UNDERSTANDING THE SIGNIFICANCE OF THE SOCIAL DETERMINANTS OF HEALTH ON THE OUTCOME OF COMPLICATED SURGICAL NEONATES AT RED CROSS WAR MEMORIAL CHILDREN'S HOSPITAL

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DECLARATION

MPH (Epi) Mini-Dissertation

I Sara Warren, Student Number WRRSAR001, 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: ___S.WARREN_____

Date: _____20/06/2012_____

Abstract

The United Nations Millennium Declaration conference held in September of 2000, set key Millennium Development Goals. Millennium Development Goal 4 requires a reduction in the mortality rate of children under the age of five years by two-thirds by the year 2015, from a baseline in 1990. In South Africa, it has been recognised that without a substantial reduction in neonatal deaths, MDG-4 will not be met.

This study will focus on the social determinants of health which play a key role in neonatal outcome in South Africa. It will evaluate the effects of these social determinants of health (Primary caregiver's education level, Primary caregiver's age, and Living Standards Measure) on the outcome of neonates admitted to, and operated on, in the general surgery unit of Red Cross War Memorial Children's Hospital (RCWMCH), within the Western Cape, South Africa.

This study is based on the hypothesis that there is an association between Neonatal outcome, and a selection of social variables, namely: primary caregiver's level of education, primary caregiver's age, and LSM.

The protocol (Part A) describes the sampling methodology that was used during the intervention. This will be followed by a literature review (Part B), Article (Part C), and Appendix (Part D).

Acknowledgments

I would like to thank my supervisors for their support. Dr Sharon Cox, the principal supervisor, for her help in securing ethics approval for this study, and for guiding the development of the protocol, literature review, and article.

I would also like to thank Professor Rodney Ehrlich, Head of the Public Health Department at the University of Cape Town, who helped me to refine the objectives of this research, and who responded to my many queries regarding the format of this dissertation.

Lastly, I would like to thank Professor Alastair Millar and my colleagues at the Department of Paediatric Surgery at Red Cross War Memorial Children's Hospital for their valued input and support during the process.

PART A : PROTOCOL

1. INTRODUCTION:

1.1. Background to study

In Sub-Saharan Africa, 4.8 million children die each year before reaching their fifth birthday[1]. Of those, 1.8 million are neonates[1] (defined as infants between the age of 0 to 28 complete days of life)[2]. The neonatal mortality rate is defined as the number of infants dying under the age of 28 days, divided by the total number of live births that year[2].The current neonatal mortality rate in South Africa is not known[3], yet there has been few published health measures employed to reduce the 2009 rate which was documented to be 19 per 1000 live births.[4]

The infant mortality rate is defined as the number of infants dying under the age of one year, divided by the total number of live births that year[2]. The infant mortality rate in South Africa has been well documented and has decreased from a rate of 58.88 in 2000 to 43.78 in 2010.[4] This decline is suggested to infer a decline in neonatal mortality rate which accounts for a portion of this figure.[4] This inference is however not well researched nor documented at present and thus no statistical conclusions on a potentially decreasing neonatal mortality rate can be drawn from the decreasing infant mortality rate.

The United Nations Millennium Declaration conference held in September of 2000[5], set key Millennium Development Goals (hereafter referred to as MDG), which provide a framework for the entire United Nations system to work coherently together towards a common end[6]. Millennium Development Goal 4 requires a reduction in the mortality rate of children under the age of five years by two-thirds by the year 2015, from a baseline in 1990[1]. Although there is no numerical target set for the neonatal and early childhood (defined as 120days post discharged from the hospital for the purposes of this study) mortality rates in the MDGs, it has emerged as an increasingly important component, and is thus receiving additional attention[7]. In South Africa, it has been recognised that without a substantial reduction in neonatal and early childhood deaths, MDG-4 will not be met [8].

Endogenous variables are defined as variables originating from within an organism, whilst exogenous variables originate from the outside[9]. Neonatal outcome is influenced by a variety of endogenous (e.g. Congenital Malformations, genetics) and exogenous variables (e.g. social determinants of health)[7]. This study will focus on the social determinants of health which play a key role in early childhood outcome in South Africa. The social determinants of health constitute

the conditions in which people are born, grow, live, work and age[10]. These social conditions exert pressure and set certain limits, and are majorly responsible for health inequalities – the oft unfair and avoidable differences in health status seen within and between countries[10.]

Multiple studies have found an inverse graded relationship between the social determinants of health and health itself[11]. Indicators for children's health include maternal education level, maternal age, access to services (water, electricity, and sanitation), housing type, and household income (per head).[8,11-16]. Despite household income (per head) being an important indicator of a child's health[11-16], obtaining an accurate measurement of this variable in our population is, for a variety of reasons, often unattainable. In the majority of these households, monthly incomes are variable, from and shared by multiple sources and are often unreliable. Hence, the Living Standards Measure (LSM), although a marketing research tool, has become the most widely used segmentation tool in South Africa.[17] This tool was created and is regularly updated by the South African Research Foundation in conjunction with the statistical consultation of ACNielsen Media International[17]. The LSM is noted to take into account access to services (water, electricity, and sanitation) and housing variables and is based on consumption. It is thus a marker of multiple social indicators including income, and effectively divides the population into ten LSM groups, 10 (highest) to 1 (lowest).[17] This LSM tool can be found in Part D (Appendix), and will be used in this study, with the aid of an LSM calculator[17], in order to stratify patients. The Maternal level of education and Maternal age variables will be substituted with the level of education and the age of the primary caregiver for the purposes of the study. The justification for this is that it is often the case within this group of neonates that the biological mother is not involved with the care of the child. Hence, the biological mother has little or no effect on the outcome of these patients.

The size of the gap between the health statuses (i.e. outcome) of the most, and least advantaged groups, gives an indication for potential improvements in a nation's health[11]. To prevent a vicious cycle of poor health, one needs to understand these social variables, and identify the groups who are at the greatest risk of poor health[11]. Knowledge of this can inform sound governance in medical and other services, and result in the optimal usage of current health resources and thereby achieve better health outcomes for children[18].

For the purposes of this study, neonates admitted to surgical services at Red Cross War Memorial Children's Hospital (RCWMCH) will be followed up for a duration of 120 days post discharge from the hospital. The justification for this is that the social determinants of health are

suggested to be related to a patient's well-being and progress post-discharge from hospital, and in their home setting[19]. This will ensure that each neonate is given adequate time in which to recover from surgery whilst in the hospital, as well as a period post-discharge within their home setting Neonatal outcome will be graded according to a measurement scale (0 = good outcome, 1 = poor outcome, 2 = deceased). Graded level one (i.e. poor outcome) will include any patient who experienced an unexpected adverse health event. Unexpected adverse events are defined in this study as a medical event that was not expected as a direct result of the patient's diagnosis, surgery, or due to any co morbidities. This grading scale is included in the data capturing form which can be found in Part D (Appendix).

Hence, this study will use Multivariate logistic regression to evaluate the effects of these social determinants of health (Primary cargiver's education level, Primary caregiver's age, and LSM) on the outcome of neonates admitted to, and operated on, in the general paediatric surgery unit of RCWMCH, within the Western Cape, South Africa.

Should the outcomes differ in different groups, recommendations will then be made in order to adjust medical care and services provided, so as to narrow the outcome grades between the most and least advantaged groups.

Gaps in the literature

RCWMCH is a unique population which drains five of the eight urban zones, and two of the four rural zones within the Cape Metropolitan Region. This is illustrated on the map of referral and support areas of the public sector hospitals within the Western Cape, South Africa. It has been included in Part D (Appendix) of this study.[20] RCWMCH manages approximately 250 000 patient visits per annum and is the only dedicated specialist paediatric hospital in sub-Saharan Africa. [21]

To date, there have been no documented studies in this group of neonates, where the effects of these social determinants of health, is unknown. Hence this study may well provide useful information pertaining to this group of patients and the effects of the social circumstances into which they are born.

2. RESEARCH AIMS AND OBJECTIVES

2.1. Research Aims

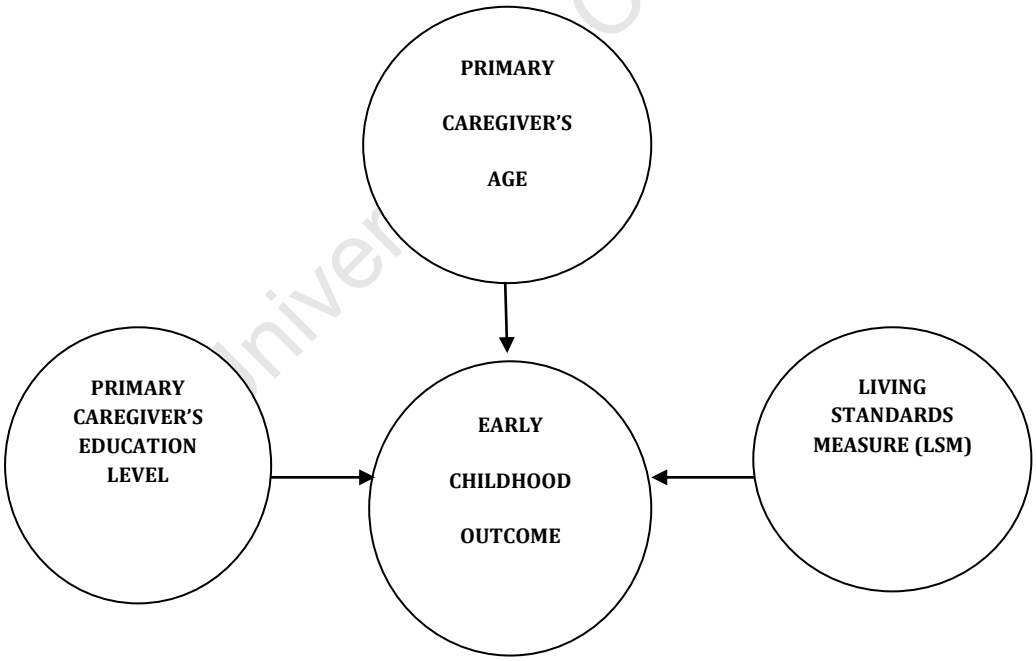
The aim of this dissertation is to determine whether the outcome of general surgery patients, admitted to, and operated on as neonates within RCWMCH in the Western Cape, is influenced by a selection of social variables.

2.2. Hypothesis

In this study, it is hypothesised that a selection of social variables, namely: primary caregiver's level of education, primary caregiver's age, and LSM influence the outcome of general surgery neonates, admitted to, and operated on within RCWMCH in the Western Cape.

Figure 1 is a schematic representation of the hypothesised factors influencing early childhood outcome which will be quantified in the study.

Figure 1: Hypothesised factors influencing early childhood outcome



2.3. Specific objectives

- To determine the rate for each of the three levels of the outcome measure as illustrated in the grading scale (i.e. good outcome, poor outcome, and deceased). These rates will be documented as “good outcome rate”, “poor outcome rate”, and “mortality rate” and will each be calculated over a denominator which will consist of all eligible participants in this study.
- To determine which social determinants of health are associated with neonatal outcome

Table 1: Objectives and data requirements to be obtained from folder review

Objective	**Data Required**	**Information to be obtained from each folder review**
Determine the Outcome rates (good outcome rate, poor outcome rate, and mortality rate)	Patient outcome details per patient	Did this patient experience one or more unexpected adverse event(s), or die

Table 2: Objectives and data requirements to be obtained from interview

Objective	**Data Required**	**Question in interview**
Identify which social determinants of health are associated with Early childhood Outcome	Primary Caregiver’s Age	What is the primary Caregiver’s date of birth?
	Primary Caregiver’s Level of Education	What is the primary Caregiver’s level of education? (Primary, Secondary, or tertiary)
	LSM	Participant to answer a list of 29 questions (see Part D - Appendix)

3. METHODS

3.1. Study Design

The Neonatal General Surgery Database of RCWMCH will be used to source patients who are to be included in this dissertation. This database contains up-to-date and detailed records of all neonates operated on in this General Surgery unit since 1st July 2010. A retrospective cohort study design will be used to study the influence of the selection of social determinants of health (primary caregiver's age, primary caregiver's level of education, LSM) on patient outcome. A folder review will be carried out on each patient's records. Added to this, an in-depth interview will be held with each participant's primary caregiver.

3.2. Study population and sampling

3.2.1. Exclusion criteria

The following patients will be excluded from the study:

- Any patient whose first admission was not during the neonatal period
- Any patient whose first admission date was not during the period 1 July 2010 to 31 August 2011
- Any patient who did not have a period of 120 days at home post discharge from hospital
- Any patient that was discharged as a palliative care case. These are patients who have been discharged for terminal care. The poor neonatal outcome of these patients' are thus expected and are not influenced by factors under study.
- Events which occurred after the first 120days outside of the hospital (i.e. if patient died at 121 days of life then he or she will be classified as alive in this study)
- All patients who did not have a major surgical diagnosis listed as Anorectal Malformation, Congenital Diaphragmatic Hernia, Duodenal Web, Exomphalos, Hirschsprungs Disease, Intussusceptions, Malrotation, Necrotizing Enterocolitis, Pyloric Stenosis, Spontaneous gastrointestinal perforations, Stenosis, and Volvulus. The justification for this is that these are the neonates who are most vulnerable due to their complicated medical diagnosis, as well as those who have high State health resources values allocated to them. The definitions for these diagnosis's are listed in Section 7 of this protocol.

3.2.2. Study location

Red Cross War Memorial Children's Hospital (RCWMCH) is South Africa's only dedicated paediatric hospital and offers a comprehensive range of specialist paediatric services to children under thirteen years of age.[21] Children from all nine provinces, and from all over Africa, are referred to RCWMCH from referral hospitals, clinics and smaller hospitals[21] however the vast majority of patients treated stem from the hospital drainage area which is depicted in the Map of referral and support areas of the public service hospitals. (Part D - Appendix) .[20] In addition, RCWMCH is the only dedicated specialist paediatric hospital in sub-Saharan Africa, managing approximately 250 000 patient visits per year and treating some of the most complex, life-threatening, and life-limiting conditions.[21]

Hence, the study population includes all complicated general surgery neonates admitted to, and operated on, at RCWMCH.

3.2.3. Sampling strategy

RCWMCH was chosen as the study site as it is South Africa's only dedicated child health hospital. As of the 1st July 2010, subsequent to the employment of a dedicated neonatal liaison sister, a neonatal database was created. This database forms a comprehensive summary of all neonates undergoing surgery at RCWMCH, and is fully inclusive of all such patients. As it is a relatively new database, all patients should be relatively easily contactable. For this reason, the study will be carried out using a consecutive sampling strategy by including all subjects, as defined in the exclusion criteria, who were operated on during the period 1st July 2010 and 31 August 2011. This will allow for all patients to have 120days post birth by the 31st December 2011 at which point data collection for the purposes of this dissertation needs to be commenced.

3.2.4. Sample Size

- Level of significance (α) = the probability of rejecting the null hypothesis when it is assumed to be true (Type I error). RCWMCH conventionally uses α = 0.05 (z = 1.96) for a 95% level of significance.
- Anticipated population proportion = 9%. This estimate was formed after having explored the current mortality rate (i.e. worst outcome grade) as reflected in the RCWMCH database.
- Estimated sample size (n) = $[p(1 – p)z^2] / d^2$.

$$= [0.1(1-0.1)(1.96)^2] / [0.1]^2$$

$$= 139$$

3.3. Measurements

Each participant will be interviewed in order to complete the LSM questionnaire. This questionnaire is a well known research tool created by the South African Advertising Research Foundation in conjunction with ACNielsen Media International, and their statistical consultant, Dr Jacky Galpin.[17] It contains a list of 29 questions and can be found in Part D (Appendix). The questionnaire will be completed via the telephone in the participants choice of language, or in person should the participant attend the hospital during the data collection phase of this dissertation. The answers to this questionnaire will then be entered into an online LSM Calculator [22] which will calculate the exact LSM level for each patient. This LSM calculator was designed by Eighty20, a niche consulting company in South Africa that has created new and innovative ways to access South African and International Consumer data.[22]

Participants will also be questioned regarding their age and level of education.

The hospital records of each participant will then be reviewed by the researcher using a data capturing form. This may include neonatal records from referring institutions. This form can be found in Part D (Appendix) and was created taking into account information required relating to the exclusion criteria, as well as to details required to answer the research question. The form contains a basic identification field in which each participants RCWMCH study participant number can be recorded. Other fields include exclusion criteria, date of birth and details of hospital attendance, and outcome. The details of primary caregiver's age, level of education, and LSM (questionnaire and score) collected during the participant interview will be recorded here.

3.4. Potential limitations

As this is a retrospective study, the researcher expects to be unable to contact some patients (due to altered contact details and loss to follow-up). A number of patients may also decline consent to complete the survey or to have their records reviewed. There is also the possibility

that some records may not be traced. These potential participant RCWMCH study numbers will be recorded and the percentage of loss, as well as any known patient details pertaining to this study, will be reflected in the results section of this dissertation. The aim is to keep this percentage as low as possible in order to ensure statistical significance of the research results.

Desirability bias may be an issue in the surveys as participants may answer in a particular way as they feel those are the answers that the interviewer wanted to hear. To minimize this bias the interviewer will not prompt the respondents.

3.5. Pilot sampling

No pilot sampling is required for the interview as the LSM survey is a well established instrument. The data collection form (Part D - Appendix) which will be used to capture details from the participants records and interview will however be piloted on two patients. Any nuisances noted will be corrected on the form before the formal research is initiated.

3.6. Logistics and time schedule

MONTH	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE
Literature Review								
Data Management								
Data Analysis								
Results								
Discussion								

The schedule for this dissertation is to hand it in by 30th June 2012.

3.7. DATA MANAGEMENT AND ANALYSIS

3.7.1. Data Management

All data will be entered into Microsoft Excel (Vista version) under appropriate categories, and then cleaned where necessary. STATA 11 (STATA for Windows, version 11, Stata Corp; College Station, TX) will then be used to analyse the data.

3.7.2. Data Analysis

The statistical methods used to answer the two objectives of this study are as specified below. Table 3 lists the types of variables that will be used.

Table 3: Types of variables

Variable Name	Type of variable
Outcome	Categorical/Ordinal
Primary Caregiver's level of education	Categorical/Ordinal
Primary caregiver's age	Numerical/Discrete
LSM	Categorical/Ordinal

For Objective 1, tabulations will be done in order to ascertain the outcome rates.

Objective 2 aims to determine which social determinants of health are associated with neonatal outcome. Tabulations will be used extensively for the data exploration of all categorical data. Associations between categorical variables and the outcomes will also be tested using Chi-squared tests (see Table 4). Most of the data are categorical but there are a few numerical variables and thus boxplots will be used to test the association between numerical variables and the outcome.

Table 4: Dummy table example of variables that may be associated with Neonatal Outcome

Variables	Response	Outcome
LSM	**1**	

	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
Primary Caregiver's Level of Education	**Primary**	
	Secondary	
	Tertiary	

It will be necessary to use dummy variables for all categorical independent variables (Table 5 - 6).

Table 5: Dummy Variables for Primary Caregiver's level of education variable

	Dummy Variables	
	Secondary	Tertiary
Primary	0	0
Secondary	1	0
Tertiary	0	1

Table 6: Dummy Variables for LSM variable

	Dummy Variables								
	LSM 2	LSM 3	LSM 4	LSM 5	LSM 6	LSM 7	LSM 8	LSM 9	LSM 10

LSM 1	0	0	0	0	0	0	0	0	0
LSM 2	1	0	0	0	0	0	0	0	0
LSM 3	0	1	0	0	0	0	0	0	0
LSM 4	0	0	1	0	0	0	0	0	0
LSM 5	0	0	0	1	0	0	0	0	0
LSM 6	0	0	0	0	1	0	0	0	0
LSM 7	0	0	0	0	0	1	0	0	0
LSM 8	0	0	0	0	0	0	1	0	0
LSM 9	0	0	0	0	0	0	0	1	0
LSM 10	0	0	0	0	0	0	0	0	1

Stepwise selection using Multivariate logistic regression will be conducted to assess which variables are associated with the neonatal outcome, adjusting for other variables on statistical criteria. Table 7 gives a summary of the statistical tests that will be used.

Table 7: Objectives related to data analysis

Objective	Question in Questionnaire or Data Collection Form	Statistical Analysis
Determine the outcome rates of these neonates	Did this patient die or have any adverse and unexpected events	Tabulations
Determine which social Determinants of health are associated with Early chidhood outcome	How old is the patient's primary caregiver What level of Education does the Primary caregiver have? What is the LSM level	Tabulations Box Plots Chi Square Test Stepwise selection using Logistic Regression

4. ETHICAL CONSIDERATIONS

All participants will be required to give written or telephonic consent. This will be requested in a language of their choice – English, Afrikaans, or Xhosa. They will be informed of their right to waive consent without prejudice. A consent form (in all three of these languages) appears in Part D (Appendix).

No negative consequence is anticipated and no financial compensation will be awarded. It is however anticipated that the findings of this study will consequently benefit future neonates in terms of altered management programs.

Patient records will be reviewed at RCWMCH and confidentiality will be maintained at all times. Each study participant will be allocated a study participant number (see Part D – Appendix for Dummy participant number allocation tool) which will be the only identification field used on the data capturing form as well as on the electronic data records. This will ensure that neither the patient name, nor hospital record

number, is visible in the study documentation, and that confidentially is maintained at all times. Added to this, the data capturing forms will be kept under lock and key within RCWMCH premises, and electronic data will be password protected. Only the principal investigator and the study supervisor will have access to this data.

The authors declare no financial implications and there is no conflict of interest.

This study will require both RCWMCH and UCT ethics approval before its commencement.

5. STRUCTURE

This dissertation will consist of four parts:

A) Protocol

B) Literature Review

C) Article

D) Appendices

6. REFERENCES:

1. Unicef. http://www.unicef.org/progressforchildren. Accessed August 27, 2011.
2. MedicineNet.com. http://www.medterms.com. Accessed August 26, 2011.
3. Pattinson R, Woods D, Greenfield D et al. Improving survival rates of newborn infants in South Africa*. Journal of Reproductive Health*. 2005; 2:4.
4. Unicef South Africa. http://www.unicef.org/infobycountry/southafrica_statistics.html. Accessed August 27, 2011.
5. United Nations. http://www.un.org/millennium/declaration/ares552e.htm. Updated 1990. Accessed August 16, 2011.
6. Millennium Project. http://www.unmillenniumproject.org. Updated 2006. Accessed August 25, 2011.
7. Millennium Development Goals: Country Report 2010.http://www.statssa.gov.za/news_archive/Docs/MDGR_2010. Updated 2010. Accessed August 28, 2011.
8. Hoque M, Haaq S, Islam R. Cause of neonatal admissions and deaths at a rural hospital in Kwazulu-Natal. *South Africa. South African Journal of Epidemiological Infections*. 2011; 26(1).
9. Dictionary.com. http://dictionary.reference.com/browse/endogenous. Updated 2011. Accessed 4 October 2011.
10. Myer L, Ehrlich R. Epidemiology. *Chapter 16: Social Epidemiology.* 2007. P.210-220.
11. Susser M. Editorial: Social Determinants of health-socioeconomic status, social class, and ethnicity. *American Journal of Public Health*. 1995; 85:7.
12. Annett A, Anderson A. Social Determinants of infant mortality in the Nordic countries, 1980-2001. *Scandinavian Journal of Public Health*. 2004; 32: 381.
13. Das Gupta M. Death clustering, Mother's education and the determinants of child mortality in rural Punjab, India. Population Studies. 1990; 44: 489-505.
14. Lake L, Reynolds L. Addressing the social determinants of health. Children's Institute. University of Cape Town. 2010.
15. Mavalankar D, Trivedi C, Gray R. Levels and risk factors for perinatal mortality in Ahmedabad, India. *Bulletin of the World Health Organisation.* 1991; 69(4):435-442.

16. Braveman P, Egerter S, Williams D. The social determinants of health: coming of age. *Annual Review of Public Health.* 2010; 32:3.1-3.18.
17. South African Advertising research foundation. http://www.saarf.co.za/LSM/lsms.htm. Updated 2011. Accessed 17 September 2011.
18. Pattinson R. Challenges in saving babies – avoidable factors, missed opportunities and substandard acre in perinatal deaths in South Africa. South *African Medical Journal*. 2003; 93:6.
19. World Health Organisation Page. http://www.who.int. Updated 2011. Accessed 27 August, 2011.
20. Map of referral and support areas of public sector hospitals. Cape Metropolitan Council. 2007
21. Cape Gateway. http://www.capegateway.gov.za/redcrosshospital). Updated 31 August 2011. Accessed 4 October 2011.
22. Eighty20. http://www.eighty20.co.za/databases/show_db.cgi?db=fulllsmcalculator. Updated 2011. Accessed 4 October 2011.
23. Anderson, D. Mosby's Medical, Nursing, & Allied Health Dictionary.United States: Mosby Inc; 2002.

7. ACRONYMS AND ABBREVIATIONS

- MDG **–** Millennium Development goals[5]
- LSM – Living standards measure[17]
- RCWMCH – Red Cross War Memorial Children's Hospital[21]

8. DEFINITIONS

- Anorectal malformation – "birth defect where the anus and rectum (the lower end of the digestive tract) do not develop properly"[23]
- Atresia – "the absence of a normal body opening, duct, or canal"[23]
- Congenital diaphragmatic hernia – "the protrusion of a part of the stomach, or intestines through an opening in the diaphragm, present at birth"[23]
- Duodenal Web – "a complete or incomplete obstruction at the duodenum due to a membranous web'[23]
- Exomphalos – "congenital herniation of intraabdominal viscera through a defect in the abdominal wall around the umbilicus"[23]
- Gastroschisis – "a congenital defect characterised by incomplete closure of the abdominal wall with protrusion of the viscera"[23]
- Hirschsprungs Disease - "the congenital absence of autonomic ganglia in the smooth muscle wall of the colon, which causes poor or absent peristalsis in the involved section of the colon, accumulation of faeces, and dilation of the bowel"[23]
- Intussusception – "prolapsed of one segment of the bowel into the lumen of another segment"[23]
- Malrotation – "failure of the intestinal tract or other viscera to undergo normal rotation during embryonic development"[23]
- Necrotizing enterocolitis (NEC) – "an acute inflammatory bowel disorder that occurs primarily in preterm or low-birth weight neonates. It is characterised by ischemic necrosis of the gastro intestinal mucosa that may lead to perforation and peritonitis"[23]
- Pyloric stenosis – "a narrowing of the pyloric sphincter at the outlet of the stomach, causing an obstruction that stops the flow of food into the small intestines"[23]

- Spontaneous gastrointestinal perforations – " a hole or puncture through the entire thickness of the gastro intestinal tract occurring naturally and without any apparent cause"[23]
- Stenosis – "an abnormal condition characterised by the constriction or narrowing of an opening or passageway in a body structure"[23]

PART B: STRUCTURED LITERATURE REVIEW

1. INTRODUCTION AND OBJECTIVES OF LITERATURE REVIEW

The South African Government aims to create a healthy and equitable society characterised by an environment where children are able to grow into healthy, secure and productive adults.[1] Given this aim, and that the United Nations International Children's Emergency Fund (UNICEF) estimates that close to 50 000 babies and young children could be saved from death every year[2], knowledge regarding the current neonatal mortality rate and factors affecting it within South Africa is crucial.

The effects of the social determinants of health on neonatal outcome is an overlooked public health problem and presents a major barrier to the protection of children's rights across South Africa.[3] Understanding the influence of these social determinants of health on neonatal outcome could thus assist Government in protecting the rights of children in South Africa. In doing so, Millennium Development Goal 4 (which aims to reduce the under-five childhood mortality rate by two thirds by 2012[2]) can then be achieved.

This study aims to determine whether the outcome of general surgery patients, admitted to, and operated on as neonates within RCWMCH in the Western Cape, is influenced by a selection of social variables.

To inform this research, the objectives of this literature review were:

- To identify neonatal and early childhood mortality rates within South Africa
- To compare South Africa's neonatal and early childhood mortality rates to that of the world's
- To explore the legal framework for neonatal health within South Africa and to compare this internationally
- To understand the social determinants of health
- To explore the relationship of primary caregiver's age to neonatal outcome
- To explore the relationship of primary caregiver's level of education to neonatal outcome
- To understand the effects of housing, access to water and electricity, sanitation, and income on neonatal outcome

- To understand the living standards measure (LSM) as a combined measure of the level of housing, income, sanitation, and access to water and electricity

2. SEARCH STRATEGY

The following search strategy was used to inform this literature review:

Strategy: Search engines accessed via the University of Cape Town library site, and others accessed via the worldwide web, were used to search for combinations of the listed search terms below. Relevant articles suggested by search engines were followed up upon. References in articles were checked so as to identify other relevant studies. Text books were also used where information could not be gained via the above mentioned search methods.

Exclusion criteria: Non-English articles

Inclusion criteria: Studies examining the social determinants of health; studies examining the effects of social determinants of health on neonatal outcome; studies exploring the Living Standards Measure (LSM); studies examining the Millennium Development Goals

Search Terms:

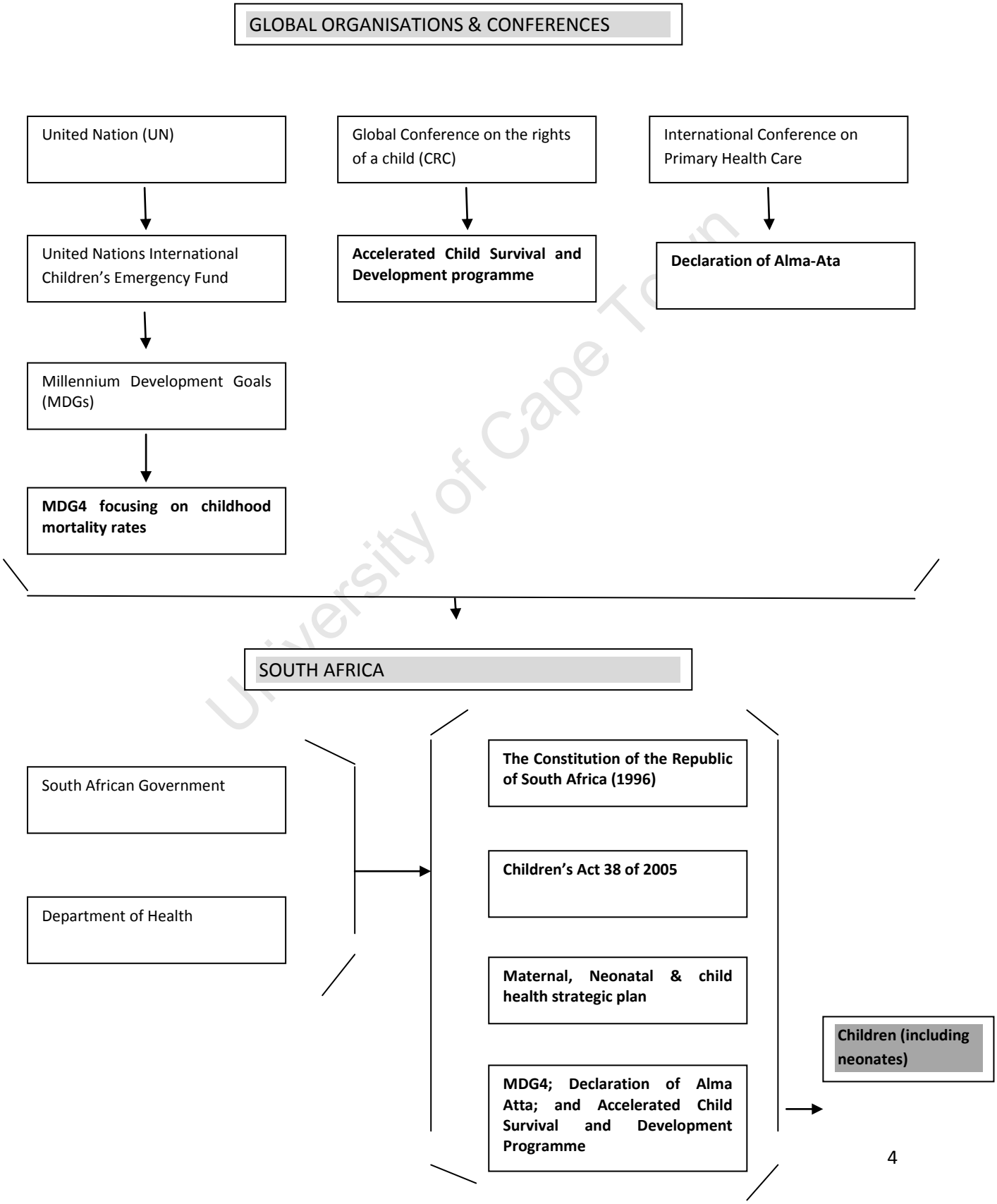
- Neonates: infants, newborns, children, premature infants
- Social determinants of health – maternal age, maternal education, water, sanitation, electricity, income, wealth, per capita income, household income
- Maternal: mother, primary caregiver
- Level of education: education, schooling, primary education, secondary education, tertiary education, college
- LSM
- United Nations (UN), UNICEF, MDG, Declaration of Alma Ata, South African Constitution, Children's Act 38 of 2005

Search Engines: Google; Google Scholar; EBSCOhost; Pubmed; Science Direct; Medline; Aleph (University of Cape Town library database).

3. SUMMARY OF LITERATURE REVIEW

3.1. International and South African framework of child health

Figure 1: Framework for Neonatal health within South Africa



3.1.1. International framework of child health:

The United Nations (UN), founded in 1945 after World war II, is an international organization which facilitates social progress amongst its 193 member states, including South Africa.[4] It has many subsidiary organizations including the United Nations International Children's Emergency Fund (UNICEF).[4] UNICEF, developed in 1950, advocates for the protection of children's rights and amongst other key goals, it collaborates with national governments through supporting the active implementation of an "Accelerated Child Survival and Development Programme".[2] This programme was developed in 1989 when world leaders concluded that children needed a special convention (the Convention on the Rights of a Child (CRC)) pertaining only to children as minors under eighteen years old often need special care and protection that their major adult counterparts do not.[5] The resulting Accelerated Child Survival and Development programme is the first legally binding instrument to incorporate the full range of human rights – civil, cultural, economic, political and social rights. Its aim is to reduce infant, under-five and maternal mortality worldwide.[6]

During an International Conference on Primary Health Care in 1978 held by the UN[6], the Declaration of Alma-Ata was produced. This expressed the need for urgent action by all governments, health workers, and the community to protect and promote the health of all the people of the world.[7]

At a UN Declaration Conference held in September of 2005[4], key development goals were set for the millennium. These Millennium Development Goals (MDGs) form a framework for the UN System to work together towards common goals which include eradicating extreme poverty, reducing child mortality rates, fighting disease epidemics such as AIDS, Malaria, and Tuberculosis, and developing a global partnership for development with specific focus on international trade and debt management, as well as on the special needs of developing and landlocked countries in particular.[8]

MDG 4 states that it is essential that the health profile of children be adequately addressed in order to prevent a vicious cycle of poor health.[2] It requires a reduction in the under-five childhood mortality rate by two thirds by 2012.[2]

3.1.2. South African framework for child health:

The South African Government, in collaboration with UNICEF, aims to create a healthy and equitable society characterised by an environment where children are able to grow into healthy, secure and productive adults.[1] Putting MDG4 into action has been one of South Africa's focus areas since 2005 hence the country prioritising child health as one of the main areas of intervention.[9] By following the strategic plans of the UN's Accelerated Child Survival and Development programme, South Africa aims to reduce childhood deaths by ensuring that all children receive those healthcare services that are deemed essential to promote their health.[10] South Africa's Parliament has also launched a maternal, neonatal and child health strategic plan (2008-2013).[11] This plan aims to guide the country's interventions in this area.

Within South Africa, the rights of children are further protected by the Constitution of the Republic of South Africa (1996)[12] and the Children's Act 38 of 2005.[13] The Constitution of South Africa guarantees everyone the right to basic healthcare services[12], whist the Children's Act provides legislation to support the UN's Accelerated Child Survival and Development Programme.[13]

3.2. Neonatal Mortality

There is no set numerical target for neonatal and early childhood mortality rates within MDG4.[2] Yet globally, deaths during the neonatal period (0 – 28 days) are estimated to account for approximately a third of all deaths in children under-five years of age.[15]

The South African neonatal mortality rate was calculated as 18 per 1000 live births in 2010 yet this cannot be compared to a 1990 baseline which is not available.[2] The 2010 global neonatal mortality rate was however 23 per 1000 live births.[15] There are no global figures from 1990 to compare with this rate. It is not known whether South Africa's neonatal mortality rate has improved or worsened over the past two decades despite the World Health Organisations report of declining neonatal mortality worldwide.[15] The under-5 mortality rate has however improved from 59 (per 1000 live births in the same year) in 1990 to 57 (per 1000 live births in the same year) in 2010.[15]

Despite not knowing South Africa's progress in terms of an improvement or worsening of neonatal mortality rates since 1990, MDG4 will only be met if deaths during the neonatal and early childhood period are substantially reduced. [2]

The leading causes of infant mortality are dehydration, disease, congenital malformation, infection, maternal substance and alcohol abuse, and sudden infant death syndrome.[16] In the South African context, neonatal mortality is also closely linked to HIV. Neonates who are HIV positive, or are HIV negative yet have HIV-infected mothers are documented to have higher mortality rates than HIV negative neonates or neonates who are HIV negative and have HIV negative mothers respectively. [16]

3.3. Social Determinants of Health

The social determinants of health constitute the conditions in which people are born, grow, live, work and age[17]. These determinants of health play a key role in early childhood outcome in South Africa and worldwide.[17]

Far less is known about the social determinants of child mortality than the biological ones. While the latter factors have been studied extensively, relatively little work has been done on the former.[18]

Endogenous variables are defined as variables originating from within an organism, whilst exogenous variables originate from the outside[9]. Neonatal outcome is influenced by a variety of endogenous (for example congenital malformations, genetics) and exogenous variables (social determinants of health)[20].

The social determinants of health include individual-level variables (such as education and age), household-level variables (such as access to water, electricity, sanitation, and housing), and community-level variables (such as norms, customs and traditions).[21] Opinions differ as to which social determinants of health are primarily responsible for neonatal mortality. This study will however concentrate on two individual-level variables (namely maternal caregivers age and level of education [3,23-27]), and on one measure incorporating four household-level variables (water, electricity, sanitation, and housing) - the Living Standard Measure (LSM)[22]. The Maternal level of education and Maternal age

variables will be substituted with the level of education and the age of the primary caregiver for the purposes of the study. The justification for this is that it is often the case within this group of neonates that the biological mother is not involved with the care of the child. Hence, the biological mother has little or no effect on the outcome of these patients. Studies have however shown that neonates who are formally adopted or fostered are more likely to have an improved health outcome as compared to those neonates who are informally cared for by an individual who is not the biological parent. Such informally adopted or fostered neonates are often unwillingly cared for.[26]

Social determinants of health present major barriers to the protection of children's rights across South Africa. Understanding the influence of the above three social determinants of health on neonatal outcome could thus assist policy makers to protect the rights of children in South Africa and in doing so, achieve MDG4.

3.3.1. Primary caregiver's level of education

According to current (2010) United Nations statistics, 96% of South African children attend primary school, 70% attend school at the secondary level, and only 7% attend at a tertiary level. [28]

The most recent World Bank figures in 2010 showed a female literacy rate of 97.50 in South Africa [29] The female literacy rate is defined as the percentage of females who can, with understanding, read and write a short, simple statement on their everyday life.[19] Research has shown a clear independent inverse relationship between maternal education level and infant mortality and morbidity.[29]

A study in Scandinavia showed that the risk of neonatal mortality decreased gradually with an increasing level of maternal education.[21] In fact, mothers with a primary education level had a 20% increased risk of neonatal mortality as compared to those mothers with a higher level of education. [21]

Nigerian statistics show that very different levels of child survivorship result from different levels of maternal education in an otherwise similar socio-economic context and when there is equal access to the use of medical facilities.[30] Hence, maternal education appears to be the single most powerful determinant of the level of child mortality. [30]

During the 1980s, a United Nations study suggested that there was no specific threshold level of maternal education that needed to be reached before advantages in child survival began to accrue; even a small amount of basic education was usually associated with improved chances of child survival, and the gains generally increased with increasing levels of education were associated with improved chances of child survival in a wide range of developing countries.[4]

A study in South Africa revealed that relative to children whose mothers had no education, mortality among children whose mothers completed primary or secondary education was reduced by 24 percent and 41 percent, respectively.[3] This study also showed that the improvement in neonatal survival, although slightly improved, was not very different between mothers with a secondary and tertiary level of education. [3]

Improved maternal education improves child survival through complex mechanisms. Research suggests that education results in an improvement in the mothers' basic childcare and ill health skills, and improved use of modern medical services.[17]

Maternal education is also associated with greater emphasis on child quality, perhaps ensuring that children are more likely to survive, have greater food and human capital investments and thus end up as higher quality citizens, being healthier, better educated, more affluent, and emotionally better developed. [31]

A Study conducted in the Unites States identified three components to the effect of education on woman which it terms instrumentality, social identification, and confidence.[32] Instrumentality is the ability to manipulate and feel control over the outside world. Social identification is concerned with engagement with modern institutions and bureaucracies. Greater confidence permits the interaction with such officials and bureaucracies. All three components have a positive impact on the health outcome of neonates. [32]

Maternal education is hence one of the major pathways through which neonatal outcome can be improved. [33] It is also interesting to note that the average female educational level in the community exerts a greater influence on infant survival than

the mother's educational level alone. This result supports assertions that child survival is strongly impacted by mass education.[33]

The maternal level of education variable will be substituted with the level of education of the primary caregiver for the purposes of the study. The justification for this is that it is often the case within this group of neonates that the biological mother is not involved with the care of the child. Hence, the biological mother has little or no effect on the outcome of these patients.

3.3.2. Primary Caregiver's Age

Maternal age is a well-known determinant of infant morbidity and mortality.[34] In general, infant mortality tended to decline with maternal age to a minimum and then increase again at older ages.[35] This pattern of neonatal mortality across maternal ages can be described as having a U-shape. The risk of infant mortality is high for young mothers, yet declines as age increases between the ages of 12 and 26. Neonatal mortality risk is then at its lowest for 27–29-year-old mothers and starts to increase from the age of thirty onwards. It is thus expected that children born to young mothers (aged less than 20 years) and those born to older mothers (aged 40-49 years) should have higher mortality than those born to mothers aged 20-39 years.[35]

Females who have their first child at a young age are at a high risk, both biologically and socially, for poor neonatal outcome. In fact maternal age of less than 20 years increases the risk of neonatal mortality by approximately 15 percent relative to maternal age between the ages of 30 and 39 years. This risk declines as age increases between the ages of 12 and 26.[36] There is a great deal of debate as to whether these consequences are due to maternal age per se, or whether they are caused by the adverse economic and social circumstances of teenagers who become mothers.[36] Some of the explanations proposed for these adverse birth outcomes are biological—i.e., that a pregnant teenager who is still growing may be

competing for nutrients with the foetus, or that pregnancy within two years after menarche increases the risk of preterm delivery. [36]

Psychological factors may also be involved, since many adolescent pregnancies are unplanned, unwanted or discovered late.[36] A pregnant teenager may lack the emotional maturity to take responsibility for a pregnancy even after she has decided to carry it to term.[36] In terms of social and economic conditions, teenagers who become mothers are more likely than others to be poor, to be under-educated or to live in areas with limited access to resources and services, and to smoke and drink alcohol.[37] Older teenagers and adolescents are however increasingly likely to be married, to have wanted pregnancies, to be at college or to be working, and can thus be expected to have improved neonatal outcome as compared to younger mothers.[37]

The risk of infant mortality is lowest for women who have their first birth between the ages of 27 and 29.[37] Delaying first births until 27-30 is recommended for the lowest risk of infant mortality, anthropometric failure, and poor child health.[38]

Age above 30 is significantly associated with an increased risk of neonatal mortality as compared to those mothers between the ages of 20 and 30.[37] Woman who give birth relatively late in their reproductive lives are likely to be more educated, more likely to have a partner, are financially wealthier, more likely to live in an urban area, and more likely to live in better sanitary conditions.[37] They, nonetheless, share increased risks of delayed childbearing which poses its own biological risks. This includes an increased likelihood of medical conditions such as hypertension and diabetes.[38] In addition, women aged 35 and older, like teenagers, have higher rates of unintended pregnancy than do women in their 20s and early 30s. Risks for poor birth outcomes increase further with age, with those older than 40 being at greater risk than 35-39-year-olds for genetically abnormal foetuses.[38]

The Maternal age variable will be substituted with the age of the primary caregiver for the purposes of the study. The justification for this is as mentioned previously.

3.3.3. Household-level variables

Further social determinants of neonatal health include access to services (water, electricity, and sanitation), housing type, and household income (per head).[3,23-27].

Nearly two thirds of South African children live in the poorest 40% of households with a per capita monthly income of less than R570.[3] Here, children live in informal settlements in shacks or backyard dwellings (29%), live in over-crowded conditions (30%), don't have access to electricity (20%), don't have access to onsite water (36%), and still use unventilated pit latrines, buckets, or open land (39%) as opposed to water-born sewerage [3]

Social structure theory suggests that poverty not only shapes children's' living conditions; it also has a lifelong cumulative influence on health.[39] Inequality of neonatal deaths rates is suggested to be due to gaps in economic and social development across rural and urban areas including differences in income, housing, access to water supplies and electricity and sanitation.[39] Research in Scandinavia showed that the systematic tendency is that the higher people are located in the social hierarchy the lower the neonatal mortality.[25]

Municipalities with a higher percentage of persons living in urban areas have a lower prevalence of neonatal death.[40] This suggests an association between urbanisation (and consequent improved housing, access to services and income) and decreased neonatal mortality rates. [40]

Multiple studies have shown a negative relationship between access to safe drinking water and neonatal mortality. In fact, the advantages of having access to safe drinking water were shown to result in a 68 percent reduction in neonatal mortality risk in a study conducted in Egypt. [41]

Neonatal mortality has also been shown to be detrimentally affected by a lack of access to household electricity.[41] A study conducted in Bangladesh showed a statistical significant negative effect of access to household electricity on neonatal mortality.[42] A second study in Mexico mirrored this result.[43]

Lastly, inadequate household sanitation is inversely related to neonatal mortality.[2] A study in rural Bangladesh showed that risk of neonatal mortality in the households

which did not have sanitation facilities was 3 to 12 times higher than in those which did.[44]

Despite household income (per head) being an important indicator of a child's health[3,23-27], obtaining an accurate measurement of this variable in our population is, for a variety of reasons, often unattainable. In the majority of these households, monthly incomes are variable, from and shared by multiple sources and are often unreliable.

As each of these determinants have an influence on neonatal outcome, and because of the inaccurate measurement of household income, it was decided to use the LSM categories as a single household level variable. This measure incorporates all of the above (access to water, electricity, sanitation as well as income) in a scoring system. The Living Standards Measure (LSM), although a marketing research tool, has become the most widely used segmentation tool in South Africa.[20] This tool was created and is regularly updated by the South African Research Foundation in conjunction with the statistical consultation of ACNielsen Media International[20]. The LSM is thus a marker of the above mentioned social indicators, and effectively stratifies the population into ten LSM groups, 10 (highest) to 1 (lowest).[20] An exact derivation of the mathematical model used to calculate the LSM score, as well as an example of this LSM questionnaire, can be found in the Appendix (Part D). The answers to this LSM questionnaire are entered into an online LSM Calculator .[45] This LSM calculator was designed by Eighty20, a niche consulting company in South Africa, and calculates the exact LSM level for each patient.

GAPS IN THE LITERATURE

RCWMCH is a unique population which drains five of the eight urban zones, and two of the four rural zones within the Cape Metropolitan Region.[46] This is illustrated on the map of referral and support areas of the public sector hospitals within the Western Cape, South Africa. It has been included in Part D (Appendix) of this study. RCWMCH manages approximately 250 000 patient visits per annum and is the only dedicated specialist paediatric hospital in sub-Saharan Africa. [46]

To date, there have been no documented studies in this group of neonates, where the effects of these social determinants of health is unknown. Hence this study may well provide useful information pertaining to this group of patients and the effects of the social circumstances into which they are born.

NEED FOR FURTHER RESEARCH

South Africa is committed to achieving MDG4 hence achieving child and family-friendly care is no longer an optional extra but an imperative. Knowledge of further social determinants of health on neonatal outcome is thus needed. Added to this, appropriate interventions should be researched in order to address the issues faced by neonates within the South African context.

CONTRIBUTION OF DISSERTATION TO LITERATURE

The information that could be gained from this dissertation is an assessment of which social determinants of health are associated with neonatal outcome within surgical neonates at RCWMCH. With this knowledge, clinical practice could be altered through improved appropriate neonatal healthcare within RCWMCH and on discharge of the patient.

The overall study could inform future interventions for neonatal management at RCWMCH as well as highlight public health problems of neonates at referral facilities.

Information gained from this dissertation could also be used to impact on the wellbeing of neonates who are not neonatal surgery patients. Such neonates may be inclined to have less contact with medical care facilities and hence may be less monitored, with caregivers who are potentially less well informed about potential medical conditions and have an increased risk of poor neonatal outcome.

REFERENCES

1. SA-UN collaborate to improve maternal and child health in Ukhahlamba district. SA Department of Health. August 2010.
2. UNICEF. http://www.unicef.org/progressforchildren. Accessed August 27, 2011.
3. Lake L, Reynolds L. Addressing the social determinants of health. Children's Institute. University of Cape Town. 2010.
4. United Nations. http://www.un.org/millennium/declaration/ares552e.htm. Updated 1990. Accessed August 16, 2011.
5. Bryce J, Gilroy K et al. The Accelerated Child Survival and Development programme in west Africa: a retrospective evaluation. The Lancet, Volume 375, Issue 9714, Pages 572 - 582, 13 February 2010
6. International Conference on Primary Health Care in 1978. http://www.who.int. Accessed August 2010.
7. Declaration of Alma-Ata. http://www.who.int. August 2010.
8. Millennium Project. http://www.unmillenniumproject.org. Updated 2006. Accessed August 25, 2011.
9. Children Count. http://www.childrencount.ci.org.za. Accessed January 2012.
10. Coetzee M. Towards child and family friendly health services. Child Nurse Practice Development Initiative. University of Cape Town. 2009.
11. SA-UN collaborate to improve maternal and child health. SA Department of Health. August 2008.
12. South African Government Information. http://www.info.gov.za. Accessed January 2012.

13. Department of Social Development. http://www.dsd.gov.za. Accessed December 2011.
14. MedicineNet.com. http://www.medterms.com. Accessed August 26, 2011
15. World Health Organisation Page. http://www.who.int. Updated 2011. Accessed 27 August, 2011.
16. Infant Mortality Rate. http://www.stat.berkeley.edu. Accessed January 2012.
17. Myer L, Ehrlich R. Epidemiology. *Chapter 16: Social Epidemiology.* 2007. P.210-220.
18. Das Gupta M. Death Clustering, Mothers' education and the determinants of child mortality in rural Punjab, India. Populations Studies. 2010; 44(3); 489-505.
19. Dictionary.com. http://dictionary.reference.com/browse. Updated 2011. Accessed 4 October 2011.
20. South African Advertising research foundation. http://www.saarf.co.za/LSM/lsms.htm. Updated 2011. Accessed 17 September 2011.
21. Annett A, Anderson A. Social Determinants of infant mortality in the Nordic countries, 1980-2001. *Scandinavian Journal of Public Health*. 2004; 32: 381.
22. South African Advertising research foundation. http://www.saarf.co.za/LSM/lsms.htm. Updated 2011. Accessed 17 September 2011.
23. Hoque M, Haaq S, Islam R. Cause of neonatal admissions and deaths at a rural hospital in Kwazulu-Natal, South Africa*. South African Journal of Epidemiological Infections*. 2011; 26(1).
24. Susser M. Editorial: Social Determinants of health-socioeconomic status, social class, and ethnicity. *American Journal of Public Health*. 1995; 85:7.
25. Annett A, Anderson A. Social Determinants of infant mortality in the Nordic countries, 1980-2001. *Scandinavian Journal of Public Health*. 2004; 32: 381.
26. Mavalankar D, Trivedi C, Gray R. Levels and risk factors for perinatal mortality in Ahmedabad, India. *Bulletin of the World Health Organisation.* 1991; 69(4):435-442.
27. Braveman P, Egerter S, Williams D. The social determinants of health: coming of age. *Annual Review of Public Health.* 2010; 32:3.1-3.18.
28. Lys A. Educate a woman, you educate a nation, *Womans News Network*. June 23, 2011.

29. Trading Economics. http://www.tradingeconomics.com. Accessed January 2012.
30. The impact of maternal education on child survival. http://www.jstor.org. Accessed January 2012.
31. Infant Survival. http://www.stat.berkeley.edu. Accessed January 2012
32. Bird S, Bauman K. The relationship between structural and health service variables and state-level infant mortality in the United States. *American Journal of Public Health*. 1995; 85(1).
33. Din-Dzietham R, Hertz-Picciotto. Infant mortality differences between white and African Americans: the effect of maternal education. American Journal of Public Health. 1998; 88(4).
34. Mazzucco W, Cusimano R, et al. A retrospective follow up study on maternal age and infant mortality in two Sicilian districts. *BMC Public Health*. 2011; 11:817.
35. Kembo J. Determinants of infant health in Zimbabwe. *Demographic Research Journal. 2009. Volume 21.*
36. Quamrul H, Islam R, et al. Effects of demographic characteristics on Neonatal, post neonatal, infant, and child mortality. *Current Research Journal of Biological Sciences* 2(2): 132-138, 2010.
37. Gage T, Fang F, et al. Maternal age and infant mortality: A Test of the Wilcox-Russell Hypothesis. *American Journal of Epidemiology*. 2009 February 1; 169(3): 294–303.
38. Finlay J. The association of maternal age with infant mortality, child anthropometric failure, diarrhoea and anaemia for first births: evidence from 55 low- and middle-income countries. *British Medical Journal*. 2011**; 1:** 2.
39. Terra de Souza A, Peterson K, Cufino E et al. Relationship between health services, socioeconomic variables and inadequate weight gain among Brazilian children. Bulletin of the World Health Organisation, 1999; 77(11).
40. Titaley C, Dibley M, Agho K, et al. Determinants of neonatal mortality in Indonesia. *BMC Public Health.* 2008; 8:232.
41. Rutstein S. Factors associated with trends in infant and child mortality in developing countries during the 1990s .Bulletin of the World Health Organization, 2000, 78 (10).

42. Chowdhury Q, Islam R, et al. Socio-economic determinants of neonatal, post neonatal, infant and child mortality. *Department International Journal of Sociology and Anthropology.* Vol. 2(6), pp. 118-125, June 2010.
43. Barham T. A healthier start: The effect of conditional cash transfers on neonatal and infant mortality in rural Mexico*. Journal of Development Economics*. 2011, vol. 94, issue 1, pages 74-85.
44. Mizanur R, Wojtyniak B, et al. Impact of environmental sanitation and crowding on infant mortality in rural Bangladesh. *The Lancet.* Volume 326, Issue 8445, Pages 28 - 30, 6 July 1985.
45. Eighty20. http://www.eighty20.co.za/databases/show_db.cgi?db=fulllsmcalculator. Updated 2011. Accessed 4 October 2011.
46. Cape Gateway. http://www.capegateway.gov.za/redcrosshospital). Updated 31 August 2011. Accessed 4 October 2011.

PART C: ARTICLE

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ABSTRACT[1]

Introduction:

The United Nations Millennium Declaration conference held in September of 2000, set key Millennium Development Goals. Millennium Development Goal (MDG) 4 requires a reduction in the mortality rate of children under the age of five years by two-thirds by the year 2015, from a baseline in 1990. In South Africa, it has been recognised that without a substantial reduction in neonatal deaths, MDG-4 will not be met.

Methods:

This study used a retrospective cohort design. Multinomial logistic regression was used to evaluate the effects of a selection of social determinants of health namely primary caregiver's age, primary caregiver's education level, and Living Standards Measure (LSM)) on the outcome of neonates admitted to, and undergoing surgical procedures in the general surgery unit of Red Cross War Memorial Children's Hospital (RCWMCH), within the Western Cape, South Africa.

Results:

The final multinomial logistic model is highly significant and includes only LSM as a predictor variable. As LSM increases by one level, the relative risk (RR = 0.18) of experiencing a poor outcome decreases by 82% as compared to those patients experiencing a good outcome. As LSM increases by one level, the relative risk (RR = of 0.12) of neonatal death also decreases by 88% as compared to those patients experiencing a good outcome.

Conclusion:

This study shows that the probability of a neonate having a good outcome increases with increasing LSM. The association of primary caregiver's age and education level with neonatal outcome is however not statistically significant within this study.

KEY WORDS: neonatal, outcome, predictors

WORD COUNT: 5163 words

INTRODUCTION

In Sub-Saharan Africa, 4.8 million children die each year before reaching their fifth birthday[2]. Of those, 1.8 million are neonates[2] (defined as infants between the age of 0 to 28 complete days of life).[3]

The United Nations International Children's Emergency Fund (UNICEF), developed in 1950, is a subsidiary of the United Nations (UN) which advocates for the protection of children's rights.[2] At a UN Declaration Conference held in September of 2005[4], key development goals were set for the millennium[5]. These Millennium Development Goals (MDGs) form a framework for the UN System to work together towards common goals. These goals include eradicating extreme poverty, reducing child mortality rates, fighting disease epidemics such as AIDS, Malaria, and Tuberculosis, and developing a global partnership for development with specific focus on international trade and debt management, as well as on the special needs of developing and landlocked countries in particular. [6]

MDG 4 states that it is essential that the health profile of children be adequately addressed in order to prevent a vicious cycle of poor health.[2] It requires a reduction in the mortality rate of children under the age of five years by two-thirds by the year 2015, from a baseline in 1990.[2] In South Africa, it has been recognised that without a substantial reduction in neonatal deaths, MDG-4 will not be met.[7]

The South African neonatal mortality rate in 2010 was calculated as 18 per 1000 live births yet this cannot be compared to a baseline in 1990, which is not available.[8] It is thus not known whether South Africa's neonatal mortality rate has improved or worsened over the past two decades, despite the World Health Organisations report of declining neonatal mortality worldwide.[9]

Social Determinants of Health

Far less is known about the social determinants of child mortality than the biological ones.[10] The social determinants of health constitute the conditions in which people are born, grow, live, work and age[11]. These determinants of health play a key role in early childhood outcome in South Africa.[10]

This study will concentrate on three social determinants of health, previously studied and known to impact on neonatal outcome, namely maternal age[7,12-16], maternal level of education[7,12-16], and maternal living conditions. The variables of access to water, electricity, sanitation, and income will be substituted by a single variable – the LSM. [17] This takes all of the above variables into account and is described below. For the purposes of this study, the maternal level of education and maternal age variables will however be substituted with the level of education and the age of the primary caregiver. The justification for this is that it is often the case within this group of neonates that the biological mother is not involved with the care of the child. Hence, the biological mother has little or no effect on the outcome of these patients.

Primary Caregiver's Age

In general, infant mortality declines with maternal age to a minimum and then increase again at older ages[18]. This pattern of neonatal mortality across maternal ages can be described as having a U-shape. The risk of infant mortality is high for young mothers, yet declines as age increases between the ages of 12 and 26. Neonatal mortality risk is then at it's lowest for 27–29-year-old mothers and then starts to increase from the age of thirty onwards.[18]

Primary caregiver's level of education

Research has shown a clear independent inverse relationship between maternal education level and infant mortality and morbidity.[14] Maternal education is hence one of the major pathways through which neonatal outcome van be improved.[14] Primary caregivers level of education (Edu) is divided into three categories namely; 0 (Primary level of education), 1 (Secondary level of education), and 2 (Tertiary level of education).

Living Standards Measure

Further social determinants of neonatal health include access to services (water, electricity, and sanitation), housing type, and household income (per head).[7,12-16] Despite household income (per head) being an important indicator of a child's health[12-16], obtaining an accurate measurement of this variable in our population is, for a variety of reasons, often unattainable. In the majority of these households, monthly incomes are variable, from multiple sources, shared by many recipients, and are often unreliable. Hence, the Living Standards Measure (LSM), although a marketing research tool, has become the most widely used segmentation tool in South Africa.[17] This effectively divides the population into ten LSM groups, 10 (highest) to 1 (lowest).[17] The LSM score includes a variety of predictors including access to water, access to

sanitation, access to fresh running water, access to electricity, asset ownership, access to a telephone, and rural or urban living choice.[17] An exact derivation of the mathematical model used to calculate the online LSM score can be found in the Appendix (Part D).

This retrospective cohort study had two specific objectives. The first one was to determine the rate for each of the three levels of the outcome measure (i.e. good outcome, poor outcome, and deceased). Objective two was to determine whether the outcome of general surgery patients, admitted to, and operated on as neonates within Red Cross War Memorial Children's Hospital (RCWMCH) in the Western Cape, is associated with a selection of social variables (Primary caregiver's education level, Primary caregiver's age, and Living Standards Measure (LSM)).

METHODS

Settings and subjects

This study was set at Red Cross War Memorial Children's Hospital (RCWMCH) which is South Africa's only dedicated paediatric hospital and offers a comprehensive range of specialist paediatric services to children less than thirteen years of age.[19]

This study was carried out using a consecutive sampling strategy by including all subjects (except those defined in the exclusion criteria) who had surgical procedures during the period 1st July 2010 and 31 August 2011.A sample size calculation revealed a required sample size of 139 participants.

Multiple exclusion criteria existed. These include:

- Any patient whose first admission was not during the neonatal period, as all study participants are defined as "neonates" for the purposes of this study
- Any patient who did not have a period of 120 days at home post discharge from hospital, except those that died during this 120 day period at home –these were recorded as "deceased" in this study.
- Any patient that was discharged as a palliative care case. Such neonates have been diagnosed with inborn pathology and or birth defect that are not compatible with sustained life. The outcome of these patients' is thus expected and is not influenced by factors under study

- Events which occurred after the first 120days outside of the hospital. This cut-off period will allow each study participant to have an equal period of evaluation for the purposes of this study.
- All patients who did not have a major surgical diagnosis listed as Anorectal Malformation, Congenital Diaphragmatic Hernia, Duodenal Web, Exomphalos, Hirschsprungs Disease, Intussusception, Malrotation, Necrotizing Enterocolitis, Pyloric Stenosis, Spontaneous gastrointestinal perforations, Stenosis, and Volvulus. The deifintitions of these terms are listed in section 7 of the protocol of this study.

Data collection

The RCWMCH database forms a comprehensive summary of all neonates undergoing surgery at RCWMCH, contains records of neonates from 1 July 2010 to 30 June 2012, and is fully inclusive of all such patients. For this reason, the study was carried out using a consecutive sampling strategy by including all subjects, as defined above, which were operated on during the period 1st July 2010 and 31 August 2011.

Each subjects' caregiver was interviewed via the telephone or in person in order to complete the LSM questionnaire, and to note their age and level of education. These questionnaires can be found in Part D (Appendix). The answers to the LSM questionnaire were then entered into an online LSM Calculator [20] in order to assign each subject's caregiver an LSM score between 1 and 10.

The hospital records of each participant were then reviewed by the researcher using a data capturing form. Neonatal outcome was graded according to a measurement scale (0 = good outcome, 1 = poor outcome, 2 = deceased).

For the purposes of this study, neonatal outcome will be defined as:

- **Good outcome:** Any neonate, who had no emergency visits to any health facility, was always found to be healthy and to have no problems at all scheduled outpatient visits, and had a good growth trend (corrected for age and premature status) according to their Road to Health Chart. This Road to Health chart is a Government produced booklet given to every neonate at birth which allows for an ongoing record of each child's health status, weight and immunization records.
- **Poor outcome**: any neonate who had one or more emergency visits to any health facility, was found to be unwell at any scheduled outpatient appointment, or had a poor growth trend

(corrected for age and premature status) according to their Road to Health Chart. **Deceased:** any neonate who died during the first 120 days post discharge from the hospital. This includes those that may have done well or poorly initially at home, yet subsequently died.

As this is a study relating to the effects of the measured determinants on neonatal outcome, and not specifically outcome related to the surgical condition itself, all co-morbidities resulting in hospital visits or poor growth trend as documented above, whether as a result of the surgical diagnosis or a separate entity, were included. HIV status was not seen as separate co-morbidity, but ill health related to HIV status would be included in the poor outcome group. The relationship of neonatal outcome with HIV status is documented in the literature and the positive, exposed or negative status of the child was not the focus of this study as it would not add to literature.

Neonatal outcomes will be transformed into a rate by calculating each outcome's total over a denominator. The denominators will consist of the total number of eligible participants in this study.

Data analysis

All data was entered into Microsoft Excel (Vista version) under appropriate categories, and then cleaned where necessary. STATA 11 (STATA for Windows, version 11, Stata Corp; College Station, TX) was then used to analyse the data. Initial data exploration of all the variables was performed using univariate statistical methods; namely histograms, box and whisker plots, summary statistics and frequency tables. Relationships between the outcome variable "Neonatal Outcome (*NOutcome*)" and predictor variables "Primary caregivers age (*PCAge*)", "Primary caregivers level of education (*Edu*)", and "Living standards measure(*LSM*)" were then examined using bivariate descriptive statistics. Box and whisker plots by Neonatal Outcome were used to examine the distribution of Primary caregiver's Age (*PCAge*) in each Neonatal outcomes group. Cross tabulations were used to explore the relationships between Neonatal Outcome and LSM, and Neonatal Outcomes and Primary caregiver's Level of Education (*Edu*).

Stepwise selection using Multinomial logistic regression was then performed since the outcome variable is a categorical variable with three outcome levels. This method was conducted to assess which of the independent variables are associated with neonatal outcome. Multinomial logistic regression uses the logit transformation of the outcome variable[21] Neonatal Outcome (*NOutcome*) and allows one to use well established linear techniques to model the relationship between *Noutcome* and the independent variables. Logistic models also allow us to calculate risk ratios which describe the effects of each predictor on the outcome[21], adjusting for the presence of other independent variables, confounders, and effect modifiers.

The independent and dependant variables are listed in Table 1.

Data	Variable Name	Type of variable
Dependant Variable	Neonatal Outcome *(Noutcome)*	Categorical/Ordinal
Independent Variables	Primary Caregiver's level of education *(edu)*	Categorical/Ordinal
	Primary caregiver's age *(PCAge)*	Numerical/Discrete
	LSM	Categorical/Ordinal

Table 1: Types of variables

Ethical considerations

This study was granted ethics approval by the University of Cape Town (REF 540/2011), and by the RCWMCH School of Child and Adolescent Health (SCAH) ethics group.

Due to the fact that eight of the primary caregivers were under the age of eighteen, consent for the participation of these neonates was obtained from the primary caregiver of all such participants' primary caregivers.

All primary caregivers signed a consent form prior to participating. This consent form was in a language of his or her choice; namely English, Afrikaans, or IsiXhosa.

RESULTS

Study Sampling Results

The neonatal surgery RCWMCH database used to source participants for this study was created subsequent to the employment of a dedicated neonatal liaison sister. Her employment description included monitoring neonatal outcome and ensuring the close follow-up of each neonate included in this recording system. Due to this, all participants were contactable and none were lost to follow-up. Despite a required sample size of 139 participants, a consecutive sampling method yielded an eventual sample size of 187 participants. All 187 participants were included in this study. Figure 1 depicts the derivation of the final sample analysed in this study.

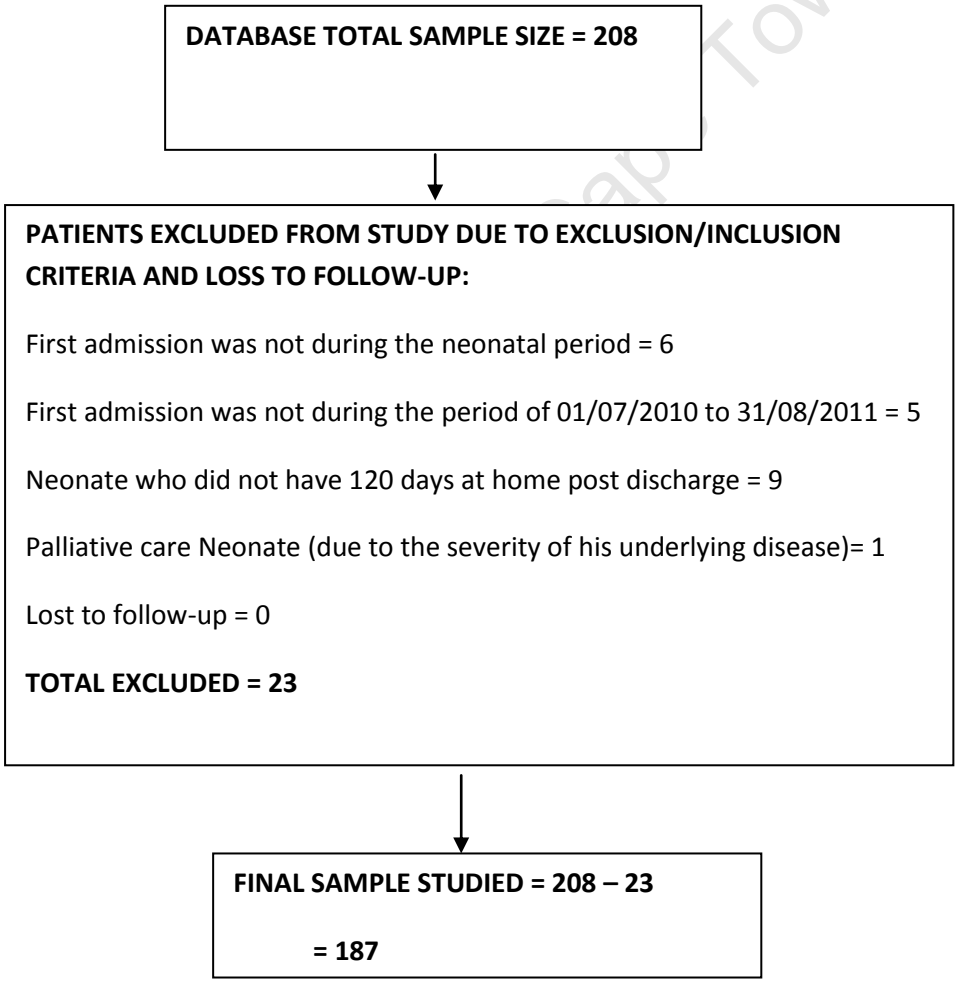


Figure 1: Derivation of final study sample

Data exploration

Each participant's data capturing form was initially analysed and included or excluded based on the study's exclusion criteria.

The primary caregiver's age was recorded on each participant's data capturing form. The primary caregiver's education level and neonatal outcome was then recorded and coded as per the data capturing tool (see Appendix D). The answers from the LSM questionnaires (of included participants) were then entered into an online LSM Calculator and a score was thus derived and recorded on each LSM questionnaire.

Data was then entered into Microsoft Excel (Vista version) under the appropriate categories. Data entry was further checked by verifying one hundred percent of the dependant variable data and twenty percent of each independent variable's data. Both of these yielded one hundred percent correct data entry rates. A manual check though the Microsoft Excel sheet was then performed to look for missing data. This revealed no missing data cells. Since data was captured into Microsoft Excel using the correct data coding, no further manipulation of data was required.

Univariate data exploration:

Primary caregiver's age (*PCAge*)

A histogram of the continuous variable *PCAge* (Figure 2) reveals that the data is positively skewed and hence does not follow a normal distribution. Age will however be used as a predictor variable and hence need not be transformed into a normal distribution pattern for the purposes of this study.

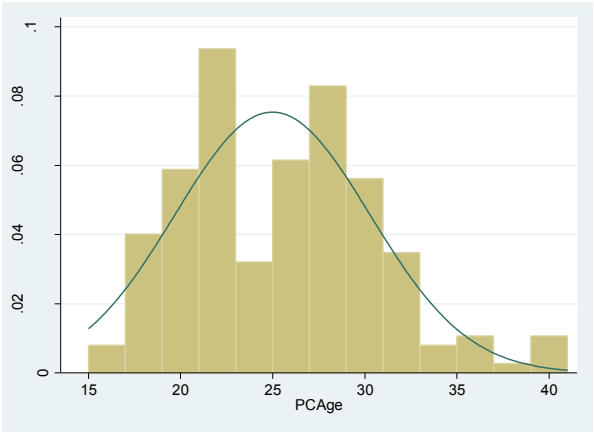


Figure 2: Histogram of Primary Caregiver's Age *(PCAge)*

Table 2 summarises the descriptive statistics of the continuous variable *PCAge.* The median Primary Caregiver's Age is 25 with a minimum and maximum age of 15 and 41 years.

	n	min	P25	median	P75	max
PCAge	187	15	21	25	28	41

Table 2: Summary statistics of Primary Caregiver's age *(PCAge)*

A box and whisker plot for *PCAge* (Figure 3) reveals that outliers exist. These are participants 16 (*Pcage*=39), 67 (*Pcage*=41), 76 (*Pcage* = 39), and 89 (*Pcage* = 41). These data points were checked against the data capturing form and were all found to be correct.

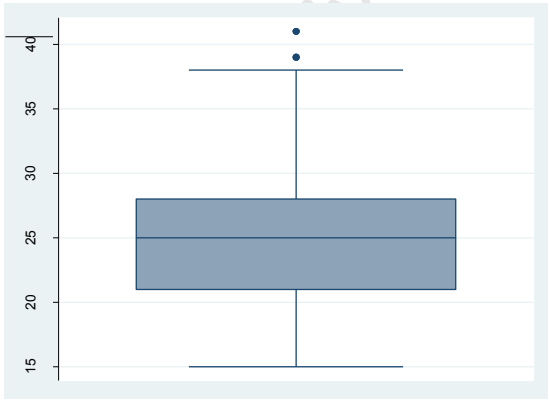


Figure 3: Box and whisker plot for Primary Caregiver's Age (*PCAge)*

It is of interest to note that four of the neonates that were included in this study were cared for by a primary caregiver that was not the biological mother. One of these neonates was cared for by the biological grandfather, whilst the remaining three were cared for by a

biological grandmother, a biological aunt, and an adoptive mother. It was not possible to analyse the effects of adoption or fostering on neonatal outcome within the scope of this study since this subset of neonates had a sample size of only four which would not yield statistically significant results. Added to this, none of these fostering arrangements were made legally official and so may bias any result that could be concluded.

Participants number 16 (*Pcage*=39), and 89 (*Pcage* = 41) are two of the four outliers. These participants are the biological grandfather and biological grandmother mentioned above. The remaining two outliers, 67 (*Pcage*=41), 76 (*Pcage* = 39), are both biological mothers who had late pregnancies. One of these pregnancies was planned, whilst the other one was not.

Neonatal outcome (*Noutcome*), Primary caregiver's education level (*edu*) and Living standards measure (*LSM*)

The Frequency distribution of the categorical variables is shown bellow in Table 3. The cells highlighted in bold in the "Percentage" column show the percentages of participants in each variable's categories. The study's second objective can be answered here where the "good outcome rate" is 78.07%, the "poor outcome rate" is 19.25%, and the mortality rate is 2.67%.

It is interesting to note that only 4.28% of the participant's primary caregiver's had a tertiary level of education.

The majority of participants have an LSM of three to six (73.79%). Only four of participants have an LSM of ten.

Variable	Frequency	Percentage	Cumulative Percentage
NOutcome			
0 = good outcome	146	**78.07**	78.07
1 = poor outcome	36	**19.25**	97.33
2 = deceased	5	**2.67**	100.00
	100	100.00	
Edu			
0	71	**37.97**	37.97
1	108	**57.75**	95.72
2	8	**4.28**	100.00
	100	100.00	
LSM			
1	4	**2.14**	2.14
2	15	**8.02**	10.16
3	22	**11.76**	21.93
4	36	**19.25**	41.18
5	40	**21.39**	62.57
6	40	**21.39**	83.96
7	14	**7.49**	91.44
8	4	**2.14**	93.58
9	8	**4.28**	97.86
10	4	**2.14**	100.00
	100	100.00	

Table 3: Frequency distribution of categorical variables

A description of the neonatal outcome variable for all 187 neonates is shown bellow in Figure 4.

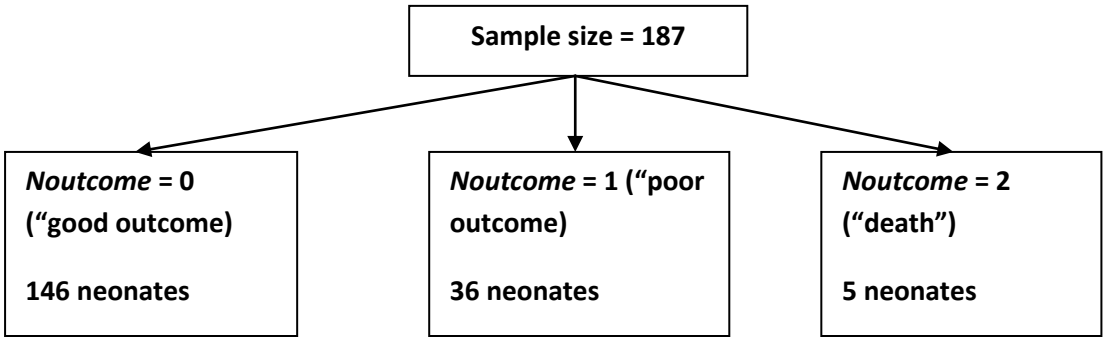


Figure 4: Description of *Noutcome*

Of those thirty six neonates that did poorly, twenty two had visited an emergency facility with unexpected illness (including a poor growth trend in eleven of these cases). Of these twenty two patients, five were diagnosed with pneumonia, eleven with gastroenteritis, two with a lower respiratory infection, one with measles, and three with bowel obstruction. Nine of the thirty six neonates who had a poor outcome had an unexpected poor growth trend at a scheduled outpatient appointment. Five neonates were found to be unwell at a scheduled outpatient appointment. Of these five patients, three required admission for severe dehydration, whilst the remaining two were found to have mild gastroenteritis and were admitted to medical emergency.

Bivariate Analysis

Exploring the relationship between Neonatal outcome (*Noutcome*) and Primary caregiver's age (*PCAge*)

In order to explore the relationship between the continuous variable Primary caregiver's Age (*PCAge)* and the categorical Neonatal outcome (*NOutcome)* variable, a box and whisker plot was used. Figure 5 bellow shows us that:

NOutcome Group 0 (good outcome): has a the highest median *PCAge* as compared to *NOutcome* group 1 and 2, and has the oldest minimum *PCAge* across all three groups. The interquartile ranges of this group are within the interquartile ranges of outcome groups 1 and 2.

NOutcome Group 1 (poor outcome): has the oldest maximum age and a median age that is between the median age of *Noutcome* groups 0 and 2. It also has a dispersion of *PCAge* which is wider as compared to both other groups.

NOutcome Group 2 (deceased): the median *PCAge* is below that of *NOutcome* groups 0 and 1. *NOutcome* group 2 also has a more narrow dispersion on *PCAge* as compared to both other groups. The maximum age is in fact the 75th quartile. One outlier exists. This is noted to be participant 164 who was 38 years old. Hence the deceased neonates are associated with young PCAge with the exception of this one outlier.

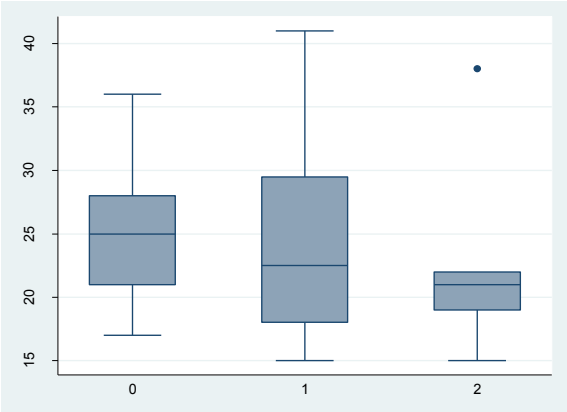


Figure 5: Box and whisker plot of Primary Caregiver's Age (*PCAge)* by Neonatal outcome *(NOutcome*)

Exploring the relationship between Neonatal outcome (*Noutcome*) and Living Standards Measure (LSM)

Cross tabulations were used to explore the relationships between the Neonatal Outcome (*NOutcome*) variable and the two categorical variables; namely Primary Caregiver's Level of Education (*Edu)* and Living standards measure (LSM).

	LSM										
Noutcome	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
0	**0**	**0**	9	30	39	38	14	4	8	4	146
	0.00	**0.00**	6.16	20.55	26.71	26.03	9.59	2.74	5.48	2.74	100.00
1	4	11	13	5	1	2	**0**	**0**	**0**	**0**	36
	11.11	30.56	36.11	13.89	2.78	5.56	**0.00**	**0.00**	**0.00**	**0.00**	100.00
2	0	4	0	1	0	0	**0**	**0**	**0**	**0**	5
	0.00	80.00	0.00	20.00	0.00	0.00	**0.00**	**0.00**	**0.00**	**0.00**	100.00
Total	4	15	22	36	40	40	14	4	8	4	187
	2.14	8.02	11.76	19.25	21.39	21.39	7.49	2.14	4.28	2.14	100.00

Table 4: Cross Tabulation of *NOutcome* and LSM

Of those cases in Neonatal outcome group 0 (i.e. Neonates that had a good outcome), 73.29% (20.55 + 26.71 + 26.03) of cases lie between LSM 4 and 6. No patients have an LSM of 1 0r 2, yet there are cases in all other LSM categories.

Of those cases in Neonatal outcome group 1 (i.e. Neonates that had a poor outcome), 66.6 % (30.5 + 36.1) had an LSM between 2 and 3. No cases have an LSM above 6.

Of those cases in Neonatal outcome group 2 (i.e. Neonates that died), 80 % had an LSM of 2. No cases have an LSM of 1, 3, 5 - 10.

The row total shows us that the majority of the cases have an LSM of either 5 (21.39%) or 6 (21.39%)

It is important to note that many empty cells exist within this cross tabulation. Statistical calculations may hence be difficult as this variable is categorical in nature. For this reason, LSM was further treated as a continuous variable within the stepwise multivariate logistic regression modelling process of this study.

Exploring the relationship between Neonatal outcome (*Noutcome*) and Primary caregiver's level of education (*edu*)

Edu	*NOutcome*			
	0	**1**	**2**	**Total**
0	35	32	4	71
	23.97	88.89	80.00	100.00
1	103	4	1	108
	70.55	11.11	20.00	100.00
2	8	**0**	**0**	8
	5.48	**0.00**	**0.00**	100.00
Total	146	36	5	187
	100.00	100.00	100.00	100.00

Table 5: Cross Tabulation of *Noutcome* and *Edu*

Of those neonates whose died (*NOutcome* = 2), 80% of their primary caregiver's had a primary education and the remaining 20% had a secondary level of education. None had a tertiary level of education.

Of those neonates whose had a poor outcome (*NOutcome* = 1), 88.89% of their primary caregiver's had a primary education, and 11.11% had a secondary level of education. None had a tertiary level of education.

Of those neonates whose had a good outcome (*NOutcome* = 0), 23.97% of their primary caregivers had a primary education and 70.55% had a secondary level of education. This *NOutcome* category was the only category to have primary caregivers with a tertiary level of education (5.48%).

Two empty cells can be seen in table 5. This poses a statistical calculation problem and hence primary caregiver's education level's one and two will be combined. A new category labelled "*edunew*" was created. Hence this variable has been transformed into a binary variable where *edunew*=0 includes all primary caregiver's with a primary level of education, and *edunew*=1 includes all primary caregiver's with a secondary and tertiary level of education. Table 6 depicts this new variable cross-tabulated with the outcome variable.

EduNew	*NOutcome*			
	0	**1**	**2**	**Total**
0	35	32	4	71
	23.97	88.89	80.00	37.97
1	111	4	1	116
	76.03	11.11	20.00	62.03
Total	146	36	5	187
	100.00	100.00	100.00	100.00

Table 6: Cross Tabulation of *Noutcome* and *Edunew*

Of those neonates who had a good outcome (*Noutcome* =0), 116 now fit into the new primary caregiver's education category names "*edunew*". No empty cells now exist in Table 6 so it seems that reducing the number of categories within the primary caregiver's level of education (*edu*) category has provided a better fit for the data.

It is interesting to note that 76.03% of those neonates who have a good outcome had a primary caregiver with at least a secondary level of education. However, of those neonates who had a poor outcome, only 11.11% of the primary caregivers had at least a secondary level of education, whilst of those neonates who died, only 20% had at least a secondary level of education. Hence, a good outcome appears to be associated with a higher education level.

Multinomial Logistic Regression

To select a suitable subset of independent variables that are associated with neonatal outcome, I used a forward selection approach. Table 7 summarises the various steps of the selection procedure and justifies the final choice.

Model	Variables in model	Log Likelihood	Likelihood Ratio Test			AIC
			χ^2	p-value	Vs	
A	Empty model	-113.56	-	-	-	231.11
B	age	-113.15	0.81	0.67	A	234.31
C	lsm	-62.69	101.74	0.00	A	133.38
D	edunew	-84.88	57.36	0.00	A	177.76
E	Lsm, age	-62.25	102.61	0.00	C	136.50
F	Lsm, edunew	-60.78	105.56	0.00	C	133.55

Table 7: Summary of model selection strategy

Model A is an empty model which only includes the neonatal outcome variable (*NOutcome*).

Model B contains primary caregiver's age (*Pcage*) as a single independent variable. It does not improve the predictive ability of the model as compared to Model A (p=0.67; AIC is bigger than in Model A). It was expected that *PCage* may have been a confounder within this model yet the AIC is larger than the AIC of Model A. Therefore *PCage* is excluded as a confounder in the relationship between the outcome and other independent variables.

Model C contains the LSM as a single independent variable. Adding LSM to the model significantly improves the predictive ability of the model as compared to Model A (p=0.00; AIC is smaller than in Model A)

Model D contains the primary caregiver's level of education (*edunew*) as a single independent variable. It significantly improves the predictive ability of the model compared to Model A (p=0.00; AIC is smaller than in Model A).

Model C is however chosen as the best model at this step due to it having the lowest Log Likelihood (Log likelihood = -62.69), and a p-value of zero.

In the following step (Model E and Model F), the two possible two-variable models are compared to Model C. Model E has an AIC which is more than the AIC of Model C. Model F's AIC only very slightly larger than that of Model C's. Model F can be seen in Table 8.

Multinomial Logistic Regression						**Number obs**	187
						LR Chi2	105.56
						Prob>chi2	0.00
Log Likelihood		= -60.78					
NOutcome		**Coeff**	**Std Error**	**Z**	**P>|z|**	**95% CI**	
1	**Lsm**	-1.50	0.31	-4.89	0.00	-2.10	-0.90
	edunew	-1.23	0.67	-1.83	**0.07**	-2.54	0.09
	constant	5.08	1.10	4.62	0.00	2.92	7.23
2	**Lsm**	-2.09	0.58	-3.58	0.00	-3.23	-0.94
	edunew	0.09	1.35	0.06	**0.95**	-2.56	2.73
	constant	4.43	1.62	2.73	0.01	1.25	7.61

Table 8: Model F

It is however noted that the coefficients of the *Edunew* variable are not significant (p> 0.05). For this reason, Model C will be chosen as the final Model. Model C is shown in Table 9.

Multinomial Logistic Regression						Number obs	187
						LR Chi2	101.74
						Prob>chi2	0.00
Log Likelihood		**=**					
NOutcome		**Coeff**	**Std Error**	**Z**	**P>|z|**	**95% CI**	
1	**Lsm**	-1.73	0.29	-5.99	0.00	-2.30	-1.16
	constant	5.56	1.08	5.14	0.00	3.44	7.68
2	**Lsm**	-2.15	0.55	-3.91	0.00	-3.23	-1.08
	constant	4.69	1.62	2.89	0.01	1.51	7.87

Table 9: Model C (Final Model)

The final model thus includes only LSM as a predictor variable. This model is highly significant (Log likelihood = -62.69; LR Chi^2 = 101.74; p-value of 0.00) which indicates a strong relationship between LSM and neonatal outcome. For those neonates with a poor outcome as compared to having a good outcome, the LSM coefficient of -1.73 (CI -2.30; -1.16) is highly significant (p=0.00) with a standard error value of 0.30.

For those neonates who died as compared to those who had a good outcome, the LSM coefficient of -2.15 (CI -3.23; -1.08) is highly significant (p=0.00) with a standard error value of 0.55.

NOutcome	Variable	β	RR
1	lsm	-1.73	0.18
	constant	5.56	-
2	lsm	-2.15	0.12
	constant	4.69	-

Table 10: Interpretation of Model C (Final Model)

As LSM increases by one level, the relative risk of experiencing a poor outcome decrease by 82% (RR = 0.18) as compared to those patients experiencing a good outcome, holding all else constant.

As LSM increases by one level, the relative risk of neonatal death decrease by 88% (RR=0.12) as compared to those patients experiencing a good outcome, holding all else constant.

No effect modification was tested in the statistical analysis of this data. The reasons for this are twofold namely; it was not an objective of this study, and the literature search did not suggest any interaction between independent variable within this study.

We can illustrate the associations in our final Model in Figure 6.

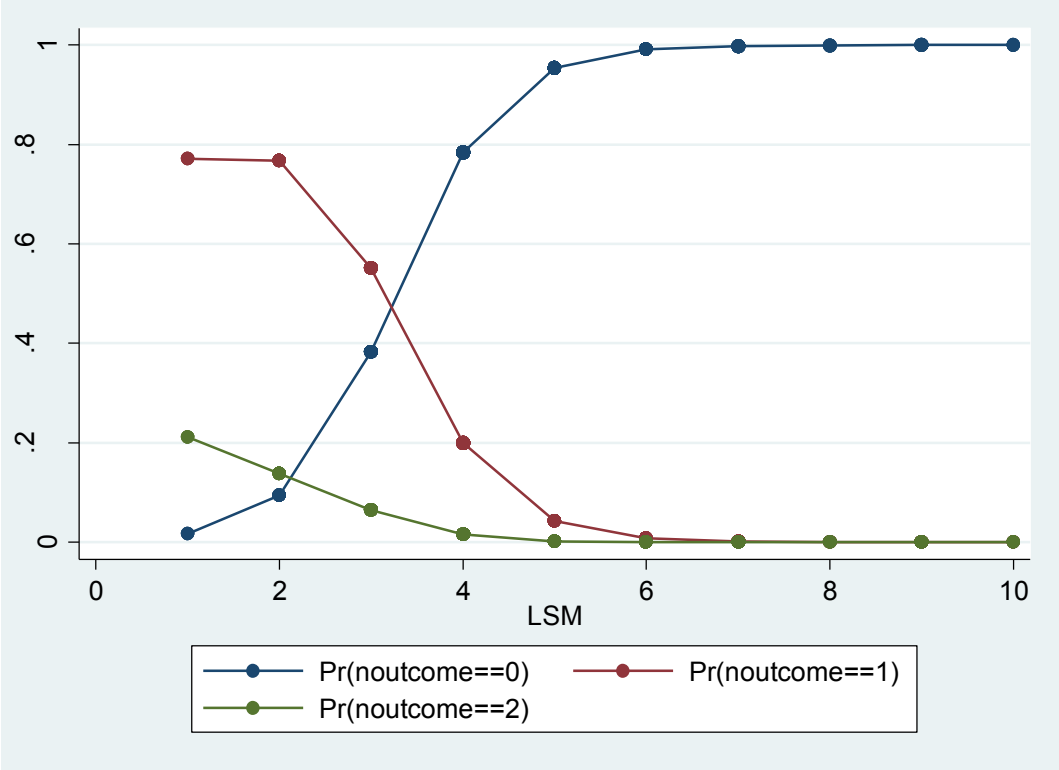


Figure 6: Illustration of the associations in the model

Figure 6 shows:

- Increasing probability of a neonate having a good outcome with increasing LSM
- Decreasing probability of a neonate dying with increasing LSM until LSM 5 after which the probability of a neonate dying remains constant. Hence this shows that those neonates who live in an environment with an LSM score of less than six have the highest risk of death

- Decreasing probability of a neonate having a poor outcome with increasing LSM until LSM 6 after which the probability of dying remains constant.
- The probability of all three outcomes remains constant from an LSM of 6 and higher.

DISCUSSION

The first objective of this research was to determine the rate for each of the three levels of the outcome measure as illustrated in the grading scale (i.e. good outcome, poor outcome, deceased). It is important to note that the 'outcome' referred to is the overall health status of the neonate and not just that related to the surgery. Thus this outcome reflects all good or ill health or poor growth patients, including all related co-morbidities as stated in the definitions of the categories of outcome. This study showed a good outcome rate, poor outcome rate and mortality rate of 78.07%, 19.25% and 2.67% respectively. Participants in this study were diagnosed as having a complicated surgical diagnosis yet their mortality rate is noted to be far below that of the 2009 national neonatal mortality rate of 19 per 1000 live births. This may reflect the inferred reduction of neonatal mortality rates in South Africa alongside documented reductions in infant mortality rates since 2000, but may also reflect the fact that the caregivers and patients were a closely followed up group with frequent health care visits and thus frequent health checks and health education opportunities.

The second objective of this study was to determine which social determinants of health are associated with neonatal surgical outcome. These social determinants of health are said to play a key role in early childhood outcome in South Africa.[10]

Three predictor variables were analysed within this study, namely primary caregiver's age, the primary caregiver's level of education, and the Living Standards Measure (LSM).

Research suggests that the risk of infant mortality is high for young mothers, yet declines as age increases between the ages of 12 and 26.[22] Neonatal mortality risk is then at its lowest for 27–29-year-old mothers and then starts to increase from the age of thirty onwards.[22] This relationship of neonatal outcome and primary caregiver's age is suggested by this study where the neonates who died had the youngest primary caregiver's, and a maximum primary caregiver age far below that those neonates who had a good or poor outcome. The participants of this study were between the ages of 15 and 41 years of age, with a mean age of 25.

Research has further shown a clear independent inverse relationship between maternal education level and infant mortality and morbidity [7,12-16]. Maternal education is hence suggested as one of the major pathways through which neonatal outcome van be improved.[14]

In this study, none of their primary caregiver's of those neonates who had a poor outcome or who died, had any tertiary education. In fact, of those neonates whose primary caregiver had a

tertiary level of education, 100% had a good outcome. This finding is in accordance with previous research which highlighted a clear independent inverse relationship between maternal education level and infant mortality and morbidity. [14]

Social structure theory suggests that poverty not only shapes children's' living conditions; it also has a lifelong cumulative influence on health.[23] Inequality of neonatal deaths rates is suggested to be due to gaps in economic and social development across rural and urban areas, including differences in income, housing, access to water supplies and electricity and sanitation.[24]

Eighty nine percent of the participants in this study had an LSM between 2 and 7. None of those that had a good outcome had an LSM of one or two, whilst of those that had a poor outcome or died, none had an LSM of above six. This suggests that a low LSM is associated with a poor neonatal outcome, whilst a high LSM is associated with a good neonatal outcome.

A multinomial logistic regression model suggested that the best model to predict neonatal outcome would include both LSM and the "*edunew*" variable (Log Likelihood =-60.78; LR Chi^2 = 105.56). The model coefficients within this model show that the "*edunew*" variable is however not significant (p=0.07 where Neonatal outcome is poor compared to good; p=0.95 where neonates are deceased as compared to having a good outcome).

The final model chosen thus includes only LSM as a predictor variable. This model is highly significant (Log likelihood = -62.69; LR Chi^2 = 101.74; p-value of 0.00) which indicates a strong relationship between LSM and neonatal outcome. For those neonates with a poor outcome as compared to having a good outcome, the LSM coefficient of -1.73 (CI -2.30; -1.16) is highly significant (p=0.00) with a standard error value of 0.29. For those neonates who died as compared to those who had a good outcome, the LSM coefficient of -2.15 (CI -3.23; -1.08) is highly significant (p=0.00) with a standard error value of 0.55.

As such, an LSM increases by one level, results in the relative risk (RR = 0.18) of experiencing a poor outcome decreasing by 82% as compared to those patients experiencing a good outcome, holding all else constant. As LSM increases by one level, the relative risk (RR = of 0.12) of neonatal death also decrease by 88% as compared to those patients experiencing a good outcome, holding all else constant.

Hence, this model shows an increasing probability of a neonate having a good outcome with increasing LSM, and a decreasing probability of a neonate dying with increasing LSM until LSM 5 after which the probability of a neonate dying remains constant. This suggests that those

neonates who live in an environment with an LSM score of less than five have the highest risk of death. The probability of all three outcomes remains constant from an LSM of 6 and higher.

This study suggests that the Living Standards Measure (LSM) could be used as a predictor of neonatal health risk. Since the LSM is primarily a marketing based segmentation tool, it has not been used in any previous studies as predictor of neonatal outcome. This study suggests that it may provide medical staff with key knowledge regarding those neonates at risk of a poor health outcome.

In order to achieve the United Nations MDG 4 by the year 2015, a substantial reduction in neonatal deaths is required.[2] This study demonstrates that the most significant predictor of neonatal outcome is their Living Standards Measure (LSM). The general trend suggests that neonatal outcome improves as ones living standard improves. Neonates at the highest risk of having a poor outcome are however those within the lowest LSM ranges of one to five. This finding presents a challenge for medical staff who treat these patients. Measures need to be put in place in order to anticipate and avoid a potential poor outcome of those neonates whose caregivers have a low LSM score. Research regarding potential protective measures which may reduce the likelihood of a poor neonatal outcome given a primary caregiver's low LSM score are thus needed. Added to this, the LSM score consists of a combination of socio-economic measures. It is suggested that the components of this score be studied in order to highlight key elements of neonate's living standards that pose the greatest risk for poor neonatal outcome.

Conclusion

This study showed that in this study population, the association of caregiver's age and level of education with neonatal outcome was not statistically significant. It did however show a strong statistical significant association between LSM and neonatal outcome.

While household income is one factor in the calculation of the LSM, water, sanitation, housing, electricity, and education are others. Hence, if this study population is to be taken as representative of neonates in South Africa, in the South African situation, while child care grants are available to those who qualify, it would seem that this support alone will not improve the outcome of neonates. If the nation is to address the situation of ill health of babies, then housing schemes providing water, sanitation, and electricity as well as education levels need to be improved in the poorest communities.

Limitations

This study has several limitations, namely:

Self-report data

The data collected for this study was self reported and thus could suffer from desirability bias. Participants may have answered in a way in which they thought the interviewer would prefer. Primary caregiver's age and education level was not verified by documentation. The measures included in the LSM data collection sheet were not verified by performing a participant home visit.

Neonatal outcome was assigned according to participant medical records within RCWMCH. This data was verified against participant's entries within the online RCWMCH booking system. Details of participant attendance at other medical facilities after their discharge from RCWMCH would have been excluded from this study. RCWMCH's complicated neonatal surgery patients are however requested to return specifically to RCWMCH to seek medical attention post discharge due to the complicated nature of their surgical diagnosis. Any participant who disregarded this order would hence bias the results of this study. The Western Cape online patient booking system (Clinicom, 2012) was however used to check for any such event. This suggested no such occurrence, yet this system does not reflect medical activity beyond the borders of the Western Cape.

Despite this dissertation having showed a relationship between Neonatal Outcome and LSM, it is population specific to this group of patients. The majority of neonates born in this country receive little planned follow up. There may be further factors which impact the outcome of neonates who are less frequently followed up within the medical services and indeed, the outcome of such 'healthier' neonates may in fact be worse than this studied population. Further studies are needed to answer this key question as it related to the majority of South African newborns.

REFERENCES

1. Adapted from dissertation abstract

2. Unicef. http://www.unicef.org/progressforchildren. Accessed August 27, 2011.

3. MedicineNet.com. http://www.medterms.com. Accessed August 26, 2011

4. United Nations. http://www.un.org/millennium/declaration/ares552e.htm. Updated 1990. Accessed August 16, 2011.

5. Millennium Project. http://www.unmillenniumproject.org. Updated 2006. Accessed August 25, 2011.

6. Millennium Development Goals: Country Report 2010.http://www.statssa.gov.za/news_archive/Docs/MDGR_2010. Updated 2010. Accessed August 28, 2011.

7. Hoque M, Haaq S, Islam R. Cause of neonatal admissions and deaths at a rural hospital in Kwazulu-Natal, South Africa*. South African Journal of Epidemiological Infections*. 2011; 26(1).

8. Unicef South Africa. http://www.unicef.org/infobycountry/southafrica_statistics.html. Accessed August 27, 2011.

9. World Health Organisation Page. http://www.who.int. Updated 2011. Accessed 27 August, 2011.

10. Das Gupta M. Death Clustering, Mothers' education and the determinants of child mortality in rural Punjab, India. Populations Studies. 2010; 44(3); 489-505.

11. Myer L, Ehrlich R. Epidemiology. *Chapter 16: Social Epidemiology.* 2007. P.210-220.

12. Susser M. Editorial: Social Determinants of health-socioeconomic status, social class, and ethnicity. *American Journal of Public Health*. 1995; 85:7.

13. Annett A, Anderson A. Social Determinants of infant mortality in the Nordic countries, 1980-2001. *Scandinavian Journal of Public Health*. 2004; 32: 381.

14. Lake L, Reynolds L. Addressing the social determinants of health. Children's Institute. University of Cape Town. 2010.

15. Mavalankar D, Trivedi C, Gray R. Levels and risk factors for perinatal mortality in Ahmedabad, India. *Bulletin of the World Health Organisation.* 1991; 69(4):435-442.

16. Braveman P, Egerter S, Williams D. The social determinants of health: coming of age. *Annual Review of Public Health.* 2010; 32:3.1-3.18.

17. South African Advertising research foundation. http://www.saarf.co.za/LSM/lsms.htm. Updated 2011. Accessed 17 September 2011.

18. Rowley D, Iyasu S, MacDorman M, et al. Neonatal and postnatal mortality. *BMC Public Health.* 2007; 7: 139.

19. Cape Gateway. http://www.capegateway.gov.za/redcrosshospital). Updated 31 August 2011. Accessed 4 October 2011.

20. Eighty20. http://www.eighty20.co.za/databases/show_db.cgi?db=fulllsmcalculator. Updated 2011. Accessed 13 March 2012.

21. University of Cape Town, Department of Public Health. Biostatistics III class notes. 2012.

22. Titaley C, Dibley M, Agho K, et al. Determinants of neonatal mortality in Indonesia. *BMC Public Health.* 2008; 8:232.

23. Pattinson R, Woods D, Greenfield D et al. Improving survival rates of newborn infants in South Africa. *Journal of Reproductive Health*. 2005; 2:4.

24. Terra de Souza A, Peterson K, Cufino E et al. Relationship between health services, socioeconomic variables and inadequate weight gain among Brazilian children. Bulletin of the World Health Organisation, 1999; 77(11).

PART D: APPENDIX

STUDY BUDGET	Currency (ZAR)
PERSONNEL	
Principal Investigator	No cost
Co-investigators Investigators	N/A
Research Supervisor	No cost
Data Assistant	N/A
Interviewees	No cost
Statistician (principal investigator)	No cost
Finance/Grants administrator	N/A
Subtotal	**No cost**
CAPITAL EQUIPMENT	**No cost**
Vehicle	N/A
Laptop	No cost
Printer, Fax & Scanner	No cost
Computer	No cost

OTHER	**No cost**
Printing and stationery (R 100 X 6 months)	600
Fuel	N/A
Data storage and management	No cost
Communication (Telephone/Cellphone/Internet) (R 100 X 6 months)	600
Travel	N/A
Staff recruitment and training	No cost
Local office costs	No cost
SUBTOTAL	**1200**
TOTAL COSTS	**1200**

RESEARCH CONSENT FORM – 2011 -> 2012

Read to respondent:

Hello, my name is Sara Warren and I am from the University of Cape Town. I would like to ask your permission to ask you questions about yourself and your baby.

Your participation in this study is very important to us and will help us to understand how we can best help babies like yours to stay healthy. Your answers will help us to know what concerns and problems are involved in taking a baby home after they have had an operation.

This interview is confidential; that is none of the information you give will be connected to you personally. I will not write your name down. Only the research team will see your answers. Your participation is voluntary, which means that you can refuse to participate and you can stop the interview at any time. Should you decide that you would not like to partake in this interview, you will not be prejudiced in any way. You will continue to receive the same treatment as those that choose to take part in this study.

This is not a test and there are no right and wrong answers. Please try to answer these questions as truthfully as possible for us to better understand how to help babies after they are discharged. If you do not understand a question, please ask me to repeat it or explain it. The interview should take 5 - 10 minutes.

This study will not involve any harm or discomfort to you. May I interview you? May I start the interview now? (**If yes, please sign below.)**

If you have any questions or want further information about the study, please contact:

Study Supervisor:
Dr. Sharon Cox
Department of Paediatric Surgery, Red Cross War Memorial Children's Hospital, Klipfontein Rd., Rondebosch 7700, South Africa, T: (021) 658 5599; e-mail: Sharon.cox@uct.ac.za

_____ _____

Printed name of participant signature Date

_____ _____

Interviewer (print) signature Date

_____ _____

Witness (print) signature Date

NAVORSING TOESTEMMING VORM – 2011 ->2012

Lees aan deelnemer:

Hello, my naam is Sara Warren en ek is van die Universiteit van Kaapstad. Ek will graag jou toestemming verkry om vir jou oor jouself and jou baba te vra.Jou deelname aan hierdie studie is vir ons baie belangrik aangesien dit ons sal help om te verstaan hoe ons babas, soortgelyk aan jou kind, beter kan help om gesond te bly. Jou antwoorde sal ons help om insig te kry oor watter bekommernisse en problem betrokke is wanneer 'n baba, wat 'n operasie gehad het, ontslaan word uit die hospital.

Hierdie onderhoud is vertroulik, dus geen inligting wat jy verskaf sal persoonlik met jou verbind word nie. Ek sal nie jou naam neerskryf nie. Net ek sal jou antwoorde sien. Jou deelname is vrywillig; dit beteken dat jy kan weier om deel te neem en jy kan enige tyd die onderhoud beeindig. Jy sal in geen manier benadeel word indien jy verkies om nie aan die onderhoud deel te neem nie. Jy sal steeds dieselfde behandeling ontvang as diegene wat gekies het om aan die studied deel te neem.

Hierdie is nie 'n toets nie en daar is geen korrekte of verkeerde antwoorde nie. Probeer asseblief om hierdie vrae so eerlik as moontlik te beantwoord sodat ons beter kan verstaan hoe om babas te help waneer hulle uit die hospital ontslaan word. As jy nie 'n vraag verstaan nie, vra my asseblief om dit te herhaal of om dit te verduidelik. Die onderhoud sal 5-10 minute neem. Hierdie studie sal jou geen ongerief of skade besorg nie. Mag ek 'n onderhoud met jou voer? Mag ek nou met die onderhoud begin? (Indien ja, teken asseblief onder). Indien jy enige vrae het verdure inligting oor die studie, kontak asseblief:

Studie Toesighouer:
Dr. Sharon Cox
Departement van Pediatriese Chirurgie, Red Cross War Memorial Children's Hospital, Klipfontein Weg., Rondebosch 7700, Suid Afrika, Tel: (021) 658 5599; e-mail: Sharon.cox@uct.ac.za

_____ _____

Geskrewe naam en handtekening van deelnemer, Datum

_____ _____

Geskrewe naam en handtekening van onderhoud voerder, Datum

_____ _____

Geskrewe naam en handtekening van getuie, Datum

INCWADI YEEMVUMELWANO – 2011 -> 2012

Fundela Umzali:

Molo, igama lam nguSara Warren, ndisuka kwi Univesithi yaseKapa. Ndingathanda ngemvume yakho ukukubuza imibuzo malunga ngawe nomntwana wakho.

Inxaxheba yakho kule(study) ibalulekile kuthi kwaye izakusincedisa ekuthini singabanceda njani abantwana abafana nalo wakho ukuba bahlale besempilweni. Iimpendulo zakho zizakusinceda siqonde ukuba yeyiphi imibuzo neengxaki abazali ababanayo xa kufika ixesha lokuthatha umntwana ekhaya emva kotyando.

Yonke impendulo oyakuthi uyinike iyimfihlelo, akukho nanye eyakuthi idityaniswa nawe ngqo. Andizulibhala igama lakho yaye ndim kuphela ozakubona iimpendulo zakho. Ayisosinyanzelo ukuba uthathe inxaxheba kule(study), into ethetha ukuba ungala ukuqhubeka nayo nangaliphi na ixesha.

Ayilovavanyo olu kwaye akukho mpendulo ilungileyo nengalunganga. Uyacelwa uyiphendule le mibuzo ngokunyaniseka kangangoko unako ukuze siqonde ukuba singabanceda njani abantwana emveni kokuba bekhutshiwe esibhedlele. Ukuba kukho umbuzo ongawuqondiyo ndicela uthi mandiwuphinde okanye ndiwucacise. Le ncoko ifanele ithathe imizuzu emihlanu ukuya kwelishumi.

This study will not involve any harm or discomfort to you. Ndingakubuza imibuzo? Ndingaqalisa ngemibuzo? (**Ukuba uyavuma, ndicela usayine apha ngezantsi.)**

Ukuba unemibuzo okanye ufuna ulwazi oluthe vetshe nge (study), nceda uqhakamshelane no:

Study Supervisor:
Dr. Sharon Cox
Department of Paediatric Surgery, Red Cross War Memorial Children's Hospital, Klipfontein Rd., Rondebosch 7700, South Africa, T: (021) 658 4918; e-mail: Sharon.cox@uct.ac.za

_____ _____

Amagama Akho, signature, Date

_____ _____

Umvavanyi, signature, Date

_____ _____

Ingqina, signature, Date

DATA COLLECTION FORM (PAGE 1 OF 2)			
	INSERT DETAILS HERE:	**INCLUDE OR EXCLUDE FROM STUDY:**	**CODING:**
Instructions for data form usage: 1) Questions in **BOLD** in column # 1 are to be gathered initially from the folder. These details will then be used to insert data into column #2 2) Questions that are not in bold will then be answered. Inclusion and excluded patients wil then be hilighted as such in column #3 3) Dummy Variable codes to then be inserted in column 4			
PARTICIPANT NUMBER			
DATE OF FIRST ADMISSION (exclude if not from 1 July 2010 to 31 August 2011):			
NUMBER OF DAYS FROM BIRTH TO FIRST ADMISSION (exclude if time to first admission is beyond 28 days)			
DATE OF FIRST DISCHARGE:			
DATE OF 120DAYS POST DISCHARGE:			
DID PATIENT HAVE 120 DAYS AT HOME POST DISCHARGED:			
WAS THIS PATIENT DISCHARGED AS A PALLIATIVE CARE PATIENT (exclude if yes)			
DATE OF DEATH (if applicable):			
NUMBER OF DAYS TO DEATH POST DISCHARGE(record as Mortality if on or before 120days post discharge, if not then count as alive in study):			
List Primary Diagnosis (exclude if not classed as "Major" as per protocol)			
OCCURENCE OF ANY UNEXPECTED ADVERSE EVENTS (details and dates)			
NUMBER OF DAYS TO FIRST UNEXPECTED ADVERSE EVENT POST DISCHARGE (exclude if beyond 120days post discharge):			
INDEPENDENT VARIABLES:			
PRIMARY CAREGIVER'S DOB:			
PRIMARY CAREGIVER'S AGE:			
PRIMARY CAREGIVER'S LEVEL OF EDUCATION (primary=0, secondary=1, tertiary=2):			
LSM (1 - 10)			

DATA COLLECTION FORM (PAGE 2 OF 2)			
FOLDER NUMBER:			
LIVING STANDARDS MEASURE (LSM) QUESTIONNAIRE			
LSM (calculated for a range of 1 (low) to 10 (high)			
QUESTION NUMBER:	**Participant to state if they have any of the items below:**	**YES**	**NO**
1	Hot running water		
2	Fridge/Freezer		
3	Microwave oven		
4	Flush toilet in house or on plot		
5	VCR in household		
6	Vacuum cleaner/floor polisher		
7	Washing machine		
8	Computer		
9	Electric stove		
10	Television Set		
11	Tumble Dryer		
12	Telkom Landline		
13	Hi-fi or music centre		
14	Built-in kitchen sink		
15	Home security service		
16	Deep freeze		
17	Water in home or on stand		
18	MNET or DSTV		
19	Dishwasher		
20	Metropolitan Dweller		
21	Sewing machine		
22	DVD player		
23	Home/cluster/townhouse		
24	1/more motor vehicles		
25	No domestic worker		
26	No cellphone in household		
27	1 cellphone in household		
28	None or only one radio		
29	Living in a non-urban area		
LSM LEVEL			

LSM VARIABLE WEIGHTING SCALE

Variable Number	Attribute	Weight
1	Hot running water	0.185224
2	Fridge/freezer	0.134133
3	Microwave oven	0.126409
4	Flush toilet in house or on plot	0.113306
5	VCR in household	0.104531
6	Vacuum cleaner/floor polisher	0.164736
7	Washing machine	0.149009
8	Computer	0.311118
9	Electric stove	0.16322
10	Television set	0.120814
11	Tumble dryer	0.166056
12	Telkom Landline	0.166031
13	Hifi or music centre	0.096072
14	Built –in kitchen sink	0.132822
15	Home security service	0.151623
16	Deep-freezer	0.116673
17	Water in home or on stand	0.123015
18	DSTV or Mnet	0.12736
19	Dishwashing	0.212562
20	Metropolitan dweller	0.079321
21	Sewing machine	0.178044
22	DVD player	0.09607
23	House/cluster house/town house	0.113907
24	1/more motor vehicles	0.16731
25	No domestic worker	-0.30133
26	No cellphone in household	0.124007
27	1 cellphone in household	0.1846676
28	None or 1 radio in household	-0.245
29	Living in non-urban area	-0.12936

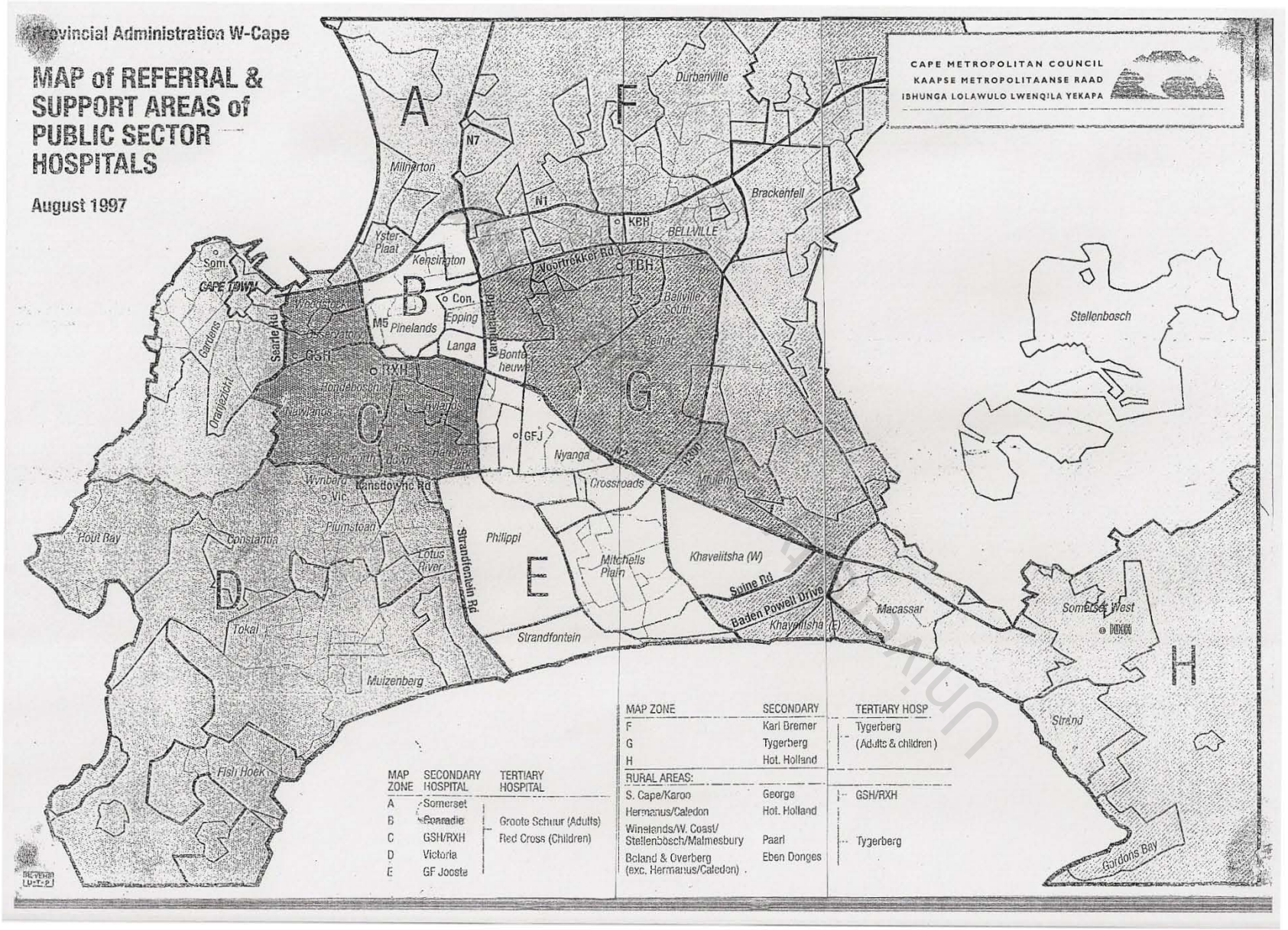
LSM CALCULATOR

LSM Group	Total weight		
1	Less than -1.390140		
2	-1.390139	To	-1.242000
3	-1.242001	To	-1.011800
4	-1.011801	To	-0.6910000
5	-0.691001	To	-0.278000
6	-0.278001	To	0.382000
7	0.381999	To	0.801000
8	0.800999	To	1.169000
9	1.168999	To	1.745000
10	More than 1.744999		

STUDY PARTICIPANT NUMBER ALLOCATION

HOSPTAL FOLDER NUMBER	PARTICIPANT NUMBER
Enter each folder number within this column	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12
	....
	....

NB: This record will be kept electronically and password protected


Provincial Administration W-Cape
MAP of REFERRAL & SUPPORT AREAS of PUBLIC SECTOR HOSPITALS
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TBH
Ysterplaat
Kensington
Som.
CAPE TOWN
Woodstock
Observatory
Con.
Epping
Pinelands
Langa
Bonteheuwel
Ballville South
Belhar
Stellenbosch
Gardens
Searle Rd
GSH
RXH
Oranjezicht
Rondebosch
Newlands
Rylands
Kenilworth
Grassy Park
Athlone Park
GFJ
Nyanga
Crossroads
Mulleni
Wynberg
Vic.
Kansdowne Rd
Plumstead
Hout Bay
Constantia
Lotus River
Philippi
Strandfontein Rd
Mitchells Plain
Khayelitsha (W)
Suine Rd
Baden Powell Drive
Khayelitsha (E)
Macassar
Somerset West
HXH
Strand
Strandfontein
Tokai
Muizenberg
Fish Hoek
Gordons Bay
MAP ZONE | SECONDARY HOSPITAL | TERTIARY HOSPITAL
A | Somerset | Groote Schuur (Adults) Red Cross (Children)
B | Conradie
C | GSH/RXH
D | Victoria
E | GF Jooste
MAP ZONE | SECONDARY | TERTIARY HOSP
F | Karl Bremer | Tygerberg (Adults & children)
G | Tygerberg
H | Hot. Holland
RURAL AREAS:
S. Cape/Karoo | George | GSH/RXH
Hermanus/Caledon | Hot. Holland
Winelands/W. Coast/ Stellenbosch/Malmesbury | Paarl | Tygerberg
Boland & Overberg (exc. Hermanus/Caledon) | Eben Donges

UNIVERSITY OF CAPE TOWN

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

18 November 2011

HREC REF: 540/2011

Miss S Warren
c/o Dr S Cox
Public Health & Family Medicine
Falmouth Building
FHS

Dear Miss Warren

PROJECT TITLE: UNDERSTANDING THE SIGNIFICANCE OF THE SOCIAL DETERMINANTS OF HEALTH ON THE OUTCOME OR COMPLICATED SURGICAL NEONATES AT IRED CROSS WAR MEMORIAL CHILDREN'S HOSPITAL

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

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

Approval is granted for one year till the 30 November 2012.

Please submit a progress form, using the standardised Annual Report Form (FHSOL6), if the study continues beyond the approval period. Please submit a Standard Closure form (FHSO10)if the study is completed within the approval period.

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

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

Federal Wide Assurance Number: FWA00001637.

JOURNAL OF PUBLIC HEALTH IN AFRICA

Instructions to Authors

Manuscripts must be written in English. The first page must contain: (a) title, name and surname of the authors; (b) names of the institution(s) where the research was carried out; (c) a running title of no more than 50 letters; (d) acknowledgments; (e) the name and full postal address of the author to whom correspondence regarding the manuscript as well as requests for abstracts should be sent; (f) three to five key words. To accelerate communication, phone, fax number and e-mail address of the corresponding author should also be included. The second page should contain: (a) authors' contributions, i.e., information about the contributions of each person named as having participated in the study (http://www.icmje.org/#author); (b) disclosures about potential conflict of interest. **Original Articles** should normally be divided into an abstract, introduction, design and methods, results, discussion and references. The abstract should contain about 250 words and must be structured as follows: background, design and methods, results, conclusions. A maximum of 20 authors is permitted, and additional authors should be listed in an ad hoc appendix **References** should be prepared strictly according to the Vancouver style. Where available, URLs for the references should be provided directly within the Word document. References must be numbered consecutively in the order in which they are first cited in the text, and they must be identified in the text by arabic numerals. References to personal communications and unpublished data should be incorporated in the text and not placed under the numbered References.

Peer-review policy

All manuscript submitted to our journals are critically assessed by external and/or inhouse experts in accordance with the principles of Peer Review (http://www.icmje.org/#peer), which is fundamental to the scientific publication process and the dissemination of sound science. Each paper is first assigned by the Editors to an appropriate Associate Editor who has knowledge of the field discussed in the manuscript. The first step of manuscript selection takes place entirely inhouse and has two major objectives: a) to establish the article's appropriateness for our journals' readership; b) to define the manuscript's priority ranking relative to other manuscripts under consideration, since the number of papers that the journal receives is much greater than that it can publish. If a manuscript does not receive a sufficiently high priority score to warrant publication, the editors will proceed to a quick rejection. The remaining articles are reviewed by at least two different external referees (second step or classical peer-review). **Manuscripts** should be prepared according to the Uniform Requirements established by the International Committee of Medical Journal Editors (ICMJE) (http://www.icmje.org/#prepare). **Authorship**. All persons designated as authors should qualify for authorship according to the ICMJE criteria (http://www.icmje.org/sponsor.htm) Each author should have participated sufficiently in the work to take public responsibility for the content. Authorship credit should be based only on substantial contributions to (a) conception and design, or analysis and interpretation of data; and to (b) drafting the article or revising it critically for important intellectual content; and on (c) final approval of the version to be published. These three conditions must all be met. Participation solely in the acquisition of funding or the collection of data does not justify authorship. General supervision of the research group is not sufficient for authorship. Any part of an

article critical to its main conclusions must be the responsibility of at least one author. Authors should provide a brief description of their individual contributions.

Uniform Requirements for Manuscripts Submitted to Biomedical Journals:

Manuscript Preparation and Submission: Preparing a Manuscript for Submission to a Biomedical Journal

The following information provides guidance in preparing manuscripts for any journal.

General Principles

The text of observational and experimental articles is usually (but not necessarily) divided into the following sections: Introduction, Methods, Results, and Discussion. This so-called "IMRAD" structure is not an arbitrary publication format but rather a direct reflection of the process of scientific discovery. Long articles may need subheadings within some sections (especially Results and Discussion) to clarify their content. Other types of articles, such as case reports, reviews, and editorials, probably need to be formatted differently.

Electronic formats have created opportunities for adding details or whole sections, layering information, cross-linking or extracting portions of articles, and the like only in the electronic version. Authors need to work closely with editors in developing or using such new publication formats and should submit supplementary electronic material for peer review.

Double-spacing all portions of the manuscript— including the title page, abstract, text, acknowledgments, references, individual tables, and legends—and generous margins make it possible for editors and reviewers to edit the text line by line and add comments and queries directly on the paper copy. If manuscripts are submitted electronically, the files should be double-spaced to facilitate printing for reviewing and editing.

Authors should number all of the pages of the manuscript consecutively, beginning with the title page, to facilitate the editorial process.

Title Page

The title page should have the following information:

1. Article title. Concise titles are easier to read than long, convoluted ones. Titles that are too short may, however, lack important information, such as study design (which is particularly important in identifying randomized, controlled trials). Authors should include all information in the title that will make electronic retrieval of the article both sensitive and specific.

2. Authors' names and institutional affiliations. Some journals publish each author's highest academic degree(s), while others do not.

3. The name of the department(s) and institution(s) to which the work should be attributed.

4. Disclaimers, if any.

5. Contact information for corresponding authors. The name, mailing address, telephone and fax numbers, and e-mail address of the author responsible for correspondence about the manuscript (the "corresponding author;" this author may or may not be the "guarantor" for the integrity of the study). The corresponding author should indicate clearly whether his or her e-mail address can be published.

6. The name and address of the author to whom requests for reprints should be addressed or a statement that reprints are not available from the authors.

7. Source(s) of support in the form of grants, equipment, drugs, or all of these.

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Conflict of Interest Notification Page

To prevent potential conflicts of interest from being overlooked or misplaced, this information needs to be part of the manuscript. The ICMJE has developed a uniform disclosure form for use by ICMJE member journals (http://www.icmje.org/coi_disclosure.pdf). Other journals are welcome to adopt this form. Individual journals may differ in where they include this information, and some journals do not send information on conflicts of interest to reviewers. (See *Section II. D. Conflicts of Interest*.)

Abstract

Structured abstracts are preferred for original research and systematic reviews. The abstract should provide the context or background for the study and should state the study's purpose, basic procedures (selection of study subjects or laboratory animals, observational and analytical methods), main findings (giving specific effect sizes and their statistical significance, if possible), principal conclusions, and funding sources. It should emphasize new and important aspects of the study or observations. Articles on clinical trials should contain abstracts that include the items that the CONSORT group has identified as essential (http://www.consort-statement.org/? =1190).

Because abstracts are the only substantive portion of the article indexed in many electronic databases, and the only portion many readers read, authors need to be careful that they accurately reflect the content of the article. Unfortunately, the information contained in many abstracts differs from that in the text (7). The format required for structured abstracts differs from journal to journal, and some journals use more than one format; authors need to prepare their abstracts in the format specified by the journal they have chosen.

The ICMJE recommends that journals publish the trial registration number at the end of the abstract. The ICMJE also recommends that, whenever a registration number is available, authors list that number the first time they use a trial acronym to refer to either the trial they are reporting or to other trials that they mention in the manuscript.

Introduction

Provide a context or background for the study (that is, the nature of the problem and its significance). State the specific purpose or research objective of, or hypothesis tested by, the study or observation; the research objective is often more sharply focused when stated as a question. Both the main and secondary objectives should be clear, and any prespecified subgroup analyses should be described. Provide only directly pertinent references, and do not include data or conclusions from the work being reported.

Methods

The Methods section should include only information that was available at the time the plan or protocol for the study was being written; all information obtained during the study belongs in the Results section.

Selection and Description of Participants

Describe your selection of the observational or experimental participants (patients or laboratory animals, including controls) clearly, including eligibility and exclusion criteria and a description of the source population. Because the relevance of such variables as age and sex to the object of research is not always clear, authors should explain their use when they are included in a study report—for example, authors should explain why only participants of certain ages were included or why women were excluded. The guiding principle should be clarity about how and why a study was done in a particular way. When authors use such variables as race or ethnicity, they should define how they measured these variables and justify their relevance.

Technical Information

Identify the methods, apparatus (give the manufacturer's name and address in parentheses), and procedures in sufficient detail to allow others to reproduce the results. Give references to established methods, including statistical methods (see below); provide references and brief descriptions for methods that have been published but are not well-known; describe new or substantially modified methods, give the reasons for using them, and evaluate their limitations. Identify precisely all drugs and chemicals used, including generic name(s), dose(s), and route(s) of administration.

Authors submitting review manuscripts should include a section describing the methods used for locating, selecting, extracting, and synthesizing data. These methods should also be summarized in the abstract.

Statistics

Describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Avoid relying solely on statistical hypothesis testing, such as *P* values, which fail to convey important information about effect size. References for the design of the study and statistical methods should be to standard works when possible (with pages stated). Define statistical terms, abbreviations, and most symbols. Specify the computer software used.

Results

Present your results in logical sequence in the text, tables, and illustrations, giving the main or most important findings first. Do not repeat all the data in the tables or illustrations in the text; emphasize or summarize only the most important observations. Extra or supplementary materials and technical detail can be placed in an appendix where they will be accessible but will not interrupt the flow of the text, or they can be published solely in the electronic version of the journal.

When data are summarized in the Results section, give numeric results not only as derivatives (for example, percentages) but also as the absolute numbers from which the derivatives were calculated, and specify the statistical methods used to analyze them. Restrict tables and figures to those needed to explain the argument of the paper and to assess supporting data. Use graphs as an alternative to tables with many entries; do not duplicate data in graphs and tables. Avoid nontechnical uses of technical terms in statistics, such as "random" (which implies a randomizing device), "normal," "significant," "correlations," and "sample."

Where scientifically appropriate, analyses of the data by such variables as age and sex should be included.

Discussion

Emphasize the new and important aspects of the study and the conclusions that follow from them in the context of the totality of the best available evidence. Do not repeat in detail data or other information given in the Introduction or the Results section. For experimental studies, it is useful to begin the discussion by briefly summarizing the main findings, then explore possible mechanisms or explanations for these findings, compare and contrast the results with other relevant studies, state the limitations of the study, and explore the implications of the findings for future research and for clinical practice.

Link the conclusions with the goals of the study but avoid unqualified statements and conclusions not adequately supported by the data. In particular, avoid making statements on economic benefits and costs unless the manuscript includes the appropriate economic data and analyses. Avoid claiming priority or alluding to work that has not been completed. State new hypotheses when warranted, but label them clearly as such.

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1. The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).
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