indeterminate molecular mass (Da) or relative molecular mass, e.g. phospholipids, proteins, and for trace elements, e.g. Cu, Zn, then g/l should be used.

Time. The 24 h clock should be used, e.g. 15.00 hours.

Units are: year, month, week, d, h, min, s, kg, g, mg, µg, litre, ml, µl, fl. To avoid misunderstandings, the word litre should be used in full, except in terms like g/l. Radioactivity should be given in becquerels (Bq or GBq) not in Ci. 1 MBq = 27·03 µCi (1Bq = 1 disintegration/s).

Statistical treatment of results. Data from individual replicates should not be given for large experiments, but may be given for small studies. The methods of statistical analysis used should be described, and references to statistical analysis packages included in the text, thus: Statistical Analysis Systems statistical software package version 6.11 (SAS Institute, Cary, NC, USA). Information such as analysis of variance tables should be given in the paper only if they are relevant to the discussion. A statement of the number of replicates, their average value and some appropriate measure of variability is usually sufficient.

Comparisons between means can be made by using either confidence intervals (CI) or significance tests. The most appropriate of such measures is usually the standard error of a difference between means (SED), or the standard errors of the means (SE or SEM) when these vary between means. The standard deviation (SD) is more useful only when there is specific interest in the variability of individual values. The degrees of freedom (df) associated with SED, SEM or SD should also be stated. The number of decimal places quoted should be sufficient but not excessive. Note that pH is an exponential number, as are the log(10) values often quoted for microbial numbers. Statistics should be carried out on the scalar rather than the exponential values.

If comparisons between means are made using CI, the format for presentation is, e.g. 'difference between means 0·73 (95 % CI 0·314, 1·36) g'. If significance tests are used, a statement that the difference between the means for two groups of values is (or is not) statistically significant should include the level of significance attained, preferably as an explicit *P* value (e.g. *P*=0·016 or *P*=0·32) rather than as a range (e.g. *P*<0·05 or *P*>0·05}. It should be stated whether the significance levels quoted are one-sided or two-sided. Where a multiple comparison procedure is used, a description or explicit reference should be given. Where appropriate, a superscript notation may be used in tables to denote levels of significance; similar superscripts should denote lack of a significant difference.

Where the method of analysis is unusual, or if the experimental design is at all complex, further details (e.g. experimental plan, raw data, confirmation of assumptions, analysis of variance tables, etc.) should be included.

Figures. Figures should not be incorporated into the article file and should be supplied as separate electronic files. Figure legends should be grouped in a section at the end of the text. Each figure should be clearly marked with its number and separate panels within figures should be clearly marked (a), (b), (c) etc. so that they are easily identifiable when the article and figure files are merged for review.

In curves presenting experimental results the determined points should be clearly shown, the symbols used being, in order of preference, ○, ●, Δ, ▲, □, ■, ×, ∔. Curves and symbols should not extend beyond the experimental points. Scale-marks on the axes should be on the inner side of each axis and should extend beyond the last experimental point. Ensure that lines and symbols used in graphs and shading used in histograms are large enough to be easily identified when the figure is reduced to fit the printed page.

Figures and diagrams can be prepared using most applications but please do not use the following: cdx, chm, jnb or PDF. All figures should be numbered and legends should be provided. Each figure, with its legend, should be comprehensible without reference to the text and should include definitions of abbreviations. Latin names for unusual species should be included unless they have already been specified in the text. Each figure will be positioned near the point in the text at which it is first introduced unless instructed otherwise.

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Plates. The size of photomicrographs may have to be altered in printing; in order to avoid mistakes the magnification should be shown by scale on the photograph itself. The scale with the appropriate unit together with any lettering should be drawn by the author, preferably using appropriate software.

Tables. Tables should carry headings describing their content and should be comprehensible without reference to the text. Tables should not be subdivided by ruled lines. The dimensions of the values, e.g. mg/kg, should be given at the top of each column. Separate columns should be used for measures of variance (SD, SE etc.), the ± sign should not be used. The number of decimal places used should be standardized; for whole numbers 1·0, 2·0 etc. should be used. Shortened forms of the words weight (wt) height (ht) and experiment (Expt) may be used to save space in tables, but only Expt (when referring to a specified experiment, e.g. Expt 1) is acceptable in the heading.

Footnotes are given in the following order: (1) abbreviations, (2) superscript letters, (3) symbols. Abbreviations are given in the format: RS, resistant starch. Abbreviations appear in the footnote in the order that they appear in the table (reading from left to right across the table, then down each column). Abbreviations in tables must be defined in footnotes. Symbols for footnotes should be used in the sequence: *†‡§‖¶, then ** etc. (omit * or †, or both, from the sequence if they are used to indicate levels of significance).

For indicating statistical significance, superscript letters or symbols may be used. Superscript letters are useful where comparisons are within a row or column and the level of significance is uniform, e.g. '^{a,b,c}Mean values within a column with unlike superscript letters were significantly different (*P*<0·05)'. Symbols are useful for indicating significant differences between rows or columns, especially where different levels of significance are found, e.g. 'Mean values were significantly different from those of the control group: **P*<0·05, ***P*<0·01, ****P*<0·001'. The symbols used for *P* values in the tables must be consistent.

Tables should be placed at the end of the text. Each table will be positioned near the point in the text at which it is first introduced unless instructed otherwise.

Please refer to a recent copy of the journal for examples of tables.

Chemical formulas. These should be written as far as possible on a single horizontal line. With inorganic substances, formulas may be used from first mention. With salts, it must be stated whether or not the anhydrous material is used, e.g. anhydrous $CuSO_4$, or which of the different crystalline forms is meant, e.g. $CuSO_4.5H_2O$, $CuSO_4.H_2O$.

Descriptions of solutions, compositions and concentrations. Solutions of common acids, bases and salts should be defined in terms of molarity (M), e.g. 0·1 M-NaH_2PO_4. Compositions expressed as mass per unit mass (w/w) should have values expressed as ng, µg, mg or g per kg; similarly for concentrations expressed as mass per unit volume (w/v), the denominator being the litre. If concentrations or compositions are expressed as a percentage, the basis for the composition should be specified (e.g. % (w/w) or % (w/v) etc.). The common measurements used in nutritional studies, e.g. digestibility, biological value and net protein utilization, should be expressed as decimals rather than as percentages, so that amounts of available nutrients can be obtained from analytical results by direct multiplication. See *Metric Units, Conversion Factors and Nomenclature in Nutritional and Food Sciences*. London: The Royal Society, 1972 (para. 8).

Gene nomenclature and symbols. The use of symbols and nomenclature recommended by the HUGO Gene Nomenclature Committee (http://www.genenames.org/) is encouraged. Information on human genes is also available from Entrez Gene (http://www.ncbi.nlm.nih.gov/sites/entrez?db=gene).

Nomenclature of vitamins. Most of the names for vitamins and related compounds that are accepted by the Editors are those recommended by the IUNS Committee on Nomenclature. See *Nutrition Abstracts and Reviews* (1978) **48**A, 831–835.

Acceptable name	*Other names**
Vitamin A	
Retinol	Vitamin A_1
Retinaldehyde, retinal	Retinene
Retinoic acid (all-*trans* or 13-*cis*)	Vitamin A_1 acid
3-Dehydroretinol	Vitamin A_2
Vitamin D	
Ergocalciferol, ercalciol	Vitamin D_2 calciferol
Cholecalciferol, calciol	Vitamin D_3
Vitamin E	
α-, β- and γ-tocopherols plus tocotrienols	
Vitamin K	
Phylloquinone	Vitamin K_1
Menaquinone-n (MK-n)†	Vitamin K_2
Menadione	Vitamin K_3, menaquinone, menaphthone
Vitamin B_1	
Thiamin	Aneurin(e), thiamine
Vitamin B_2	
Riboflavin	Vitamin G, riboflavine, lactoflavin
Niacin	
Nicotinamide	Vitamin PP
Nicotinic acid	
Folic Acid	
Pteroyl(mono)glutamic acid	Folacin, vitamin B_c or M
Vitamin B_6	
Pyridoxine	Pyridoxol
Pyridoxal	
Pyridoxamine	
Vitamin B_{12}	
Cyanocobalamin	
Hydroxocobalamin	Vitamin B_{12a} or B_{12b}
Aquocobalamin	
Methylcobalamin	
Adenosylcobalamin	
Inositol	
Myo-inositol	*Meso*-inositol
Choline	
Pantothenic acid	
Biotin	Vitamin H
Vitamin C	
Ascorbic acid	

Dehydroascorbic acid

*Including some names that are still in use elsewhere, but are not used by *Public Health Nutrition*.

†Details of the nomenclature for these and other naturally-occurring quinones should follow the Tentative Rules of the IUPAC-IUB Commission on Biochemical Nomenclature (see *European Journal of Biochemistry* (1975) **53**, 15–18).

Generic descriptors. The terms **vitamin A**, **vitamin C** and **vitamin D** may still be used where appropriate, for example in phrases such as 'vitamin A deficiency', 'vitamin D activity'.

Vitamin E. The term **vitamin E** should be used as the descriptor for all tocol and tocotrienol derivatives exhibiting qualitatively the biological activity of α-tocopherol. The term **tocopherols** should be used as the generic descriptor for all methyl tocols. Thus, the term **tocopherol** is not synonymous with the term **vitamin E**.

Vitamin K. The term **vitamin K** should be used as the generic descriptor for 2-methyl-1,4-naphthoquinone (menaphthone) and all derivatives exhibiting qualitatively the biological activity of phylloquinone (phytylmenaquinone).

Niacin. The term **niacin** should be used as the generic descriptor for pyridine 3-carboxylic acid and derivatives exhibiting qualitatively the biological activity of nicotinamide.

Vitamin B_6. The term **vitamin B_6** should be used as the generic descriptor for all 2-methylpyridine derivatives exhibiting qualitatively the biological activity of pyridoxine.

Folate. Due to the wide range of C-substituted, unsubstituted, oxidized, reduced and mono- or polyglutamyl side-chain derivatives of pteroylmonoglutamic acid that exist in nature, it is not possible to provide a complete list. Authors are encouraged to use either the generic name or the correct scientific name(s) of the derivative(s), as appropriate for each circumstance.

Vitamin B_{12}. The term **vitamin B_{12}** should be used as the generic descriptor for all corrinoids exhibiting qualitatively the biological activity of cyanocobalamin. The term **corrinoids** should be used as the generic descriptor for all compounds containing the corrin nucleus and thus chemically related to cyanocobalamin. The term **corrinoid** is not synonymous with the term **vitamin B_{12}**.

Vitamin C. The terms **ascorbic acid** and **dehydroascorbic acid** will normally be taken as referring to the naturally-occurring L-forms. If the subject matter includes other optical isomers, authors are encouraged to include the L- or D- prefixes, as appropriate. The same is true for all those vitamins which can exist in both natural and alternative isomeric forms.

Amounts of vitamins and summation. Weight units are acceptable for the amounts of vitamins in foods and diets. For concentrations in biological tissues, SI units should be used; however, the authors may, if they wish, also include other units, such as weights or international units, in parentheses.

See *Metric Units, Conversion Factors and Nomenclature in Nutritional and Food Sciences* (1972) paras 8 and 14–20. London: The Royal Society.

Nomenclature of fatty acids and lipids. In the description of results obtained for the analysis of fatty acids by conventional GLC, the shorthand designation proposed by Farquhar JW, Insull W, Rosen P, Stoffel W & Ahrens EH (*Nutrition Reviews* (1959), **17**, Suppl.) for individual fatty acids should be used in the text, tables and figures. Thus, 18 : 1 should be used to represent a fatty acid with eighteen carbon atoms and one double bond; if the position and configuration of the double bond is unknown. The shorthand designation should also be used in the abstract. If the positions and configurations of the double bonds are known, and these are important to the discussion, then a fatty acid such as linoleic acid may be referred to as *cis*-9,*cis*-12-18 : 2 (positions of double bonds related to the carboxyl carbon atom 1). However, to illustrate the metabolic relationship between different unsaturated fatty acid families, it is sometimes more helpful to number the double bonds in relation to the terminal methyl carbon atom, *n*. The preferred nomenclature is then: 18 : 3*n*-3 and 18 : 3*n*-6 for α-linolenic and γ-linolenic acids respectively; 18 : 2*n*-6 and 20 : 4*n*-6 for linoleic and arachidonic acids respectively and 18 : 1*n*-9 for oleic acid. Positional isomers such as α- and γ-linolenic acid should always be clearly distinguished. It is assumed that the double bonds are methylene-interrupted and are of the *cis*-configuration (see Holman RT in *Progress in the Chemistry of Fats and Other Lipids* (1966) vol. 9, part 1, p. 3. Oxford: Pergamon Press). Groups of fatty acids that have a common chain length but vary in their double bond content or double bond position should be referred to, for example, as C_{20} fatty acids or C_{20} PUFA. The modern nomenclature for glycerol esters should be used, i.e. triacylglycerol, diacylglycerol, monoacylglycerol *not* triglyceride, diglyceride, monoglyceride. The form of fatty acids used in diets should be clearly stated, i.e. whether ethyl esters, natural or refined fats or oils. The composition of the fatty acids in the dietary fat and tissue fats should be stated clearly, expressed as mol/100 mol or g/100 g total fatty acids.

Nomenclature of micro-organisms. The correct name of the organism, conforming with international rules of nomenclature, should be used: if desired, synonyms may be added in parentheses when the name is first mentioned. Names of bacteria should conform to the current Bacteriological Code and the opinions issued by the International Committee on Systematic Bacteriology. Names of algae and fungi must conform to the current International Code of Botanical Nomenclature. Names of protozoa should conform to the current International Code of Zoological Nomenclature.

Nomenclature of plants. For plant species where a common name is used that may not be universally intelligible, the Latin name in italics should follow the first mention of the common name. The cultivar should be given where appropriate.

Other nomenclature, symbols and abbreviations. Authors should consult recent issues of *Public Health Nutrition* for guidance. The IUPAC rules on chemical nomenclature should be followed, and the recommendations of the Nomenclature Committee of IUBMB and the IUPAC-IUBMB Joint Commission on Biochemical Nomenclature and Nomenclature Commission of IUBMB in *Biochemical Nomenclature and Related Documents* (1992), 2nd ed., London: Portland Press (http://www.chem.qmul.ac.uk/iupac/bibliog/white.html). The symbols and abbreviations, other than units, are essentially those listed in *British Standard* 5775 (1979–1982), *Specifications for Quantities, Units and Symbols*, parts 0–13. Day should be abbreviated to d, for example 7 d, except for 'each day', '7th day' and 'day 1'.

Elements and simple chemicals (e.g. Fe and CO_2) can be referred to by their chemical symbol (with the exception of arsenic and iodine, which should be written in full) or formula from the first mention in the text; the title, text and table headings, and figure legends can be taken as exceptions,. Well-known abbreviations for chemical substances may be used without explanation, thus: RNA for ribonucleic acid and DNA for deoxyribonucleic acid. Other substances that are mentioned frequently (five or more times) may also be abbreviated, the abbreviation being placed in parentheses at the first mention, thus: lipoprotein lipase (LPL), after that, LPL, and an alphabetical list of abbreviations used should be included. Only accepted abbreviations may be used in the title and text headings. If an author's initials are mentioned in the text, they should be distinguished from other abbreviations by the use of stops, e.g. 'one of us (P. J. H.)…'. For UK counties the official names given in the *Concise Oxford Dictionary* (1995) should be used and for states of the USA two-letter abbreviations should be used, e.g. MA (not Mass.) and IL (not Ill.). Terms such as 'bioavailability' or 'available' may be used providing that the use of the term is adequately defined.

Spectrophotometric terms and symbols are those proposed in *IUPAC Manual of Symbols and Terminology for Physicochemical Quantities and Units* (1979) London: Butterworths. The attention of authors is particularly drawn to the following symbols: m (milli, 10^{3}), μ (micro, 10^{6}), n (nano, 10^{9}) and p (pico, 10^{12}). Note also that ml (millilitre) should be used instead of cc, μm (micrometre) instead of μ (micron) and μg (microgram) instead of γ.

Numbers. Numerals should be used with units, for example, 10 g, 7 d, 4 years (except when beginning a sentence, thus: 'Four years ago...'); otherwise, words (except when 100 or more), thus: one man, ten ewes, ninety-nine flasks, three times (but with decimal, 2·5 times), 100 patients, 120 cows, 136 samples.

Abbreviations. The following abbreviations are accepted without definition by *Public Health Nutrition:*

ADP (GDP)	adenosine (guanosine) 5'-disphosphate
AIDS	acquired immune deficiency syndrome
AMP (GMP)	adenosine (guanosine) 5'-monophosphate
ANCOVA	analysis of covariance
ANOVA	analysis of variance
apo	apolipoprotein
ATP (GTP)	adenosine (guanosine) 5'-triphosphate
AUC	area under the curve
BMI	body mass index
BMR	basal metabolic rate
bp	base pair
BSE	bovine spongiform encephalopathy
CHD	coronary heart disease
CI	confidence interval
CJD	Creutzfeldt-Jacob disease
CoA and acyl-CoA	co-enzyme A and its acyl derivatives
CV	coefficient of variation
CVD	cardiovascular disease
Df	degrees of freedom
DHA	docosahexaenoic acid
DM	dry matter
DNA	deoxyribonucleic acid
dpm	disintegrations per minute
EDTA	ethylenediaminetetra-acetic acid
ELISA	enzyme-linked immunosorbent assay
EPA	eicosapentaenoic acid
Expt	experiment (for specified experiment, e.g. Expt 1)
FAD	flavin-adenine dinucleotide
FAO	Food and Agriculture Organization (except when used as an author)
FFQ	food-frequency questionnaire
FMN	flavin mononucleotide
GC	gas chromatography
GLC	gas–liquid chromatography
GLUT	glucose transporter
GM	genetically modified
Hb	haemoglobin
HDL	high-density lipoprotein
HEPES	4-(2-hydroxyethyl)-1-piperazine-ethanesulfonic acid
HIV	human immunodeficiency virus
HPLC	high-performance liquid chromatography
Ig	immunoglobulin
IHD	ischaemic heart disease
IL	interleukin
IR	infra red
kb	kilobases
K_m	Michaelis constant

LDL	low-density lipoprotein
MHC	major histocompatibility complex
MRI	magnetic resonance imaging
MS	mass spectrometry
MUFA	monounsaturated fatty acids
NAD+, NADH	oxidized and reduced nicotinamide-adenine dinucleotide
NADP+, NADPH	oxidized and reduced nicotinamide-adenine dinucleotide phosphate
NEFA	non-esterified fatty acids
NF-κB	nuclear factor kappa B
NMR	nuclear magnetic resonance
NS	not significant
NSP	non-starch polysaccharide
OR	odds ratio
PAGE	polyacrylamide gel electrophoresis
PBS	phosphate-buffered saline
PCR	polymerase chain reaction
PG	prostaglandin
PPAR	peroxisome proliferator-activated receptor
PUFA	polyunsaturated fatty acids
RDA	recommended dietary allowance
RER	respiratory exchange ratio
RIA	radioimmunoassay
RMR	resting metabolic rate
RNA, mRNA etc.	ribonucleic acid, messenger RNA etc.
rpm	revolutions per minute
RT	reverse transcriptase
SCFA	short-chain fatty acids
SDS	sodium dodecyl sulphate
SED	standard error of the difference between means
SFA	saturated fatty acids
SNP	single nucleotide polymorphism
TAG	triacylglycerol
TCA	trichloroacetic acid
TLC	thin-layer chromatography
TNF	tumour necrosis factor
UN	United Nations (except when used as an author)
UNICEF	United Nations International Children's Emergency Fund
UV	ultra violet
VLDL	very-low-density lipoprotein
V_{O2}	O_2 consumption
V_{O2max}	maximum O_2 consumption
WHO	World Health Organization (except when used as an author)

Use of three-letter versions of amino acids in tables: Leu, His, etc.
CTP, UTP, GTP, ITP, as we already use ATP, AMP etc.

Disallowed words and phrases. The following are disallowed by *Public Health Nutrition*:
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